

Psycholinguistics

Introduction and Applications

Second Edition





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Foreword

Psycholinguistics can be defined as the psychology of language, but this definition is deceptively simple. Psychology, as the study of behavior, is an ever-expanding field, embracing new theories, research methods, and data of many kinds. The formal study of language is rooted in linguistics, one of the oldest domains of scholarship and one that is continually renewed by efforts to understand the structure of language. Psycholinguistics is the hybrid offspring of psychology and linguistics, and, like many hybrids, it is vigorous and fruitful. A proper understanding of psycholinguistics requires a deep knowledge of its parent fields, but it can be a daunting effort to gain even a basic understanding of either psychology or linguistics, let alone their dynamic intersection. The challenge to the learner is clear. Fortunately, the answer to that challenge is clear as well.

This remarkable book lays out the field of psycholinguistics like a feast on the table of knowledge. As it moves deftly between theory and experiment, this text reviews contemporary understanding of basic questions on the use of language, such as: How do we acquire a first or later language? How do we understand and produce sentences? How do our brains process language? What causes errors in language production and what do these errors tell us about the neural organization of language? How do neurologic disorders such as stroke lead to impairment of language?

Deep knowledge of the subject matter is beautifully matched with eloquent but straightforward expression to produce a book that is inviting and rewarding to read. Above all, Lise Menn and Nina Dronkers carry the reader along a journey that explores the excitement of research in psycholinguistics, marking the way with signposts of scientific accomplishment and pointing out pathways of potential discovery. Readers who may have been frustrated in previous attempts to fashion an understanding of psycholinguistics from other books or a collection of journal articles are well advised to read this book for a clear and comprehensive account of the field. Readers who know little about either psychology or linguistics should not be intimidated, as this book will escort them

through the forest of theories, hypotheses, and discoveries, culminating in a satisfying assessment of what is known and how it came to be known. Instructors who seek a book that will both encourage and educate their students will find this one to be a most worthy candidate. Readers of diverse backgrounds and levels of expertise will enjoy this book as a trustworthy and entertaining companion. This second edition retains the considerable strengths of the first but offers several enhancements to make the book even better.

Psycholinguistics: Introduction and Applications, Second Edition is authoritative in its command of information and enjoyable in its exquisite use of words to talk about words. What better way to learn about psycholinguistics?

—Raymond D. Kent, PhD
Professor Emeritus
University of Wisconsin–Madison



Introduction

Psycholinguistics and What It's Good For

- 0.1** The Plan of This Book
- 0.2** What's the Difference Between Linguistics and Psycholinguistics?
- 0.3** A Few Examples of What Psycholinguistics is Good For: Language Problems
- 0.4** A Psycholinguistic Explanation of a Language Problem
- 0.5** In Defense of My Writing Style: *Apologia pro stilo suo*

0.1 The Plan of This Book

Because people studying psycholinguistics have many different backgrounds, this book introduces the basics of language and linguistics in Chapter 1, the brain in Chapter 2, and the methods of experimental psychology (as part of the presentation of the key findings of experimental psycholinguistics) in Chapter 5. If you are already acquainted with one or more of these areas, you can probably skim the corresponding part of the book. If you have a good background in experimental psychology, you will probably prefer to read the condensed presentation of experimental psycholinguistics in the online workbook on the companion website instead of the version in the text.

We start covering the most important findings of psycholinguistics in Chapters 3 and 4. Chapter 3 explains why psycholinguists think that the concepts in our minds are linked by a huge, mostly subconscious

network of similarities and information about whether things are close or far apart in real or imagined worlds of space and time.

In Chapter 4, we present evidence to support the statement that this huge, subconscious network also links the words in your mind not just by what they mean and how they sound, but also by their grammatical properties—because grammar, like a set of blueprints for construction, is what organizes a sentence and specifies the proper place for each of its words.

The second half of the book is about the applications of psycholinguistics to understanding language learning and some of the most important kinds of language problems. Chapter 6 presents the spoken language of people with the rather common and often disabling language disorder called **APHASIA**, and shows how what we've learned in the first five chapters can help us to understand their problems. Chapter 7 looks at what has been discovered about how children learn to speak their first language, starting from before they are born.

