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**Sentence Processing in Aphasia:  
Single Case Treatment Studies  
Volume I**

**Jane Marshall**

**Submitted for the Degree of: PhD  
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**City University  
Department of Clinical Communication Studies**

Dedication

To Jerry

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### Declaration

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## Abstract

This study presents three single case investigations of sentence processing disorders in aphasia. Assessment of the subjects was guided by models of normal sentence production and comprehension, and involved several new tests which were developed to investigate particular aspects of processing. The assessment phase generated hypotheses about where the processing system was breaking down for each patient. Although all three subjects showed disordered verb retrieval and use, different processing impairments were identified. The first subject had a deficit in the connections between verbs' semantic and phonological representations. The second subject had a hypothesised deficit in the early message level processes. The third subject had a semantic verb deficit which particularly impaired access to verbs' thematic information. Therapies were developed in the light of these hypotheses. Post therapy evaluation showed that all subjects made significant gains, although the nature and extent of their gains varied. These treatment responses are interpreted against the presumed cognitive models. The concluding discussion addresses a number of theoretical questions about the nature of the language processing system and how therapy may influence the workings of that system. Possible future directions for research are proposed.

## Chapter 1 Agrammatism - Decline and Fall

1.1 In 1916 Kleist defined two types of aphasic output. The first, agrammatism, was associated with Broca's aphasia and characterised by short utterances, effortful articulation and the omission of function words and inflections. Paragrammatism, Kleist's second category, featured fluent speech which retained many syntactic elements. Here the impression of syntactic integrity was flawed by lexical errors and the frequent substitution of grammatical morphemes.

Paragrammatic speech was associated with damage to the posterior areas of the cortex and, therefore, with Wernicke's aphasia. (see speech samples in Tables 1.1 and 1.2)

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Table 1.1 Agrammatic Speech Sample

---

B.L.	Wife is dry dishes. Water down! Oh boy! O.K. Awright... O.K. ... Cookie is down ... fall, and girl, O.K., girl ... boy um ...
Examiner	What is the boy doing?
B.L.	Cookie is ... um ... catch
Examiner	Who is getting the cookies?
B.L.	Girl girl
Examiner	Who is about to fall?
B.L.	Boy ... fall down!

(Schwartz 1987)

---

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Table 1.2 Paragrammatic Speech Sample

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Examiner	What does 'strike while the iron is hot' mean?
Patient	Better to be good and to Post Office and to Pillar Box and to distribution to mail and survey and headmaster. Southern Railways very good and London and Scotland.

(Kinsbourne and Warrington, 1963)

---

The descriptive features of agrammatism have been observed across a variety of speech output tasks, and in several different languages (eg: de Villiers 1974; Gleason, Goodglass, Green, Ackerman and Hyde 1975; Gleason, Goodglass, Obler, Green, Hyde and Weintraub 1980; Luria 1970; Traill 1970). There is even intriguing evidence that deaf American Sign Language users, who have become dysphasic, display agrammatic omissions of morphology (Poizner and Kegl 1992).

The common appearance of output with broadly similar features lead to the view that agrammatism represented a syndrome which could be explained both neurologically and in terms of a single underlying language deficit. This belief spawned numerous group studies, particularly during the 1970s and 80s, which explored hypotheses about the nature of this deficit. In the following section I shall briefly review some of these hypotheses and suggest that while they illuminate aspects of agrammatism none successfully accounts for the entire complex of symptoms.

## 1.2 Phonological Theories of Agrammatism

Although the omission of function words and inflections is characteristic of agrammatism the pattern is not absolute (see Howard 1985, and Caplan 1987 for reviews). A number of studies suggest that phonological factors play a part in determining whether or not grammatical morphology is realised. For example Goodglass and Berko 1960 found that syllabic inflections (/iz/, /id/) were more robust than non-syllabic inflections (/s/, /t/). Other studies have shown that sentence initial function words, which tend to be phonologically reduced, are particularly vulnerable to omission (Goodglass, Fodor and Schulhoff 1967; Gleason et al 75). Goodglass (1973; 1976) used these findings to argue that agrammatics are impaired in processing words which are not 'salient'. Two of his defining features of salience were stress and phonological prominence.

The most developed phonological theory of agrammatism was offered by Kean (1977; 1980). She argued that the items omitted by agrammatics

did not form a coherent syntactic or semantic group. For example, free standing function words and inflections encode a variety of different meanings and perform different syntactic functions. However they are phonologically similar, in that they are not involved in the assignment of sentence stress. This lead Kean to suggest that 'clitics', or items which are not phonological words, constitute the affected class in agrammatism.

Kean's theory has been directly challenged both in terms of its ability to explain agrammatics' speech data (Kolk 1978) and on theoretical grounds (Lapointe 1983). A more general difficulty is the evidence that syntactic or semantic factors may 'override' phonology in determining whether morphology is omitted. For example Goodglass and Berko (1960) found that the possessive -s affix and third person singular -s were omitted more frequently than the plural, even though the phonological form of these inflections was the same. Semantic features are also important. Prepositions which mark spatial relationships are more likely to be produced than prepositions which play a purely syntactic role, even when the phonology is identical (Friederici 1982). Even more problematic is the finding that agrammatic people do not just omit clitics. There is evidence that they are also substituted (Miceli, Silveri, Romani, & Caramazza 1989) and even added to produce word class errors (Whitaker 1972).

A further difficulty for Kean arises from agrammatics' performance with content words. These should be unaffected by a condition which only impairs clitics, and certainly word class effects within phonological words should not be seen. However this is not so. Many studies have shown that main verb retrieval is specifically impaired in agrammatism, both in spontaneous speech and naming (eg: Myerson and Goodglass 1972; Marin, Saffran and Schwartz 1976; Hand Tonkovich and Aitchison 1979; McCarthy and Warrington 1985; Miceli, Silveri, Villa & Caramazza 1984; Zingeser & Berndt 1990).

Finally Kean's theory fails to explain many of the structural abnormalities seen in agrammatism. While some of these problems arise from the omission of clitics, this is not always the case. Agrammatics also fail to produce content word structures, such as Adj,Adj N and SVOO (eg Gleason et al 1975; Helm-Estabrooks and Ramsberger 1986) and even in SVO structures word order errors are seen (Saffran, Schwartz and Marin 1980). The example of agrammatic speech given in table 1 shows a structural poverty which goes beyond the deficit in grammatical morphology.

### 1.3 Syntactic Theories of Agrammatism

The role of function words and inflections is primarily syntactic. It is unsurprising, therefore, that their omission in agrammatism was seen as evidence of a central syntactic disorder (Berndt and Caramazza 1980; 1981). Support for this view came from evidence that agrammatics were unable to exploit grammatical morphemes in a range of comprehension (eg Heilman and Scholes 1976; Goodenough, Zurif & Weintraub 1977) and metalinguistic tasks (eg Zurif, Caramazza & Myerson 1972; Zurif, Green, Caramazza & Goodenough 1976; Von Stockert and Bader 1976).

However these findings might simply be interpreted as further evidence of agrammatics' phonological insensitivity to grammatical morphemes, rather than signs of a syntactic deficit per se. Here the evidence offered by on-line experiments is relevant. Using a word monitoring task Tyler (1987) explored an agrammatic's sensitivity to violations of both derivational and inflectional morphology. Like non dysphasic controls, the agrammatic subject's reaction times were delayed when the target word was presented following a word with an inadmissible derivational affix. He was less sensitive to inflectional violations. However when these produced a non word, his latencies like 'normals' increased. It seemed that the agrammatic subject was processing 'clitics', otherwise his performance would not have been affected by inflectional non-words. However, his insensitivity to syntactically inappropriate inflections suggested

that he cannot process their syntactic properties. Another, recent, on-line investigation similarly concludes that Broca's dysphasics are aware of inflectional morphology but cannot process its syntactic information (Friederici, Wessels, Emmorey & Bellugi 1992).

Further support for a syntactic deficit, which is independent of the function word impairment, came from evidence that agrammatics' comprehension problems are not confined to tasks which require processing of grammatical morphemes. They are also poor at comprehending word order (Parizi & Pizzamiglio 1970; Caramazza and Zurif 1976; Schwartz, Saffran & Marin 1980).

The Syntactic Hypothesis argued that agrammatics have sustained damage to a central syntactic processor. The absence of function words and inflections in agrammatic speech was due not to their phonological properties, but to a failure to elaborate the underlying syntactic form of an utterance (Marshall 1977; Lapointe 1985). The hypothesis predicted that all tasks, both input and output, involving syntactic processing will be impaired. The evidence of paragrammatism, where grammatical morphology is preserved, generated further speculation that syntactic processing might be served by a discrete neuroanatomical site which is uniquely damaged in agrammatism (Caramazza and Zurif 1976).

Perhaps the most destructive finding for the Syntactic Hypothesis was the discovery that many agrammatic people were still able to make complex grammaticality judgements (Linebarger, Schwartz, Saffran 1983; Schwartz, Linebarger & Saffran 1985; Schwartz, Linebarger, Saffran & Pate 1987). The claim that this can be achieved through sensitivity to prosodic, rather than syntactic factors was ruled out by Berndt, Salasoo, Mitchum and Blumstein (1988) who showed that agrammatics' performance did not decline when all intonational cues were removed from the stimuli. Agrammatics also performed well on an on-line version of the task (Shankweiler, Crain, Gorrell and Tuller 1989), which countered another criticism that grammaticality judgements tap only off-line processing (Wulfeck 1988).

More extensive cross-linguistic research also created difficulties for the syntactic hypothesis. It was found that the extent to which grammatical morphology is omitted in agrammatism reflected its role and prominence within the speaker's language (eg Bates, Friederici and Wulfeck 1987; Bates Wulfeck and MacWhinney 1991). Thus Broca's dysphasics from heavily inflected language cultures have shown remarkable preservation of the syntactic features thought to be affected in agrammatism (eg Slobin 1991).

Another major problem was the discovery of dissociations in tasks requiring syntactic processing. Patients were reported who were agrammatic in production but not comprehension (Miceli, Mazzucchi, Menn & Goodglass 1983; Kolk, Van Grunsven and Keyser 1985; Nespoulous, Dordain, Perron, Ska, Bub, Caplan, Mehler and Lecours 1988; Caramazza and Hillis 1989) and others, with short term memory deficits, who displayed asyntactic comprehension without a production deficit (Caramazza, Basili, Koller and Berndt 1981). Dissociations were also observed between the written and spoken modalities (Howard 1982; Bub and Kertesz 1982; Howard 1985).

One dissociation which proved less robust was the classic division between agrammatism and paragrammatism. Investigations revealed that agrammatic patients frequently substituted, rather than omitted, grammatical morphology (eg Heeschen and Kolk 1988) particularly in languages where omission would yield a non word (Grodzinski 1984). Conversely paragrammatics did not just substitute grammatical markers, they also omitted them, and showed other signs of disordered syntax (Butterworth and Howard 1987; Martin and Blossom-Stach 1986). It seemed that syntactic disorders were not unique to agrammatism but could occur in a variety of forms of aphasia.

Further difficulties for the Syntactic Hypothesis came from reports of dissociations between the different aspects of syntactic production, notably the composition of word order and realisation of grammatical morphology (Berndt 1987; Parisi 1987). These studies also showed that dysfluency was dissociated from the other features

of agrammatism, thus challenging an earlier view that telegraphic speech was a compensatory response to the articulation problem (Lennenberg 1983). As above, Berndt (1987) identified dissociations between production and comprehension. However this only applied to subjects whose production deficit consisted of the omission of grammatical markers. Subjects with structurally simplified output were also impaired in sentence comprehension. The Central Syntactic Hypothesis, in its original form, was clearly too generalised to account for these data. The production of syntax seemed to entail different elements which could be separately impaired in agrammatism. However, the association between structural simplification and agrammatic comprehension suggested that a revised syntactic hypothesis might permit a new form of parallelism.

#### 1.4 'Trace Theory'

Grodzinski (1984,1986) argued that the production and comprehension impairments seen in agrammatism were attributable to a failure in the computation of s-structure representations. His argument is rooted in Chomsky's Government and Binding theory (1981). Under this theory sentences have two levels of syntactic representation. D-structure represents the basic thematic relations of a sentence, with arguments directly assigned to positions by the predicate. The S-structure reflects the actual ordering of arguments in the surface string. The two levels are related to each other by transformations, which move arguments from their original D-structure positions. The history of these movements is recorded in the S-structure by non-lexical nodes, identified as traces, eg:

The cat<sub>i</sub> was attacked t<sub>i</sub> by the dog.

The trace (t) and its co-index (i) records that 'the cat' has been moved from its original position as object of 'attacked'.

Grodzinski suggested that traces are unavailable to agrammatics. As a result they are impaired in both the production and comprehension

of sentences involving moved arguments. Their performance with passives is pivotal to his argument. Several studies have shown that agrammatics are at chance when comprehending passives (Caplan 1987 for review). The fact that passives are not below chance, or consistently reversed, indicates that agrammatics can process their morphology. However they lack any consistent means of determining who is agent. This, Grodzinski argues, is due to an inability to exploit traces. Agrammatics correctly assign the prepositional phrase to agent. However the sentence subject, which for agrammatics is not linked to a post verbal trace, is uninterpretable. Due to its position as first NP, this argument is also (by default) assigned to agent. Thus agrammatics have two competing agents and are forced to chose randomly between them.

There have been several challenges to Grodzinski's theory. One difficulty is that it fails to account for all the data, particularly agrammatics' quite poor performance with active 'traceless' sentences (Jones 1984; Black, Nichols and Byng 1992). One study explicitly tested Grodzinski's claim by assessing agrammatic patients in Hebrew, which permits the formation of passives both with and without a trace. Only two of the four subjects showed significant comprehension impairment. Yet this was not due to a trace deficit. Passives without traces were equally impaired (Druks and Marshall 1991). Martin, Wetzel, Blossom-Stach and Feher (1989) also tested the 'trace theory' by investigating agrammatics' performance with truncated passives, where there is no prepositional phrase competing for the agent role. According to Grodzinski these passives should be consistently reversed. Yet this was not the case, scores with truncated passives were not below chance. (For additional critique see Caplan 1987)

### 1.5 Short Term Memory Deficit

An alternative to the syntactic account of the comprehension impairment in agrammatism implicates a failure in short term or

phonological working memory (eg Caramazza et al 1981; Saffran 1990; and Gathercole and Baddeley 1993 for review).

A number of investigations with normal language users indicate that working memory, and particularly the phonological loop, may be involved in language comprehension. For example Waters, Caplan and Hildebrandt (1987) demonstrated that articulatory suppression (which prevents phonological rehearsal) impaired judgements of complex sentences. Similar results were achieved by Baddeley, Eldridge and Lewis (1981). The precise role of the phonological loop in comprehension is disputed. Baddeley and Lewis (1981) argue that it may retain a verbatim record of the sentence on which to perform complex syntactic analysis; while Waters et al (1987) suggest that the loop may store the product of the parse during the mapping operations.

The 'normal' evidence predicts that subjects with short term memory impairments may experience allied comprehension problems. A number of STM patients seem to have shown this pattern (eg Vallar and Baddeley 1984). However, the relationship between the two deficits is unclear. The case reported by Saffran (cited in Caplan 1987) is a good example. This patient had both a STM and comprehension deficit. However one did not obviously generate the other. For example, varying sentence length did not affect understanding and the patient was able to make good grammaticality judgements, even when long distance violations were involved. Group studies have provided similar challenges. Martin et al (1989) found that agrammatics' comprehension of truncated passives was no better than full forms, despite the decrease in sentence length, and Schwartz et al (1987) showed that agrammatics were capable of detecting violations even in long, multiple clause, sentences. Perhaps the most damning evidence comes from subjects with unambiguous STM impairments, but normal comprehension (Campbell & Butterworth 1985; Howard and Butterworth 1989).

