A4 'KNOWING' A WORD

This section and the next explore the nature of vocabulary. They ask what information we need to carry in our minds and what processes we need to apply in order to locate any word that we need. Note that much of the discussion will necessarily be tentative. Psycholinguists have come to certain conclusions by reflecting on what we know of words and how they operate. From these, they have constructed **models** (diagrammatic representations) of our lexical competence. Although the models are tested experimentally, the results are sometimes contradictory or difficult to interpret. So be warned that this section and the next pose questions to which we may not yet have single or clear answers. You will be encouraged to form your own views.

First, a note of caution about the term 'word'. We think we know what a word is because we are so used to seeing words separated by pauses on the printed page. But this does not serve to characterise a word when it occurs in connected speech. The best way of conceiving of a word is as a movable unit of meaning which cannot be broken into smaller free-standing pieces.

Furthermore, we should not lose sight of the fact that some units of meaning (e.g. 'in front of', 'bus stop', 'by and large') consist of more than one word. So it is often more precise when discussing vocabulary to refer to **lexical items** rather than to words.

Psycholinguistic studies of vocabulary and how we use it fall into three areas:

- Lexical entries: What information do we need to store in our mind about a lexical item?
- Lexical storage: how are lexical items stored in relation to each other?
- Lexical access: What is the process that enables us to retrieve lexical items when we need them?

Sections A4, B4 and C4 focus mainly on the first question. The present section reviews the information that a lexical entry has to contain. Section B4 examines more closely what we need to know about the forms of words, while Section C4 focuses upon how we attach meanings to them.

We start by assuming that each language user has a personal vocabulary store, or **lexicon**, from which they select words for use and to which they refer the words they encounter in the utterances of others. We envisage each person's lexicon as consisting of a large set of **lexical entries**, one for each lexical item. The question to be considered is: what does a lexical entry of this kind need to contain?

Content vs function words

An important distinction needs to be made between two types of item in the mental store:

- CONTENT words (nouns, verbs, adjectives and adverbs) which carry the kind of meaning that we can look up in a dictionary. They are also referred to as **lexical words**.
- FUNCTION words (or **functors**): words which do not have a clear meaning but which contribute to the syntactic structure of the text. Examples might be: *the, of,* the auxiliary *do* (as in *Do you like . . . ?*). These are also termed **grammatical words**.

Prepositions of position and movement have a demonstrable meaning but a function that is mainly grammatical. (In some languages, the same function might be performed by a prefix or a suffix.) Generally, these prepositions are classed as function words.

Function words form a **closed set**: we rarely add to their number. By contrast, the set of content words is open, with language users very prone to coin new lexical items to express new concepts. In English, function words usually carry weak stress:

the BUNCH *of FLOWERS that he* BOUGHT *for* JANE.

This gives the listener some help in distinguishing them auditorily from content words.

Evidence from brain imaging suggests that function words may be stored and processed separately from lexical ones. Why might this be an advantage? Compare the different processes that a listener goes through:

- On encountering a function word, a listener only needs to match the word to a phonological sequence which is stored in the mind.
- On encountering a content word, a listener not only has to find a match in the phonological store but also has to access the meaning of the word.

Contents of a lexical entry

What information do we need in order to be able to recognise and understand an item of vocabulary when we encounter it in speech or writing? As we have just seen, a lexical entry for a content word must provide information of two different types – it must tell us about **form** and about **meaning**.

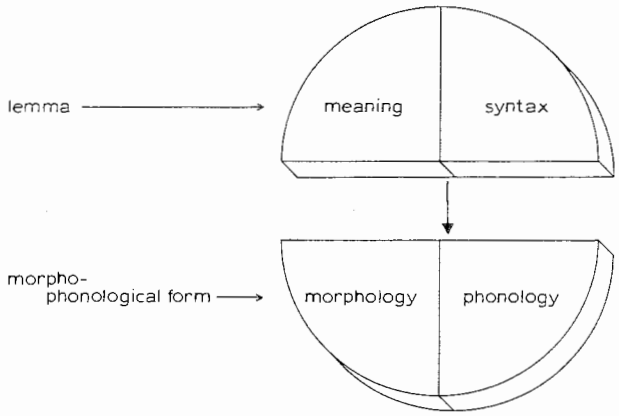

Figure A4.1 A lexical entry
Source: Levelt (1997: 188)

One model (Levelt 1989) suggests that a lexical entry is composed as shown above: Let us consider each of the components in turn.

