# Psycholinguistics

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**Psycholinguistics**

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# INTRODUCTION

### Psycholinguistics as a field of study

Psycholinguistics is the study of how the mind equips human beings to handle language. Its central concern is with the cognitive processes that underlie the storage, use and acquisition of language, and their correlates in observable neural activity in the brain. In addition, psycholinguists use their understanding of the mind to shed light on certain long-standing questions concerning language as a phenomenon. They include how language evolved, whether and why it is restricted to the human race, what the precise relationship is between language and thought and whether language shares functions with general cognition or operates independently of it.

Psycholinguistics is a relatively new area of study, though interest in the mind-language relationship has a long history. Over the centuries, there has been frequent discussion of language acquisition and of the origins of language - notably in the writings of Aristotle and in the Enlightenment debate between **rationalist** followers of Descartes, who believed that much human knowledge was innate, and **empiricists** such as Hume and Locke, who asserted that it was entirely acquired. A parallel interest in the psychology of adult language developed during the 19th Century, with initiatives such as Broca's work on the location of language in the brain and Galton's on word association.

However, in the first half of the 20th Century, progress in all areas of cognitive science was discouraged by the dominant **behaviourist** view that the human mind is unknowable. The term *psycholinguistics* was probably first coined in the 1930s but the field did not emerge as a discipline in its own right until the mid-1950s, when George Miller mapped out possible areas of inquiry in a series of essays (reprinted as Miller, 1968). About the same time, researchers at Haskins Laboratories began their pioneering work into the perception of phonemes. A further landmark was Chomsky's 1959 rebuttal of the behaviourist assumptions expressed in Skinner's *Verbal Behavior*.

Chomsky concluded that language is a genetically acquired faculty; this **nativist** stance triggered a new, and more scientific, interest in first language acquisition, and began a controversy that continues to the present day.

Much early inquiry into how adults assemble and understand language was closely allied to linguistic theory, on the assumption that Chomsky's early transformational-generative grammar (1965) represented **psychological reality** - i.e. provided a model of the operations of the mind as well as a linguistic account of grammatical structure. Attempts were made to investigate the **Derivational Theory of Complexity**, which hypothesised a correlation between the number of transformations that a given sentence demanded in TG theory and the difficulty of processing the sentence. There was particular interest in passive and negative structures. The findings were mainly negative or inconclusive, and at this point the paths of linguistics and psycholinguistics began to diverge.

Today, psycholinguistics is a multi-disciplinary field, drawing upon cognitive psychology, theoretical linguistics, speech science, phonetics, computer modelling, neurolinguistics, clinical linguistics, discourse analysis and pragmatics. One can identify two distinct traditions. The dominant one applies principles and research methods from cognitive science, and is strongly evidence-led. Typically, researchers study small-scale effects with a view to building, little by little, a composite account of the language operation under investigation. Research methods include observation of natural language, controlled experiments that tap in to a specific process, concurrent and retrospective verbal reports and the imaging of the brains of individuals performing a particular language function   The second tradition continues to assume that the accounts of language proposed by linguists correspond closely to the way in which the mind actually performs. Researchers employ a theoretical framework, often a Chomskyan one, in order to interpret samples of language. Because their concern is with competence rather than performance, they often rely upon indirect methods, such as grammaticality judgements, for eliciting information.

What both traditions share is a concern with cognition - with the types of mental process, some highly automatic, some more intentional, that language users employ. Writers sometimes extend the boundaries of psycholinguistics beyond cognition to

include the study of personal variables such as affect or contextual variables such as interlocutor relationships. These factors do indeed receive attention within psycholinguistics, particularly for the way they contribute to individual performance; but they are more strictly the concerns of social psychology and discourse analysis, which have their own distinct research traditions. Similarly, COGNITIVE LINGUISTICS is sometimes assumed to be part of psycholinguistics, but is based upon a different set of assumptions that draw chiefly upon semantic theory.

**Research assumptions**

It will be evident that much psycholinguistic research is normative, in that it traces common patterns in the behaviour of language users. However, there is no implicit assumption that all users behave identically or that a single user behaves identically in different contexts. Individuals clearly vary markedly in their vocabulary range and in their powers of self-expression. In addition, performance by one person must inevitably vary from situation to situation according to interlocutor, to level of formality, to genre of discourse and to transient factors such as tiredness, level of noise or the effects of alcohol.

The rationale in seeking similarities in performance is that any act of assembling or making sense of language is bound by constraints relating to the physical behaviour demanded of the user and to the means of transmission. Thus, any reader has to move their eyes across a page or screen and to construct a link between a group of marks and a stored mental representation that associates the marks with a word in their language. To be sure, performance at a given moment may be affected by immediate factors such as tiredness or anxiety; but the chief goal of the psycholinguist is to identify the processes that are employed under typical conditions.

Some aspects of the cognitive processes underlying language use are general to all performers, while others reflect the nature of the language being employed. The processes adopted by a reader of an ideographic script such as the Chinese one obviously differ in some important respects from those adopted by a reader of an alphabetic script. Studies of the mental operations underlying language use can thus be comparative and cross-linguistic, highlighting processing differences that might impede the acquisition of a second language.