The role of STM in comprehension is not obvious. On-line experiments have shown that speech is interpreted on stream, thus minimalising the demand for a stored verbatim record (eg Tyler and Marslen-Wilson 1982; Tanenhaus and Carlson 1989, and see chapter 4). This verbal record may be required only when on-line processes have failed, for example when recovering from garden paths. A similar conclusion is reached by McCarthy and Warrington (1987) in their investigation of two subjects with STM impairment. Here comprehension only broke down when either pragmatic expectations were flouted or additional cognitive demands were imposed. It was presumed that both these conditions required back-tracking operations which were unavailable due to the STM deficit.

It seems that the memory hypothesis cannot directly account for the comprehension impairments seen in agrammatism, even in cases where there is a clear STM deficit. However it is probable that memory problems interact, in subtle ways, with other input deficits, particularly those which impair the on-line processing of the speech stream.

## 1.6 Summary and Conclusion

None of the unitary accounts of agrammatism succeeded in explaining the syndrome. Furthermore the attempts to validate them produced increasing evidence about the differences between agrammatic patients. These dissociations not only confounded the search for a unifying explanation but also led most commentators to question the very existence of agrammatism (eg Howard 1985; Badecker and Caramazza 1985 but see Grodzinski 1991). One direct consequence for the new 'scepticism' was a call for an alternative research methodology. While agrammatism was believed to encompass a homogenous set of symptoms group studies were valid. We now know that these patients are likely both to differ from one another and to display remarkable similarities to contrastive groups, such as paragrammatics. This has led to the call for single case investigations (eg Caramazza 1986), which aim to account for individual aphasic sentence disorders

against models of normal sentence processing. Undoubtedly one difficulty here is the embryonic and disputed nature of the models. The debates about normal sentence production and comprehension are reviewed in Chapters 2 and 4. Chapters 3 and 5 will relate current processing theories to aphasic deficits.

The fall of agrammatism, as a theoretical concept, also has therapeutic implications. While the concept stood, clinicians were encouraged to seek a single therapeutic response (eg Helm Estabrooks and Ramsberger 1986). It now seems that various therapies, catering for different types of sentence processing disorders, will have to be developed (see Chapter 6 for review). This apparently increases the complexities of treating aphasic sentence disorders. However it also opens the door to an exciting collaboration between theory and therapy. New theories about the nature of individuals' sentence problems may help to generate novel therapeutic ideas. The administration and evaluation of the therapies might then contribute to our theoretical understanding of the disorder and even sentence processing itself.

This study presents three single case therapy studies. The patients' deficits and strengths are interpreted against current models of sentence processing. These models also informed the aims and content of the therapies. The treatment outcomes are evaluated and interpreted against the theoretical model and in all cases this stimulates a review of the patient's language disorder. The final chapter considers the implications of these studies for current theories about sentence processing.

## Chapter 2 Models of Normal Sentence Production

### 2.1 Garrett's Model of Sentence Production

The model which has most influenced theorising about dysphasic sentence production was created by Garrett (1980, 1982a; 1982b). It was derived from an analysis of normal speech errors, which Garrett classified in the following way:

#### **Word Exchanges**

Example: 'Well you can cut rain in the trees'

Word exchanges only affect open class vocabulary and usually occur between words of the same grammatical class. The error is insensitive to phonological form, in other words exchanging words rarely sound alike. Exchanges typically cross phrase boundaries.

#### **Word Substitutions**

Examples: 'Its a far cry from the 25 dollar days' (target: cent)  
'You look all set for an exhibition'  
(target: expedition)

As these examples suggest, word substitutions tend to be either phonologically or semantically related to the target.

#### **Shifts**

Example: 'Did you stay up late very last night'

In shifts one element of the utterance is mislocated. Unlike exchanges the errors tend to involve closed class vocabulary. These errors also disrupt phrasal stress.

#### **Sound Exchanges**

Example: 'This is the lariatel pobe' (target: parietal lobe)

Sound exchanges usually involve neighbouring words, or at least words within the same phrase. They tend to affect phonologically similar words and often involve words of different grammatical class. Thus their properties directly contrast with word exchanges.

### **Stranding Errors**

Examples: 'She writes her slanting' (target: slants her writing)

'It waits to pay' (target: pays to wait)

In stranding errors two content words exchange leaving behind their inflections or articles. The stranded morphology adapts, phonologically, to its new environment. This can be seen in the second example above where the verb inflection (originally /z/) accommodates to its new stem.

Even this brief review highlights important divisions between the error types. Firstly open and closed class vocabulary tend to participate in different errors, for example word exchanges involve open class vocabulary, whereas shifts implicate closed class words. Secondly some errors seem sensitive to the phonological properties of words, while others are more sensitive to their semantic features or grammatical class. Finally errors can be divided according to whether they affect neighbouring or distant words. These divisions suggest that the different errors reflect the malfunctioning of discrete components of the sentence production system.

Garrett used the error patterns to infer the nature of the production model. The components of his model are outlined below, with reference to the example sentence: 'The girl guide gives a posy to the prime minister'. The relationship between the model and the different errors is also discussed.

### **The Message Level Representation**

This is a non-linguistic level where the speaker formulates the conceptual content of the message. Garrett says very little about the processes involved, although other commentators have elaborated further (Levelt 1989). See section (2.6).

## **The Functional Level Representation**

Several processes occur here. The semantic representations of the content words are accessed. Imprecision might result in a semantic word substitution (eg 'scout' for 'guide').

The semantically specified lexical items are assigned to roles within an abstract structure. Garrett is non-committal about the nature of this structure, but Schwartz (1987) describes it in terms of a predicate argument structure. Generating this involves a number of operations. First the verb's argument and thematic role information is retrieved. For example 'give' specifies three arguments, with the thematic roles of goal, source and theme. Then lexical items are assigned to the thematic role positions, eg:

goal     prime minister  
theme    posy  
source   girl guide.

An error during the creation of the predicate argument structure might result in a word exchange. For example if goal and source are mis-assigned the final sentence might be:

'The prime minister gives a posy to the girl guide'.

The characteristics of exchanges can also be explained. Closed class elements are not yet computed, therefore exchanges can only implicate content words. Only the semantic representations of these words are available, therefore errors occurring at the Functional Level should be insensitive to phonological factors. The word class effect is also predicted, in that words of the same grammatical category are more likely to be mis-assigned to each other's roles. Finally the tendency for exchanges to cross phrase boundaries is consequent on the span of the predicate argument structure.

## **The Positional Level Representation**

This level involves a number of processes. The speaker creates the sentence planning frame, or the surface syntactic form. All

necessary function words and inflections are accessed within the frame. The planning frame can be imagined as having 'gaps' marking the position of content words, eg:

the (     ) (     )s a (     ) to the (     )  
          N           V           N           N

A breakdown during the creation of the planning frame might result in fragments of grammatical morphology becoming misaligned, or a shift error.

The phonologies of the content words are retrieved and inserted into the gaps in the planning frame. A number of errors might occur here. Firstly phonological retrieval may fail, resulting in a phonological word substitution. Secondly the process of insertion may go awry. If words are misplaced in the planning frame they will become attached to the wrong fragments of morphology, which will generate a stranding error. Alternatively segments of the content words' phonologies may become detached during insertion, resulting in a sound exchange. The proximity of words participating in sound exchanges suggests that this level is computed on a phrase by phrase basis.

The Positional Level Representation specifies the syntactic and phonological properties of the sentence. Prior to articulation there is one final stage of adjustment.

### **The Phonetic Level Representation**

Here the phonological forms of the function words and inflections are specified. This occurs after the insertion of content words to ensure that the grammatical morphology agrees with the neighbouring vocabulary. For example the -s inflection on the verb may adopt a number of forms: /s/, /z/, / z/. Specification can only take place once the root is known. The accommodation seen in stranding errors is evidence of the Phonetic Level processes.

## **Critiques of Garrett's Model**

### **2.2 Evidence Against the Computational Separation of Open and Closed Class Vocabulary**

In Garrett's model open and closed class vocabulary are processed separately. With open class words semantic retrieval occurs at the Functional Level and phonological retrieval at the Positional Level; whereas closed class words are accessed by the syntactic routines which compose the planning frame. This division is supported by the evidence that open and closed class words participate in different speech errors.

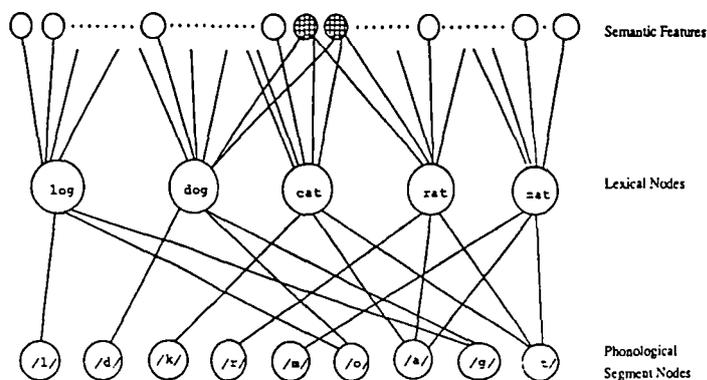
Stemberger (1984, 1985) also conducted an error analysis which suggested that content and function words behave differently. For example he found that substitution errors were common with open class words, and rare with closed class words, while omissions showed the opposite trend. Furthermore phonological errors were almost exclusively confined to open class vocabulary. Yet Stemberger argued that the apparent class distinction is, in fact, due to frequency effects. He contended that both phonological and substitution errors reflect lexical retrieval problems. These are more likely to occur with low frequency words, which have lower resting levels of activation. Consistent with this account was the finding that substitution errors tended to be of higher frequency than the intended target. Closed class words have very high frequencies. As a result they rarely generate retrieval problems and therefore rarely appear in substitution or phonological errors. Stemberger provided a different account of omissions. He suggested that these arise from a tendency to retrieve basic, unelaborated phrase structures. These structures fail to supply slots for the required grammatical morphology, and therefore result in the omission of function words and inflections. A frequency effect is also operating here in that the unelaborated forms, which participate in many more complex structures, are the most common.

Stemberger suggests that a single, frequency sensitive, lexicon processes both function and content words. However, some separation between the word classes is still implied since closed class words are particularly vulnerable to omission if inadequate phrase structures are retrieved.

### 2.3 Evidence Against the Separation of Semantic and Phonological Processing

Garrett's model divides semantic processing, which occurs at the functional level and phonological processing which takes place at the positional level. This predicts that errors originating at the functional level should be insensitive to phonological factors. However Dell and Reich (1981) present evidence that this is not the case. They found that words involved in exchanges were phonologically related more often than would be predicted by chance. Furthermore semantic substitutions showed a tendency to be phonologically similar to the target. Dell (1986, 1988) draws on these findings to reject Garrett's two store lexicon. Instead he proposes a network lexicon composed of semantic, lexical and phonological nodes (see figure 2.1).

Figure 2.1 Lexical network structure in the spreading activation production model.



(from Dell and O'Seaghdha 1992)

In Dell's lexicon activation spreads downwards from the semantic nodes and upwards, in the form of feedback, from the phonological level. The spreading activation accounts for the phonological influences seen in semantic substitutions. Using the example in figure 2.1, 'rat' may be produced in error for 'cat' because it receives competing activation from the semantic nodes and competing feedback from the phonological level.

#### 2.4 Evidence of Phonological Priming Effects in Syntax Generation

In Garrett's model syntax is formulated in two stages. An abstract structure is composed at the functional level which then provides a specification for the planning frame. This syntactic processing takes place prior to the retrieval of the phonological forms of words and therefore should be impervious to phonological lexical priming. However Bock (1987 a) found that if the priming was powerful enough it could influence syntax. Her experiment asked subjects to read words aloud prior to describing pictures of events. In several trials the word which had to be read aloud was strongly phonologically related to one of the objects in the picture. Bock found that subjects preferred to begin the sentence with the unprimed word. This effect was seen with both active and passive sentences. Bock concluded that phonological primes inhibited access of the related target. This forced the subjects to formulate syntactic structures which allowed the less available phonological form to appear late in the sentence.

The finding suggests that Garrett's model should be revised to permit lexical phonological influences over syntax. Bock (1987) offered two mechanisms to achieve this. In one, phonological retrieval problems result in planning frames being aborted at the positional level. This information is fed back to the functional level which constructs an alternative structure placing the more available words early in the sentence. The other proposal is a parallel race model. This suggests that several alternative functional level structures are composed at the outset. Each structure is processed at the

positional level and the one which achieves phonological realisation first will be produced. In the priming experiment, structures which place the most phonologically accessible words early in the sentence will tend to win the race.

## 2.5 Summary of the Critiques of Garrett's Model

The critiques so far presented suggest that many of the computational divisions inherent in Garrett's model may not be justified. There is evidence that content and function words may not constitute separate processing vocabularies. Strict divisions between the semantic and phonological processing of words may not be supported by speech data. Finally the influence of lexical phonological priming on structure suggest that more feedback should be permitted between the positional and functional levels. These findings do not entirely refute the model. However they do suggest that it should be revised to accommodate more interactions, both within the lexicon (Lapointe and Dell 1989) and between lexical and syntactic processing (Bock 1987; Berndt 1991).

A further difficulty with Garrett's model is its lack of specification. There is very little information about the processes involved at each level, or about the communication between levels. In the following sections two aspects of processing are considered in greater detail. The first addresses the processes involved in translating thought into language, or the generation of messages. The second discusses the creation of syntax. Finally I shall consider the role played by verbs in sentence production.

## 2.6 The Generation of Messages

Garrett does not discuss the mechanisms which compute messages, although he clearly perceives them as non-linguistic. In this section, following Levelt (1989), I shall suggest that the Message Generator is more linguistically structured and informed than Garrett proposes.

### 2.6.1 World-Word Mappings

One immediate difficulty for the Message Generator is that there is no automatic mapping between the conceptual possibilities presented by the world and the meanings of individual words. This is particularly true in the case of verbs. Gentner (1981) cites the example of English and Spanish verbs of motion. English verbs tend to conflate the manner of motion into the verb, with directional information being encoded elsewhere:

'The bottle floated into the cave.'

Spanish verbs typically incorporate the direction, leaving manner within the modifying phrase:

'La botella entro a la cueve, flotando'

Even within the same language one event can be lexicalised in a number of ways. The event in fig 2.2 might be described as 'pouring' or 'filling', depending on whether the movement of the water, or the effect on the glass, is being focussed.

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Figure 2.2 Pouring/Filling Event

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The problem of world-word mappings is considered by Gleitman (1990) in the context of language acquisition. Gleitman explores Locke's contention that word meanings are learned by observing the real-world contingencies for their use. A number of objections are offered. Firstly parental language rarely reflects the here and now. For example the mother may say 'eat your peas' while the child is playing with a toy truck. Even when language does directly refer to perceived events, mappings may still be opaque. This is because events are multiply interpretable. For example a pushing event might be described by 'push', 'move', 'roll', 'slide' or 'run', depending on what is being focussed. Finally many features of events are closed to observation. Gleitman cites the verbs 'look' and 'see'. Both are verbs of perception, but 'look' is active or exploratory, while 'see' is stative. This distinction is not easily discerned from the environments in which the words occur. Furthermore blind children, who clearly lack observational experience with these verbs, nevertheless learn them as effectively as sighted children (Landau and Gleitman 1985). Gleitman suggests that world-word mappings are so problematic that children need some alternative means of deriving lexical semantics. In particular she argues that children use language data, especially syntactic structures, to deduce word meanings. This is supported by experimental data showing that young children are able to infer the meanings of novel verbs from the sentence structures in which they appear (Fisher, Hall, Rakowitz and Gleitman, in press).