Form (See also Section B3)

❑ **Phonological/orthographic information.** We need some kind of mental representation of a word against which we can match any example of the word that we encounter. This stored information will obviously vary according to modality. If we are dealing with speech, we need a phonological model of the word; if we are dealing with reading, we will need an orthographic one. We can assume that the two are closely related, and are connected to the same unit of meaning. So forms of the word GIVE might be linked in this way:

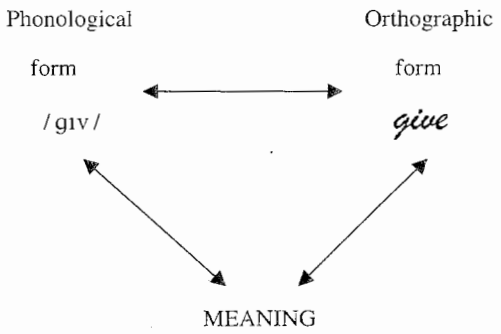

Figure A4.2 Form and meaning

In fact, the situation is not quite as simple as this account suggests. Both phonological and orthographic representations have to allow for **variation**. They have to take account of the fact that a speaker may have any one of a number of regional accents or that a written text may appear in any one of a number of different typefaces.

In addition, there is the issue of **homonymy**. There is a single phonological and orthographic representation of the word LIKE, but it must be connected to two entirely different entries, as in:

I LIKE ice-cream. She looks LIKE my sister.

❑ **Morphological information.** In order to use a word, we need to know how to modify it when, for example, we want to refer to more than one item or to place an event in the past. So we need to store information on the entire range of **inflections** associated with the word. For GIVE, we would need:

GIVE → gave

GIVE → (have) given

Besides inflectional morphology, we also need to store information on the **derivational morphology** of a word. Part of the lexical entry for the word HAPPY must be an indication that we form the opposite by adding UN- and not IN- or DIS-:

HAPPY → UN- (or UNHAPPY)

This, as we will see, is a controversial area. Some commentators argue that the whole word UNHAPPY is stored; others that there is simply a link between HAPPY and the prefix UN-.

Meaning

The meaning component of a lexical entry is sometimes referred to as its **lemma**.

- **Syntax.** It might seem strange that the lemma includes syntactic information about a word. However, this reflects current approaches to grammar which see vocabulary and grammar as closely linked. Using the example of GIVE, the lexical entry would need to contain information on word class (GIVE = a verb) to enable the word to be used in generating sentences. It would also need to include information on the types of syntactic structure that are associated with the word:

  GIVE (_ NP, NP) GIVE (_ NP, *to* + NP)
  [Where NP is a noun phrase such as *Mary* or *a present*]

  This tells us that, once we choose to construct a sentence around the verb GIVE, we commit ourselves to using one of the two sentence patterns shown: *give (Mary) (a present)* or *give (a present) to (Mary).*

  The entry can contain further semantic information about what we could appropriately fit into each of the NP slots. It might tell us that, in the 'NP, NP' pattern, the first NP has to be a recipient (probably animate) while the second NP is a gift (probably inanimate).

- **Range of senses.** The lemma attaches meaning to the word. This is not as simple as it sounds, and it might be better to think of the lemma as containing a range of meanings. Consider the fact that:
  - One word may have several linked senses. Compare different meanings of TURN in:

    I turned the corner.
    Turn over the page.
    The room turned cold.

    Our interpretation of a particular word may also vary according to context. Compare the meaning of the word SURGERY as used in relation to a doctor and to a surgeon.
  - The issue of word meaning is complicated further by the fact that most words do not refer to single objects in the real world, but represent a whole class of objects or actions. It is not too difficult to explain how meaning can be attached to the expression *the moon* because what is involved is a one-to-one relationship The expression refers to a single entity which forms part of our knowledge of our environment. It is much less easy to explain how in everyday speech we manage to use **categories** such as DOG or JUMP. Where does a DOG end and a WOLF begin? What is the difference between JUMPING and LEAPING?

