1 Introduction to the study of reading

KEY TERMS

written and spoken language
alphabetic writing system • logographic writing system • syllabic writing system
reading-age match design • longitudinal study • training study

CHAPTER OUTLINE

In today's world the ability to read is a valued and vital skill. People in the developed world are surrounded by print and it is difficult to imagine a life in which you did not interact with written text on a daily basis. We read environmental print (signs and advertisements) on the journey to school, college or work. We engage in occupational reading for work and informational reading for research and learning. We also read a wide range of material in our spare time, such as fiction and nonfiction, newspapers and magazines, and websites and articles on the Internet. Advances in technology mean that reading, in the form of e-mails and text messages, is now a primary means of social communication for many people. In developing countries, reading enables access to information about the essentials of everyday life, such as healthcare and agricultural techniques, as well as opening up educational and employment opportunities. Reading, in its many forms, plays a central role in our working and social lives.

WHAT IS READING?

Reading is clearly an important skill. In fact, reading is much more than a single skill: it involves the coordination of a range of abilities, strategies and knowledge. The number and type of factors that are involved in reading, and the impact each has on the process, can be hard for skilled adult readers to appreciate because, for us, reading is relatively effortless. It is an ability that we can quite easily take for granted. To examine what is involved in reading, consider the following short passage:

> Henry and his younger sister Ruby were going to visit their great-aunt for tea. She was eighty-eight years old. When they stepped outside it was raining cats and dogs, so Henry fetched his brolly. First they walked to the bank and then to the florist's. Great-aunt Julia was particularly fond of alstroemeria.

To read and understand this passage, readers need to read and access the meanings of the individual words. They move their eyes across each line of text, stopping (or fixating) on individual words. Some words may be unfamiliar, which can disrupt understanding. For example, *alstroemeria* is a flower, commonly known as a Peruvian Lily, and *brolly* is British slang for an umbrella. Some words may not conform to common rules of pronunciation, which may cause difficulties for younger and poorer readers. In this text, *aunt* has an exceptional spelling-to-sound pattern: the letter string is pronounced differently than in other words that contain the same sequence of letters, such as *gaunt*, *flaunt* and *daunt*. *Great* is another word that might cause difficulties because the letter string 'eat' is not pronounced in the same way in all similarly spelled words, for example *meat, feat, wheat* and *cheat*. Other words may have more than one meaning. Take the word *bank*: are Henry and Ruby going to the river to feed the ducks? The correct meaning is chosen by considering the context.

Once the words have been read and their meanings selected, the reader needs to combine the words into meaningful **clauses** and **sentences**. The word string *It was raining cats and dogs* is a common idiom in British English. Idioms are multi-word

expressions that have a figurative meaning that is not a literal interpretation of the words. In this passage, the expression takes the idiomatic (or figurative) meaning: cats and dogs are not literally falling down from the sky, rather it is raining heavily. If the expression is unfamiliar, which might be the case for a younger reader or nonnative speaker, the figurative meaning cannot be retrieved from memory and the phrase will seem odd in the context of the text.

As well as making sense of individual sentences, the reader needs to integrate the ideas presented in successive sentences. *She* in sentence two can be linked back to the great-aunt. *She* does not refer back to Henry, who is male and would be referred to with the pronoun *he*; *she* is not Ruby, who is Henry's younger sister and therefore unlikely to be eighty-eight years old. The reader also needs to make sense of the text as a whole: why do Henry and Ruby go to the florist's? General knowledge about the convention of taking gifts when visiting elderly relatives for tea (as well as on other occasions) is used to make the inference necessary to understand Henry and Ruby's actions: they went to the florist's to purchase some flowers to give to their great-aunt. In addition, in British English the term *tea* can be used to indicate different things. These include: a cup of tea; a pot of tea with cake and sandwiches (afternoon tea); an early evening meal (high tea); and the main evening meal, which can also be called dinner or supper. In this text, the context does not make clear the meaning of *tea* (although my experience of great-aunts leads me to think that they will be enjoying cake and sandwiches).

This analysis of a simple five-sentence text illustrates that reading is a complex activity, one that involves a range of different skills, processes and types of knowledge. Researchers of reading investigate these and other factors to determine how children learn to read and why, for some children, reading breaks down. Given the complexity of reading, the challenge to understand how children learn to read and why some children fail to acquire adequate reading skills can, at times, appear daunting. However, an understanding of the reading process is considered (by some at least) to be ultimately rewarding. As Huey (Huey, 1968/1908) stated: 'to completely analyse what we do when we read, would almost be the acme of the psychologist's achievements, for it would be to describe many of the most intricate workings of the human mind.'

Because of the range of cognitive skills and processes and types of knowledge involved in reading, it can be useful to break the task of reading into manageable chunks. One way to conceptualise reading ability is to think about it as comprising two components. One component concerns word reading, the ability to translate the printed word into sound, which enables the retrieval of the word's meaning. The other component concerns comprehension skills, retrieving the sense of individual words, combining clauses to make sentences, and making meaning from successive sentences and paragraphs. This distinction between word reading and reading comprehension is recognised in a widely used conceptual framework of reading, the Simple View of Reading (Gough and Tunmer, 1986; Hoover and Gough, 1990), and has been used to structure this book. Skilled word reading and reading comprehension, and the development of each, are considered in separate chapters. Likewise, the reading difficulties experienced by children who have problems primarily with word reading and those who have problems primarily with reading comprehension are reviewed in different chapters.

THE RELATIONSHIP BETWEEN WRITTEN AND SPOKEN LANGUAGE

Before children are taught to read, they have developed spoken language skills that provide a foundation for the development of both word reading and reading comprehension. However, understanding a spoken word and accessing its meaning in the printed form are not the same thing: competence in a spoken language does not guarantee success in understanding printed text in the same language. It is important, therefore, to consider the relationship between written and spoken language. This relationship will inform how we approach reading instruction and the remediation of reading difficulties. What skills do we need to teach beginner readers? What skill, strategy or knowledge instruction will ameliorate the difficulties experienced by poor readers? Can we nurture 'reading' skills in pre-readers?