**The present chapter**

It will be clear from this brief profile that the field of psycholinguistics is a very diverse one, though interfaces between its various areas and a common interest in cognition provide it with a degree of coherence. The present account will focus upon the three main areas identified at the outset: namely, language storage, use and acquisition. They clearly fall within Applied Linguistics viewed as the study of language in performance; but they are also relevant to those who associate Applied Linguistics more closely with language learning, since they provide insights into the cognitive challenges that attend the use of a second language (L2).

## LANGUAGE STORAGE AND RETRIEVAL

**Memory and the nature of knowledge**

An early model of the role of human memory in language use (Atkinson & Schiffrin, 1968) represented it as consisting of three stores: a sensory store in which a reader or listener very briefly retains a  trace of the linguistic input, a temporary store in which spoken / written input is analysed or output is assembled and a more permanent store holding both linguistic and world knowledge.  Current models refer to the short-term store as **Working Memory** (WM) and the durable one as **Long Term Memory** (LTM). The former holds not only the utterance under consideration but also linguistic information retrieved temporarily from LTM for the purpose of dealing with it. In the most well-known account of memory (Baddeley, 1990), a Central Executive (functioning not unlike a control tower in an airport) directs operations. It also determines the level of **attention** within WM that a language user needs to accord (a higher level, for example, for a listener in conditions of noise or a speaker giving a public address); and how WM attention is to be distributed if there are twin demands upon it (for example, listening and writing notes in a lecture).

The chief characteristic of WM is its limited capacity. Language users overcome this constraint by developing form-meaning connections which are **automatic** (Schiffrin & Schneider, 1977) and thus make minimal demands upon attention. In addition, WM contains an **articulatory / phonological loop** (Gathercole & Baddeley, 1993) which enables a language user to rehearse a piece of language so that it can be held in the mind for longer without decaying.

Psycholinguistic accounts of storage focus upon the nature of the linguistic knowledge in LTM which enables the language user to command phonology, to retrieve lexical items and to produce utterances that are grammatically correct. Alongside the question of **representation** (the precise form in which this information is stored), one also needs to consider how language users manage to access the information when they have need of it. This demands highly automatic processes, of which the user is largely unaware. It is thus possible to distinguish between conceptual knowledge of the language and **procedural** knowledge of how to employ its forms.

A recent development in thinking has resulted from an increased awareness of the enormous storage capacity of the human mind. This has lent support to an **exemplar** view of storage, which challenges traditional notions of language as rule-governed behaviour and/or as dependent upon 'ideal' forms of words or phonemes. Instead, the premise is that linguistic knowledge may be constructed on the basis of traces of multiple encounters with the features in question, which have been stored in LTM (Bybee & Hopper, 2001). Thus, if one encounters an [aː] that diverges markedly from one's own value or a dialectal variant of a syntactic pattern, one matches it not to a central standard or an internalised rule but to previous experience of a form that resembles it. Exemplar models have given rise to a view of language acquisition (whether in L1 or L2) as **emergent** (see LANGUAGE EMERGENCE) in the sense that it is a process driven by accumulating random samples of language in use and generalising across them.

**Phonology**

The exemplar view has particular resonance in considering phonological representation. Speech scientists have long struggled to account for the variability of the phoneme, which has been shown to have no simple one-to-one relationship with acoustic cues in the input and (as phonologists have long known) varies greatly according to the phonemes that adjoin it. One way of dealing with this issue is to conclude that the syllable rather than the phoneme forms the smallest unit of analysis for the listener or speaker; but that we are capable of separating words into phonemes

because literacy and rhyming games have taught us how to. A different set of solutions challenges the assumption that phonological representation in the mind takes the form of some kind of template or prototype against which variants can be matched for goodness of fit. A more recent view is that the mental representation of each phoneme is **under-specified**, consisting only of a sub-set of features that are sufficient to distinguish it from others (Keating, 1988). But an exemplar position (Bybee, 2001), is now gaining increasing support, partly because it accounts for the way in which listeners manage to adjust gradually to unfamiliar varieties by dint of multiple encounters with speakers of those varieties (each of which leaves a trace behind it).

**Lexis**

The nature of lexical knowledge has been a major area of psycholinguistic enquiry. For an accessible account see Aitchison 2003. A language user is envisaged as possessing a vocabulary store in the mind (a **mental lexicon).** Content words are stored there as **lexical entries** containing sufficient information about each word to enable one to use it in speech or writing. There is a degree of controversy as to whether productive derivational affixes such as *un-* have their own entries or whether a word such as *unhappy* is stored as a whole.

Levelt (1989: 188) represents a lexical entry as consisting of two parts, one relating to form and one to meaning. The first includes mental representations of the phonological and orthographic forms of an item together with inflectional information. The second (the **lemma**) represents the range of possible senses associated with the item. It also includes information on syntactic structure (for example, the valency of a verb).

Producing and receiving language make different demands upon the lexicon. The point of departure for a speaker or writer is a meaning which he/she wishes to map on to the most appropriate form; while that of a listener or reader consists of a form (auditory or visual) that has to be mapped on to a meaning. Early research on lexical retrieval focused on speech production and sought evidence in **Slips of the Tongue** (Fromkin, 1980). The rationale was that, by comparing an incorrectly selected word with the target, one might identify the characteristics of the word that were driving the

search. Semantic links between chosen word and target were to be expected; but it was striking that speakers also seem to be guided by formal information about the word being sought, including its first syllable, its stressed syllable, its rhythm and the number of syllables. Producers of language thus seem to possess an awareness that a sought word exists and certain prior intimations as to the form it takes.