There are two extremely important issues here, so far as lexical storage is concerned:

a The area of meaning covered by any given word is heavily influenced by the existence of other words alongside it. We can only fully understand how to use the word HAPPY if we recognise the existence of alternatives such as CONTENT or PLEASED or DELIGHTED which limit the semantic boundaries within which HAPPY operates. The conclusion to be drawn is that there are very close links between lexical entries which fall within a particular area of meaning. Only in this way would we be able to select exactly the item we needed and rule out others. To put it simply, 'No word is an island': the meaning of word X is very much determined by its relationship to Word Y and Word Z.

b The area of meaning that we associate with a word is heavily dependent upon the way in which we categorise the world around us. To give an example, English uses one verb *to be*, but Spanish has two (temporary being vs permanent being) and Portuguese has three. A major area of research in psycholinguistics attempts to establish the nature of the categories that we form, and how they become established in the process of acquiring our first language.

The description above should have given you some idea of what a complete lexical entry needs to contain. The entry for the word GIVE might include the following:

GIVE

Form: Phonological: /gɪv/ Orthographic: *give*
Morphological: gives – gave – given

Syntax: Word class: verb
Phrase structure: (_NP_1, NP_2) (_NP_2 *to* + NP_1)
NP_1: a recipient, usually animate
NP_2: a gift, usually inanimate

Core meaning: transfer an entity from one person to another.

Activity Now suggest what you would expect to find in a lexical entry for the following items:

TELL AFRAID ACCUSE END (noun)

LEXICAL STORAGE AND LEXICAL ACCESS

The psychology of words and word meaning makes an important distinction between:

Lexical storage: how words are stored in our minds in relation to each other.
Lexical access (or **lexical retrieval**): how we reach a word when we need it.

This section introduces some basic concepts. Section B5 examines evidence of how words are stored; Section C5 examines models of how we manage to retrieve them.

Storage assists access

Words are not stored in the mind independently. On the contrary, every content word appears to have close links to others. Let us consider why this is necessary.

Assume a speaker is seeking a word for a fruit. Using the meaning as a point of departure, the speaker might retrieve the whole set of fruit, which includes:

APPLE – PLUM – PEAR – GRAPE – BANANA – ORANGE – PEACH – CHERRY

The fruit is yellowish, which restricts the search to the first five. It is roundish and of medium size, which limits us to the first three.

So far, our speaker has only tried to access the word through meaning. But the word can also be found through its form. It is possible that, **in parallel** (i.e. at the same time as exploring the lexicon through meaning sets), the speaker has associated the sound /eə/ with the word that is being sought. This would provide a different a set of words:

BEAR – CARE – DARE – FARE – PEAR – RARE – SHARE – TEAR – WEAR etc.

There is only one word which fits both criteria – PEAR.

This is an extremely simplified version of what happens. But it illustrates the way in which form and meaning can interact in helping us to retrieve a word that we need.

Now consider the process in reverse – from the point of view of a listener who hears the word CARROT.

- in form, the initial sounds link in to the whole set of words beginning with /kæ/
- in meaning, the context might (or might not – a controversial issue) indicate that the current topic was vegetables and lead the listener to open up the set of vegetables.

The result might be a tie between CABBAGE and CARROT, which would be resolved when the speaker heard the next sound /r/.

The notion of words as linked by a network of forms and meanings is an important one when considering how an infant or a foreign-language learner acquires their vocabulary. Learning a new lexical item is not just a question of mastering the form of the item and associating it with a sense or range of senses. It is also a question of linking the item to the whole network of previously learnt words. If a child learns the word TERRIFIED, it has to

a form a connection with HORRIFIED and TERRIER which are similar in form.
b form a connection with AFRAID and SCARED which are similar (but distinct) in meaning.

Weak links and strong links

Within the mental lexicon, some words are clearly more closely linked than others. Recent accounts of these links have been strongly influenced by a **connectionist** view of language processing (McClelland *et al.* 1986). Connectionism models itself upon the way in which the brain operates by transferring signals across multiple neural (nerve) connections. Simplifying greatly, it suggests that, when a connection is used a great deal, it gets proportionately stronger; when a connection is little used, it gets weaker. Thus, the link between the words FISH and CHIPS is a strong one because the two often occur together; similarly the link between AFRAID and SCARED is a strong one because the two often compete when we need a word to express fear. A link exists between FISH and RIVER or AFRAID and CALM but it is not of the same strength.

The notion of connection strength is useful because it accounts for

frequency: the words we use most are the ones that are easiest for us to retrieve. This is because the connections to them are more often used.

collocation: we retrieve certain words together because they are so closely connected: we talk about a *heavy smoker*, never a **large smoker* or a **compulsive smoker*.