Gentner (1978) suggests that children may gradually build up their lexical knowledge, with more observationally salient features being acquired earliest. In her 'cooking' experiment she found that young children appreciated the differences between verbs which expressed various manners of action (such as 'beat', 'stir' and 'shake'), better than verbs which lexicalised the effect (such as 'mix'). This suggested that children were predisposed to map perceptual properties of events onto words. The less salient properties, such as the effect, were mapped later.

Other investigators have indicated that children are sensitive to different lexicalisation patterns from a surprisingly early age. Choi and Bowerman (1991) explored English and Korean children's use of verbs of motion. These languages differ greatly in their expression of movement. English verbs typically conflate manner, cause and deixis into the verb, with path expressed separately. Korean verbs have complex lexicalisation patterns which vary according to whether the verb is transitive or intransitive. Transitive verbs incorporate path and figure/ground information, while intransitive verbs do not. The investigators found that from about 17 months onwards both English and Korean children were sensitive to the different ways that their languages lexicalised movement. For example English children were heavily dependent on separate path particles, such as 'up' and 'down', whereas Korean children correctly conflated this directional information into transitive motional verbs.

This investigation suggests that children's expressions of movement do not simply reflect universal sensory-motor concepts. They also seem able to sub-categorise events according to the properties of their linguistic culture. Choi and Bowerman argue that children may have innate 'privileged notions' or semantic primitives. In the case of motion events these might include features such as path, figure, ground, manner, deixis, etc. Through exposure to their native language children learn which features are typically conflated into verbs, and which are expressed separately. Once the lexicalisation patterns are identified they are used to govern future construals of events.

Thus world events do not map in a simple, one-to-one, fashion onto the lexicon. Words, and particularly verbs, are selective about which features they focus in their semantics. This presents a learning problem for children, who need to discover the lexicalisation patterns of their native language. Various solutions have been suggested, including syntactic bootstrapping, in which the child infers meanings from syntax (Gleitman 1990; Fisher et al, in

press), gradual componential learning (Gentner 1978) and the use of semantic primitives to guide observation (Choi and Bowerman 1991; Pinker 1989). Whatever the learning process it seems that children have to develop the ability to construe events in ways which are consistent with their linguistic environment. In other words their message generator must become sensitive to which features of the event can be mapped onto the terms available in the lexicon.

#### 2.6.2 Generalisations in Event Construal - Jackendoff

In the previous section I suggested that language describes a construal of the world, rather than the world itself. If each person's construal were entirely idiosyncratic, severe communication problems would arise. As it is people generally manage to convey thoughts and information to one another quite successfully. Jackendoff (1978, 1983) suggests that this is possible largely because people adopt similar, unifying, procedures for representing the world, at least when they are planning to talk about it. This unity can be glimpsed through syntactic parallels, which link the expression of different types of event. For example similar structures are used to describe physical motion, change of possession and communication, eg:

- i) John pushed the car to the garage.
- ii) John gave the car to his son.
- iii) John conveyed the message to his neighbour.

The similarity of these structures suggest that the events share basic underlying concepts, such as the transfer of an entity from one location to another. In sentence (i) the transfer is physical. In (ii) it is possessive and in (iii) communicative.

Conceptual generalisations, as in the examples above, enable us to employ structures relating to the spatial world in order to express more abstract events. Consider the following examples:

- iv) Peter drove from London to Carlisle.
- v) Peter worked from nine till five.

Both sentences describe the movement of a person, or event, along a path. In (iv) the path is spatial, while in (v) it is temporal. Further evidence of this parallelism can be observed in verbs' ability to function within different semantic fields. Take the following examples:

vi) The train went to Edinburgh.

vii) The inheritance went to the struggling Phd student.

In (vi) 'go' is functioning within the spatial semantic field, while in (vii) it is possessive.

From examples such as these Jackendoff developed his Thematic Relations Hypothesis. This argues that our concepts of events are underpinned by a limited set of sensory-motor primitives, such as causation, location, path etc. The primitives are extended into more abstract domains to express complex notions such as change of possession, communication, and time.

Jackendoff's theory suggests that language depends upon the ability to construct limited and highly organised schematizations of events. Of course our general ideas and knowledge about the world are much less constrained. When thinking about event (ii) we may consider John's intentions, what stratagems his son applied to get hold of the car, the wisdom of this action etc. However when we express the event we are forced to apply a more selective schema, which is organised according to linguistic principles. Generating such precisely structured idealizations may be one of the responsibilities of the Message Generator.

### 2.6.3 The Nature of Messages - Levelt (1989)

The properties of messages have been considered in detail by Levelt (1989). He argues that messages must have a 'grammar' in order to be accessible to the linguistic processor. 'Grammatical' or well formed messages have four principal features:-

- they are propositional
- they have an argument and thematic structure

- they have perspective
- they are tuned to the target language

The propositional characteristic asserts that messages should have a truth value, which can be either denied or supported. People do not only think in propositions, they also command spatial and kinesthetic representations and can move from one code to another. The truth of the proposition 'Tim is taller than James' can be evaluated by translating it into a spatial image and comparing it to what we know about these two people. However if the intention is to speak, information must be represented in the propositional code.

The propositional principal implies that messages cannot simply refer. For example 'Shula' does not constitute a grammatical message. Yet utterances can contain just a single referent, particularly in response to questions, eg:

'Who chaired the staff meeting?'

'Shula'.

Levelt suggests that in such elliptical cases the message generator may have formulated an entire proposition, most of which is jettisoned in production. This is supported by evidence of case marking in elliptical utterances. Eg compare:

a) 'Who chaired the staff meeting?'

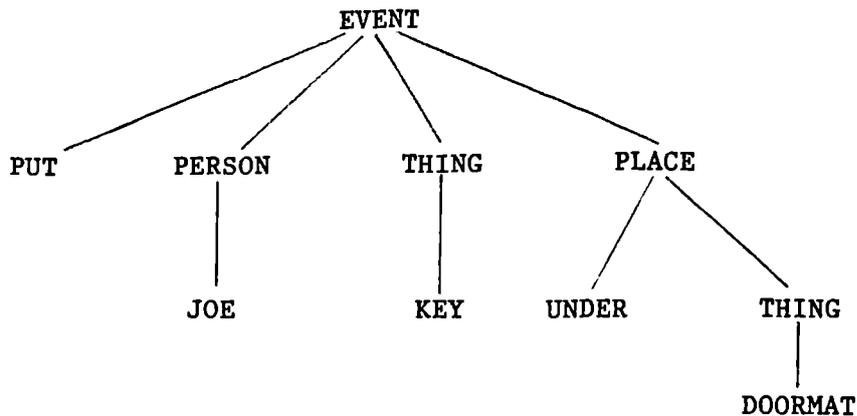
'She did'.

b) 'Who did Shula reprimand?'

'her'.

If (b)'s message consisted of just a single entity, how could the correct case be selected? It seems that the message is marking the role of the referent within a propositional structure.

The second feature of messages is their structure. This codifies the relationship between the different entities, or arguments, of an event. For example 'Joe put the key under the door mat' might be represented as:



As this representation suggests, message structures are created from a limited set of primitives, such as THINGS, PERSONS, PLACES etc.

In addition, message structures specify the thematic role performed by the different arguments. In the example above, Joe fulfils the role of agent, the key is theme, and the doormat the goal. Following Jackendoff, Levelt suggests that the thematic roles derived from physical events may be extended into non-physical domains. For example Goals may also be the recipients in possessive events or times in temporal events.

The third feature of messages is that they have perspective. This accounts for the ability of language to express a different focus over events. Take the following sentences:

- a) Shula gave the book to Tim.
- b) Tim received the book from Shula.

Both express the same thematic structure, but the perspective is different. (a) focuses the giver, while (b) focuses the recipient. It seems that the message must mark which information is to be foregrounded in the final utterance. Foregrounded features would include the topic of the utterance and information which is novel to the discourse.

There is a good deal of experimental evidence showing interactions between message perspective and output. Tannenbaum and Williams

(1968) asked subjects to describe simple line drawings of events, using either active or passive structures. Production latencies were measured. Before being shown the pictures the subjects heard a long preamble, which concerned either the agent or the patient of the event which they were about to see. The authors predicted that if the preamble was about the patient, passive structures would be facilitated, whereas if it was about the agent, actives would be easier. The results confirmed this prediction and suggested that the preamble established event focus. If this was consistent with the requested structure production was eased. If not, a conflict occurred and latencies increased.

Other studies have shown that speakers prefer to map foregrounded information onto prominent grammatical positions. Bock and Warren (1985) asked subjects to recall a number of sentences involving nouns of different imageability or conceptual accessibility, eg:

The doctor administered the shock.

The shock was administered by the doctor.

The old hermit left the property to the university.

The old hermit left the university the property.

In recalling sentences subjects tended to place the most imageable noun in the prominent syntactic position, such as subject or, in the case of datives, direct object. This was regardless of the original form of the sentence and occurred with both active and passive structures. Pure word order was not equally affected. When recalling phrases involving nouns of different imageability, the least imageable noun was often placed first, eg:

The lost hiker fought time and winter.

(my underlining)

Therefore it seemed that the focus information in messages acted upon the structure of the sentence, rather than the ordering of words within phrases.

Brown and Dell (1987) also identified grammatical effects which arose from foregrounded information in the message. They asked subjects to retell stories, each involving a particular instrument. In some

stories the instrument was typical of the event (eg a knife in the case of a murder), and in others it was atypical (such as an icepick). It was presumed that novel instruments would be foregrounded in the message. In retelling the events subjects either omitted typical instruments, or mentioned them only in supplementary clauses, eg:

'The robber grabbed a knife and stabbed the man'.

In contrast atypical instruments were usually expressed, and in the same clause as the action, eg:

'The robber stabbed the man with an icepick'

Here the speaker's message seems to have encoded a more intimate relationship between the main event and the specific instrument, a relationship which is reflected in the eventual structure of the sentence.

The above studies support the claim that the message structure is marked for focus. Information about perspective seems to act powerfully upon the syntactic form of the sentence, but less on local word ordering (Bock and Warren 1985). This suggests that message information may only be available during the earlier stages of sentence computation.

The fourth feature of messages is that they are tuned to the target language. I have already argued that the message generator needs to be informed about the lexicalisation patterns of the speaker's language (section 2.6.1). There are further language specific requirements. Deixis is one. The English system of deixis has two points of reference with respect to the ego: proximal and distal (eg 'here' vs 'there'), while Spanish has three: proximal, medial and distal. It is unlikely that English and Spanish speakers think differently about distance. However when preparing for speech, they are compelled to formulate different deictic codes in their message structures.

Tense marking is another area in which languages differ. For example in English tense inflection is obligatory, while in Malay it is not.

This suggests that messages of English speakers must contain temporal information, even if it is of no communicative value, whereas Malayan messages can presumably omit it.

Levelt argues that linguistic tuning is achieved during language acquisition. During this period the child learns which conceptual features have to be encoded into the message in order for it to be compatible with the target language. Once acquisition is complete the interaction stops. The message generator has learnt the language specific requirements and can act autonomously.

### Summary

This section has suggested that messages must have several properties in order to act as effective input to the language generator. They must be sensitive to the lexicalisation patterns of the target language. For example they must distinguish those features of events which are typically conflated into verbs from those which are expressed separately. They must be propositional, or express a truth value. They must be structured, and these structures probably call upon a limited set of conceptual primitives which extend across several semantic domains. Messages must have focus and perspective, which eventually influence syntax. Finally messages must take account of the requirements of the target language, such as whether or not tense information is encoded. None of these constraints need act over our general thinking. It is only when concepts are prepared for expression that these linguistic factors must operate.

### 2.7 The Generation of Positional Frames

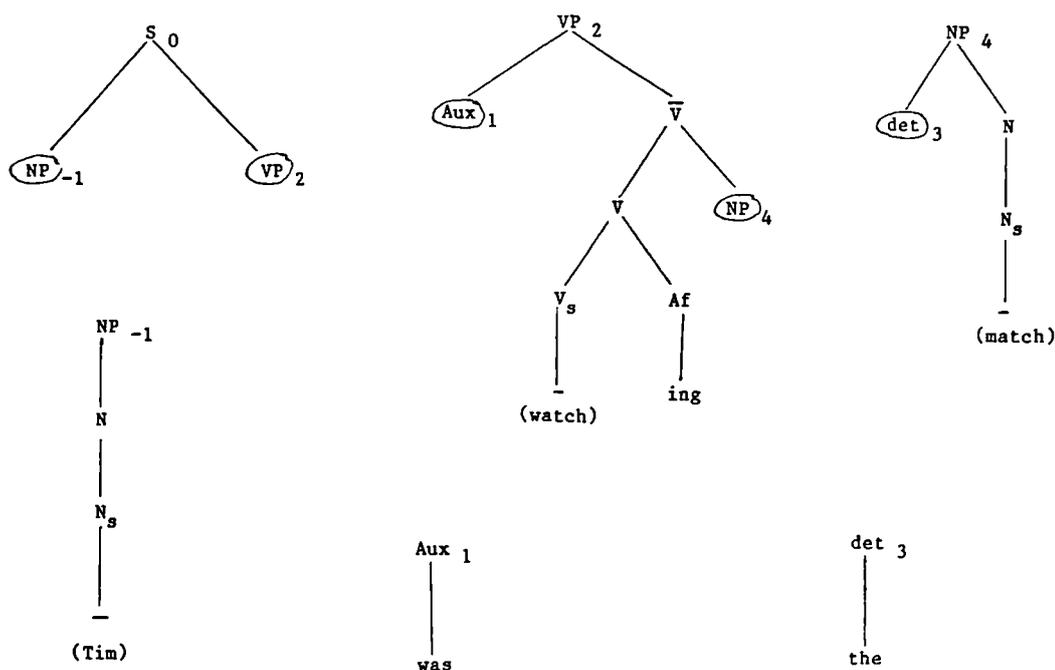
Garrett says very little about the processes which generate positional frames, or the surface syntax. He does not specify how the frames are stored and accessed or how the functional level representation acts as input. Indeed I have already suggested that this may not be the only input received by the positional level. The phonological availability of words also seems to influence syntactic

processing (Bock 1985), as do message features (Bock and Warren 1985; Brown and Dell 1987; Levelt 1989).

### 2.7.1 'Fragment Theory'

Lapointe (1985) and Lapointe and Dell (1989) have offered a more developed account of syntactic processing. They suggest that positional frames are stored in the form of fragments. Figure 2.3 shows the fragments which make up the sentence 'Tim was watching the match'.