In Chapter 8, we study what our minds do when we are reading, and what that implies for how reading should be taught, and in Chapter 9, we explore some of the similarities and differences between learning a first language and a second language, and why a learner's age affects how quickly and how well they learn a second language. Finally, in Chapter 10, we show how thinking about language and communication psycholinguistically can help in the language classroom and the clinic.

In the online workbook, you will find exercises based on clinical and/or language **classroom** situations so that you can get practice in applying your new concepts to analyzing real-world language behavior.

The text has a glossary; all words and phrases that are printed like **THIS** in the text are defined there.

On the companion website, in addition to the workbook, you'll find audio and video materials that will help you get closer to the experience of being an observer or a participant in an experiment, suggestions for further reading, links to other useful web sites, and, for most chapters, an optional Challenge section with additional material and exercises for advanced and ambitious readers.

0.2 What's the Difference Between Linguistics and Psycholinguistics?

The boundary is fuzzy, but basically, **linguistics** is about how to describe languages, dialects and speech styles accurately and in detail: the different kinds of speech sounds, how the sentences are put together, the

kinds of meanings the words have, how the speakers make new words, the differences between formal and informal language, the changes in rapid and casual speech, their relationships to one another, and how they change over historical and even pre-historic time. Linguistics also gives us the concepts and vocabulary that we need to describe language problems accurately. It also lets us catalogue the differences and similarities between languages or dialects in ways that don't make (or thinly conceal) value judgments.

PSYCHOLINGUISTICS, in contrast, tries to discover how we manage to actually DO all the things that go into speaking and understanding, reading and writing. How do sound waves hitting your ear become, in less than half a second, your understanding of what another person means? How, in speaking a modest two-second sentence, have you managed to find the dozen or so words that you need to express your meaning out of the tens of thousands of words stored in your mind, put them in the right order so that they make sense, and get them all pronounced clearly enough for your hearer to understand, even though, in order to do this, your tongue and lips had to perform a complicated ballet involving hundreds of individual movements? Psycholinguistics uses experiments and intense laboratory observations to break into these incredibly fast, highly skilled language performances and to study the accumulation of the experiences that have built up those unconscious skills over our lifetimes. It also integrates the current findings of **NEUROLINGUISTICS** about how language is remembered and deployed by our brains; that is the subject of Chapter 2.

0.3 A Few Examples of What Psycholinguistics is Good For: Language Problems

Think about language problems: What comes to mind? If you are a clinician or a language teacher, or a close relative of someone with a language disorder, or if you are studying or working outside your home country and still stressed by understanding the language around you, most of your everyday life probably floods into your mind at the thought of language problems.

If you are not in one of those situations, language problems may be a more remote idea; probably, you will think of children or foreigners struggling to be understood. Or, perhaps, of yourself trying to remember words in a technical course or foreign language, or the names of people and places in an unfamiliar or imaginary world. Perhaps you may think of older people trying to remember names of people, places,

or even fairly common objects, like *pliers*; parents calling children by the name of their brother or sister, or even the name of a pet (children do not find this amusing). Accidentally blending two things you wanted to say at the same time: for example, saying “everything under the world” when you wanted to say “everything under the sun” or “everything in the world” (a real example from a published collection of speech errors). Words that you are looking at on a computer screen can sneak into what you are saying if you are talking on the telephone at the same time (*Do you have time to go to a carpet sale—I mean a movie—tomorrow?*). Hearing somebody say something that, in fact, is not what they said; misconstruing unfamiliar words in titles, song lyrics, or prayers (*Do you know who painted the ceiling of the sixteenth chapel?*).

All of these are “normal” language problems. Much worse are the problems of people who have had strokes or other injuries affecting the language areas of the brain, and the problems of children with developmental language disorders. In this book, we develop the descriptive and conceptual tools for understanding how these language problems seem to happen. Gradually, we see how those tools can help with the design of second language curricula and programs or with language testing and therapy, and how they can simply provide us with a feeling of insight into our own language behavior and that of people around us—insight that will help us deal with everyone’s language problems with as much grace and humor as possible.