In terms of reception, current accounts of how words are identified by a listener or reader do not assume a simple one-to-one match between input and word. **Competition** models (Rastle, 2007: 72) postulate that a listener or reader balances cues at many levels in order to achieve word recognition: a reader might take account of letters, digraphs, sub-letter features, letter order, syllables and whole word forms. Potential word matches are accorded different levels of confidence, according to how closely they fit the evidence on the page and according to criteria such as frequency - until one of these **candidates** wins out over the others. The term **activation** is often used to describe this process: it can be thought of as a type of electrical current that boosts the candidates to varying degrees until one of them lights up.

Lexical retrieval in both production and reception is assisted by the way in which entries are stored in the mind. Current models envisage them as linked by a complex **network** of interconnections. A word such as CHAIR has links to others in the lexical set of furniture. But, for listeners, it also has links to words such as CARE that resemble it phonologically and, for readers, links to words such as CHAIN which resemble it orthographically. Other associations are based upon frequency of co-occurrence (CHAIR-TABLE, CHAIR-MEETING) and upon sense relations such as synonymy, antonymy and hyponymy. The connections between words differ in strength, with CHAIR-TABLE much stronger than CHAIR-BED. **Connectionist** computer programs (e.g. McLelland & Rumelhart, 1981) have simulated the way in which strengths of connection are said to evolve. They do so by means of a mechanism which strengthens a connection that occurs frequently and allows infrequent ones to atrophy.

Listeners and readers are assisted by a process of **spreading activation** (Collins & Loftus, 1975): after encountering a word such as *doctor*, they automatically activate closely linked words such as *nurse* or *patient,* recognising them more readily if and

when they occur. Researchers investigate lexical connections of this kind by means of a method known as **priming** which measures how much faster words are recognised when preceded by a word that appears to be associated with them.

A further important line of lexical research relates to word meaning and addresses the question of how language users form and employ **categories**. How do we determine whether an unfamiliar entity falls into a category such as BIRD or FURNITURE? Rosch (1975) premised that users structure their categories around a highly typical example (in the case of BIRD, a robin). They determine whether a new real-world object fits the category by its 'goodness of fit' to this model. However, **Prototype Theory** has been much challenged; and recent commentators have preferred an exemplar view, with the category constituted instead by the user's ability to recall many different instances.

**Grammar**

The fact that speech is assembled successfully under tight pressures of time raises questions about the traditional notion of a syntax based upon applying elaborate rules which license permissible combinations of words and exclude others. An alternative, psycholinguistic account (Wray, 2002) holds that our capacity to produce speech rapidly is dependent upon frequently occurring groups of words being stored in the mind as pre-assembled chunks. Thus, one does not have to assemble afresh a sequence such as *I wish I knew…* or *What would you say if…* each time one utters it; but can draw on a unit which is, in effect, part of the lexicon. Similarly, one can recognise it as a formulaic utterance when it occurs in connected speech, without having to parse it.

## LANGUAGE USE

We now turn to the **processes** that are employed when a language user engages in speaking, writing, reading and listening. Psycholinguistics aims to build up detailed pictures of the four language skills by investigating effects, often small-scale, that are associated with performance. The analysis is heavily influenced by the **information processing** approach in cognitive psychology, which tracks a given piece of information through a number of stages, at each of which it is transformed. A listener,

for example, might be represented as constantly reshaping the form of the message being received: proceeding from acoustic input to a phonological representation and then from phonemes to syllables and on to words, to clauses and to an 'idea unit'.

This can be shown in flow-chart form, but it does not tell the whole tale. Evidence suggests that, in producing or analysing language, the human mind is capable of operating at several different levels in parallel. The listener is capable of analysing the input into clauses at the same time as extracting word meanings, identifying words and detecting phonemes. In addition, a language user is more flexible than a sequential model might suggest. If there is a clash between the user's goals and the outcome of processing or if there is an inconsistency in the message, he/she might loop back at any point to reverse a previous decision. This kind of regression is especially seen in writers, who sometimes change part of a text while actually producing it, as well as in the final editing phase.

As already remarked, the productive and receptive skills follow opposite directions of processing. The former take a meaning to be expressed and map it on to a form of words, while the latter take a form of words and map it on to a meaning. All four skills draw heavily on non-linguistic as well as linguistic knowledge; but they do so at different stages of the operation. Thus, what is often broadly termed 'context' (world knowledge, knowledge of the individual being communicated with, perception of the user's own goals) affects the initial planning in speaking and writing but contributes to analysing the signal in the case of listening and reading.

An important distinction can also be made in terms of **modality**, given the different operating conditions of written and spoken language. Writers normally have time to plan their ideas and to polish the words that give expression to them. Similarly, readers can vary their speed and the level of attention that they bring to their task. By contrast, most speech (especially in interactive situations) has to be assembled under strong pressures of time, while a listener has little control over the speech rate of the interlocutor and thus over the pace at which the input is received. In addition, differences of both modality and linguistic structure mean that the processes underlying SIGN are very distinct and form a separate area of study in their own right.