Spreading activation

Part of the evidence for associative links between words comes from a phenomenon called **spreading activation**. If you have just recently seen the word DOCTOR, you will recognise words such as *patient, hospital* or *medicine* more quickly as a result.

The idea is that activation (think of it as a kind of electrical impulse) runs along the connections which link the words in our minds. When we see or hear the word DOCTOR, it triggers off a reaction which 'lights up' words which have close connections to DOCTOR. This means that the words are more readily available to us in case we need them. Of course, activation does not last for long; it quite quickly **decays**.

Note that the activation effect is automatic. We cannot turn it on or off. It is not the same as a **context effect**. Consider what might happen if you read a text with the title CAMELS. Your reading would benefit from two distinct processes:

- **Spreading activation**. Seeing the word CAMEL would trigger automatic associations with closely connected words in your lexicon such as *hump, desert, sand* and help you to recognise those words more quickly if they occur.
- **World knowledge**. Knowing that the text is about camels might lead you to create certain expectations at a rather more conscious level: there may be something in the text about storing water in the hump, something about the two types of camel, something about survival in a hot climate.

Spreading activation is believed to be the explanation for an effect known as **priming**. In the example above, CAMEL is said to **prime** *hump, desert* and *sand*. A researcher might show a subject a sentence containing the world CAMEL and then test how quickly the subject responds to words that are or are not associated with it. This type of experiment often takes the form of a word/non-word task (known as a **lexical decision** task) where a button has to be pressed every time a group of letters on a screen is an actual English word.

Experimenter: You'll see/hear a sentence and afterwards you'll see/hear a word or a non-word. Press the button if you recognise the word.
[We saw a camel at the zoo . . . fosk – bank – lidge – hump]

The time taken to press the button is measured in milliseconds. This **Reaction Time** will be quicker to *hump* than to *bank*, because *hump* has been activated by prior exposure to CAMEL.

Priming can be used to discover important facts about spreading activation such as:

- How closely associated do words have to be for activation to occur?
- How long does the activation of associated words last?

AN INFORMATION PROCESSING APPROACH

A6

During the first half of the twentieth century, work in psychology was heavily influenced by a movement known as **behaviourism**. Behaviourists argued that the human mind was unknowable. They insisted that the only scientific source of data for psychology was human behaviour, which was observable in a way that mental processes were not. Human behaviour came to be seen as the product of **habit**, represented in the relationship between an external situation or **stimulus** and a standardised **response** to it.

In the 1950s, cognitive psychologists reacted against behaviourism by proposing an approach which charts the flow of information through the brain while a particular mental task is performed. The basic idea is that raw data is acted upon stage by stage by the mind and is progressively reshaped. Here is the kind of **information processing** which occurs when somebody asks you the way to the station. You have to:

identify the words in the question
⇓
organise the words into a syntactic pattern
⇓
turn the question into a **proposition** (an abstract idea)
⇓
search your memory for information
⇓
retrieve the information
⇓
turn the information into words
⇓
utter the words

This approach to analysing cognitive operations has influenced psychological descriptions of the language skills, and lies behind the flowchart graphics that often appear in Psycholinguistics books. Directly or indirectly, the information processing approach has provided us with several new ways of looking at how language is processed by the user. We review five of them here.

Perception and pattern recognition

For the reader or listener, there are two important stages in processing a stimulus:

sensation: the unanalysed experience of sound meeting one's ear or light meeting one's eye.

perception: the mental operation involved in analysing what the signal contains. The term 'perception' is applied to lower-level processes, where the language user is decoding information that is physically there.

An important part of the perceptual process is **pattern recognition**, where the form of a word is matched to a stored representation in our mind (see Section B4). Many studies in cognitive psychology have investigated how we recognise patterns of all kinds. The process is said to involve

a breaking the input into different characteristics (colour, shape, size, relationship of the parts)
b matching the whole to a representation which is based upon previous experiences and is stored permanently in Long Term Memory.
c allocating an identity or a category to the sensation

Activity How might these stages of pattern matching apply in the case of:

- a reader who sees the letters *t-a-b-l-e* on the page?
- a writer who starts from the concept TABLE and needs to find a word for it?