0.4 A Psycholinguistic Explanation of a Language Problem

We haven’t yet developed our promised tools, so I can’t give you a completely worked out example of a psycholinguistic explanation of a language problem; but here’s a sketch of one (which I hope you haven’t run into personally). Imagine that your new sweetheart, Chris, suggests that the two of you eat dinner at a restaurant that you used to go to with your previous partner, Sam, and you accidentally say, *Sure, Sam, I’d love to!* How did the wrong name get in there? And how did it get into the exact place in the sentence where a name belongs, instead of perhaps replacing the verb, making you say, *Sure, Chris, I’d sam to?* And why was it “Sam” rather than the name of someone else, and why was it a personal first name rather than any of the dozens of other kinds of words that are stored in our minds?

Chris naturally feels that you made this mistake because you still have Sam on your mind as a romantic partner. That’s possible, but it doesn’t

have to be true. However, even an anxious or angry Chris knows that you haven't confused the *people*; you've just confused their *names*. This makes one of our first psycholinguistic points: Words (including names) are not the same mental objects as the things or people they refer to. Yes, the word and the person or thing that it refers to are usually closely connected in your mind. However, the connection between them can be weak (maybe you just met the person at a party) or nonexistent (you never heard the name in the first place). That's fairly obvious. What is less obvious is that the name of someone you know can come into your conscious mind when you are not consciously thinking of the person—or that the name can come to awareness first, dragging the concept of the person behind it. In Chapter 3, we present some evidence supporting these ideas.

A psycholinguistic explanation of a "wrong name" error has to start from two basic theories: first, a *general psychological theory* of how information is stored in your mind and retrieved when you need it and, second, a *specific psycholinguistic theory* of how sentences are formed in your head before they are spoken, and how the words in those sentences get put in the right order and given the right emphasis to convey what you meant by saying them.

0.5 In Defense of My Writing Style: *Apologia pro stilo suo*

I have written this book in the plainest English (although I'm sure there's still room for improvement). I'm not doing this to be cute or folksy, but on psycholinguistic principles. Understanding a description or an explanation means building a clear mental model of it. Passive voice, nominalizations (like the word *nominalization* itself) instead of clauses with real subjects and verbs, and terms that make readers go back to see what they mean (like *the former* and *the latter*) all add to the mental processing load. Extra work figuring out what the writer means interferes with building mental models of the new information being conveyed.

Real or realistic examples are essential for building a clear mental model of what the writer is trying to communicate; questions, names and a few exclamation points help to keep readers alert and focused. Personal pronouns also encourage sharper mental model building, I think. I don't have hard evidence for that claim, but there are plenty of hints in the mental-model and **MIRROR NEURON** literature that we understand what others are doing by subconsciously imagining doing something of the sort ourselves. By saying *The tip of your tongue* instead of *The tip of the tongue*, I'm trying to jump-start that process.

Letting readers know what a barrage of new information is good for gives them not only a reason to care about learning it, but a way to remember it when the time to use it finally arrives. We don't have to teach the "pure" science in a vacuum and then teach its applications separately. And after 40 years in the profession, most of them working in interdisciplinary settings, I find that combining linguistics with its applications invigorates it as well as making it more understandable, because applying any science to the real world challenges its theoretical assumptions and demands accountability.

Unfortunately, the habit of reading and writing in standard disembodied academic style is so deep that some people think it is unscientific and less rigorous to write simple active declarative sentences like *We asked 10 people with aphasia to name these pictures than Ten aphasic persons were instructed to label the stimuli*. Why do some people think that sentences that are easier to understand are not scientific? Partly because they are used to scientific writing that is loaded with sentences in academic style, and partly because, as cognitive scientist Dan Sperber (2010) says, "All too often, what readers do is judge profound what they have failed to grasp."

And someplace we researchers also got the idea that descriptions of research should contain as few references to human beings as possible, as if science were untouched by human hands or minds. But good professional science journalists (and researchers who write well) know that science is created by people, even if a few of them hide behind wizards' masks, and that people who are learning science deserve to know where knowledge comes from, so that they don't feel betrayed when new discoveries upset what they learned previously.