Some accounts of language performance (especially in discussion of SECOND LANGUAGE ACQUISITION) view it as a form of skilled behaviour, achieved through long practice. They draw upon cognitive theories of **expertise** that attempt to represent how skills such as driving a car or playing chess are acquired. Often quoted are Anderson's ACT models (e.g. Anderson 1983), which treat expert behaviour as the outcome of a transition from **declarative knowledge** (knowledge that) to **procedural knowledge** (knowledge how). Declarative knowledge clearly has no role in the acquisition of L1 oral competence. However, it certainly contributes to the acquisition of literacy. Extended practice in a skill such as reading brings two main benefits which reduce the demands upon a language user's working memory. Firstly, what begin as individual steps within a larger operation gradually become combined. Secondly, what begin as processes requiring deliberate attention become increasingly automatic until they make minimal demands upon the attention of the performer. The notions of *proceduralisation* and *automatisation* of behaviour are sometimes used when accounting for the ease with which speakers as well as writers manage to retrieve words and structure utterances.

**Speaking**

As noted, the planning of speech takes place under enormous pressures of time. A degree of thinking ahead occurs while the speaker is actually articulating, but brief pauses of 0.2 to 1.0 seconds are normally essential for planning the form of the next utterance. If the opportunity to pause is suppressed, speech production is adversely affected. **Juncture pauses** of this type occur mainly at syntactic boundaries; the clause in particular seems to form an important unit of planning. By contrast, **hesitation pauses** (filled and unfilled) can occur anywhere within an utterance and even within words. They might result from a failure to retrieve a word or from a failure of planning - a plan that is revised, is not adequately formulated or is lost during articulation.

Early speech production research examined Slips of the Tongue involving syntax and morphology. The evidence suggested that a syntactic frame is prepared by a speaker in advance of lexical items being slotted into it (explaining why *He found a wife for his job.* was substituted for the target *He found a job for his wife.*) and that

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morphological markings are added at quite a late stage (Hence *She come backs tomorrow*).  For a discussion, see Fromkin, 1988.

Drawing upon this and other evidence, a number of researchers have proposed models that represent the stages through which a speaker needs to proceed when assembling an utterance. The most comprehensive and authoritative account is offered by Levelt (1989). Levelt's original 1989 model features four major stages (conceptualisation, formulation, articulation and self-monitoring); however an updated version (1999) subdivides the second and third of them, indicating a speaking operation that falls into six phases:

- **Conceptualisation:** generating an idea or set of ideas for expression and planning how to express them;
- **Grammatical encoding**: constructing a syntactic frame for the next utterance and identifying the lexical items that will be slotted into it;
- **Phonological encoding**: converting the abstract plan into a string of words in phonological form;
- **Phonetic encoding:** adjusting the phonological sequence to make articulation easier; linking each of the syllables to a set of neural instructions to the articulators; storing the instructions temporarily in the mind;
- **Articulation:** producing the utterance.
- **Self-monitoring**: focusing attention on the message just before or while it is uttered in order to check for accuracy, clarity and appropriacy.

**Writing**

The path adopted by a writer necessarily follows that of a speaker in terms of conceptualising an idea, converting it to linguistic form and checking the accuracy, clarity and appropriacy of the end-product. Accounts of writing (e.g. Kellogg, 1996) have therefore tended to follow Levelt's model of speaking quite closely.  However, there are major differences in the greater opportunity allowed for planning and self-monitoring, the substitution of orthography for phonology and the fact that neural signals are sent to the fingers, not the articulators. To this, one can add that the product of writing is typically expected to be more precise, concise and polished than that of speaking - emphasising the importance of the planning and monitoring phases.

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Unsurprisingly, there has been much discussion of the role of planning. An influential model by Hayes & Flower (1980) defines the environment within which the writer operates and takes account of rhetorical considerations such as the writer's goals, the writer's awareness of the readership and the nature of the topic. Scardamalia & Bereiter (1987) distinguish the **knowledge telling** of less skilled writers, a largely linear approach to the generation, linking and presentation of ideas, from the **knowledge transforming** of more skilled ones, based on planning, structuring and revision. The same commentators (Bereiter & Scardamalia, 1987) analyse the challenges that children face in holding writing plans in their minds while carrying out the mechanics of forming letters.

There has also been research interest in the **execution** stage of writing (equivalent to Levelt's 'articulation'). Early studies of slips of the pen and keyboard (Hotopf, 1983) demonstrated that writers give reduced attention to function words and that incorrect sequences of letters (THE → *teh*) can become highly automatic and difficult to reverse. Evidence suggested that the writer's plan for text currently being produced is held in some kind of phonological form (an intention to write 20A might result in *28*).

More recently, the widespread use of PCs has permitted **keystroke logging** (Sullivan and Lindgren, 2006), which provides evidence of the editing decisions that are made when a text does not fulfil a writer's original intentions. Besides correcting typos, changes might relate to overall goals, to the foregrounding of important information, to clarity of expression or to inadequate identification with the reader's point-of-view.