The storage of data

Early information processing theory (Atkinson and Shiffrin 1968) suggested that there were three types of memory store, with data transformed as it passed between them:

sensory storage	an exact trace of the current stimulus
short term storage	of information currently being processed
long term storage	of knowledge

The sensory store held a trace of a stimulus while the stimulus was being matched to a pattern. In terms of language, the trace might be visual, in the form of an impression of the word on the page. Or it might be auditory, in the form of an 'echo' of the voice of a speaker. It was suggested that we have two separate sensory stores – a visual one referred to as **iconic memory** and an auditory one called **echoic memory**. In both, the trace of the stimulus appeared to fade quickly. It was suggested that iconic traces lasted for only about 0.5 seconds; but that echoic traces lasted longer, with a first phase of about 0.25 seconds for pattern recognition and a second phase of at least 3 seconds as a back-up against which an interpretation could be checked.

Activity

Think about the differences between the reading signal and the listening one. Can you suggest why we might not need iconic memory in order to retain the visual form of words in reading? Why does it seem logical for echoic traces to last longer than iconic ones?

The listening and reading processes were represented as follows:

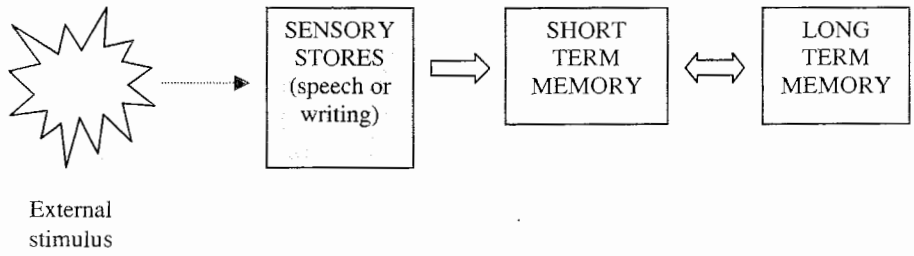

Figure A6.1 A three-store model of human memory

Let us follow this path in terms of a reader reading a single word. The reader briefly retains an image in their sensory store of the actual word as it appears on the page. The form of the word is passed to **Short Term Memory**, which stores current information. In order to identify the word, the STM needs to make a lexical search. However, the STM only holds temporary information needed for immediate purposes. So it has to extract lexical information from **Long Term Memory**. This means that the STM is more than just a store: it is also responsible for language operations. (For this reason, the title **Working Memory** is now usually preferred.) Later, after processing a complete clause or sentence, the reader may want to store the piece of meaning they have acquired. In that case, they transfer it into Long Term Memory.

We will look at a more recent theory of memory and language in Section C6.

Processing as subject to limitations

Working Memory is believed to have a very **limited capacity** for information. This has important consequences for the way in which we process language:

- Some language tasks (e.g. listening and speaking simultaneously) make impossibly heavy demands on Working Memory.
- We need to rapidly transform the language we hear and read into pieces of abstract information. It is easier to retain a few pieces of information than many words.
- We constantly need to transfer useful information into Long Term Memory to avoid congestion in Working Memory.

Processing as a constructive operation

Listening and reading were once considered 'passive' skills. They were seen as part of a simple process of transmitting information: the speaker/writer encoded a message

which was then decoded by the listener/reader. In fact, it is an enormous simplification to think of a message changing hands in this way.

- We now recognise that listening and reading are active processes. The minds of listeners and readers are actively engaged in constructing a **meaning representation** on the basis of the evidence they receive. Once they have built such a representation for the current sentence, they then have to attach it to what they have heard or read so far. So the receptive skills involve not just **constructing** meaning but also **integrating** it into what has already been understood.
- Listeners and readers may have to guess the intentions of the speaker/writer. So they do not simply receive a message; they have to remake it.
- Listeners and readers are independent individuals. They select what they want from a piece of speech or writing. They make judgements about which parts appear most relevant to them, or which parts constitute major pieces of information and which are minor. These may be different from the intentions of the speaker/writer.

Levels of representation

The process of producing or understanding language involves taking linguistic information through a series of stages (**levels of representation**) and changing it at each step. The listener, for example, might need to build acoustic features into phonemes, phonemes into syllables, syllables into words, words into syntactic patterns, syntactic patterns into propositional (abstract) meaning. The process of listening, it seems, involves assembling larger units from smaller ones. This is often referred to as **bottom-up processing**.

Activity Which features in reading are different from those in listening? Which are similar? What 'bottom-up' stages do you think the reading process goes through?