If reading is simply 'speech written down', then we need to teach children how to decode the printed word into its spoken form, but little else. Indeed, some reading researchers hold the view that as long as children are taught to read and access the meanings of individual words, comprehension will follow. An alternative view is that written and spoken language have little in common: they are two systems used to represent language that differ in several fundamental ways. If this were the case, then reading instruction would need to involve more than word reading skills. Perfetti (1985) labelled these two positions the 'commonality' and 'distinctiveness' views; as he observes, neither is an accurate description of the relation between written and spoken language.

What is unique about reading?

Print and speech are essentially different modes of communication that share a common linguistic foundation. A useful framework in which to compare the two modes is to consider how they differ in terms of two fundamental design features: the physical form of the signal and the social function of the message (Perfetti, 1985, 1994; see also Garton and Pratt, 1998). These two design features of print and speech lead, in turn, to a number of other differences, which are summarised in Figure 1.1.

The physical form of the signal

We use our eyes to read words on the page (or computer screen): print is visual[1] and is presented spatially on the page in front of us. In contrast, we use our ears to hear words that are spoken in real time: speech is aural and is presented temporally. These differences lead to another important distinction: print is permanent, whereas spoken language (unless recorded) is temporary. Readers have the opportunity to go back over the message if they have misunderstood or forgotten something, because the previous input is available; in contrast, listeners are reliant on what information is retained in memory.

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[1] The obvious exception is Braille, a system of touch reading for the blind comprising raised symbols.
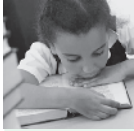
	Written language	Spoken language
The physical design of the signal		
	permanent	temporary
	spatial	temporal
	visual	aural
	word boundaries	no word boundaries
	punctuation	stress and intonation
	can re-read	memory demands
The social design of the message		
	topic is fixed in advance	topic can be negotiated
	decontextualized	shared reference
	formal register	informal register

Figure 1.1. *Differences between written and spoken language*

Source: Adapted from Garton and Pratt (1998) and Perfetti (1985).

Another difference between print and speech concerns the demarcation of individual words. In written language, word boundaries are clearly marked: there is a blank space between each word (unless flouted for literary effect by writers, for example 'upturnpikepointandplace' from *Finnegan's Wake* by James Joyce). Spoken language rarely has silence between words: the words blend together. This is illustrated in Box 1.1: *Visual records of spoken language.* As a skilled language user, it is difficult to reflect on this feature of speech, but think back to an experience such as learning a new language in school. At the outset, it was probably much easier to recognise individual words printed on the page than in conversation with a native speaker or when listening to recorded dialogues, because the words in a stream of speech appeared indistinguishable.

A particular advantage of speech is that the speaker will usually accompany their message with nonlinguistic cues, such as hand gestures and facial expressions, and paralinguistic cues, such as stress and intonation. In print the author can use punctuation (the exclamation mark, comma and question mark) to achieve similar effects; italics, capitals and underlining are also options. But these features of written language do not convey emphasis, focus and meaning to the extent that the nonlinguistic accompaniments and paralinguistic features of speech can. That is one reason for authors including directions to describe how speech was delivered. For example, ' "Well you will soon be better now," said Anne *cheerfully*'; ' "I think very differently," answered Elizabeth *shortly*' (from *Persuasion* by Jane Austen, italics added). And my new favourite: ' "Oh right." *Her voice contained such contempt* that Sandström closed his eyes' (from *The Girl Who Played with Fire* by Stieg Larsson). These directions guide

## BOX 1.1. VISUAL RECORDS OF SPOKEN LANGUAGE (INSPIRED BY WHITNEY, 1998)

There are many different ways to represent the spoken language visually, as depicted in this comparison. Different writing systems represent the spoken language in different ways, representing sound (alphabetic languages such as English, Greek or Japanese *kana*) or meaning (Chinese). Sign language is also a visual medium used by the hearing impaired. Braille, on the other hand, is essentially a tactile medium, although the raised dots (represented in bold here) can be represented visually as shown. The spectrogram, which is a recording of an English speaker saying this phrase, illustrates how speech does not follow the convention of breaks between words on the written page.

Spectogram	
English	see you later
Phonetic alphabet	siː juː ˈleɪʧ.ər
Greek alphabet	Τ α λέμε
Japanese syllabary	じゃあ、また　あとで。
Chinese syllabary	再見
English text	C U L8R
Braille	
British Sign Language	

the reader's interpretation. In speech, sarcasm is often conveyed by intonation, which can aid a listener's interpretation. In print, the reader must use the context alone to interpret the phrase appropriately (see Figure 1.2).

The social design of the message
Written language is generally used for different purposes to spoken language, and this has consequences for both the content and the form of the message. Speakers and writers make choices. Speech is generally interactive and conversational, so the choice
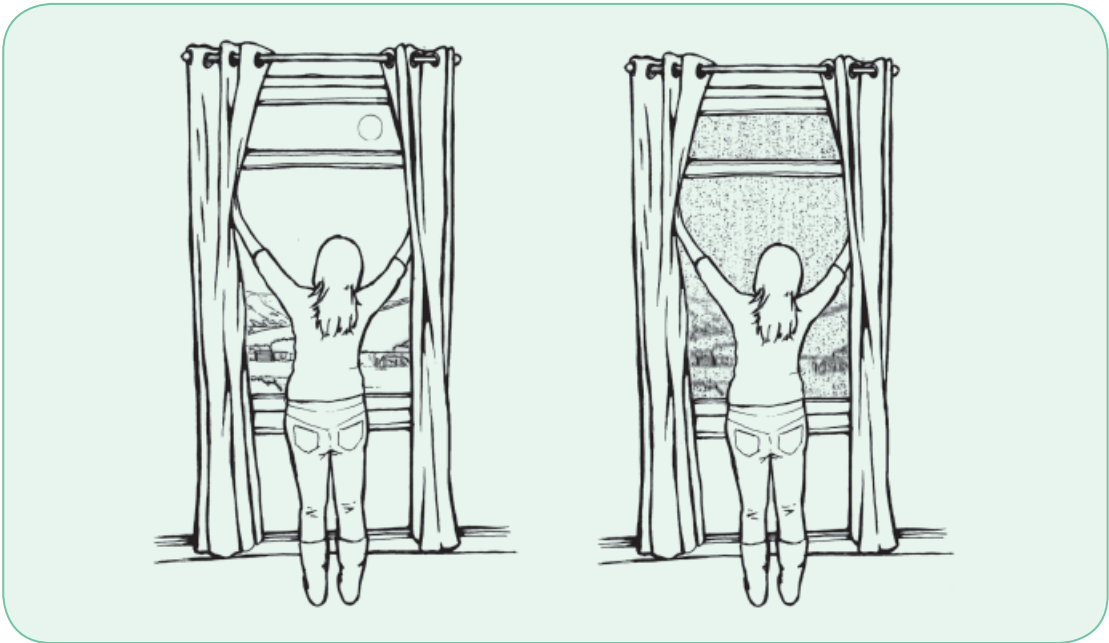
Figure 1.2. *What a nice day!*