Figure 2.3 The syntactic fragments involved in the sentence: 'Tim was watching the match'



This figure illustrates several features of the theory. Firstly fragments can contain other fragments. So the S fragment incorporates a noun phrase and verb phrase fragment. Secondly inflections and function words are treated differently. The former are 'hard wired' into the phrase fragments, such as the -ing affix

within the verb phrase, while the latter are represented in separate fragments. Thirdly the fragments contain lexical slots, which are filled either by the phonologies of the content words, or in the case of function word fragments, by free standing grammatical morphemes. Finally fragments are numerically indexed. This controls the sequence in which they are processed, and hence the final ordering of the sentence. Thus the NP<sub>1</sub> is lexicalised first, then the Aux<sub>1</sub> fragment, then the VP<sub>2</sub> fragment and so on.

Fragments are accessed via a notion store. It is presumed that the functional level representation specifies semantic features such as tense and aspect which ultimately receive syntactic expression. These features are tabulated in a 'notion store', under a system of columns and rows. Columns are headed by notions of attitude, voice and aspect, while the rows express tense and number. Thus the sentence 'Tim was watching the match' falls within the indicative/active/durative column and the past/singular row. The resulting co-ordinate within the notion store activates the relevant phrase and function word fragments. The notion store is presumed to be organised according to principles of markedness. Least marked structures are represented in the top left cells, and the most marked in the bottom right. The search through the notion store is also conducted on a left to right basis. Initially the columns are scanned to find the correct notions of attitude, voice and aspect. Then the search tracks down the rows to find tense and number.

Lapointe and Dell argue that their model is consistent with speech error data. Errors may arise during stem insertion. The order in which this occurs is controlled by the phrase indices. However the sequence may be disrupted if later words are activated before earlier ones, producing an exchange error. Let us consider how such an error could occur on my example sentence. Here 'watch' should be inserted into the verb phrase fragment before 'match' is realised. However 'match' may become prematurely available, particularly since it receives some bottom up activation from the verb, due to their shared final cluster. If this happens 'match' may be inserted into the verb

phrase. Following insertion all activation is shut down and the noun is no longer available to fill its proper place. 'Watch' however still is activated and therefore is inserted into the noun phrase fragment.

Other speech errors reflect the organisation of the notion store. This predicts that when error structures are produced the least marked structures, which are represented top left in the store, should replace more marked structures which are accessed later in the search. They cite experimental data which largely supports this prediction, although order of acquisition effects were also seen. This suggested that structures which are acquired late may be laid down in separate, far right, columns in the notional store.

In Lapointe and Dell's account the lexicon is comparatively passive. Words have simply to be accessed and inserted into positional frames. Other accounts suggest that the lexicon may play a more active part in selecting or generating those frames.

### 2.7.2 Lexical Influences in Syntax Generation

In Stemberger's model (1985) syntactic and lexical access occur in parallel, and interact. Phrase structures are directly accessed by the semantic and pragmatic information in the message. These structures influence lexical retrieval by supplying category specific slots which have to be filled. This explains why substitution errors are almost always of the same grammatical class as the intended target. Just as syntax affects word selection, so words can influence syntax. This can be seen in speech errors. In both exchanges and word substitutions, syntax is accommodated to the error:

'Most cities are true of that' (target: that is true of most cities)

'unless you have a magnifying glass' (target: binoculars)

Such accommodation can only occur if words are empowered to select syntax.

Stemberger suggests that verbs may play a particularly important role in selecting structures. For example 'look' requires a post verbal prepositional phrase, whereas 'see' calls for a noun phrase. A similar role for verbs is proposed by Bock (1987). In her model different syntactic forms are made available with the verb. For example the verb supplies both an active and passive form, or in the case of datives, both prepositional and double object structures. Structures have different base strengths, eg active forms are more powerful than passives, and this determines which forms are most likely to be realised. However base strengths may be overruled by the comparative accessibility of the different subject candidates. Take an event in which a bee stings a man. If 'man' is more accessible than 'bee', say because of the focus information within the message, a passive will be produced, even though the active is the stronger form.

Bock's model suggests that syntax is largely projected from the lexicon. Levelt (1989) also favours this account (and see Bresnan 1978; Haegeman 1991). Such lexicalist views greatly enhance the responsibilities of the verb within sentence production.

## 2.8 The Role of the Verb in Sentence Production

There is considerable evidence that verbs differ from other members of the lexicon. They are more abstract than nouns, they have a greater breadth of meaning, a different frequency distribution and are acquired later (Gentner 1981). Verbs are also handled differently in paraphrase and translation (Reyna 1987; Gentner and France 1988). These distinctive features suggest that verbs may perform a particular role in sentence production.

Most commentators agree that verbs encode a constellation of syntactic and semantic information, although they differ about how this information should be represented. One representation suggests that verbs carry three main 'components' of meaning (eg Carlson and Tanenhaus 1988). Firstly they offer a core meaning which expresses

the basic nature of the event. 'Set' has several core meanings, which can be seen in the following sentences:

'he set his alarm clock' (set = adjust)

'he set his alarm clock on the shelf' (set = place)

'the jelly set firm.' (set = congeal)

Secondly verbs supply thematic information. This outlines the number of arguments involved in the event and the role played by each argument. For example 'load' optionally expresses three thematic roles: agent, theme and goal. Thirdly verbs supply subcategorisation frames which indicate which syntactic structures are permitted within the verb phrase. 'Load' offers the following frames:

V NP                    i. 'the man loaded the truck.'

                          ii. 'the man loaded the boxes.'

V NP into NP        iii. 'the man loaded the boxes into the truck.'

V NP with NP        iv. 'the man loaded the truck with boxes.'

Verbs must also provide information about how the thematic roles should be mapped onto the subcategorisation frames. For example 'load' maps either the theme or goal onto the direct object, whereas 'fill' maps only goal onto this position.

Other commentators have challenged the notion of thematic roles (eg Rappaport and Levin 1988). One problem is their ambiguity. For example in sentence (iv) above the truck seems to act as both goal and patient, given that the motion event changes its state from empty to full. Also they argue that no theory of thematic roles successfully accounts for the varying mapping principles, as seen in the sentences above. Rappaport and Levin therefore propose that, instead of thematic grids, verbs supply lexical conceptual structures (and see Pinker 1989). These define the meaning of the event, outline the number of entities involved, and position those entities within the meaning structure. The different mapping options seen in verbs such as 'load' are explained by proposing several conceptual

structures. Thus (iii) and (iv) have different structures which might be represented:

iii. x cause y to come to be at z

iv. x cause z to change state by means of causing y to come to be at z

(x = man; y = boxes; z = truck)

Although theories of verb representation differ they all suggest that verbs indicate the number of arguments involved in the event, the function or role of those arguments, information about which syntactic structures are permitted and directives about how the arguments should be mapped onto those structures. This suggests that much of the information needed in sentence production might be directly supplied by the semantic/syntactic representation of the verb. There is some experimental support for this position. In one experiment 64 adults were introduced to a novel verb via a passage which defined its meaning (Gropen, Pinker, Hollander, Goldberg & Wilson 1989). They were then asked to judge the use of that verb in a number of structures. The verbs expressed the transfer of an object. In some there was a strong possessor effect, in that the focus was more on the recipient acquiring the object. In others the focus was more on the manner of transfer, eg a particular instrument might be used. The experimenters were interested in subjects' judgements of dative forms. They found that double object forms were much more acceptable when the verb expressed a possessor effect. When the focus was on transfer they preferred the prepositional structure. In other words the subjects used the semantic representation of the verb to predict which syntactic forms would be permitted. Similar findings have been achieved in other experiments, even with quite young children (eg Gropen, Pinker, Hollander & Goldberg 1991). These experiments suggest that syntax can be directly projected from the verb, even when subjects have only partial information about that verb.

It seems that verbs act as a major resource in sentence production. In terms of Garrett's model the verb drives the creation of the predicate argument structure at the functional level, supplies planning frame options and indicates how the argument structure should be mapped onto those frames. It has been further suggested that the semantic representation of verbs may act as a point of connection between linguistic and non-linguistic representations of events. In other words verb structures may ease the transition between the message level and the language processor (Gonzales, Shapiro, Zurif and Baker 1990).

## 2.9 Conclusion

Unsurprisingly, the debate about sentence production is far from resolved. While some of the views presented here clearly conflict, others may be reconciled. Indeed some commentators suggest that their contribution might be considered as an extension to the basic Garrett-type model (eg Bock 87, 89; Lapointe and Dell 1989). In conclusion, therefore, I shall attempt to recast elements of Garrett's model, incorporating some of the additional features which have been considered during this chapter.

### The Message Level

Following Levelt (1989) I have argued that messages differ from general cognition in several important ways.

Messages must be propositional, or encode verifiable information. Utterances which apparently only refer, such as single word responses to questions, are probably elliptical expressions of full propositional structures.

Messages must be structured and this structure should reflect the way in which meanings are related in language. For example messages may draw upon the same semantic primitives which feature in verb meanings, such as arguments or thematic roles.

Messages must be sensitive to the lexicalisation patterns of the target language. This enables them to formulate concepts which are likely to achieve a lexical match. Lexical sensitivity particularly applies to the creation of verb concepts, since verbs are very selective about which features of events they focus in their semantic representations.

Messages should express perspective, which highlights which aspect or participant in the event is being focussed. This defines the topic of the utterance, and may eventually determine subjecthood and verb selection.

Finally messages should be informed about language specific requirements, such as whether or not temporal information should be encoded.

#### The Functional Level

Here concepts within the message retrieve the semantic representations of content words. A verb is accessed which expresses the argument relations and focus requirements of the message. The verb provides complex semantic/syntactic information, either via a thematic grid or a lexical conceptual structure. The key nouns are mapped onto this extended verb form. The resulting functional level representation expresses the meaning relations of the sentence, or who does what to whom.

#### The Positional Level

Here the surface syntactic form is retrieved, together with all function words and inflections. The planning frame may be accessed from a store of syntactic fragments (Lapointe and Dell 1989) or directly projected from the verb. The functional level representation must be mapped onto the planning frame. Once again the verb facilitates this process by supplying mapping information, which dictates the assignment of its thematic roles or arguments to syntax. However, there are other influences. The focus of the message has a powerful effect over which noun acts as subject, as

does the phonological accessibility of the content words. If the retrieval of a noun is blocked, for whatever reason, the structure of the sentence may be revised to permit early expression of the more available words.

Communication between these levels is clearly complex, and not unidirectional. For example phonological effects are seen at the functional level (Dell and Reich 1981) and message information influences the planning frame (eg Bock and Warren 1985). Some interaction between levels seems essential.

This outline suggests that sentence production in dysphasia may fail for a number of reasons. Some patients may be unable to structure the meaning relations of the sentence at the functional level. Others may be failing more at the positional level, where the surface syntactic form is computed. It is also possible that some dysphasic sentence disorders may have a lexical origin. In particular a verb deficit would make much of the information needed for sentence production unavailable. Finally some dysphasic people may have lost the ability to construe messages. While not hampering general cognition, this would result in an inability to formulate concepts which are compatible with the language generator.

### Chapter 3 Dysphasic Sentence Production Deficits & The Normal Model

This chapter will review some of the main sentence production 'symptoms' in aphasia and attempt to interpret them against the Garrett type model.

#### 3.1 Omissions of Function Words and Inflections

The most widely reported symptom of agrammatism is the omission of function words and inflections, often with relatively preserved content word production (see Chapter 1). Garrett himself cited this dissociation as evidence of the computational separation between open and closed class vocabulary (Garrett 1982). He argued that agrammatism reflected a disorder in the positional level procedures which process closed class words.

A lexical decision experiment with normal speakers and agrammatics apparently supported this view (Bradley, Garrett and Zurif 1980). The non-dysphasics produced different results for different vocabulary types. Open class words stimulated frequency effects while closed class words did not. This suggested that content and function words were processed separately, which was consistent with the Garrett model. With the agrammatic subjects the word class effect disappeared. They showed frequency effects for both content and function words. These subjects were apparently processing all types of vocabulary via the frequency sensitive content word procedures. By inference, they had lost the mechanisms which normally deal with closed class words, a loss which was paralleled in their production. (There have been several failures to replicate this study, see Gordon and Caramazza 1982 for a critique).

The Bradley et al experiment suggested that agrammatic subjects may process closed class words via abnormal asyntactic routines. A similar view is offered in a single case study (Nespoulous et al 1988). The subject, MM, had a selective problem with certain French pronouns and auxiliaries. Yet the problem only occurred when he had

to use these words in sentences, eg he had no difficulties reading them aloud in isolation. In one task MM was asked to read words written on separate cards. He coped well, even with his problem items, until he realised that the words he was reading were forming a sentence. At that point he began to make function word errors. It seemed that MM could employ an asyntactic routine for reading single closed class words. Once he had to process these words within a sentence the strategy could not be applied and output failed.

Caramazza and Hillis (1989) describe a subject who was like MM. This patient, ML, had reduced utterance length and omitted closed class words across a variety of output tasks, including spontaneous speech, reading sentences, sentence repetition and writing sentences to dictation. Like ML, he could read function words aloud provided they were presented in isolation. Naming and sentence comprehension were relatively unimpaired. The authors concluded that ML had a lesion at the positional level. However there were difficulties with this interpretation. Firstly ML also had some word order problems, which were not easily accounted for via the positional deficit. Secondly it was unclear why the deficit simply resulted in omissions, and not also substitutions of grammatical morphology. Finally, like other subjects (eg Miceli et al 1989) ML showed a dissociation between function words and inflections, the latter being less severely impaired.

While problematic for the pure Garrett model these last two features might be explained by Lapointe and Dell's 'Fragment Theory' (1989 see section 2.7.1). The pattern of omission may reflect the organisation of the notion store. It will be remembered that this progressed from the least to the most elaborate structures. If the processes which search through the store are impaired, only the most simple structures, which are accessed first, will be available, and these will typically include few grammatical markers. This might also account for the reduced MLU, in that the minimalist structures will omit elaborating content words. The dissociation between function words and inflections can also be accommodated. Inflections are

'hard wired' into the phrase structures, while function words are represented separately. Again, limited resources might result in only the phrase fragments being available.

Other dissociations between aspects of grammatical morphology may require a different explanation. In some cases production depends on phonological factors. For example non-syllabic inflections are particularly vulnerable (Goodglass and Berko 1960) as are reduced, sentence initial, functors (Gleason et al 1975). These omissions may reflect a breakdown in the late, phonetic processes which realise the phonology of function words and inflections, rather than a disorder in the positional level itself (Saffran 1982). It would be anticipated that this deficit would be linked to the articulatory disturbance which is common in Broca's dysphasia. The fact that several subjects have been reported who omit grammatical morphology but have no articulatory problems suggests that this explanation may, at best, only account for some patients (eg Miceli et al 1983).

Positional Deficits may broadly account for the omission of function words and inflections seen in 'agrammatism'. However Garrett's model has difficulty explaining the variability of errors. The greater elaboration provided by Lapointe and Dell helps to account for some of the data, while other errors may reflect a later, phonological problem. Berndt (1991) suggests that no model yet explains the range of closed class errors seen in dysphasia.

### 3.2 Word Order Errors & the Mapping Hypothesis

Disordered production of function words and inflections is not the only problem seen in 'agrammatism'. These subjects also show word order problems, which may or may not co-exist with the morphological deficit (eg Berndt 1987; Parisi 1987).

Saffran and her co-workers explored the word order problem in detail (Saffran, Schwartz and Marin 1980a; Saffran, Schwartz and Marin 1980b). They asked agrammatic subjects to describe a number of

action pictures. Some showed people acting upon objects, such as a boy pulling a wagon; some showed people acting upon people, such as a boy pushing a girl; and some showed objects acting upon people, eg a ball hitting a boy. Subjects' responses were very affected by the type of event. Where animates were acting upon inanimates they often produced good sentences. However when they had to describe events involving two people, or things acting upon people, they frequently failed. Errors included reversals and a total inability to compose word order, eg:

'a teenager hit the ball on the head' (a ball hitting a boy)  
'the man's running .... no .. the little girl's running in her arms ... her father' (a girl running into her father's arms).