However, information can, of course, flow in the other direction. We potentially receive important cues from:

- **Context**. The next word in the following sentences is highly predictable:

  Later, heavy clouds will come in from the West, bringing a chance of . . . The weather is likely to be cool for the time of . . .

  No prizes for inserting the words RAIN and YEAR. Some commentators believe that we are able to recognise predictable words like these more quickly thanks to the evidence provided by the preceding context.
- **Known words**. Suppose I hear the following sentence:

  A lot of our VELATIVES were there.

  The only candidate that remotely fits the fifth word is RELATIVE. Because the word is well-established in my lexicon, it is possible that I might fail to notice the irregular pronunciation.

Both of the above are referred to as **top-down processing** because they involve using higher-level information (context and whole words) to support lower-level processes (respectively, word and phoneme recognition).

The terms 'bottom-up' and 'top-down' have come into Psycholinguistics from computer science. There, a bottom-up process is one that is **data-driven** – it relies upon evidence that is physically present. A top-down one is **knowledge-driven** and relies upon external information. You can see parallels in the way in which the terms are used in Psycholinguistics. We will examine bottom-up and top-down processing more closely in Section B6.

WRITING SYSTEMS

A7

In comparing writing across languages, we need to distinguish between:

- a **writing system**: a method of writing such as the alphabet
- a **script**: a form of writing (Arabic script, Greek script)
- an **orthography**: the writing conventions of a particular language.

Activity

Below are examples of various orthographies (sources: Garman 1990; Coulmas 1989; Harris and Coltheart 1986). Describe the differences between them. Then put yourself in the position of somebody using each of these types of writing. Describe the process of mapping from an idea in your mind to a word on the page.

Chinese

木	mù	tree
木木	lín	woods

Japanese

車	kuruma	car
車で	kuruma + de	car + *de* (= in the car)
水で	mizu + de	water + *de* (= in the water)

Arabic

كتب	(letters **ktb**)	kutub	books
كتب	(letters **ktb**)	katab	he wrote

Spanish

teléfono	tay-lay-foh-noh	telephone
supermercado	soo-per-mer-cah-doh	supermarket

BOTTOM-UP AND TOP-DOWN PROCESSING

B6

Levels of representation

You are walking through the streets of (let us say) London, when you encounter the sad sight of a homeless person in a doorway. In an accent which resembles London Cockney, the person says to you:

[gɒʔnɪʧɑɪnʤ]

(The symbol ʔ represents a 'glottal stop' – a brief blockage of air at the back of the throat. For the other symbols, see the table on page xviii.) How from that sequence of sounds do you manage to construct words and ultimately some kind of meaning? Here are the levels of representation through which a listener might conceivably need to proceed:

	Level	Form
⇓	PHONETIC	[gɒʔnɪˈʧɑɪnʤ]
⇓	PHONOLOGICAL	/gɒtenɪˈʧeɪnʤ/ + rising intonation
⇓	SEGMENTATIONAL	got # any # change
⇓	LEXICAL (lexical access)	have got = [POSSESS] change = [MONEY] [SMALL]
⇓	SYNTACTIC	(have you) got any change? NP: you VP: [have got] [any change]
⇓	PROPOSITIONAL (abstract meaning)	 ?
	PRAGMATIC	[I want you to give me some money]

Figure B6.1 Bottom-up lexical processing

Activity

- Describe what happens at each level.
- Now describe the process in reverse. Imagine how the speaker constructs the utterance, starting with the intention: *I want you to give me some money.*

– Are there any ways in which you feel that this analysis of the listening process might be inadequate?

It is unlikely that the process we have just examined represents what actually happens. There are a number of reasons. Among them are:

- Speaker and listener might have the sequence *Got any change?* stored in their lexicon as a single formulaic chunk. If so, they would not need to assemble it from its parts.
- It is not clear that syntactic analysis has to follow lexical access. The two might perhaps occur together.
- Some commentators have questioned whether there is indeed a phonological level, at which we derive a standardised form of the words we have heard.
- Perhaps most importantly, listening does not happen one step at a time. We do not wait until the end of an utterance before beginning to process it. We process it while the speaker is producing it.

In addition . . .

- This is a **bottom-up** account based entirely upon linguistic data. So far, we have taken no account of the possible effects of context (e.g. world knowledge or previous experience of homeless people).

Serial vs parallel processing

Evidence suggests that a listener begins to process an utterance about 200 milliseconds (a fifth of a second) after the speaker has begun to speak. This is about the length of a syllable. So we process an utterance while it is happening. This means that the kind of **serial** process shown in the *Got any change?* example does not happen. Instead, it seems that we process linguistic information in parallel.