**Listening**

In accounts of the receptive skills, a distinction is usually made between a perceptual phase in which the input is analysed into linguistic units and a conceptual phrase when a meaning-based representation is constructed. The former, often referred to as **decoding**, requires the detection of lexical and syntactic forms in the input. In line with the example of reading given under 'storage' above, the general assumption is that a listener weighs multiple cues to the identity of a word: matching phoneme,

syllable and contextual indications against a stored record of the different forms that the word might take.

Matters are complicated in listening by the fact that pauses between words in connected speech are irregular and infrequent. The listener thus has to engage in a process of **lexical segmentation**, determining where word boundaries are most likely to fall. The decisions made are often supported by prosodic features of the language being heard: among them, lexical stress and syllable structure. The main segmentation strategy in English appears to exploit the fact that 90% of content words in running speech begin with a stressed syllable - so it is relatively failsafe to assume that each stressed syllable initiates a new word (Cutler, 1990).

A further headache for listening researchers lies in the highly variable nature of the signal. It is not simply phonemes that vary. Because of the pressures of the intonation group, words vary greatly from one context to another in terms of duration and the precision with which they are articulated. They also vary in the extent to which they are assimilated to the word that follows them. It therefore has to be assumed that the oral forms of words are represented in the listener's lexicon in a way that allows considerable deviation from the citation form - or, again, that users store separate examples of the many variations they have encountered.

In addition, speakers differ enormously in terms of voice pitch, speech rate, hesitancy, prosody and accent. Traditional accounts envisaged listeners as **normalising** to these features: editing them out in order to focus on the message being conveyed. However, recent research (Johnson & Mullenix, 1997) suggests that they may actually be processed alongside the message and retained in memory.

Accounts of how listeners handle syntax (as process known as **parsing**) have to come to terms with evidence that decoding takes place **on-line** (Marslen-Wilson and Tyler, 1980). Listeners do not wait until the end of a clause but attempt to analyse what they hear at a very brief delay behind the speaker of about a quarter of a second. This means that, in parsing, listeners rely upon probability, upon distributional cues and upon factors such as animacy in order to anticipate the structure of the input they are

processing (van Gompel & Pickering, 2007). Granted, parsing is assisted by intonation, which often corresponds to syntactic boundaries. However, it seems that listening, even in one's first language, is a highly tentative process, with hypotheses constantly being formed and revised. For an accessible account of this and other issues in listening, see Field, 2008.

## Reading

**Eye tracking** equipment has taught researchers a great deal about the physical process of reading (Rayner & Pollatsek, 1989). The reader's eye moves across the page in short sweeps known as **saccades.** It rests on most content words, though around 60% of function words are read peripherally. In alphabetic languages, a **fixation point** usually occurs every 7 to 9 characters. Fixation by a skilled reader lasts on average for about a quarter of a second, but is extended where there are longer or unfamiliar words. Readers regress from time to time: with skilled readers this tends be to check understanding; with less skilled readers it is often to check the accuracy of word identification. An important consideration is that a major component of reading skill is the ability to adjust one's reading style (length of saccade and length of fixation) to the type of text being read and to the reader's own goals.

As with listening, it is necessary for readers to hold decoded words in their minds until the end of a clause or sentence is reached and a syntactic pattern can be imposed on them. There is evidence that the words are stored in some kind of phonological form (Perfetti, 1985) - hence the fact that readers sometimes report a 'voice in the head'. This may be a relic of pre-literacy; but it seems more likely that it serves to distance stored recall of the earlier part of a sentence from the visual processing of current word.

Two issues in reading research have implications for pedagogical theory. One concerns the extent to which it is useful to teach sound-spelling relationships (an approach known as **phonics**) in a language such as English with a relatively opaque orthography. Should teachers instead focus on **whole word** recognition? A **dual-route** model of reading (Coltheart, 2005), based upon evidence from dyslexia, proposes that in decoding words a reader has need of two routes - a faster (lexical)

one that identifies whole words and a slower (sub-lexical) one that applies **grapheme-phoneme correspondence** (GPC) rules to achieve word recognition. Even an adult reader has need of the latter route in order to deal with unfamiliar names, to match words never seen before in print to words known orally - or to work out how to pronounce words only encountered in writing.

The other controversy was triggered by Goodman's (1967) description of reading as a 'psycholinguistic guessing game' and his claim that good readers employ context and co-text to predict what is to come, in order to avoid having to decode every word they encounter. This lent support to a **whole language** approach to the teaching of reading, in which children were encouraged to read for pleasure and to guess the meaning of text that they could not decode. Goodman's assertion has been widely discredited (see Gough & Wren, 1999). It is by no means as easy to predict upcoming words as he suggested. In addition, a skilled reader is capable of decoding words highly automatically and matching them to their meanings; there is thus no benefit in falling back upon prediction which (unlike decoding) makes major demands upon working memory. In fact, it is weak readers who use context in this way, because they find word recognition too demanding. Competent readers do indeed make use of context, but do so in order to enrich their interpretation of what they have read, understand the writer's intentions etc.