The authors followed this with an anagram task in which subjects had to arrange 3 sentence fragments to describe pictures. Again success depended on the nature of the event, as this set of results shows:

Pictures showing:	Error Rate:
a) a person acting upon a thing	approx 12%
b) a thing acting upon a thing	approx 12%
c) a person acting upon a person	over 25%
d) a thing acting upon a person	over 45%

These subjects did not seem to have a positional level disorder. Depending on the event they could compose syntax and, as the above samples show, they were also producing function words and inflections. However there was a profound word order problem. This was not due to a naming deficit, since it also appeared in the non-verbal anagram task.

Saffran et al argue that these patients were failing to compute functional level representations. In particular they were not assigning nouns to the argument functions of the verb and therefore had lost the linguistic mechanism for composing word order (although see Caplan 1983). Instead they adopted a pragmatic mapping device, which was influenced by two strategies:

- i) map the animate entity onto subject
- ii) map the most potent entity onto subject.

These strategies reflect normal message influences on word order (see section 2.6.3) and can explain the above anagram results. Condition (a) satisfies both strategies, therefore the error rate is low. In condition (b) there is no animate involved, therefore strategy (i) cannot be used. However strategy (ii) does apply, since the active object is most potent, and this explains the high success rate. In condition (c) the first strategy again cannot help, since there are two animates. The second strategy is also problematic, in that judging the relevant potency of two people is difficult, therefore the error rate has crept up. Condition (d) incurs the most errors because the two strategies directly conflict.

Similar word order problems have been observed with fluent subjects (Martin and Blossom-Stach 1986; Caramazza and Miceli 1991). Here the miss-assignments are more striking because the subjects are able to compute quite sophisticated syntactic forms, such as passives, eg: 'She was given an Oscar by Meryl Streep' target: Meryl Streep was given an Oscar by her (Martin and Blossom-Stach 1986).

The patient described by Caramazza and Miceli was asked to change the voice of 280 active or passive sentences, while preserving their meaning relations. Almost all his responses on this task were syntactically correct. However there were several word order errors, particularly with passives and when the sentences were reversible. These patients' problems are interpreted as a deficit at the functional level, which directs the assignment of thematic roles to sentence positions. Caramazza and Miceli (1991) argue that the precise nature of this deficit is still not understood.

Saffran et al (1980a; 1980b) observed that, in addition to the word order problem, many of their patients had difficulties with the main verb. Verbs were often omitted or took the form of pseudo verbs, which were derived from nouns, eg:

'The girl is rosing. The woman and the little girl was rosed' (a girl giving flowers to a teacher).

When appropriate verbs were produced they tended to be in the gerundive, or nominalised, form. The authors argue that the verb

deficit might contribute to the word order problem. It seemed that verbs were either unavailable, or, in the case of gerundives, stripped of their argument information. Without this information the subjects lacked the resources needed to compute the functional level representation.

### 3.3 Verb Deficits and Sentence Disorders

It has been suggested that much of the information needed for sentence production may reside with the verb (see section 2.8). The verb not only provides argument information at the functional level, but may also help to specify positional frames.

Like Saffran et al (1980a; 1980b) many authors have noted the co-existence of verb disorders and agrammatism (Hand et al 1979; Miceli et al 1983; McCarthy and Warrington 1985). Typical manifestations include verb omission, the nominalisation of verbs, a dependency on frequent and non specific verbs such as 'do', reduced verb argument structure and impaired verb morphology. These deficits may simply reflect the greater semantic and syntactic complexity of verbs and indeed some authors have suggested that verbs are always more vulnerable in aphasia, regardless of type (Kohn, Lorch and Pearson 1989; Williams and Canter 1987). However other studies have shown that verb impairments are particularly associated with agrammatism, even in naming tasks. The contrastive, anomic subjects, either produced more verbs than nouns or performed equally across the word classes (Miceli, Silveri, Villa and Caramazza 1984; Zingeser and Berndt 1990). Manning and Campbell 1992 also describe an optic aphasic with better verb than noun naming. It seems that verb production deficits may be specifically related to sentence disorders, although the nature of that relationship is difficult to determine.

One possibility, entertained by Miceli et al (1984), is that action naming is not purely lexical. It is suggested that the speaker formulates a predicate argument structure, maps it onto a syntactic

frame and then isolates the verb for production. Thus the naming task simply confirms agrammatics' known syntactic difficulties. However, deep dyslexics, who are usually agrammatic speakers, also show specific problems in reading verbs (Coltheart, Patterson and Marshall 1980). These effects are seen even when abstractness is controlled (Shallice and Warrington 1975; Nolan and Caramazza 1982). It would be difficult to argue that oral reading is anything other than a lexical task. Therefore deep dyslexia adds further evidence of the interesting co-existence of sentence and verb disorders.

Explaining this co-existence is complicated by the fact that verb deficits can apparently arise from different stages of processing within the lexical model. Miceli, Silveri, Nocentini and Caramazza (1988) tested 25 dysphasic subjects on action and object naming and verb and noun comprehension. Dissociations were found between verb and noun production. Word class effects in comprehension were also seen, which went in both directions. Of particular interest was the discovery that comprehension and production did not necessarily correlate. There were individuals who were selectively impaired in verb or noun comprehension and others with category specific deficits confined to production.

Other studies have produced similar results. Caramazza and Hillis (1991) investigated noun and verb production in two dysphasic subjects. Both displayed good comprehension skills, indicating that the central semantic system was intact. Naming assessments revealed modality specific problems. One subject was impaired in written verb production while the other was impaired in speech. Baxter and Warrington (1985) also report a patient with a phonological dysgraphia which was sensitive to word class. This patient had difficulty spelling function words, low frequency abstract words and verbs. Yet comprehension and spoken production of all these words was excellent. For example although the patient could not spell 'connect', she used it in the following spoken sentence: 'If you put a plug on a sewing machine then you would connect it to the electricity'.

It seems that category specific verb deficits may not just arise within the semantic system. The above patients reveal problems confined to the more peripheral components of the lexical system, such as the orthographic or phonological output lexicons. This finding may reflect the type of testing used. Verb representations encode a range of semantic information, including core meaning, thematic role structures and mapping directives (see section 2.8). The comprehension test used by Miceli et al (1988) required subjects to differentiate between antonymously related verbs, such as 'push' and 'pull'. This only tests core meaning and would not identify people who were failing to retrieve thematic role or mapping information. Therefore it is possible that some of their subjects with apparently pure output deficits were, in fact, concealing subtle semantic impairments. Yet this caveat probably does not apply to all the studies. The sophisticated verb use quoted by Baxter and Warrington (1985) would suggest that this patient's verb semantic representations were indeed intact.

This finding must influence the debate about the relationship between verb deficits and sentence production disorders. It seems reasonable to suggest that only semantic verb deficits, which obscure the verbs' grammatical information, would necessarily impair sentence production. This is the position adopted by McCarthy and Warrington (1985). Their subject, ROX, named nouns more easily than verbs. He also made semantic errors with verbs in both comprehension and production, which were not seen with nouns. The comprehension impairment was particularly marked in tasks which required discrimination between thematically related (or reverse role) verbs, such as 'buy' and 'sell'. Although classified as 'agrammatic' ROX showed striking preservation of some syntactic features, such as articles, pronouns and many prepositions. The structural problems which were evident seemed to arise from the verb retrieval deficit, eg:

'The man is a sack of potatoes' (target: carrying)

'the daughter was chairing' (target: sitting)

The authors conclude that ROX had a category specific semantic

impairment with verbs and that this directly generated his sentence production disorder.

ROX indicates that a verb deficit need not eliminate all syntactic features in output. Only verb dependent structure need be affected. A similar conclusion is reached by Byng and Black (1989). They investigated the production of 6 dysphasic subjects. Three showed marked verb omission, in that an abnormal proportion of their utterances comprised single noun phrases. However many of these phrases contained syntactic structure, eg:

'beautiful train of velvet gown'

'little baby bear'

Where syntax was reduced was in the production of predicate argument structure. None was able to relate more than two arguments to a verb and argument omission was common. Despite this the subjects produced several utterances containing a verb and three phrases. Crucial here was the status of the phrase. If it expressed an argument of the verb, it was vulnerable to omission. If it expressed modification, such as the time or location of the event, it was more likely to be realised. It seems that these patients' structural restrictions reflected an inability to control verb argument information. It would not be unreasonable to relate this problem to the absence of verbs in their output.

A similar relationship is proposed by Mitchum and Berndt (in press). They describe a fluent patient, ML, who, like ROX, had normal production of many syntactic features. However aspects of verb morphology, such as auxiliaries and inflections, were frequently omitted. ML's sentences were either very simple or ill-formed. He was particularly poor at creating appropriate word order, even when elements of a target sentence were provided. Verb production was significantly more impaired than noun production, both in spontaneous speech and naming.

The authors hypothesised that the sentence production deficit was due to an inability to access verb phonology. To test this they employed

a cuing task in which ML was asked to create a sentence from a provided (unambiguous) noun or verb. Noun cues tended to be used appropriately, usually in combination with high frequency, non specific verbs, eg:

'we have a jug of wine'

Verb cues were often used in infinitival or imperative constructions, which required no overtly realised subject, eg:

'I love to read'

'take it to the room and follow the road'

or in responses in which the word class of the cue is unclear, eg:

'I get my tea and she have and spill'

'he get the bucket where the pour'

ML's sentence production difficulties were not overcome by providing the phonological form of the verb. He was still unable to order nouns around the verb and even seemed unsure about their status as verbs.

ML, like ROX and the subjects described by Byng and Black, seemed to lack the crucial grammatical information encoded with verbs. Without this he could not compose a predicate argument structure or retrieve appropriate positional frames, even when a verb was provided. However other syntactic features were preserved, such as noun morphology. His syntactic deficit seemed consequent on the verb disorder.

The above studies suggest that a central verb deficit can directly impair sentence production. What about the converse - would an intact verb lexicon facilitate production? Zingeser and Berndt (1988) suggest that it might. Their anomic subject had very poor confrontation naming, although verbs were named better than nouns. However spontaneous speech was surprisingly good, with little evidence of the naming problem.

To explore the role of context in naming the authors administered a cuing assessment. The subject was asked to produce 44 nouns under six conditions:

1. With 'low probability' sentence cues, which were minimally biasing to the target. eg: 'The only food I never eat is ...' (tomatoes)
  2. With low probability sentence cues and pictures, where the same sentence was accompanied by a picture of the target
  3. With 'high probability' sentence cues, which had a strong semantic bias to the target. eg: 'after dinner they washed the ...' (dishes)
  4. With high probability sentence cues and pictures.
  5. With definition cues  
eg: 'a water basin having faucets and a drain' (sink)
  6. With pictures alone.
- (all the sentence cues and definitions were spoken)

These cues offer different types of information. Definitions provide semantic information; 'low probability' sentences provide syntactic information; while 'high probability' sentences provide a combination of both.

High probability sentence cues were by far the most effective. These triggered over 90% acceptable single word responses. Naming to definitions, pictures and low probability sentences with pictures was approximately equal (68%, 70% and 64% respectively). Low probability sentences alone stimulated just 4 correct responses.

This patient's naming benefited most from cues which combined syntactic and semantic features. The authors suggest that in spontaneous speech the subject's relatively spared verb production might generate similar cues, in that these verbs provide a constellation of semantic and syntactic information which can stimulate noun production. Obviously in confrontation naming this facilitatory information was not available. It seems that while some subjects' sentence production may fail due to a verb deficit, others may be able to exploit intact verb representations in order to overcome aspects of their dysphasia.

### 3.4 Message Level Deficits

Section 2.6 argued that messages must obey certain linguistic principles in order to be compatible with the language generator. This opens the possibility that some dysphasic people may have lost these principles and thereby the ability to formulate messages. While not hampering general cognition, this would impair the translation of thought into language.

This recalls the views of Hughlings Jackson (1874), who defined aphasia as an inability to formulate propositions, or use language to express thoughts. Jackson saw this as an intellectual, rather than purely linguistic, function.

Investigating the intellectual underpinnings for language in dysphasic people is clearly very difficult. One problem is that aphasia makes even non-verbal testing problematic. Another difficulty is that dysphasic people often have a range of neurological problems in addition to their language impairment, such as dyspraxias and perceptual problems. Isolating these factors from a pure message deficit may be extremely problematic.

Some right hemisphere patients seem to have difficulties at the message level. Although these patients perform well on formal language testing they show subtle deficits in interpreting the speaker's intention, particularly with non-literal uses of language. For example if asked to match a metaphor to a picture they may select the literal rather than figurative depiction (Winner and Gardner 1977) and they also have problems with sarcasm, irony and jokes (Kaplan, Brownell, Jacobs and Gardner 1990; Bihrlé, Brownell, Powelson and Gardner 1986). Their comprehension of narrative is impaired, in that they seem unable to use context to make assumptions or predictions about what the speaker means, and cannot revise their interpretation of stories in response to new information (Molloy, Brownell and Gardner 1990). Similar difficulties have been observed in production. When retelling stories right hemisphere patients had

difficulty integrating elements of the story with its overall narrative structure, even though they used the same number of words as non brain damaged subjects (Wapner Hamby and Gardner 1981, Joannette, Goulet Ska and Nespoulous 1986). Furthermore, unlike left hemisphere and non brain damaged patients, they seem unable to benefit from general heading cues when constructing stories (Schneiderman, Murasugi and Saddy 1992).

These findings indicate that the right hemisphere may play a role in message level processing. This processing is almost certainly multileveled (Joannette et al 1986). It may be that the right hemisphere is particularly responsible for interpreting or planning the macrostructure, or global meaning of an utterance. This aspect of processing seems more available to patients with left hemisphere damage, despite their language impairment. For example dysphasic people have been shown to understand indirect requests better than their right hemisphere counterparts (Hirst, Le Doux and Stein 1984) and to fare better with jokes (Bihrlé et al 1986).

Other aspects of message level processing may be impaired in aphasia. Head (1926) argues that dysphasia impairs all tasks which require symbolic thinking, or internal verbalisation. For example some of his subjects could describe objects before them in a room quite successfully. However if asked to adopt a different perspective, eg describe the relative position of objects with respect to each other, they would fail. Head suggests this is because the second task requires more symbolic mediation. Other symptoms found by Head recall the right hemisphere problems outlined above. In one task he showed patients a picture of a theatre scene in which the audience is outraged because a man is in his shirt sleeves (this was 1926). Although the dysphasic patients had no problem perceiving the picture they were unable to interpret the events shown. Similarly they could not appreciate jokes or keep to one train of thought.

While these problems suggest a message level deficit in dysphasic people some caution is required. Head's subjects were mostly head

injured veterans from the first world war. It is likely, therefore, that many had global neurological deficits, including possible right hemisphere damage. It may be this involvement, rather than the aphasia per se, which generated the message disorder.

It has been suggested that some subjects with jargon aphasia may have problems at the message level (Ellis, Miller and Sin 1983). The patient described by Weinstein (1981) produced sophisticated, syntactically well formed speech, with no neologisms. However it was totally incoherent and unrelated to the topic. For example when asked to describe what was wrong with him he replied:

'Well, it has been suggested that there were certain oddities and restrictions technically the activity of the student body, so to speak'.