about the topic of a conversation is something that is negotiated between conversational partners and often centres on a shared body of knowledge or common interest, such as your opinion of a recent movie or the recent success of your favourite football team (unless you are stuck with the self-centred 'party bore'). In contrast, the author selects the topic of the written message in advance. In this respect a lecture, which is spoken, is much more similar to written text than to conversation.

Speakers and writers also make choices about the actual language used in each mode. We tend to use a different type of language (or register) in speech to that in print. Written language tends to be more formal than spoken language: much spoken language occurs in casual conversational settings. Obviously the register differs depending on context. You would choose a different style of clothes to wear when going out for a drink with friends from those you would wear to a job interview. Similarly, you would not use the same style and delivery of language when chatting about your degree course with friends and explaining to a potential employer how your studies make you the best candidate for the job.

The interactive context of speech-based communications contrasts with writing, in which the flow of information is from author to reader. As a result, sensitive speakers will adapt the level of detail and explanation depending on their audience (such as small child, adult or nonnative speaker) and listeners have the opportunity to ask for clarification if they do not understand. These options are not available to authors and readers. Some academics disagree with the conceptualisation of printed meaning as a

one-way street from author to reader. There is the view that understanding print is a dialogic construction of meaning between the author and each particular reader, who will bring different experiences, prior knowledge and goals to the task (Bakhtin, 1981). Clearly, the adequacy of comprehension and the types of **inferences** generated by the reader will depend on an individual's skill and general knowledge. However, most texts have a core meaning intended by the author so that, in an ideal situation, a group of similarly skilled readers will all derive approximately the same central meaning, the one the author intended. If not, how would we be able to discuss the content of a book in a reading group?

Speech is embedded in a shared, supportive communicative context. The context will include cues additional to the actual words: gesture, intonation, facial expression and the physical environment. Conversations with young children often feature objects that are physically present ('Look at the doggie') and the purpose of the intended meaning may often be very evident ('Don't touch that hot stove!'). Early encounters with print may be set within a familiar context, for example the brand name on a packet of cereal. More typically, however, print is 'decontextualised': it is not about the 'here and now', there is no shared physical context between author and reader and the text may concern past, future, or even fictitious, events (Snow, 1983).

Reading involves the interpretation of language that is not bound to a shared social or physical context. The context for the interpretation of the message will come from the set of expectations that a reader (or listener) brings to the text and what has already been read (or spoken) (Sperber and Wilson, 1995). So, for example, we do not interpret the phrase *First they walked to the bank* in the Henry and Ruby story as an indication that they might rob a bank. In a different context, for example a story about Bonnie and Clyde, we might assume that intention.

What challenges does the learner reader face?

The examination of written and spoken language demonstrates that writing is not simply 'speech written down'. The mode of delivery and the function of a message both determine how we perceive the information. They also influence the content and register of the information, and can have an impact on our relationship with the author of the message. Further, the two components of reading – **word recognition** skills and text comprehension – involve attention to different levels or units of language. Therefore, each component presents different challenges to young readers on their journey to literacy: challenges in learning how to decode the printed words on the page and challenges in comprehending the meaning of the printed message.

Challenges related to word reading

The goal of reading is to understand what is read. The main challenge for beginner readers is learning how to **decode** the printed symbols in order to access the meanings of the words they represent. Reading comprehension is not possible if the reader cannot read the words on the page. This should be apparent when you examine examples

of the same phrase represented by different writing systems, such as English, Greek, Japanese, Chinese and English text messaging in Box 1.1: *Visual records of spoken language*; unless, of course, you are a polyglot. In this section, the challenges that arise from the broad differences between **logographic, syllabic and alphabetic writing systems** are briefly reviewed, followed by a discussion of those posed by different alphabetic systems. What is common to all writing systems is that learning to read words involves a focus primarily on words or subword units; that is, a focus on the elements that make up the written word. It should be noted that the vast majority of research on reading development focuses on reading in alphabetic systems, and almost all of that is on English. For the reader interested in literacy development in Chinese, good sources are Hanley (2005) and McBride-Chang (2004).

Different writing systems Different languages use different writing systems, so readers of each type of system face particular challenges. For example, Chinese and the *kanji* system of Japanese, which is based on Chinese, use a logographic writing system. This system primarily codes the meaning of words, rather than the sounds: a unique symbol (or character) is used to represent each meaning unit (or **morpheme**). There is a phonetic (sound) component as well as a semantic radical (meaning) component to the majority of characters, although the phonetic component is not always a reliable guide for pronunciation. Each symbol corresponds to a single **syllable** in the spoken language. Chinese has approximately 450 different syllables in the spoken language.

Other writing systems break down the graphic representation of the word into smaller units that represent the sounds, rather than the meaning, of the spoken language. Japanese uses two syllabic systems (*kana*), *hiragana* and *katakana*, alongside borrowed Chinese characters (*kanji*). The *kana* system represents sounds in the words at the level of syllables, but not their meanings. Languages such as English, Spanish, German and Finnish use an alphabetic writing system, in which single letters or letter combinations (known as **graphemes**) are used to represent the spoken sounds (**phonemes**) of the language. The graphemes do not carry meaning. So, for example the word *pat* has three sounds – /p/, /æ/ and /t/ – and is written with three letters represented by three symbols, but these individual graphemes – 'p', 'a' and 't' – do not provide clues to the meaning of the word.