I have also avoided peppering the text with distracting citations. References are in the text when I describe a major finding in detail, but otherwise they are postponed to the end of the chapter. Specific references for the material in each section of each chapter are in the supplementary online materials, including the Instructor's Manual and the Student's Workbook.

If you're not comfortable with this writing style, I hope you will be by the time you're a few chapters into this book.

Reference

Sperber, Dan (2010). The guru effect. *Review of Philosophy and Psychology*, 1, 483–592.

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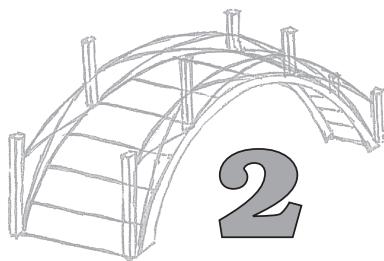
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The invitation to write the first edition of this book came as a lovely gift in a time of grief; I had lost my beloved husband of 20 years, the linguist William Bright, in October 2006. The chance of creating a work that would say to a larger world what I had been teaching in classes, workshops, and lectures was one of the main things that kept me going. I thank the late Dr. Sadanand Singh, Stephanie Meissner, and everyone at Plural Publishing for their patience; also Audrey Holland for impatiently nipping at my heels. This book would not have come into existence without her.

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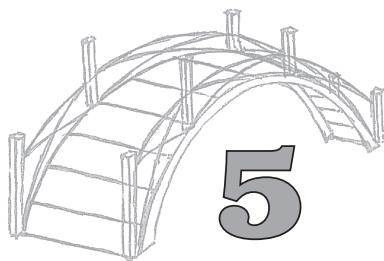
Brains and Language

- 2.1** Thinking about the Brain: A Quick History
- 2.2** What Does It Mean to Say That the Brain Processes Information?
- 2.3** How Can a Bunch of Cells Learn or Know Something?
- 2.4** Activation and Its Spread
 - 2.4.1** Activation and Memory
 - 2.4.2** Real-World Learning: Establishing Multimodal Connections
 - 2.4.3** Spreading Activation and the Process of Understanding a Word
- 2.5** Brain Areas for Specialized Functions
 - 2.5.1** Areas for Primary Motor and Sensory Functions
 - 2.5.2** Learning from Aphasia: Early Studies of Language Localization
 - 2.5.3** New Tools, New Ideas
- 2.6** Structural Connectivity: The Visible Connections Between Nerve Cells
- 2.7** Functional Connectivity: The Brain Areas That Work Together
- 2.8** Does the Right Side of the Brain Participate in Language?

Wouldn't it be great if we could actually see these fiber tracts in our own brains? Well, through the wonders of magnetic resonance imaging, now we can see the traces of these pathways in the living brain. Here's how it works. Water diffuses in many directions in our brains, but the membranes around the axons constrain the flow of water to one direction, rather like garden hoses. With the MRI scanner, the direction of that flow can be calculated and the path of the flow color-coded to show where these tracts are traveling. With more processing of the data, we can also "rebuild" these tracts into three-dimensional structures that we can rotate and trace. Using these new tools, we can study which brain areas are "wired" together by fiber tracts. In addition to the information we get from standard MRI scans about the various areas of nerve cells that are affected in a brain injury, we can now also see which fiber tracts have essentially broken and which ones are spared. This is hugely valuable in working with brain-injured patients because it adds more information about the extent of the damage they have sustained. Remember, fiber tracts are just as important as cortical regions in processing language, and they must be included in our models.

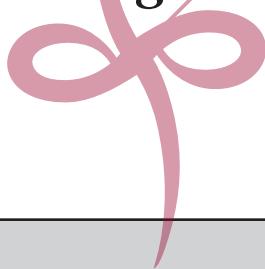
So, let's pull together what we have learned so far. Although there are many cortical areas containing neurons that do the work of processing different components of language, they are all connected to each other with hard-wired structural connections: axons that tie neurons to other neurons. Those neurons can be in the same lobe or different ones, but all together they make up a large language network. This is the biggest change in our thinking about language systems in the brain in the last 50 years. We have moved from a fairly strict localizationist point of view where language happens in one or two places and information is passed from point to point in a serial fashion, to one where different pieces of the process happen in many different cortical areas, sometimes in serial and sometimes in parallel, connected by an organized set of axons that combine together to make up the language network.