However this patient again showed signs of widespread cognitive impairment, such as disorientation and denial. It is probable that his message problems were an aspect of his general confusion, rather than a specific problem with planning for language.

Have any patients been described who show problems just with verbal planning? Dynamic aphasia (Luria 1970; Luria and Tsetsikova 1978) seems to fit this description. Patients with this disorder show adequate naming and sentence formulation skills, but cannot employ them spontaneously. Luria attributed the problem to defective 'inner speech', and suggested that it could be overcome by providing external cues. For example, in one case the patient was given three counters to represent the scheme of the sentence. By pointing to these in turn the patient could stimulate production and the quality of his output improved enormously. Costello and Warrington (1989) describe a patient with extremely limited spontaneous speech. For example he could not answer biographical questions, generate sentences from given words, or complete sentences with phrases (although he could do this if just one word was required). He was also unable to arrange given words into a sentence. Despite this he showed some striking language skills. His comprehension was good and he could name and produce extended output with pictorial prompts.

For example when shown a sequence of pictures he produced:

'Two boys fighting over a comic. One gent comes along and sees them and says "what have you here?" He makes them shake hands and he makes them wander off and then he wanders off himself reading the comic'. The authors conclude that this patient had a problem with verbal planning. His general planning skills were unimpaired, eg he could sequence pictures and cope with problems of daily living. The problem was specific to the processes which prepare for language. As in Luria's example this could be overcome by external cues, in this case in the form of pictures.

People with dynamic aphasia seem unable to drive their relatively preserved language with an internally generated message. Once this is provided externally their difficulties are virtually overcome. Other dysphasic people may be similarly affected by message demands. It has been observed that naming pictures and naming spontaneously often do not correlate. One patient has already been described whose spontaneous production was better than confrontation naming (Zingeser & Berndt 1988 and see Hadar, Jones & Matecole 1987). However other subjects have been identified who, while poor in open narrative, produce more effective output when describing highly focussed pictures (eg Nicholas, Obler, Albert, and Helm Estabrooks 1985; Williams and Canter 1987). It seems that these subjects perform best when the message demands are minimised. More evidence comes from remediation studies. One difficulty often encountered in these studies is the achievement of generalisation (eg see Byng and Lesser in press for review). Patients often acquire skills within the context of a formal task, but cannot use them to communicate self generated messages. Of course this may reflect a failing within the therapy, which could be overcome by different techniques. However it does seem that genuine, message driven, language may be more problematic in aphasia than the production of externally stimulated responses.

The examples above present 'circumstantial' evidence of message disorders. Direct testing of the cognitive systems which underpin

language is more difficult. However some non-verbal investigations have revealed interesting, and differential, conceptual problems in dysphasic people. In one task Broca's and Wernicke's dysphasics were shown three pictures and were asked to identify the two that went together (Semenza, Denes, Lucchese and Bisiacchi (1980)). Two types of association were tested. One was 'class' or category membership, eg a picture of a pear was to be linked with a picture of grapes. The other was 'thematic' relationship. Objects were judged to be thematically related if they occur contiguously in space or time, for example in this context 'pear' was related to 'tree'. The subjects responded differently to the two types of relationship. Broca's dysphasics could identify class links, but not thematic links, while the Wernicke's dysphasics showed the opposite trend. The authors relate these results to the different type of language disorder shown by the two groups. Broca's patients have a particular problem in expressing relations - and this was matched by a poor conceptual appreciation of 'thematic' relations. Wernicke's aphasics have reduced content word information, reflected in their poor appreciation of class membership.

Another non-verbal task was presented by Cohen, Kelter and Woll (1980). They asked groups of Broca's and Wernicke's dysphasics to link a target picture to one member of a pair. Some of the pictures were related by attribute, eg: snowman, swan, turkey; some were related by situation, eg: bullfight, guitar, violin; and some by action, eg: lawnmower, vacuum cleaner, razor. All dysphasics were poor on matching pictures under the attribute and action conditions, but were unimpaired in the situation condition (control subjects performed equally across the 3 conditions). The authors suggest that the situation condition required 'global' comparisons, which are unaffected in aphasia. However the action and attribute condition required skills which were closer to language. For example the action condition required intact verb concepts, while the attribute condition required analytical competence, which may be essential for propositional thinking.

The two studies above show that some dysphasic people may have difficulty with aspects of conceptualisation. This is not a global problem. All the groups tested performed well on some of the discriminations. Their failures seem in some way related to their language problems. This is also suggested in a single case investigation (Nickels, Byng and Black 1990). Three 'agrammatic' subjects are described who show symptoms of a verb disorder. All had impaired verb production, limited expression of verb argument relations and poor comprehension of word order. In addition one subject, LC, performed badly on a test of event conceptualisation. Here pictures had to be sorted into two groups, according to whether they portrayed events, eg a newspaper being blown down a road, or situations, eg a street scene with nothing happening in it. LC was at chance on this task. She did not have a general semantic deficit or picture recognition disorder, eg her performance on the Pyramids and Palm Trees Test was within normal limits. It seems that LC had a specific problem understanding representations of events, a problem which may relate to her verb disorder.

### 3.5 Conclusion

This chapter reviewed dysphasic sentence production deficits against the Garrett-type model. Rather than proposing a single, syntactic, deficit it suggested that disorders may arise from a number of causes. Some 'agrammatic' subjects may have a positional level deficit. This would account for their problems with function words and inflections, although the model has difficulty explaining the variety of problems seen. Breakdowns may also occur at earlier stages within the model. Saffran et al (1980a, 1980b) identified problems at the functional level, where verb argument relations are specified. This 'mapping' disorder may be one expression of a lexical verb deficit, and the relationship between verb and sentence disorders was discussed. Here it was suggested that while a semantic verb impairment may disrupt sentence production, a facility with verbs might equally stimulate production. Finally some dysphasic people may have a problem at the message level. This may explain

dynamic aphasia, where patients seem unable to employ their surprisingly preserved language to convey messages. It may also explain some general aspects of dysphasia, such as the fact that dysphasic people often produce better output in constrained, externally mediated conditions than when expressing their own thoughts and feelings. In addition some investigations have identified islands of conceptual difficulty, particularly when tasks require linguistically relevant categorisations.

This review has strong implications for therapy. No single treatment is likely to benefit all sentence production problems in aphasia. Clearly an individual response is required which should be based, in part, on an analysis of where production is failing. Responses to the therapy may further enlighten the nature of the patient's processing deficit. This psycholinguistic approach to therapy has underpinned a number of sentence treatment studies (see review in Chapter 6). It also forms the basis of the three treatment studies presented in Chapters 9 - 11.

In the following chapter I shall review some of the current theories about normal sentence comprehension. Chapter 5 will then consider aphasic comprehension deficits against these theories.

## Chapter 4 Sentence Comprehension

### 4.1 Normal Comprehension Processes

The processes involved in sentence comprehension are even more disputed than those involved in production. Much of the debate concerns whether the different components of the comprehension system act autonomously, or interactively (eg see Norris 1987 for review) and this, in turn, influences the discussion about the temporal nature of the process (see Tyler 1989; 1992).

Black et al (1991) sketch the possible 'stages' involved in sentence comprehension.

- i) Acoustic and phonological processing segments the incoming speech stream into words and phrases. As each phonological word is identified lexical access and recognition takes place.
- ii) A syntactic representation is composed which specifies the syntactic role of the phrases and the relations between them. Black et al say little about how this representation is generated, partly because their model only addresses the comprehension of svo sentences. However, clearly the parsing operations which occur here are extremely complex (eg see Caplan 1987). Of particular importance is the ability to interpret function words and inflections, since these play a significant role in signalling constituent type and constituent relations.
- iii) Lexical processes access the semantic representations of the content words. Of particular importance is the retrieval of the verb's semantics. This defines the nature of the event and provides information about the possible number of arguments and their thematic roles. For example 'load' optionally specifies three variables, corresponding to agent, theme and goal.

- iv) The product of the parse must be integrated with the lexical/semantic information. In particular the verb's thematic roles have to be mapped onto syntactic positions.

Once mapping is achieved the semantically interpreted phrases are combined to form a complete semantic representation of the sentence. This outlines the characteristics of the event and specifies who is doing what to whom.

- v) The semantic representation serves as input to inferential processes which draw upon real world and discourse knowledge. These processes subtly influence interpretation, as is shown by the following sentences:

She was kissed by Hitler in her youth.

She was kissed by Bob in her youth.

While offering a useful outline, the above sketch clearly tells us very little about what is involved in each component of the comprehension system. It also suggests that comprehension is largely achieved by a series of independent processing stages. In the following sections I shall consider some of the components of the model in greater detail and present evidence that, far from acting independently, these components influence one another, even during on-line processing.

#### 4.2 Parsing and The Role of Lexical Information

Commentators agree that the parser starts to compute its analysis as the sentence is being heard (eg Pulman 1987). This on-line analysis is often conceived as two stage (eg Frazier and Fodor 1978). A 'shortsighted' analyser identifies local phrases which are then passed to a sentence level processor which assembles a global syntactic interpretation.

Progressive parsing is clearly efficient and concurs with our intuition that sentences are interpreted as we hear them. However it does generate a number of problems. One is ambiguity, in that the initial portion of a sentence may signal quite different syntactic structures, eg:

Peter believed that ..

- a) lie, even though others didn't.
- b) John was telling the truth.

There have been various responses to this problem. Some suggest that the parser postulates several structures in parallel, and only selects the correct structure at the end of a sentence. Others suggest that just one, preferred, form is computed, which may later require revision (see Caplan 1987 and Pulman 1987 for reviews).

The existence of garden path sentences suggests that the latter may be closer to the truth. Garden paths occur when the parser has formulated a structural interpretation which cannot accommodate the end of the sentence. The classic example is:

The horse raced past the barn fell.

Here the parser initially mis-analyses 'the horse raced past the barn' as a complete sentence. As a result the actual main verb 'fell' cannot be accommodated.

Frazier (1989) suggests that the parser selects preferred structures by using a number of strategies. One is 'Minimal Attachment'. Under this principle the parser postulates the fewest additional nodes, within a tree-type structure. Take the following sentence:

The spy saw the cop with a telescope.

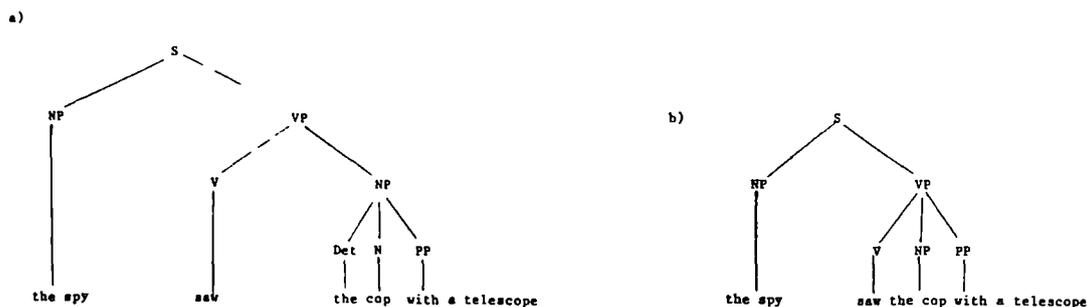
This sentence could be parsed in two ways (figure 4.1). The principle of Minimal Attachment selects (b), because this entails one

fewer node. Thus 'with the telescope' is incorporated into the verb phase, rather than being ascribed to 'the cop'.

---

Figure 4.1 Parsing options for the sentence  
'The spy saw the cop with a telescope'

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Another parsing strategy is Late Closure. Under this principle the parser delays closing a phrase for as long as possible. This may lead to garden paths. Take the following sentence:

Even before the police stopped the driver was getting nervous.

Using Late Closure the parser prefers to analyse 'the driver' as the object of stopped, whereas in fact it is the subject of the following clause.

It is argued that these syntactic principles dominate the first parse, regardless of lexical content (eg Rayner Carlson and Frazier 1983). In other words the following sentence is initially parsed using Minimal Attachment, even though the result is anomalous:

The spy saw the cop with a revolver.

Revision occurs after lexical/semantic information is retrieved.

Other investigators have suggested that the parse is more lexically informed from the outset (eg Tyler 1989; Tanenhaus and Carlson 1989). One study (Tyler and Marslen-Wilson 1977) employed syntactically ambiguous phrases, such as 'shaking hands' and 'landing planes'. These phrases were presented in contexts which biased one or other of their possible readings, eg:

- (i) If you've been trained as a pilot, landing planes ..
- (ii) If you walk too near the runway, landing planes ...

Subjects heard these sentences over head phones. Immediately after the ambiguous fragment a continuation word was flashed up on a screen. This was compatible with one of the possible interpretations of the phrase, eg either 'is' or 'are'. The subject had to read this word aloud as quickly as possible. The experimenters assumed that naming latencies would be slower when the continuation word was inconsistent with the subject's preferred analysis of the fragment. Furthermore any delay would confirm that the subject had already computed this analysis, presumably by exploiting the biasing information in the preceding context.

The results confirmed this assumption. Thus subjects read 'is' faster after (i) and 'are' faster after (ii). Their overall speed of response indicated that the effect was not due to post-stimulus analyses. It seems that subjects' parsing was influenced, on-line, by a combination of lexical and pragmatic information.

Tanenhaus and Carlson (1989) offer similar findings. Reporting an experiment by Stowe they argue that the parser is influenced by the on-line assignment of thematic roles. The experiment used a number of sentences which violate the principal of Late Closure, and therefore typically induce garden paths, eg:

- a) Even before the police stopped the driver was getting nervous.
- b) Even before the truck stopped the driver was getting nervous.

Stowe predicted that the garden path effect would be influenced by whether or not the subject of the subordinate clause was animate. An inanimate subject, as in (b), is likely to be interpreted as the theme, rather than agent, of the verb. This will encourage an intransitive reading of the verb and, thereby, early closure of the subordinate clause. As a result the garden path will be suppressed. In contrast, an animate subject, as in (a), will probably be interpreted as the agent. This will enhance a transitive reading of the verb and, therefore, encourage garden paths. The experiment required subjects to read the sentences one word at a time and press a button if they thought they had become ungrammatical. Reading times and grammaticality judgements were recorded.

Reading times increased when the subject of the subordinate clause was animate. This confirmed Stowe's prediction and suggested that parsing was influenced by the semantic processes which assign thematic roles. This effect seemed strong enough to override pure syntactic rules, such as Late Closure.

These, together with Tyler's results, challenge the view that parsing is an autonomous process (and see Altmann and Steedman 1987 for similar views). It seems that syntactic analysis might be sensitive to lexical, semantic and pragmatic information. This would clearly support an interactive, rather than serial, view of comprehension.

#### 4.3 Lexical Recognition and The Role of Context

Just as lexical information informs parsing so syntactic information seems to assist in lexical retrieval. There is considerable evidence that word recognition is sensitive to context. Some of this evidence comes from gating experiments. In these subjects hear successively

longer fragments of words which they are asked to try and identify. On average subjects identified single words after about 330 msec was heard. However, when the same words were presented in sentences, the recognition point dropped to about 200 msec. It seems that context enables subjects to recognise words even when very little acoustic information is available (Grosjean 1980).

Tyler (1982) looked at contextual effects in a word monitoring task. The target words were presented in three contexts:

Normal Prose            The church was broken into last night. Some thieves stole most of the lead off the roof.