**Meaning construction**

The output of decoding in both listening and reading is said to be an abstract and decontextualised 'idea unit'. Two further phases of processing are then necessary. In the first, the listener or reader has to invoke world knowledge, knowledge of the speaker or writer and knowledge of the immediate situation, in order to achieve a semantically enriched interpretation of the raw proposition. It is often necessary to employ **inference** (Brown & Yule, 1983) in recognising connections that may only have been made implicitly. Understanding a sequence like *Bill lay on the floor. A knife lay by the body*. requires the reader to infer that Bill is dead and that the knife may have been a murder weapon. After reading, a reader may find it difficult to distinguish what they have actually read from what they have inferred.

In a further phase, the listener / reader has make decisions concerning the item of information they have derived from the input. It can be allowed to decay if it is trivial or can be carried forward either in a generalised form or in detail. It must then be integrated into the mental representation that the listener / reader has constructed of the discourse so far. This entails recognising a logical link between a new item of information and the one that immediately preceded it. It also entails monitoring to ensure that the new item is consistent with what has been heard or read already or whether any misunderstanding has occurred. Children acquiring reading are often insensitive to conflicting pieces of information (Oakhill and Garnham, 1988: 115-118).

Finally, in constructing an extended discourse representation, macro- information has to be distinguished from micro- and a hierarchical model has to be built of the overall line of argument. Skilled comprehenders build more complex representations, because they are more able to determine when to initiate a new conceptual structure and when not (Gernsbacher, 1990). Weak comprehenders operate linearly, repeatedly starting new structures instead of elaborating existing ones.

Some psycholinguists believe that, after a decoding phase in which listening and reading employ different modalities, the two skills map on to a shared comprehension route. This, however, is open to question. The reader has the opportunity of looking back in order to check understanding and to resolve pronominal anaphors such as *she it* or *this*. By contrast, the listener is entirely dependent upon the discourse representation that has been built up in the mind: this has implications for processes such as anaphor resolution, adjusting the sense of a word to fit its co-text and checking the consistency and relevance of new information. From this, it would seem that meaning construction in listening is different in kind and that it imposes a greater cognitive load upon the language user.

## LANGUAGE ACQUISITION

### Nativist theory

The agenda in the study of language acquisition was set by Noam Chomsky's assertion (1965) that language must be an innately acquired faculty. Chomsky's arguments were based upon a number of aspects of acquisition which, he claims,

cannot be explained without assuming some kind of language-specific component in the mind that provides the infant with a head start. They include: the short period of time within which a child achieves grammatical competence, the lack of correction or explicit teaching by adults, the 'poverty of the stimulus' available to the child in the form of natural speech with its hesitations, false starts and syntactic errors, and the fact that all normally developing children acquire full competence, regardless of differences in their intellectual capacity.

A nativist account has to incorporate the fact that what human beings acquire is not simply Language but a specific tongue. Chomsky's current theory (Chomsky & Lasnik, 1993) posits that the genetically transmitted **Universal Grammar** which enables the acquisition of a first language has two components. The first is a set of **Principles,** which enable the infant to recognise features that are common to most or all of the world's languages. The second is a set of binary **Parameters,** which can be set to accord with the language to which the child is exposed. Thus, an infant exposed to a language such as Italian, where a subject pronoun can be omitted, adopts the so-called **pro-drop** setting; while one exposed to English recognises a situation where such a pronoun is obligatorily employed in all circumstances and sets the parameter against pro-drop.

A serious obstacle for nativist accounts lies in explaining convincingly how humankind acquired this particular faculty - particularly in light of the fact that language changes relatively fast whereas the brain that produces it and the genes that transmit it evolve relatively slowly (Deacon, 1997). Chomsky himself (1988) falls back upon a **catastrophic** version of events, in which a set of favourable conditions suddenly coincided and enabled language to emerge.

Often associated with nativist accounts is the notion that there is a **critical period** (Lenneberg, 1967) for the acquisition of a first language, possibly determined by the way in which UG functions. It originated in a theory that the two hemispheres of the brain might be 'plastic' at birth, with the left hemisphere gradually becoming the dominant one for language during the first five years of life. The evidence was that children who suffered left hemisphere brain damage before the age of five were more

likely to end up as right hemisphere dominant. In fact, this finding was not corroborated by recent studies; and the consistency of the theory was undermined when commentators extended the cut-off point to adolescence. There is indeed some evidence (Skuse, 1993) that children who are denied exposure to language early in life can acquire vocabulary but master syntax only imperfectly. However, in such cases, it is often difficult to rule out the possible effects of neglect, delayed cognitive development and even brain damage from abuse.

**Alternative theories**

A number of alternatives to the nativist view emphasise the role of the linguistic environment to which the child is exposed. Some of them can be broadly defined as cognitive. They include the view of Jean Piaget (Piatelli-Palmerini, 1980) that language acquisition is driven by cognitive development as the child succeeds in making sense of the world around it. On this analysis, a sense of **object permanence** (the continued existence of objects when they are out of sight) might be a prerequisite for an utterance such as *cup gone*.