Advantages and disadvantages of different writing systems Each writing system has advantages and disadvantages. The logographic system works well for Chinese. Spoken Chinese is a tonal language in which a subtle change in the pitch of a **vowel** will change the meaning of a morpheme. As a consequence, there may be five or more meanings for one spoken syllable and there are many words in Chinese that sound very similar but have different meanings (McBride-Chang, 2004). Words that have different meanings but sound the same are called **homophones**. An example is the English word *fair*, which as an adjective can refer to someone with blond hair or pale skin, an unbiased decision and also clear weather, and as a noun can refer to a trade event or a carnival. The word purported to have the most meanings in the English language is *set* (estimated at between 424 and 464, depending on who is counting).

Homophones are more prevalent in Chinese than in English. There is no system to code tone in the written form of Chinese. One advantage of the logographic writing system is that it prevents a great deal of ambiguity because the symbol clearly indicates the meaning of the word (different symbols would be used for the different meanings of *fair*). However, the reader needs to learn the different symbols first (Chinese is not pictographic). Therefore, a disadvantage is that the beginner reader has to learn lots of characters: approximately 2570 in the first six years of reading instruction. Although some recent Chinese dictionaries contain up to 60 000 characters, the vast majority (99%) of characters in texts are from a constrained set of around 2400 (Hanley, 2005).

The Japanese writing system of coding for spoken syllables is a good system for Japanese because the language has an estimated 116 permissible syllables. In contrast, one would require approximately 15 000 symbols to code all of the permissible syllables in the English language (Frost, 2005). Thus, a syllabic writing system would not be a practical writing system for English (or other alphabetic languages). The main advantage of writing systems that code for sound is that there are few actual symbols to learn: for example, the 26 letters in English can be used to code the 44 phonemes that we use in our spoken language. However, as illustrated above, the written symbols do not carry meaning. Thus, in English we may often rely on the context provided by the text to disambiguate the meaning of a word, for example *bank* or *fair*.

More on alphabetic writing systems   Not all alphabetic writing systems are equal. The consistency between the spelling-to-sound relations (how to pronounce each grapheme) differs among languages. In addition, the consistency between the sound-to-spelling relations (how to write each phoneme) differs. The writing system of a language that represents the sounds is called an **orthography**. Some alphabetic languages have what can be called a shallow (or transparent) orthography. In languages such as German, Spanish and Finnish, the majority of graphemes (individual letters or letter combinations) represent the same phoneme in the spoken language. For example, in German the letter 'a' is always pronounced in the same way, unless it takes an umlaut; for example *der Ball, die Bank, der Park* (Goswami, Ziegler and Richardson, 2005). As a result, the pronunciation of each grapheme is consistent and this feature may aid the acquisition of word reading in these languages. Finnish is also completely consistent in this respect.

Some alphabetic languages, most notably English, do not have such a consistent relation between graphemes and phonemes. The orthography of these languages is often termed deep (or opaque). In English, the grapheme 'a' can be used to represent different phonemes in the spoken language; compare the pronunciation of 'a' in *cat, father* and *ball.* This means that for English the spelling of a word is not always an accurate guide to its pronunciation, because some graphemes have more than one pronunciation. See the poem in Figure 1.3 for a humorous illustration of the complexities of English pronunciation.

The degree of consistency of how to write each phoneme also differs among languages. French has fairly consistent spelling-to-sound (pronunciation) rules, but an individual sound may be represented in print in different ways, for example the graphemes

Is English a dreadful language?

I take it you already know
Of tough and bough and cough and dough?
Others may stumble, but not you,
On hiccough, thorough, lough and through?
Well done! And now you wish, perhaps,
To learn of less familiar traps?

Beware of heard, a dreadful word
That looks like beard and sounds like bird,
And dead: it's said like bed, not bead –
For goodness sake don't call it 'deed'!
Watch out for meat and great and threat
(They rhyme with suite and straight and debt).

A moth is not a moth in mother,
Nor both in bother, broth in brother,
And here is not a match for there
Nor dear and fear for bear and pear;
And then there's dose and rose and lose –
Just look them up – and goose and choose,

And cork and work and card and ward,
And font and front and word and sword,
And do and go and thwart and cart –
Come, come, I've hardly made a start!

A dreadful language? Man alive!
I'd learned to speak it when I was five.
And yet to write it, the more I sigh,
I'll not learn how 'til the day I die.

Try reading this anonymous poem aloud: it is difficult not to mispronounce at least one
or two words!

Figure 1.3. *Is English a dreadful language?*

'o', 'au', 'eau', 'aux' and 'eaux' all correspond to the same sound (Harley, 2008). The same is true for German, which has relatively consistent spelling-to-sound rules but less consistency in how to write down each sound. This means that in French and German, as well as English, there is more than one way to spell each phoneme. For English, we have examples such as the /i/ sound in *my, pie, sigh* and *bye*. As a result of these features, there is less predictability in the relations between print and sound in English than in other alphabetic languages and English-speaking children are generally slower to learn to read English than are native speakers learning to read in a highly regular language, such as German, Italian or Spanish (Seymour, Aro and Erskine, 2003).

Challenges related to comprehension

The differences in the delivery of the message and the social function of speech and print lead to differences in the language used in each medium. As Chafe and Danielewicz (1987) point out: 'There can be no doubt that people write differently from the way they speak' (p. 83). Written language makes use of vocabulary and syntactic constructions that may not be familiar to children from their everyday spoken interactions. It also involves the integration of information within longer units of language than are common in speech. These challenges – vocabulary, syntax and integration – are discussed next.

Vocabulary Written language uses a richer and more varied vocabulary than spoken language. It may surprise you to know that books written for children contain words that are less common and less familiar than those typically used in conversations among adults. Expert witness testimony, which may often include some very specific terminology, contains fewer rare words than children's literature. One reason for these striking differences is that speakers produce language in real time. They do not usually have the luxury of planning time, or the opportunity to reflect on what they have said, to edit or revise the language used, or to consult a thesaurus. Conversational language also contains more instances of colloquialisms: we tend to use *kid* rather than *child*, *bike* rather than *bicycle*, and fillers such as 'you know' (Chafe and Danielewicz, 1987; Redeker, 1984).