Let us assume that the listener is operating at the phonological level, attributing a standard form to [ʧɑɪnʤ], the last part of the utterance. By this point, they might have reached the segmentational level with GOTANY and be inserting possible word

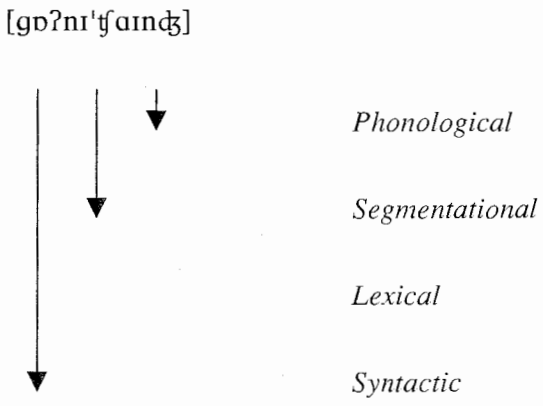

Figure B6.2 Parallel processing

boundaries. They might have reached the syntactic level with GOT and be working out its grammatical role. So different parts of the utterance are being processed at different levels – all at the same time.

The role of context

The sequence in pp. 65–6 assumes that processing operates in one direction – bottom-up – and that it is based entirely on data in the input (on what the listener hears or the reader sees). But it is possible that our analysis of the input is influenced by external factors in a top-down way.

It may be that we recognise the sequence [gɒʔnɪ'ʧɒnʤ] more quickly because of factors which are not essentially linguistic:

analogy: previous occasions when we have heard a homeless person utter it
world knowledge: the expectation that a homeless person may need to beg
paralinguistic evidence: an outstretched hand
an expectation based on words already uttered (*I need something to eat and I don't have any money.*)

All these factors are often loosely referred to as 'context', though it is preferable to be precise about what kind of context is involved. Outside information of this kind is clearly available to the listener at some stage. The big issue is: does it influence **on-line processing**? Is it used at the actual time we are matching the input to words?

❒ An argument for a role for context: it enables us to decide more accurately what words are present in the input, and to choose only words which are appropriate.

❒ An argument against: it enormously complicates the decisions we have to make. We not only have to match sounds to words; we also, at the same time, have to decide which words are contextually most likely – including words that do not remotely resemble the input.

In a much-quoted experiment, a researcher (Swinney 1979) asked subjects to listen to sentences, each of which contained an ambiguous word. The sentences provided very clear contexts, indicating that one of the senses of the ambiguous word was appropriate and one was not. For example:

> The man was not surprised when he found several spiders, roaches and other bugs in the corner of the room.

While the sentence was being played, Swinney asked subjects to undertake a priming task, designed to test how quickly they recognised words presented to them on a screen. (You will recall that when we hear, for example, the word *doctor*, we recognise the associated words NURSE, PATIENT etc., much more quickly.) Among the words shown to subjects immediately after they had heard the word *bug* were ANT (associated with one sense of *bug*) and SPY (associated with another).

Subjects showed a faster than normal recognition of both ANT and SPY.

Activity What conclusions do you draw about whether we do or do not use context when accessing the meanings of words?

> With other subjects, the priming task was repeated a short time after the ambiguous word *bug*. Here, subjects recognised the target word faster than normal when it was associated with the appropriate sense (here ANT), but not when it was associated with the incorrect sense (SPY). This effect seems to begin about 200 milliseconds (a fifth of a second) after an ambiguous word has been heard.

What conclusions do you think the experimenters reached?

Top-down lexical processes

Read the words below. Do you notice anything about them?

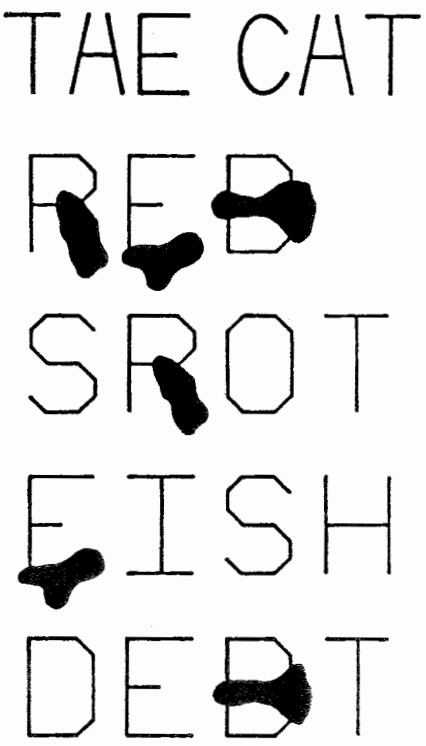

Figure B6.3 Top-down processing
Source: Rumelhardt and McClelland (1986: 8)