Much quoted in recent years as signalling a return to empiricism (some would say to behaviourism) have been **connectionist** simulations of acquisition based upon computer modelling. A connectionist computer program employed a learning mechanism that strengthened past tense connections that were correct (e.g. SEE linked to past tense SAW) and weakened those that were not (SEE linked to regular past tense SEED). Purely on the basis of this type of feedback, the program was shown to be capable of  'acquiring' around 500 past tense links (Rumelhart & McLelland, 1986). No abstract rule was employed; the performance of the program was purely based upon generalisation across examples and upon identifying cases that did not fit the norm (again, an exemplar principle). However, the extent to which programs such as this model can be said to model the real-life acquisition of inflections is open to challenge. They rely upon standardised input from programmers; the input focuses on only one inflection type; and the learning process requires many passes before the links are established.

More persuasive accounts are furnished by neurologists such as Deacon (1997), who take the view that an emergent language loaded on to cognitive operations that were

formerly reserved for other purposes. The brain then gradually modified to accommodate this new faculty. As a human invention, language is designed in some ways to fit human capabilities (for example, phonological distinctions shared by many languages seem to map on to biases in the human auditory system); this might assist the process of transferring language between generations.

**Child language development**

Chomsky's theories triggered a wave of research into first language acquisition, much of it focusing on empirical data and much of it neutral on whether language is innate. There has been extensive research, some experimental, some based on longitudinal studies, into the syntax, morphology, lexis, and phonology of the developing child. A consistent finding has been the extent to which both the rate and timing of language development vary from one infant to another. Instead of age, **Mean Length of Utterance** (Brown, 1973) is often used as an indicator of development, since there is an obvious correlation between how many words (or morphemes) an infant can produce and the complexity of the syntactic patterns (SVO, SVOA etc.) that the infant can command.

Also used as a mark of the child's growing mastery of syntax is the range of verbs used and the complexity of the valencies associated with them (PUT, for example, requires the specification of both the object and the location where it is put). Other indicators can be found in the emergence of features that are lacking or inconsistent in early speech. They include sentence subjects, correct form of the subject pronoun, the verb *to be* (both copula and auxiliary), and function words generally. Progress can also be traced in the acquisition of syntactic patterns such as the correct ordering of questions and negatives, where there is evidence of a common developmental path

In morphology, thinking has been shaped by Berko's early (1958) demonstration that infants appear to move from holistic forms of words (e.g. *dogs* acquired as a single unit) to generalised rules that enable them to attach a relevant inflection to an unfamiliar word (*WUG+s*). This process leads to a pattern known as **U-shaped development** in which infants first show signs of having acquired an irregular past tense form (*made*) and then resort temporarily to the **overgeneralised** use of a regular inflection (*maked*) before reverting again to the correct form. Contradictory evidence

has led some researchers to question how widespread and consistent this phenomenon really is. Another early research question, inspired by nativist theories, was whether inflections are acquired by a child in a fixed order. The early work of Brown (1973) is sometimes quoted as demonstrating such an order; but the 'bound morphemes' investigated were very mixed, and the sequence was by no means clear-cut since there were considerable overlaps.

Research into the acquisition of lexis has suggested that an early vocabulary of 50-100 words in which nouns predominate, is followed by a **vocabulary spurt** (Clark, 1993) where there is a sudden and rapid increase in the number of words, including verbs, that are acquired each day. The spurt is believed to coincide with a **naming insight**, a recognition by the child of the symbolic nature of language. However, not all children follow the standard pattern; some appear to acquire vocabulary more steadily, perhaps because they are oriented towards syntactic as well as lexical features.

A second area of lexical acquisition research has explored the way in which infants succeed in associating meanings with words. An important line of enquiry concerns the way in which concepts are formed. A solution was found in the theory (see 'Lexical storage' above) that a child identifies a **prototype**, a highly typical member of a category, and then determines whether a newly encountered creature or object belongs to the category by its 'closeness of fit' to the prototype. Most recently an alternative **exemplar** view has been favoured, with (taking DOG as an example) the child storing in the mind traces of many different instances of creatures that have had the label DOG attached to them (Hintzman, 1986). Membership of the group is then determined not by a single prototypical breed but by a whole range of dogs that can be called up in memory.

A further issue associated with vocabulary concerns the choice between the possible meanings that can be attached to a word. How does the child determine that the word DOG refers to the whole creature rather than (say) its tail or the fact that it is eating a bone? Markman (1989), Clark (1987) and other commentators have identified a number of assumptions which a child appears to bring to the acquisition of lexis. They include: that a noun refers to a whole object rather than part of it; that there is a one-

to-one match between a word and a category; and that the first word encountered in a given area is likely to be at basic level (not a superordinate such as ANIMAL or a subordinate such as SPANIEL).

In phonological development, the child faces the important challenges of establishing articulatory settings and of co-ordinating the movement of the articulators from one setting to another. Certain phonemes are acquired earlier than others, with plosives and nasals preceding fricatives. The child compensates for its incomplete phonological repertoire by substituting a mastered phoneme for a more problematic one (Smith, 1973). This seems to reflect difficulties of production rather than of perception, since children have proved capable of distinguishing the difference between their own realisation of a word and an adult's. There is evidence (Werker & Tees, 1984) that children can distinguish between a wide range of speech sounds at a very early age, but that their phoneme categories gradually become more restricted to conform to the contrasts made by the target language.