We get a clearer picture of the distributions of different word types when we examine collections (corpora) of written and oral language (as illustrated in Figure 1.4). Some words that appear frequently in samples of written language do not feature once in vast samples of spoken language. A study of the vocabulary used in reading schemes and storybooks written for 5- to 7-year-olds provides a good illustration of the frequency of rare and infrequent words (Stuart *et al.*, 2003). Stuart and colleagues' corpus of texts written for young readers contains just over 268 000 words and nearly 10 000 different words are represented. Within that sample, 51% of the individual words appear only once or twice. These infrequently occurring words are much more likely to be **content words**, those that carry meaning such as *house, grow, jolly* and *easily*, than grammatical **function words**, such as *at, the* and *it*.

These statistics suggest that young beginner readers face two challenges relating to reading vocabulary. First, they may encounter some words that are not very familiar to them from their experience with spoken language. Second, young readers may have limited experience in reading many content words and will consequently lack the opportunity for these words to become familiar and stored in memory, because they occur so infrequently in print. The major challenge facing beginner readers is accessing a word's entry in their **lexicon** (their mental dictionary or store of words) for a word that they know, but have never seen before in print (Gough and Hillinger, 1980).

Sentence structure Another challenge comes from sentence structure. Writers and speakers tend to use different types of syntactic construction. Speakers are more likely to chain clauses together with 'and', whereas writers use more elaborate or complex devices to link clauses. One reason for this speech–print difference is the social context: speech lends itself to a less formal register. Although the length of

Average values for major sources of spoken and written language		
	Rank of the median word[1]	**Number of rare words per 1000 words[2]**
Printed texts		
Books for adults	1058	52.7
Books for children	627	30.9
Books for pre-schoolers	578	16.3
Adult speech		
Expert witness testimony (such as that used in court)	1008	28.4
College graduates talking with friends, spouses etc.	496	17.4

Figure 1.4. *Comparisons of vocabulary in written and spoken language samples*

Source: Adapted from Hayes and Ahrens (1988).

Notes:

1. The values are taken from a corpus of written English that ranks words by their frequency of occurrence (Carroll, Davies and Richman, 1971). The rank of the median word is the frequency rank of the average word in each of the five different samples.
2. A rare word is defined as one with a rank lower than 10 000.

spoken utterances can exceed 100 words, the most frequent length is a single word. The length of written sentences follows a more normal distribution and they tend to be longer, around 24 words (Chafe and Danielewicz, 1987; see also Redeker, 1984). One reason for the difference is that we, as speakers, take into account the additional memory constraints involved in processing speech and use less convoluted sentence structures; the listener does not have a page to review.

Integration   A final comprehension challenge, which has been alluded to throughout this section, is that when comprehending written language readers often have to integrate information over extended sections of text – sentences, paragraphs, pages. A similar situation exists for a formal academic lecture, but in the everyday conversational use of speech this is rarely the case. Thus, although readers may have the opportunity to re-read and check details, they have to keep track of several protagonists, in multiple episodes, over many pages of text in a book that may be read over several days.

In *Harry Potter and the Deathly Hallows* (Rowling, 2007), the first chapter alone includes six characters who speak, plus an additional twelve who are referred to either as present in the scene or as the topic of conversation. There are 36 chapters in all plus an epilogue: approximately 600 pages of text in total. Books aimed at younger children are not necessarily simpler in structure. In the first chapter of *The House at Pooh Corner* (Milne, 1928), there are four characters who speak, three others are mentioned, and both the characters and the location change between episodes: the first two episodes concern Pooh visiting Piglet and their journey to see Eeyore; the third episode switches to focus on Eeyore and Christopher Robin before Pooh and Piglet arrive.

Summary: Written and spoken language

Spoken language is an important foundation for reading, but key differences between written and spoken language can influence the process of reading and learning to read. First, consider word reading: the writing systems used for different languages code primarily for meaning or for the sounds of the spoken language. Alphabetic scripts, which code for sound, differ in regularity between the written and spoken forms. As a result, children learning to read in different languages face various challenges.

Second, consider comprehension. Differences between the physical forms of the signal used for reading and speaking and between the social functions of the message in these two modalities influence the ease of comprehension. Written language often includes vocabulary and syntax that are not common in spoken language. In addition, written text is usually longer than conversation, which in some circumstances may overload memory resources. However, written text can be re-read. Although our reading ability depends on both the ability to read the written word and our spoken language comprehension skills, we must bear in mind that the two modalities pose unique challenges in relation to comprehension and communication.

HOW TO STUDY READING DEVELOPMENT AND READING DIFFICULTIES

The section above reviewed differences in the form and content of print and speech that lead to specific challenges faced by children when learning to read words and understand written text. Later chapters examine the development of word reading ability and reading comprehension and look at specific reading difficulties, in which either word reading or reading comprehension fails to develop adequately. For the study of different aspects of reading development and difficulties, researchers have developed a varied range of innovative measures and types of experimental design. These require a brief overview for readers who are new to psychology or to the study of reading.

How to measure reading

When we consider the measurement of reading ability, it is important to be clear about what is being measured. Typically, we measure the *processes* involved in reading words and understanding text *as the reader is reading*. With word reading, we may measure how a child pronounces a word or nonword: for example, do they read the **nonword** *puscle* to sound like *puskell* or to rhyme with the real word *muscle*? In Chapter 3, you will see how the pronunciation of nonwords can provide useful information about the strategies used to read aloud new or unfamiliar words. Another measure

of word reading is fluency or speed: the time taken to read a list of words or non-words. Time is indicative of how much processing is required: easy tasks are completed quickly and more difficult tasks take longer. Timed measures of word reading provide an index of the efficiency and automaticity of word reading skills. So it takes longer to read an unfamiliar five-syllable word such as *alstroemeria* than a more familiar one such as *particularly*.

We can obtain useful information about the processes involved in reading comprehension through timed measures. The logic is the same as for word reading: the time taken to complete an assessment of comprehension reflects the amount of processing involved. Thus, it will take longer to read a sentence that requires some additional thinking to make it relate to the story, for example *Great-aunt Julia was particularly fond of alstroemeria* compared with *Great-aunt Julia was particularly fond of flowers*, even after taking into account differences in length.

There are a variety of timed measures commonly used in the study of reading comprehension. We can record the time taken to read a sentence, as above, or to read a single word. In a **semantic priming** task, a target word is presented after another word, sentence or text and the time taken to respond to the target word is measured. The task might involve reading the word aloud, or a judgement such as whether or not the word is a real one or its meaning fits with the overall sense of the text. The idea is that, as we read, related concepts are activated. Therefore, a reader (or listener) should respond more quickly to the word *hot* when presented after the word *sun* than to an unrelated word like *bird*. Similarly, the reader will respond more quickly to *hot* after the sentence: *It was a beautiful summer's day* than the sentence *The bird sat on the branch*. To study a reader's understanding of text, we can also time how long it takes to answer a question about its content.