You may have noticed that the H in THE is exactly the same shape as the A in CAT. Similarly, certain letter shapes in the degraded words are identical, but we read them differently according to the word in which they appear. For some commentators, this suggests that our recognition of letters is influenced by our knowledge of whole words. This is an example of a **top-down** effect, with knowledge at the word level shaping recognition at the letter level.

Attempts have been made to demonstrate this kind of word effect in speech.

> Ganong (1980) used a computer to produce variants of certain sounds: for example, he produced a range of sounds which went in stages from a clearly identifiable /k/ to a clearly identifiable /g/. He then added them to word stems. One of these stems was -ISS, giving a set of recorded items which changed gradually from a clear exemplar of an actual word KISS to a clear exemplar of a non-word GISS. Presented with various versions of KISS, Ganon's subjects were generally correct in identifying the /k/. But, presented with versions of GISS, they often reported the less typical variants of /g/ as /k/. This suggested that our knowledge of whole words influences the way we perceive phonemes.

Autonomous vs interactive models

The evidence we have examined appears contradictory. It suggests that there are top-down effects resulting from our knowledge of words, but none resulting from context. This may be the case. But you should note that both Swinney's and Ganon's findings have been challenged by other researchers. The area is a controversial one – and has divided psycholinguists into two camps: those who view language processing as **interactive** and those who claim that it is **autonomous**.

- On an **interactive** view, our minds operate in parallel, simultaneously considering a range of different types of cue to the presence of a word in the signal. Information is freely exchanged between all levels of processing, including context. When we are reading a word, parallel information is available from: letter features (curves, horizontal lines, etc.), letters, the order in which letters occur and the word as a whole. It may also be available from context.
- The **autonomous** view is that each level of processing operates independently. On this analysis, information from letter features feeds forward to support letter recognition; letter recognition then feeds forward to support word recognition. Contextual information does not influence perception until we have fully processed what is physically present on the page.

An interactive model might appear to have the advantage of speed. Its weakness is the complexity of the decision-making involved in considering a cocktail of cues which varies greatly from one utterance to another. An autonomous model might appear to be slower. But it has the advantage of always following the same process. As a result,

it can become highly **automatic**: this means that it might in fact be faster and make fewer demands upon our mental resources.

Activity Consider the process involved in identifying a string of phonemes. Do you think that it is enhanced or complicated if at the same time we have to consider what words the phonemes might form?

B7 WRITING AT WORD LEVEL

An adult writing in English has to produce

- 'regular' words whose spelling conforms to their spoken form (*living, canteen*)
- 'irregular' words such as *yacht*
- words whose spellings follow a particular pattern (*light, night, tight*).

To what extent does an adult using English orthography rely upon grapheme-phoneme correspondence (GPC) rules? Or does writing in English rely mainly (like writing in Chinese) upon mapping directly from an idea to a whole word? Or do English writers store words together which have similar forms, so that they can work out spellings by **analogy**?

Slips of the pen and keyboard

One interesting source of evidence can be found in the mistakes that writers make, which offer insights into the criteria that a writer applies when retrieving the written form of a word from memory. However, we have to be careful to distinguish:

- motor errors, where there is a failure in the signal that the brain sends to the hand or in the contact between hand and keyboard
- lexical errors, where the wrong written form has been selected.

Activity Study the data below, which represents some of the author's own slips of the keyboard, collected over an extended period. To them have been added examples of slips of the pen and typewriter from a well-known set of data collected by Hotopf (1983). Try to decide the cause or causes of each group of slips.

1 Eliminate slips which you think were simple motor errors.
2 Review the other errors to see if they support a view:
   - that phonology plays a part in English writing
   - that analogy between words plays a part in English writing
   - that English writing depends mainly upon a mapping from idea to whole word.
3 Which slips seem to result from a planning process at a higher level than the word?
4 What do the slips tell us about the processing of function and lexical words?