If we think back to our cities-and-roads analogy again and conjure up a mental image of a local city neighborhood with its own side streets, we can compare that to a small cluster of neurons connected by short axons. They each have their own little network with like-minded activities. Tie a group of these neighborhood networks together with roads (longer axons) and you get a city, perhaps one with its own certain specialty (e.g., producing chocolate, making movies, coordinating articulatory movements!). Those cities work together to form states and countries (mini-networks) that also work together and thus are able to accomplish far more than the neighborhoods alone (think: speech



Experimental Studies of Normal Language Production and Comprehension

*An Introduction to Experimental
Methods in Psycholinguistics
and Neurolinguistics*



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5.0 The Plan for This Chapter

In this chapter, we'll look at experimental studies whose results have been helpful for understanding the basic language processing concepts that we've been talking about, and whose methods are easy to understand. Some of the studies here are famous; others are not (or not yet), but their findings are important for clinicians and teachers and relevant for speech technology. If you enjoy reading about them and want to learn more, you'll find many more of them explained in the full-year psycholinguistics and neurolinguistics textbooks and handbooks listed under Further Readings in the Materials for Chapter 5 on our companion website.

I am deliberately avoiding the usual styles of scientific writing and textbook explanation so that you get a better sense of what research is like. Science is created by real people, not superhumans, and what they are doing is just trying to figure out explanations for things and then see how well their explanations work. When you read research papers and typical textbooks, phrases like, "It was hypothesized that reaction times to competing stimuli would increase at points of ambiguity," you may have a hard time imagining the actual people who were really sitting around with their coffee mugs and saying, "Don't you think they ought to be slower at reacting to something else just after they see the ambiguous word?" Of course, you may not want to hear the full story. When you just want to know the results, and are not planning to do a similar experiment yourself, you may not care much how the researchers got those results, let alone how much trouble they had figuring out how to get them. So I won't ask you to slog through the history of all of the experiments that I'll describe. But textbook and Internet-based summaries of research have to skip over some details, possibly including the ones that you would need to know if you were trying to decide whether and how the original work applies to the problems you are really interested in. So you need to be able to read the original work that is published in print or online scientific journals. And that can be difficult, because journals demand that authors condense their articles heavily. Authors do this by using technical vocabulary and skipping explanations of points that would be familiar to their regular readers. (Journals also are usually stuck in a severe tradition of pompous and impersonal writing; articles that were originally written rigorously but in a natural prose style may get rewritten using lots of passive voice and impersonal (no-Agent) constructions, so that they sound "scientific," even though

this makes the information that they contain harder to process, as every psycholinguist knows.)

My goal in introducing psycholinguistic experiments is not to give you a large number of results, but to pick some that illuminate different levels of language processing and use them as examples to introduce some of the vocabulary and concepts you will need for reading more standard sources. After working through them, you'll be ready to go on to standard textbooks like the ones at the end of the chapter, and from there to the journals. Psycholinguistic experiments are designed in the same way as experiments in other sciences, so if you already have a science background and don't need to learn about experimental design, you can read alternate shorter expositions of some of these experiments on the companion website. However, if your background isn't in experimental psychology, it might be a good idea to read both versions of a few of the experiments, starting with those in the text and then going on to read those on the companion website. Also, the shorter versions on the companion website are in a more standard "scientific" writing style, so that you can see how it's done.

5.1 Introduction to Psycholinguistic Experiments: Why Do People Do Them and How Do People Come Up With the Ideas for Them?

5.1.1 Psycholinguistic Experiments and Why We Do Them

What are psycholinguistics experiments like, and why do we have to do them? Psycholinguistic experiments can be as simple as asking people to rate sentences on whether they make sense or are grammatical, to repeat words and nonwords as accurately as possible, or to circle letters on a page. Or they may have complex designs and depend heavily on equipment. For example, some involve computing exactly where someone is looking (using an **EYE-TRACKER**). Others need computers to flash an image of a word or an object and then compute how many milliseconds it takes a person to make a judgment about what they've seen (Is it a word? Is it a kind of animal?). Still others record a person's brain waves in various laboratory situations that simulate everyday events (summaries of this kind of study are often featured in the popular press).