Other behaviours are typically recorded after a text has been read. These are generally used to assess aspects of comprehension (rather than word reading), specifically the *product* of what has been read. The researcher may, for example, be interested in memory of the content of the text, which can be assessed by a retelling of the text or recognition of sentences from the text. Open-ended questions to tap memory or understanding of key concepts are commonly used. These measures are sometimes referred to as 'off-line' measures.

Experimental designs for the study of reading development and difficulties

Many types of experimental design have been used to study both reading development and difficulties. The consideration of design issues might not be top of everyone's reading list, but it is important. More and more frequently, the media reports 'cures' for reading difficulties, such as **developmental dyslexia**, as well as for a whole host of medical and social conditions. An appreciation of appropriate experimental designs enables evaluation of the quality of evidence presented. As a student of reading development, an understanding of the strengths and weaknesses of different research designs is essential in order to be able to appraise the outcomes of a particular study.

Unfortunately, the list of possible research designs is lengthy and understandably some readers may wonder why researchers do not simply decide on which is the best method and use that one. The aim of this section is to explain the purpose, advantages and disadvantages of the most commonly used designs. As we will see, there is no single 'best' design: each has its own strengths and weaknesses and is suitable for addressing particular research questions. It is also possible to combine different methods in a single study, for example comparing different types of training in a **longitudinal study**, to look for converging evidence as to which particular variables are causally implicated in both word reading and reading comprehension development or failure (Bradley and Bryant, 1983).

The basic cross-sectional design

Many studies of reading development and reading difficulties have used a cross-sectional design. The researcher collects data at the same time from different groups of readers, for example younger versus older children or good versus poor readers. The performance of the two groups is compared. Earlier, I discussed how alphabetic languages adopt a convention of representing the sounds, rather than the meaning, of the spoken language. Therefore, researchers have been interested in whether or not there is a relation between children's ability to manipulate (or play with) spoken language and their success in learning to read.

The ability to manipulate the spoken sounds in our language is called **phonological awareness**. One task designed to measure this skill is a phoneme deletion (or elision) task. In a deletion task, children are asked to take away a sound (in this case a phoneme) from a word: *say 'frog' without the /f/ sound*. To establish whether this skill is related to reading level, a researcher could compare the ability of good and poor readers to perform this task. The design may require some screening or pre-testing to select suitable participants for each group, for example good and poor readers, but it is essentially a relatively simple, quick and cost-effective way of finding out whether or not there is an association between the skills of interest. Typically, better readers obtain higher scores than poorer readers on phoneme deletion tasks, and performance on such tasks is predictive of reading progress in beginner readers.

Studying the causes of reading success and failure: Design issues

The cross-sectional design can usefully identify an association between two variables, but that association does not imply a causal relation. I will use a frivolous (but hopefully memorable) example to illustrate this point. In a population of 5- to 12-year-olds, word reading ability and height will be related: children who are taller tend to be better readers. That does not mean that a child's height determines or causes their word reading skill, however. Ehri (1979) has pointed out that any two variables, such as word reading and height, can be related in one of four different ways:

1. Height may be a *prerequisite* of reading – you need to reach a certain height before you are ready to learn to read.

2. Height may *facilitate* the development of word reading – taller children learn to read faster than shorter children of the same age.

3. Height may be a *consequence* of reading – reading makes you taller.

4. Height may be an *incidental correlate* of reading, as in this example. It is simply the case that older children have had more years of reading instruction and also more years in which to grow.

Cross-sectional comparisons do not distinguish between these alternatives. So the cross-sectional design cannot help the researcher to determine *how* two variables are related and should not be used to infer causality. Thus, we should be wary of making causal inferences from correlational studies, even where there may be theoretical reasons to infer the direction of cause and effect. Substitute 'phonological awareness' for 'height' in the above example. Awareness of the sounds that make up the spoken forms of words may be a prerequisite or facilitator of learning to read in an alphabetic language; alternatively, this awareness may be a consequence of learning to read and experience with how the individual sounds in spoken words are represented by graphic symbols. Finally, it may be an incidental correlate of word reading skill, and have no bearing on reading development.

Clearly, we need to identify which skills are causally related to the development of word reading and reading comprehension so that we can develop appropriate teaching methods. We also need to identify which skill impairments cause (or lead to) reading difficulties, so that we can develop interventions to help children with poor reading. There are three commonly used research designs to explore causality: longitudinal studies, which can identify the skills that facilitate typical reading development and the conditions that lead to reading difficulties; ability-match comparisons, which are often used to study the causes of reading failure; and training (or intervention) studies, used to determine the skills that foster reading development and skill deficits that result in reading problems.

Longitudinal studies: Tracking the development of skills over time

In longitudinal studies, researchers examine the development of a skill or range of skills over time. Measures are taken at different time points and can be analysed to assess two things: whether some variables predict later reading ability (and growth in reading ability); and whether a particular variable is a better predictor of reading development than (early) reading skill is a predictor of that variable.

To illustrate this design, consider a skill that might facilitate growth in reading comprehension: vocabulary knowledge. These two skills are related: children with better vocabulary knowledge are typically better at reading comprehension than children with poorer vocabulary knowledge. These relations are, perhaps, not surprising: a reader must be able to understand the individual words in order to understand the text. In relation to the development of reading comprehension over time, we might wish to establish whether or not vocabulary predicts growth in reading comprehension: do good vocabulary skills help to drive comprehension development?

If we find support for this relation, we might also want to consider any evidence for a reciprocal relation: does good reading comprehension lead to better vocabulary development?

Clearly, early comprehension will be related to later comprehension. To identify whether or not early vocabulary skills facilitate the development of reading comprehension over time, we need to control for initial reading comprehension ability. If early vocabulary skills explain a child's later reading comprehension level, over and above their standard of reading comprehension at the start of the study, we can reasonably assume that vocabulary plays a causal role in reading comprehension development. The same logic can be applied to test for reciprocal relations.