Anomalous Prose        The power was located in great water. No buns puzzle some in the lead off the text.

Scrambled Prose        In was power water the great located. Some the no puzzle buns in lead text the off.

Subjects were asked to listen to these sentences and press a button as soon as they recognised the prespecified target word. Average monitoring reaction times were: 275 msec in Normal Prose, 336 msec in Anomalous Prose and 360 msec in Scrambled Prose. Interpreting these results Tyler suggests that before an entire word is heard several possible candidates are activated, which begin with the same sounds. Thus the initial phonemes of 'lead' activate 'lent', 'let', 'lesson' etc. Context helps eliminate inappropriate candidates. The best environment is Normal Prose, which supplies both semantic and syntactic information. Anomalous Prose, which provides only syntactic clues also eases access, although less so than Normal Prose. Scrambled Prose, which is just a string of unrelated words, provides little or no help.

This experiment suggests that word recognition is not a discrete process. The retrieval of individual words is strongly influenced by

the developing syntactic and semantic representation of the entire utterance.

#### 4.4 The Mapping Process in Comprehension

The 'model' presented in 4.1 suggests that two representations are formed during sentence comprehension, syntactic and semantic. These are integrated by the mapping process, which assigns the verb's thematic roles to the syntactic phrases. Black et al (1991) argue that two main sources of information are used during mapping. Firstly there are general rules which apply irrespective of the particular verb. For example agents are always mapped onto subjects in active sentences, and onto prepositional phrases in passives. Secondly, as in production, specific mapping directives may be provided by the verb. This is illustrated by emotive verbs. For example 'fear' maps the role of experiencer onto subject, whereas 'frighten' maps stimulus onto this position:

Paul Gascoigne fears Vinney Jones.  
Vinney Jones frightens Paul Gascoigne.

Verbs expressing change of possession and communication also apply item specific rules, as is illustrated by the following pairs of sentences:

Shula gave the semi-final tickets to Tim.  
Tim received the semi-final tickets from Shula.

Tim taught the off side rule to Shula.  
Shula learnt the off side rule from Tim.

Carlson and Tanenhaus (1988 and see Tanenhaus and Carlson 1989) suggest that real world/pragmatic knowledge also influences mapping. They presented a number of temporarily ambiguous sentences to non-dysphasic subjects. Some of these ambiguities involved alternative thematic assignments, eg:

a) Bill loaded the truck with bricks.

b) Bill loaded the truck onto the ship.

These were compared with control sentences where no such ambiguity could arise, eg:

Bill filled the truck with bricks.

Bill drove the truck onto the ship.

Subjects were asked to read the sentences and judge whether or not they made sense. Their reaction times were measured. The ambiguous sentences took longer to judge. However the effect was not general. Only those sentences with non-preferred assignments were slower. This would apply to sentence (b) above, where the truck is unexpectedly acting as the theme. It seems that the on-line assignment of thematic roles is at least partly influenced by real world knowledge. In other words, in loading events, trucks are typically goals, rather than themes. When this turns out not to be the case the early assignment must be revised, and a delay is incurred.

It seems that three main sources of information are used during mapping. Firstly there are some general mapping procedures, which apply to sets of thematic roles, regardless of the particular verb involved. Secondly some verbs supply idiosyncratic mapping directives. This is true of stimulus/experiencer verbs and verbs expressing change of possession or communication. Finally we also use real world knowledge about the likely functions of the nouns. This was seen in the experiment above where subjects' preconceptions about trucks influenced early mapping decisions. This latter observation is of particular interest in that it suggests that pragmatic interpretation is not an isolated, final stage, of comprehension. It seems that, from the outset, inferential processes are interacting with the more purely 'linguistic' procedures.

#### 4.5 The Role of the Verb in Sentence Comprehension

The importance of verb information in sentence comprehension is undisputed. Verbs, in particular, help uncover the semantic

relationships within a sentence. They outline the nature of the main event and specify which thematic roles are involved. They also help to link the developing semantic structure to syntax, by providing mapping directives. What is debated is precisely when verb information becomes available during comprehension, and how it might interact with other input processes, such as parsing. Some commentators argue that only verbs' syntactic, or subcategorisation, information is used in the initial parse of an utterance (Clifton Frazier and Connine 1984) while others place greater emphasis on the retrieval of argument information (Shapiro, Zurif and Grimshaw 1988). Tyler (1985) argues that all forms of verb information are used, even in the immediate vicinity of the verb.

Clifton et al (1984) explored the effects of verbs' subcategorisation preferences in sentence comprehension. Subjects had to read sentences and carry out an on-line lexical decision task. The decision probe was presented following the word immediately after the verb, eg:

- i) The babysitter read the (probe) story to the sick child.
- ii) The babysitter sang the (probe) story to the sick child.

The experiment used two groups of verbs. One had preferred transitive readings (eg 'read' above). The other had preferred intransitive readings (eg 'sing'). (Preferences were established in a previous production task). The authors hypothesised that preferences would influence reaction times on the lexical decision task. Sentence (ii) is inconsistent with the subcategorisation preference, in that a direct object follows a preferred intransitive verb. This is signalled by the post verbal determiner. Therefore at this point the subject may have to revise previous syntactic expectations, and compute an alternative parse. The processing cost may result in a delay on the decision task. In (i) the sentence is consistent with the verb preference, therefore no such delay should occur.

Results confirmed this hypothesis and suggested that verb subcategorisation information is used on-line to assist sentence parsing. This information is not exhaustive. It seems that the parse is initially computed on the basis of the preferred subcategorisation frame. If this expectation is dashed revision becomes necessary.

Clifton et al (1984) conducted a second experiment which showed that verbs' subcategorisation preferences also influence the interpretation of gaps. However this effect was tempered by biasing pragmatic information. Two types of gapped sentence were used. Some had lexical fillers and others were linked to a wh word, eg:

- iii) Tommy's girlfriend was impressed by the car that Tommy drove (gap) at the race track.
- iv) Tommy's girlfriend was impressed by what Tommy drove (gap) at the race track.

Subjects were asked to read and judge the grammaticality of these sentences, and performance times were measured. Where preferred intransitive verbs occurred with a gap (as in the two examples above) judgements were slower and often wrong. However this effect was less powerful when pragmatic information was available, as in sentence (iii). 'The car', being a likely direct object for 'drove', encourages a transitive reading of the verb, and eases interpretation of the gap.

Clifton et al's studies suggest that information about verbs' preferred subcategorisation frames guides the initial parse of sentences. However this effect is not blind to the developing semantic interpretation. In the second experiment lexical and pragmatic information was powerful enough to override pure syntactic preferences.

Shapiro Zurif and Grimshaw (1988) suggest that verb argument information, rather than subcategorisation frames, is immediately

engaged during comprehension. They asked subjects to carry out a lexical decision task while reading a sentence. The decision probe was presented immediately after the verb. The verbs varied according to the number of their argument structures and subcategorisation frames. Shapiro et al hypothesised that the complexity of the verb would influence performance on the decision task. This was only partly confirmed. The number of subcategorisation frames permitted by a verb was not important. For example 'donate' and 'send' produced similar latencies, even though 'send', as an alternating dative, has one more subcategorisation frame than 'donate'. However the number of argument structures was influential. Thus 'remember', which permits 4 possible argument structures, resulted in slower latencies than 'accept' which has just 2. The effect was seen even when the previous context biased one structural reading of the verb (Shapiro, Zurif and Grimshaw (1989), which suggested that all possible argument structures are retrieved with a verb regardless of its environment.

These findings are difficult to reconcile with Clifton et al (1984). Shapiro et al argue that argument information is exhaustively and immediately derived from the verb, but that subcategorisation information may not be. Yet Clifton et al suggest that subcategorisation frames are drafted into early processing. The two studies also propose different contextual effects. In Clifton et al context was seen to override verbs' syntactic preferences, while Shapiro et al argue that verb processing is insensitive to context.

Unlike the above commentators Tyler (1985) argues that all aspects of verb information inform on line comprehension. In her experiment subjects had to listen to sentences and press a button whenever they heard a particular word. Four contexts were used, which manipulated the relationship between the monitor-word and the preceding verb. These are illustrated below:

- a) The crowd was waiting eagerly. The young man grabbed the guitar and ..
- b) The crowd was waiting eagerly. The young man buried the guitar and ...
- c) The crowd was waiting eagerly. The young man drank the guitar and ...
- d) The crowd was waiting eagerly. The young man slept the guitar and ...

(guitar was the monitor-word)

In (a) the relationship between the word and verb is normal. (b) is pragmatically implausible, but not linguistically anomalous. In (c) the word violates the selection restrictions of the verb and in (d) it violates subcategorisation constraints. Tyler anticipated that these violations would disrupt processing and therefore increase the monitoring times. The results confirmed her expectations:

Normal condition (a):	241 msec
Pragmatic anomaly (b):	268 msec
Selection Restriction Violation (c):	291 msec
Subcategorisation Violations (d)	320 msec

These results suggest that when a verb is encountered its syntactic, semantic and pragmatic properties all become immediately available and are used to constrain the on going analysis of the utterance.

#### 4.6 Summary and Conclusions

This chapter outlined the possible components of a sentence comprehension model. Phonological procedures segment the incoming speech stream into words and phrases. The parsing mechanism computes a syntactic representation of the sentence. Lexical and semantic processes retrieve the meanings of the content words and identify the thematic roles involved in the main event. Mapping integrates this semantic information with the syntactic structure; and finally real world knowledge influences the interpretation of the utterance. While this suggests that comprehension is achieved via discrete

processing 'stages' a good deal of evidence was presented to support a more interactive view. For example lexical information seems to influence parsing, syntactic context directs lexical access and pragmatic knowledge informs mapping. One interaction which was not considered was between phonological and syntactic analysis. We might anticipate that prosodic features, such as pauses and intonation, could help disambiguate many of the so called garden path sentences. Indeed Pulman (1987) and Cooper and Paccia-Cooper (1980) offer evidence that this is the case.

This outline suggests that sentence comprehension problems in dysphasia could arise from many causes. Some people may have difficulties in the early processes which identify phonological words and phrases. Some may be failing to parse, while others may be unable to process meaning relationships or map them onto syntax. The interactive nature of comprehension suggests that a failure in one 'section' could implicate other, apparently unrelated, aspects. Verbs, in particular, seem to inform the entire comprehension process. They supply vital semantic information, both about the nature of the event and the thematic roles involved. They dominate the mapping process by providing information about how their roles should be assigned to syntax and there is good evidence that verb information directs parsing. Therefore, as in production, a sentence level disorder could originate from a lexical deficit with verbs.

## Chapter 5 Dysphasic Sentence Comprehension Disorders

This chapter will review some of the comprehension disorders identified in aphasia and will attempt to relate them to the 'model' outlined in chapter 4.

### 5.1 Phonological Disorders

Caramazza, Berndt and Basili (1983) present a subject whose comprehension impairment seemed due to a deficit in the early phonological processes. All auditory input tasks (such as lexical decision, rhyme and homophone judgements) were impaired, although written word comprehension and lexical decision were normal. In addition, there was a sentence comprehension disorder, even with written sentences. This only occurred when the sentences required syntactic analysis. When meaning could be inferred lexically performance was good.

Caramazza et al argue that the syntactic disorder was a product of the phonological problem. They suggest that the subject was unable to generate a phonological record of sentences and therefore had nothing on which to perform syntactic analysis. This view was supported by memory tasks which showed that recollection of word order and the grammatical elements of sentences was very poor.

The assertion that syntactic analysis requires a phonological record of the sentence might be disputed, given the on-line nature of parsing (see section 4.2). We might also challenge the associated claim that impaired short term or phonological working memory will necessarily handicap comprehension (see section 1.5). However, despite the difficulties it seems that a sentence comprehension disorder might arise purely from a phonological deficit. The possible manifestations of this deficit and the ways in which it might interact with the other components of the comprehension system clearly merit further investigation.

## 5.2 Syntactic Deficits

For a long time it was felt that the comprehension impairment in 'agrammatism' reflected a syntactic disorder, or an inability to parse (see section 1.3). This was supported by evidence that agrammatics were unable to exploit grammatical markers, such as function words and inflections, in a number of comprehension, judgement and monitoring tasks (eg Heilman and Scholes 1976; Bradley et al 1980; Friederici A D 1985). One study looked at the comprehension of determiners (Goodenough et al 1977). Dysphasic subjects were shown arrays of tokens, eg a white circle, a black circle and a black square. They were then given a command, such as: 'press the black one'. Anomic subjects responded to these inappropriate instructions by pausing and then pressing one member of a pair, eg in this case the black circle. Broca's dysphasics, however, seemed unaware of the determiner. They rarely hesitated and typically responded as if the instruction was: 'press a black one'.

Zurif et al (1972) (and see Zurif and Caramazza 1976) suggest that this insensitivity to function words may have a direct consequence for parsing abilities. They asked Broca's dysphasics and non-dysphasic subjects to judge which words went together in a sentence anagram task. As expected, non-dysphasic subjects grouped function and content words together to form tight phrase structures. In contrast the Broca's subjects tended to ignore the function words, and often linked content words together anomalously. It seemed that these subjects were unable to use function words to signal phrase boundaries, a process which is intrinsic to parsing.

While the syntactic hypothesis no longer stands as a general explanation of agrammatism there is still evidence that some individuals may have a specific problem with parsing.

Tyler investigated the on-line syntactic abilities of one dysphasic subject, DE (1985, 1987 & 1989). In one task DE was asked to monitor for a word in three different contexts: Normal Prose, Anomalous Prose

(which was syntactically correct), and Scrambled Strings (see section 4.3). Monitoring times were recorded. Non-dysphasic subjects' reaction times are fastest in Normal Prose, second fastest in Anomalous Prose, and slow in Scrambled Strings. Tyler suggests that this is because 'normals' are able to use the developing semantic &/or syntactic representation to facilitate word recognition. DE's results showed a similar pattern, suggesting that he too was using structural information to assist word retrieval. However there was an important difference. Monitoring times were tapped at different points during the utterance, eg some probes were presented early in the sentence, while others were presented late. Non-dysphasics' responses showed powerful word position effects, although only with Normal and Anomalous Prose. Words presented late in the utterance were responded to faster than early probes. Tyler argues that late probes are benefiting from the global semantic and/or syntactic representation of the utterance. With Scrambled Strings no such representation is available, therefore word position effects are not seen. DE showed word position effects with Normal Prose, but not Anomalous Prose. This suggests that he was able to form a global semantic representation of an utterance, but not a purely syntactic one.

DE's syntactic skills were tested in a second word monitoring task. Here the probe was presented immediately after a verb. In some cases the relationship between the verb and the probe was normal. In others the probe violated either the verb's selection restrictions or subcategorisation constraints. Pragmatic anomalies were also tapped (see section 4.5). DE's monitoring latencies were very similar to non-dysphasics', in that his responses were delayed by both semantic and syntactic violations. However, in one respect he was different. He was much more affected by pragmatic violations, indeed these induced the greatest delay.

It seems that DE retained some syntactic abilities. He was aware of both the structural and semantic properties of verbs, and used them to constrain his interpretation of material within the verb phrase.

This suggests that he could perform some local syntactic analysis (and see Tyler 1989). However he could not develop a syntactic representation spanning an entire utterance, in that his monitoring latencies in Anomalous Prose did not reveal word position effects. Tyler argues that this deficit may account for his apparent over dependence on pragmatic information.