The exasperating problem with all our skills and knowledge, including language and language processing, is that everything we

know or know how to do is inside our own heads, so it seems as though we should be able to become aware of our knowledge by just thinking about it, the way philosophers traditionally have done. But if we ask ourselves how we remember words or make sentences (or how we remember faces or tie a bow), either we get nothing or we get an answer that is, at most, a very small part of the truth. Maybe this will seem less annoying if you imagine trying to use your own eye to see inside itself; you wouldn't expect to be able to discover your lens, your retina, or the **BLIND SPOT** where your optic nerve connects to the retina. In the same way, figuring out the workings of your brain can't be done by just thinking about them.

Why isn't observation enough? Observation of what people do when they are using language—especially, as we have seen, observation of errors—is indeed one of the best places to start from. But figuring out how brains work just by looking at natural behavior is not going to get us to a deep understanding. Imagine figuring out how a computer works by looking only at how people use it and what the screen shows when there's a crash—yes, it requires electricity and has a keyboard and a screen, but what's inside and what's actually happening there?

Psycholinguists use experiments to study language processes that happen too fast to grasp or that stay below the level of consciousness—and almost all language processes fall into those categories. We also use experiments to study language knowledge and processing in people who can't easily show us what they know, like young children or people with *aphasia*. In this chapter, we'll look at some experiments with monolingual normal adults, and we'll include some studies of adults reading. In later chapters, we'll look at young children, bilingual adults, and classroom and clinical populations, and we'll look at reading in more detail.

5.1.2 Where Do Ideas for Psycholinguistic Experiments Come From?

First, observation. Let's begin, then, as the most innovative experimenters do, with observations of people having real-life language problems. Like experimental psycholinguists, we analyze those problems using what we already know about linguistic structures and about psycholinguistic processing. Up until now, we've thought mostly about production of spoken language, but most psycholinguistic experiments and many kinds of clinical and classroom tests are about comprehension, and many of those are about comprehending written language. So let's

consider some real-life places where normal language users are likely to make temporary errors in comprehending written language; for skilled readers, these are usually places where top-down processing happens to make false predictions.

We'll start with a familiar example of an error where top-down processing can cause a person to make mistakes. A **PROOFREADER'S ERROR** is a failure to notice a typing or a typesetting mistake, even when you are reading over something important (perhaps a job application or a wedding invitation) to make sure that it's perfect. Proofreading is still necessary in the computer age, because spell-checker and grammar checking programs don't catch errors that make real words and don't violate any obvious grammar rule. And of course, people sometimes forget to use their spell-checkers.

In January 2013, the Missouri State University bookstore gave student customers their new books in book bags saying MISSOURI STATE UNIVERISTY. The original artwork was submitted by the bookstore's marketing manager, and someone there also approved the proof of the artwork that the vendor sent them before printing the bags. The bookstore gave out 6,000 misprinted bags before anyone with the authority to scrap them was notified. 2,500 remaining bags were then destroyed.

Source: Springfield (MO) *News-Leader*, Feb. 12, 2013.

One test for proofreading ability is to hand people an ordinary printed page and ask them to circle every *f* on it. If you try this, you'll see that they will miss many of the *fs* in the word *of*, because it's such a predictable word that we barely register it when we read. We do much better with catching the *fs* in other words. This isn't just a matter of skipping *of* as our eyes move across a page, as people used to think. What happens is that our top-down processing of syntax tells us that *of* should be in certain places. We rely on that top-down information so much that we barely attend to the bottom-up information—that is, the actual marks on the page in those places. As you'd predict, then, when the word *of* is missing entirely from a spot where it belongs, we're more likely to overlook that omission error than we are to overlook a missing word that has more meaning and is less predictable. Here's an example that escaped its proofreader on May 26, 2009, from an online science news article: *Traditional studies thus undermine this complexity by only accounting for the responses single neurons.* (University of Leicester, 2009).