The ability-match (or reading-age match) design

The **ability-match** or **reading-age match design** is a variant on the simple cross-sectional study, and has been used widely in the study of developmental dyslexia. It requires three groups of participants: good and poor readers matched for chronological age, and an additional group of younger, typically developing readers. The latter group are selected so that their word reading ability is at the *same absolute level* as that of the older poor readers, but is normal for their age. See Bryant and Goswami (1986) for an overview, and Cain, Oakhill and Bryant (2000a) for an extension of this design to study reading comprehension.

To illustrate the ability-match design, I will go back to the example of the relation between performance on a phoneme deletion task and word reading skill. The cross-sectional design can demonstrate that the two skills are related, but cannot establish the direction of causality, specifically whether poor **phonemic awareness** results in poor word reading or poor word reading leads to poor phonemic awareness. The reading-age match design can be used to test (or rule out) one possible direction of causality: that superior phoneme deletion skills arise from superior reading ability. Here, the comparison between the poor readers and the reading-age match group is of critical interest. If the poor readers and the reading-age match group differ on a phoneme deletion task, we can rule out the possibility that superior phoneme deletion skills arise from superior reading ability, because the two groups are matched for absolute level of reading skill.

This is of course a strong test, because the younger reading-age match group will have less well-developed cognitive skills in general. One implication of this design is that the younger reading-age match group have achieved the same level of competence in reading as the older poor readers through a different route, because they are matched on measures of word reading but differ on a measure of phoneme deletion.

The reading-age match design has its limitations: it can only be used to rule out a causal link in one direction, from reading ability to the skill in question, and cannot be used to prove a link in the opposite direction. However, it is a relatively quick method for identifying (or ruling out) likely causal candidates. This information can inform the design of other more expensive and time-consuming methods, such as longitudinal and training studies, which provide more robust tests of causality.

Training and intervention studies

The **training study** or **intervention** design has two main uses. It is widely used to assess whether or not a particular training programme aids the development of the target skill and can therefore be used to test the effectiveness of a particular teaching method or therapy. In the scientific study of reading it has another, slightly different, use, which is to test causality.

To illustrate the basic design, I will use a different example again from the study of reading comprehension development. At the start of this chapter, I outlined why it is important to make inferences to understand text: for example, *Why did Henry and Ruby go to the florist's?* Inferences such as this one (to buy some flowers) rely on the integration of information presented in the text with the reader's general knowledge. There are good theoretical reasons to propose a relation between inference making and good comprehension and there is a large body of research that demonstrates that children with reading comprehension problems have difficulties with inference making. Good inference making skill is, therefore, a candidate cause of good reading comprehension; expressed differently, poor inference making might result in poor reading comprehension.

To test the hypothesis that poor inference skills cause comprehension problems with a training study, we could select a group of children with poor reading comprehension and train them to make inferences. After the training, we could measure their ability to make inferences to see if the training worked. We could also test the poor comprehenders' ability to understand text in general, to see if this has also improved. This latter test is important because we want our training to generalise beyond measures of inference making to broader measures of reading comprehension.

An important component of any training study is the comparison group (or groups). For the current example, the comparison group could comprise good readers who participated in the same training; alternatively, we might compare the poor comprehenders' performance to that of another group of poor comprehenders who received a different training regime. If the poor comprehenders who receive the inference training make greater gains in reading comprehension than the other groups, we have good evidence that the skill targeted in their training – inference making – is causally implicated in this improvement.

Although often touted as the best design to provide evidence for causality, there are limitations to what we can conclude from intervention studies. Importantly, the training effect might not have arisen because of a direct improvement in the skill being trained. For example, many inferences rely on the integration of information presented in the text with the reader's general knowledge. If children are taught how to identify where and when inferences are required, does improvement arise because of better integration skills or because of better identification of clues in a text? Another possibility is that training in inference awareness and identification leads to improved activation of relevant general knowledge when reading. When we consider the complexity of some of the skills that are associated with good comprehension (and good word reading), it is obvious that a clear test of one skill may not always be possible. For these reasons, it is important to consider how training might influence performance indirectly, through a common mediating variable (see Guthrie, Taboada and Coddington, 2007, for further discussion of this issue).

Summary: How to study reading development and reading difficulties

The measurement of reading can involve on-line measures, such as how quickly a word or sentence is read, and off-line measures, such as responses to comprehension questions. On-line measures typically provide an insight into the efficiency of the processes involved in reading; off-line measures supply information about the quality of the product of reading.

The review of design issues illustrates that there is no one 'best' method to establish which variables are causally related to reading development. Further, some research designs are best suited for the study of typical reading development; others are useful for studying the causes of reading failure. Each method has its limitations, so it is prudent to use a combination of methods and to look for converging evidence as to which particular variables are causally implicated in both word reading and reading comprehension development or failure.

The good news is that, through carefully controlled studies, researchers have come a long way towards identifying the critical skills needed for success in word reading. Less research attention has been paid to comprehension, its more complex cousin, although advances are being made. Importantly, literacy can be taught.

OVERVIEW OF THE REST OF THIS BOOK

The next two chapters concern the skilled adult reader: word reading (Chapter 2) and reading comprehension (Chapter 3). Having established the skills, strategies and knowledge used by the skilled adult reader, we turn to reading development: the development of word reading (Chapter 4) and reading comprehension (Chapter 5). Two subsequent chapters focus on reading difficulties: children (and adults) who fail to develop age-appropriate word reading skills (Chapter 6) and those with poor reading comprehension (Chapter 7). Chapters 8 and 9 concern the implications of the research and theory outlined in previous chapters for intervention, teaching and assessment. The concluding chapter draws together the main themes that emerge from the research covered in this book and considers how our knowledge about reading development and difficulties fits the conceptual framework of the Simple View of Reading.

KEY POINT SUMMARY

- **Reading and learning to read involve two broad sets of cognitive skills, processes and knowledge: those involved in reading the words on the page and those involved in comprehending what is read.**

- There are different ways to represent the spoken language in writing: some written languages use symbols that represent the meaning of words; others use symbols that represent the sounds of the spoken language. Each system has advantages and disadvantages.