**Child Directed Speech**

Chomsky's assertions that adult speech is 'degenerate' and that adults do not correct children's language have been subjected to considerable scrutiny. The way in which adults address children appears to be informed by an instinct for how much the child comprehends rather than attempting to emulate the child's own speech, and is finely attuned to the child's development. **Child Directed Speech** (previously referred to as *motherese* or *baby talk*) has been found to be largely correct grammatically and to contain a number of features (for example, stress and intonation patterns) which potentially assist the acquisition process. Adults also employ features such as tag questions that draw the child into communication. The view that adults correct content rather than language has been confirmed; but there is extensive evidence in adult-child discourse of back-channelling and confirmation checks that **recast** the child's productions in a correct form. A caveat here is that most studies of interaction relate to western societies; there has been discussion as to the extent to which CDS is culturally determined.

**A note on acquiring a second language**

*Field: Psycholinguistics*

Except in cases of early bilingualism, the circumstances of a second language (L2) learner are clearly very different from those of a first. Most obviously, an L2 learner already has an established language, and with it a restricted phoneme system, an established lexical network and certain assumptions about how language operates. For those who believe that language is innate, the question is raised of whether UG remains available or partially available to support acquisition. In addition, the learner is cognitively developed: more analytical and less impressionable than an infant. For coverage of SECOND LANGUAGE ACQUISITION, see separate entry.

## OTHER ISSUES

Psycholinguistic research and theory also addresses a number of large issues that relate to the nature of language as a phenomenon. They include:

- *What is the relationship between thought and language*? After many years of scepticism about the Sapir-Whorf Hypothesis, evidence is emerging (Gumperz & Levinson, 1996) that the language we use has some impact upon our categorisation of the real world.

- *What are the different functions of the hemispheres of the brain?* It is now well established that the 'dominance' of the left hemisphere in most individuals is due to its control of smaller-scale operations, and that the right hemisphere plays an important part in processing discourse and intonation.

- *Is language part of general cognition or is it separate?* There is conflicting evidence from syndromes where both IQ and language are impaired and from syndromes where one is impaired but the other is not.

- *Is language exclusive to human beings?* To what extent do the communication systems of other species resemble language? And is it possible to train other primates to acquire a form of language? Bold claims are sometimes made, but, so far, the evidence is not persuasive on either count.

- *How did language evolve?* It is possible to establish the physiological, psychological and neurological pre-requisites for language, but it is much more difficult to determine how and why it emerged. Theories range from the socio-cultural to the cognitive and the coincidental.

## FUTURE TRENDS

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Evidence of changes of state in the brain during the performance of language tasks already plays an important role in psycholinguistics; but the use of neurolinguistic data is likely to expand as the relevant technology becomes more widely available. Electrodes attached to the scalp can be used to track small variations in electrical activity in the brain known as **Event Related Potentials.** The peaks of an ERP are measured by their polarity (positive or negative) and by how many milliseconds intervene between a stimulus and an effect. Especially promising is the recent use of this technology with infants, to investigate the extent to which they respond to different features of phonetic and lexical input.  Psycholinguists also rely increasingly upon **brain imaging** to confirm and refine assumptions, derived from experimental studies, about language storage and use. The advantage of modern scanning techniques such as MfRI is that they permit, not just a one-off snapshot of the parts of the brain engaged in a particular linguistic process, but a sequence of images of how the brain reacts over time.

**Eye tracking** equipment has been used in reading studies for some time; but it is now being put to other uses - for example tracking a language user's gaze across pictures to establish how rapidly semantic relationships are processed. A parallel trend in writing is the development of computer programs to log both the keystrokes and the timing of writers.  In studies of speech perception, there has been a considerable expansion in the use of **synthetic speech**, which can be manipulated to heighten particular features, to reduce audibility or to change speech rate.

A number of issues outlined in this chapter remain unresolved and are likely to feature prominently over the next few years. They include the function of competition in lexical retrieval; the part played by formulaic language in the assembly of speech; the role of phonology in reading and writing; and how listeners normalise to voices and accents. Particular attention is likely to be given to exemplar accounts of language storage and acquisition and to the emergentist view of language which they foster. The function of the grammar rule is likely to be further questioned and conventional views of lexical and phonological categories may be overturned.

## FINAL REMARKS

*Field: Psycholinguistics*

Psycholinguistics is a fast-growing field of study which has contributed enormously over the past 50 years to our understanding of language as a phenomenon. However, there are two causes for regret in relation to its present status. The first is the fragmented nature of the field, even within academic institutions: psycholinguists can be found in departments of psychology, applied linguistics, education, clinical linguistics and speech science, often with limited cross-departmental links. The second is the failure of psycholinguists to disseminate their findings adequately to a wider audience (including within applied linguistics). There is a tendency for cognitive psychologists to present their results in jargon-heavy prose, intended solely for the eyes of close colleagues, and not to transmit important insights to others who might benefit from them. The result is that psycholinguistics is sometimes regarded by the linguistics community as esoteric or unnecessarily complex. Psycholinguists need to do more to build contacts with those who share their preoccupation with language in use.

## ASSOCIATED ENTRIES

Clinical linguistics - Key concepts in language learning - Language emergence - Neurolinguistics - Second Language Acquisition - Sign language

8633 words

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