- Written English uses 26 letters used to represent the 44 sounds in our spoken language, but it does not have a one-to-one correspondence between the written and spoken forms. Thus, some written forms can be pronounced in several ways, for example the letter 'a' represents different sounds in *cat, father* and *ball,* and some sounds can be written down in different ways, such as the /i/ sound in *my, pie* and *bye.*

- An examination of written and spoken language indicates that writing is not simply 'speech written down'. Differences in the mode and function of the message in written and spoken language and also in the content and register of the information may pose challenges for the (beginner) reader.

- Different methods are used to measure the processes and products of reading. Both accuracy and timed measures are typically used to assess the processes involved in word reading. Timed measures can be used to assess the processes involved in comprehension, as a person is reading. The product of comprehension is often assessed with untimed measures after reading.

- A range of research designs can be used to study reading and to test for causal relations between basic skills and reading success. Designs include ability-match comparisons, longitudinal studies and training (or intervention) studies. Each method has its limitations, so converging evidence from one or more designs should be sought.

FURTHER READING

Perfetti (Perfetti, 1994) provides an excellent overview of differences between speech and print, as do Garton and Pratt (1998). An article by Cunningham and Stanovich (Cunningham and Stanovich, 1998) includes a very accessible introduction to vocabulary differences between speech and print:

Cunningham, A.E. and Stanovich, K.E. (1998) What reading does for the mind, *American Educator,* 22: 8–15.

Garton, A. and Pratt, C. (1998) *Learning to Be Literate: The Development of Spoken and Written Language* (2nd edn), Oxford: Blackwell Publishers.

Perfetti, C.A. (1994) Psycholinguistics and reading ability. In M.A. Gernsbacher (ed.), *Handbook of Psycholinguistics*, San Diego, CA: Academic Press, pp. 849–94.

Different orthographies are described by Goswami and Bryant (1990), who also explain different experimental designs in some detail (see also Bishop, 1997, Chapter 9, for a brief review of experimental design).

Bishop, D.V.M. (1997) *Uncommon Understanding: Development and Disorders of Language Comprehension in Children*, Hove: Psychology Press/Erlbaum.

Goswami, U. and Bryant, P.E. (1990) *Phonological Skills and Learning to Read*. Hove: Erlbaum.

If you are interested in reading development in nonalphabetic orthographies, McBride-Chang (2004) and Hanley (2005) are good places to start:

Hanley, J. R. (2005) Learning to read in Chinese. In M.J. Snowling and C. Hulme (eds), *The Science of Reading: A Handbook*, Oxford: Blackwell Publishing, pp. 316–35.

McBride-Chang, C. (2004) *Children's Literacy Development*, London: Arnold.

DEFINITIONS

ability match or reading-age match design	research design in which the performance of a group of children, such as poor word readers, is compared with that of a (usually younger) group of children who are at the same level of (reading) ability.
alphabetic writing system	a writing system that represents the phonemes of the language.
clause	a group of words comprising a subject, e.g. 'the cake', and a predicate, e.g. 'was very tasty', which must contain a verb.
content words	words that convey meaning, such as nouns (*house*), verbs (*grow*), adjectives (*jolly*), adverbs (*easily*). Also referred to as open class words because new words can be added to this category.
cross-sectional design	a research design in which the performance of different groups is compared.
decode	the ability to translate letters and letter strings into pronunciations.
developmental dyslexia	a condition in which the development of word reading and spelling abilities is impaired.
function words	words with a grammatical role, such as prepositions (*at*), determiners (*the*) and pronouns (*it*). Also referred to as closed class words because there is a (more or less) fixed number of words in this category.
grapheme	a letter or group of letters that represents a phoneme, e.g. the letter *k* in the word *kiss*; the letters *sh* in the word *shop*.
homophones	words with different meanings that sound the same, such as *bark* (of a dog) and *bark* (of a tree) or *buy* (purchase) and *bye* (farewell).
inference	the process of going beyond the explicit information in a text to make links between different parts of the text or between the text and general knowledge.
lexicon	the mental store or dictionary of words. Also referred to as the mental lexicon.

logographic writing system	a writing system that represents the meaning (words or morphemes) of the language.
longitudinal study	a research design in which measures are taken for the same individuals at different time points and analysed to assess whether some variables predict later ability and/or growth in ability.
morpheme	the smallest linguistic unit in a word that carries meaning. There are three morphemes in *un-read-able*.
nonword	a letter string that does not form a word. It is usually, but not always, pronounceable. Compare *blimket*, which can also be referred to as a pseudo-word, and *sbkln*, which is not pronounceable in English.
orthography	the writing system of a language. A shallow (or transparent) orthography is an alphabetic writing system in which there is a close relationship between the written forms (spellings) and pronunciation; a deep (or opaque) orthography is an alphabetic writing system in which there is not a consistent relationship between spellings and pronunciation.
phoneme	the smallest unit of speech sound, which can change the meaning of a word: /k/ is the phoneme represented by the letter *k* in the word *kiss,* and /m/ is the phoneme represented by *m* in *miss*; /ʃ/ is the phoneme represented by the letters *sh* in the word *shop*, and /t/ is the phoneme represented by *t* in *top*.
phonemic awareness	a type of phonological awareness, specifically the ability to reflect on and manipulate the phonemes in the spoken language.
phonological awareness	the ability to reflect on and manipulate the spoken sounds in the language.
priming	occurs when one stimulus influences a person's response to a later stimulus.
semantic priming	involves the presentation of two stimuli related in meaning. It is usually facilitatory, for example the presentation of the prime *dog* would lead to a faster response to the subsequent target word *bone*.
sentence	a grammatical unit made up of one or more clauses.
syllabic writing system	a writing system that represents the spoken syllables of the language.
syllable	a unit of a word that can be spoken without interruption, comprising a vowel or a vowel plus consonant(s). *Kiss* and *shop* are examples of monosyllabic words; *kissing* and *shopping* are examples of bisyllabic words.

syntax	the aspect of grammar that specifies word and phrase order in a language.
training and intervention studies	a research design in which at least one group of individuals receive tuition in a type of knowledge, skill or strategy, thought to be causally implicated in the development of the skill of interest, such as reading.
vowel	a letter of the alphabet (*a, e, i, o, u* and sometimes *y*) that stands for a spoken vowel, which is a speech sound made with the vocal tract open.
word recognition	the ability to derive a representation of a printed word that enables access to its meaning.