Tyler's findings with DE are similar to the results obtained by Baum (1989). She tested a group of Broca's dysphasics on a word monitoring task which explored sensitivity to both 'local' and 'long distance' syntactic violations (the latter spanned clause boundaries, while the former were within the clause). Non-dysphasics' monitoring times were delayed by both types of violation. In contrast, the Broca's subjects were unaffected by long distance violations, although they were by local ones. This was not simply a consequence of length. When local violations were 'padded out' with additional material within the clause they still induced delay.

Baum's and Tyler's results recall the two stage theories of parsing (see section 4.2). These argue that analysis initially identifies local phrases which are then integrated, by a global analyser, into a sentence level representation. It seems that some 'agrammatic' subjects may retain the local parser but not the global one. This local parser may be particularly dependent on lexically stored grammatical information, such as the subcategorisation rules of verbs.

Caplan, Baker and Dehaut (1985) also suggest that dysphasia may impair parsing abilities. They tested a large number of dysphasic subjects on a range of sentences, eg:

Active:	The elephant hit the monkey.
Passive:	The elephant was hit by the monkey.
Cleft Subject:	It was the elephant that hit the monkey.
Cleft Object:	It was the elephant that the monkey hit.
Dative:	The elephant gave the monkey to the rabbit.



when their deficient syntactic analyser makes them incapable of doing so successfully. The scope of the parser also accounts for subjects' greater difficulty with three argument and multi verb sentences. These increase the domain over which the parser has to operate and therefore multiply the number of errors.

The subjects tested by Caplan et al were particularly troubled by non-canonical sentences, in which arguments have been moved from their D-structure positions. This recalls trace theory, which argues that agrammatic subjects cannot interpret the non-lexical nodes in surface structures (Grodzinski 1984 & 1986 and see section 1.4). While this theory clearly fails to account for agrammatism in general, there is evidence that some individuals may have a particular problem parsing the non-lexical categories of PRO and trace.

Hildebrandt Caplan and Evans (1987) tested a single dysphasic subject KG on a range of sentence types. The authors were interested in KG's ability to comprehend co-indexation. A number of sentences contained overt co-indexation, which was expressed either through reflexives or pronouns, eg:

Patrick said that a friend of Joe's hit himself.

Patrick said that a friend of Joe's hit him.

Others involved 'covert' co-indexation, expressed through either PRO or trace, eg:

- i) Patrick forced Joe<sub>i</sub> [PRO<sub>i</sub> to hit him].
- ii) Patrick<sub>i</sub> promised Joe [PRO<sub>i</sub> to pray].
- iii) Patrick<sub>i</sub> seems to Joe [t<sub>i</sub> to be praying].

Like trace, PRO co-indexes an empty category to a preceding noun in the sentence. For example in sentence (i) there is no overt subject for the verb 'hit'. PRO, together with its co-index, establishes that 'Joe' is the subject of the verb. The co-indexation of PRO is

dominated by the properties of the preceding verb. Thus in (i) PRO is co-indexed to the object of 'forced', while in (ii) it is co-indexed to the subject of 'promised' (see section 1.4 for a discussion of trace).

KG found overt co-indexation (pronouns and reflexives) much easier to understand than the indexation of PRO and trace. However he was able to interpret some non-lexical elements. For example he succeeded with passives, which contain traces, and made few errors in sentences where PRO was controlled by the object of the preceding verb, as in (i) above. His failures mainly occurred on complex trace sentences and on subject PRO sentences, which require 'long distance' co-indexation. Generally PRO sentences were easier than sentences containing traces.

Hildebrandt et al suggest that KG's comprehension was impaired by a resource limitation and a particular difficulty in co-indexing traces. Their interpretation differs from Grodzinski in that traces seem partially available, at least when the other syntactic demands are relatively slight. However, when syntax is complex, KG's limited parsing resources revealed the trace deficit.

### 5.3 Mapping Deficits in Sentence Comprehension

Linebarger et al (1983; and see Schwartz et al 1985) present striking evidence that 'asyntactic' comprehension may not arise from a parsing deficit. Their agrammatic subjects could not understand semantically reversible sentences but nevertheless performed well on a grammaticality judgement task. Furthermore they were sensitive to a range of violations, including some with empty elements and traces. These subjects clearly retained quite sophisticated parsing skills.

A second judgement task suggested that their comprehension deficit lay in the mapping process, which assigns the verb's thematic roles to syntax (Schwartz, Linebarger, Saffran and Pate 1987). Subjects were asked to judge the plausibility of a variety of sentences, eg:

### Lexical Anomalies

- i) The spoon ate the table. (basic)
- ii) The table was eaten by the spoon. (moved argument)
- iii) Yesterday morning, the spoon which I bought years ago, ate the table in the front room. (padded)

### Structural Anomalies

- iv) The puppy dropped the little boy. (basic)
- v) The puppy ran around excitedly and accidentally dropped the little boy onto the wet grass, which upset Louise. (padded)
- vi) It was the little boy that the puppy dropped. (moved argument)

The 'agrammatic' subjects detected all lexical anomalies well, which was unsurprising since these items required no syntactic analysis. They were also well above chance on the basic and padded structural anomalies. This was more unexpected and again suggested some ability to parse. Take the following item:

As the sun rose the bird in the cool wet grass swallowed the worm quickly and went away. (my underlining)

The fact that most 'agrammatics' judged this sentence as acceptable suggested that they were parsing the noun phrases appropriately (rather than simply identifying the nouns immediately around the verb and applying an asyntactic word order heuristic). Their good performance with the padded sentences also challenged a resource limitation hypothesis and suggested that memory load was not a factor.

The agrammatics' performance was most impaired with the moved argument structural anomalies. The authors argue that this problem was not due to a parsing deficit, given that these subjects had successfully detected violations with empty elements on the previous grammaticality judgement task. Instead they propose that it reflected a mapping disorder. The subjects could interpret the basic and padded sentences, because here the arguments occupy canonical or

D-structure positions, and mapping relations are 'transparent'. In the moved argument condition this is no longer the case. Although the subjects could process the syntax of these sentences they could not apply the mapping procedures which relate syntactic form to the verbs' thematic roles.

Caplan and Futter (1986) also suggest that comprehension may fail due to an inability to assign thematic roles. Their single agrammatic subject (SP) was tested on a range of sentence structures. Her performance showed some striking consistencies. For example she comprehended simple actives, cleft subjects and datives well but made errors on passives and cleft objects. The authors suggest that SP is applying a linear mapping heuristic, which is expressed thus:

'Assign the thematic roles of agent, theme, and goal to  $N_1$ ,  $N_2$ , and  $N_3$  in structures of the form  $N_1$ - V-  $N_2$ - $N_3$ .

Her successes reflect application of this rule, for example it explains her comprehension of structures in which canonical order is maintained. Where the rule could not be applied performance broke down. In addition to this mapping strategy SP showed some surprising knowledge about the thematic structures of individual verbs. For example she only assigned a goal argument when dealing with dative verbs. If the verb did not have a third argument SP did not apply her heuristic.

The mapping hypothesis has been used to account for subjects with a different level of comprehension deficit. Unlike those in Schwartz et al (1987) and Caplan & Futter (1986), these subjects were unable to interpret even simple active reversible sentences (Saffran et al 1980; Jones 84; Jones 86; Byng 1988; Black et al 1991; Nickels et al 1992). Once again the problem did not seem to be syntactic. The syntactic feature used by this form, eg word order, did seem available. For example two of the 'agrammatics' tested by Black et al (1991) showed their appreciation of word order in a number of

tests. However they could not relate word order to the meaning relations of the sentence.

It seems that some subjects' mapping abilities break down only in moved argument conditions, when the relationship between the surface structure and thematic roles is non-transparent. For others mapping may fail even when arguments remain in their D-structure positions. Saffran and Schwartz (1988) argue that these results speak to two variants of the mapping hypothesis. In one variant, verbs no longer supply mapping information such as the number and nature of their thematic roles, or information about how those roles should be assigned to syntax. This generates a severe disorder, affecting even simple active sentences. In the second variant verb-specific information remains but subjects have lost the mapping procedures which direct assignment of thematic roles across a variety of syntactic structures. This variant explains the greater difficulty seen with non-canonical forms. (but see Caramazza and Miceli 1991 for a critique).

#### 5.4 Verb Deficits in Sentence Comprehension

As in production, it seems that at least one variant of the mapping deficit may, in fact, reflect a lexical problem with verbs. Subjects with this level of disorder might be expected to show reduced verb knowledge, even in single word tasks.

Here the method of testing is crucial. In particular, tests are needed which tap the grammatical features of verbs' representations. One such test was devised by Byng (1988). This required the subject to match a single verb to a video representation of an action. Three types of verb were included: reverse action pairs, such as 'hit' and 'miss', reverse direction pairs, such as 'push' and 'pull' and reverse role pairs, such as 'buy' and 'sell'. The latter were particularly relevant in that discrimination between them demanded knowledge about their thematic role structures. For example 'buy' and 'sell' both encode source, goal and theme. However the verbs

differ in how they map these roles onto syntax. 'Buy' maps goal onto subject, while 'sell' maps source. This mapping relates to the focus that the verbs adopt over buying and selling events. Thus when the focus is on the goal, 'buy' is used to describe the event.

Actions were depicted on a split video screen and the patients were asked to match a spoken or written verb to one member of the display. Verbs were presented with both related and unrelated distractors. Two 'agrammatic' subjects performed similarly on this test. They coped well with the reverse action and reverse direction verbs, but found reverse role verbs significantly harder. It seemed that they could make close semantic discriminations between some verbs on the basis of their core meanings, but when that discrimination demanded recourse to the structural information encoded with verbs it was likely to fail. In particular these subjects seemed to lack information about the thematic roles of verbs. As a result their comprehension of even simple active reversible sentences was poor.

Some on-line studies have also suggested that dysphasics may lack grammatically relevant verb information. Tyler (1988) tested a fluent dysphasic (RH) on the word monitoring task described above (section 5.2). In this task the probe word is presented immediately after a verb. In a number of cases the word violates either the semantic or syntactic constraints of the verb. Unlike non-dysphasics, and DE above, RH's monitoring latencies were barely disrupted by the syntactic violations. This indicated that verbs' subcategorisation information might be playing a diminished role in his sentence comprehension.

Shapiro et al (1990) replicated their on-line lexical decision task with dysphasic subjects (see section 4.5). As before the study employed different types of verb, eg:

- a) obligatory transitive verbs (eg 'fix')
- one subcategorisation frame - NP
- one argument structure (x,y)

- b) obligatory three place verbs (eg 'put')
  - one subcategorisation frame - NP,PP
  - one argument structure (x,y,z)
  
- c) non-alternating dative verbs (eg 'donate')
  - two subcategorisation frames - NP; - NP,PP
  - two argument structures (x,y); (x,y,z)
  
- d) alternating dative verbs (eg 'send')
  - three subcategorisation frames - NP; - NP,PP; - NP,NP
  - two argument structures (x,y); (x,y,z)

Subjects had to listen to sentences during which an unconnected word, or non word, was flashed onto a screen. They were asked to signal as quickly as possible whether this was a real word or not and their reaction times were measured. In several trials the decision probe was presented immediately after the verb. The Broca's dysphasics performed similarly to the 'Normals', in that their reaction times were affected by the argument complexity of the verb. Thus (c) and (d) verbs induced slower responses than (a) and (b) verbs. The authors argue that these subjects, like non-dysphasics, are retrieving all the argument options of the verb. The fluent subjects performed differently. Their data was less coherent, probably because this was quite a mixed group. However their latencies were not influenced by the verbs' argument structures. It seemed that these subjects were not accessing all the syntactic and semantic information encoded with verbs.

## 5.5 Summary and Conclusions

This chapter has suggested that dysphasic sentence disorders may reflect the malfunctioning of different 'areas' of the comprehension system. Phonological disorders have been identified, which may limit the material available for syntactic analysis. Others have described parsing disorders, although these may not eliminate all syntactic procedures. Local parsing, which particularly depends on the

grammatical information supplied from the lexicon, may still be achieved, while the construction of a global syntactic representation of the utterance may be impossible. Some subjects may have a particular problem interpreting traces, although again the problem seems less absolute than previously suggested. A number of subjects with apparently asyntactic comprehension may not have a parsing deficit at all. These subjects may have a mapping disorder, in which they are unable to relate syntactic functions to their semantic, or thematic, roles. It was suggested that one variant of the mapping deficit may reflect impoverished verb representations and evidence of reduced verb knowledge in dysphasia was presented.

One issue which has not been addressed is the relationship between comprehension and production. It is tempting to view the comprehension 'model' as simply an inverted production system. In other words one syntactic level of processing may construct the surface form for output and parse the speech stream during input. The dissociations seen in dysphasia between comprehension and production argue against this view (see section 1.3). Clearly there must be some separation between the input and output models. However elements may be shared. Mapping deficits have been found to affect both input and output (eg Jones 1986; Byng 1988). This suggests that a single mechanism may assign thematic roles in both comprehension and production. One resource used by this mechanism is the semantic and syntactic information supplied by verbs.

This review has a number of implications for therapy. As in production, it seems that treatment should be based on an analysis of where processing is failing. Indeed even different variants of the mapping deficit may require different therapies. Treatment effects might, in turn, illuminate the architecture of the processing systems. For example mapping therapies have improved both comprehension and production, even when tasks have only focussed on input (Jones 1986). This supports the contention that one mapping process subserves both input and output. In contrast generalisations from syntactic therapies have been less extensive, which may suggest

that parsing and the generation of syntax for output are accomplished separately. Such therapeutic issues are considered further in the following chapter.

## Chapter 6 The Treatment of Sentence Disorders in Aphasia

### 6.1 Introduction

In this chapter I shall review some of the approaches which have been used to treat sentence disorders in aphasia. Sections 6.2 - 6.5 will cover therapies which are not based on theories of sentence processing. These are presented in order to highlight the properties of the psycholinguistic approach to treatment, which will be covered in sections 6.7 - 6.10. Finally I shall discuss the relationship between theories of sentence processing and treatment.

### 6.2 The Helm Elicited Language Programme for Syntax Stimulation (HELPSS)

This programme was developed by Helm-Estabrooks as a treatment for agrammatism. It progresses through the syntactic hierarchy identified by Gleason et al (1975). The treatment entails graded production. First the patient has to repeat the therapist's model, then produce the target structure in response to a completion cue. Production is assisted in both cases by pictures.

Helm-Estabrooks and Ramsberger (1986) administered HELPSS to 6 agrammatic patients. All had limited output, consisting of short, content word phrases. Auditory comprehension was relatively spared. Prior to therapy the subjects were assessed on the Northwest Syntax Screening Test and a Cookie Theft sample.

After therapy expressive scores on the NSST significantly improved, although receptive scores did not. The Cookie Theft descriptions also contained more content units (items of information) and grammatical morphemes. Since all the subjects were at least five years post onset it is unlikely that these effects were due to spontaneous recovery.

Although these patients seem to have improved it is difficult to relate their gains to the content of therapy. Firstly there is no analysis of whether subjects employed the trained structures following treatment. Secondly some of the individual results are difficult to explain. For example JC's output on the Cookie Theft was essentially unchanged after therapy, even though he made considerable progress on the expressive sections of the NSST.

The HELPSS programme was examined in a second, more experimentally rigorous, study (Doyle, Bourgeois and Goldstein 1987). This involved four chronic Broca's patients, each of whom were given 3 treatment sessions per week for 6 months.

Results showed successful training of all sentence forms. Most individuals showed generalisation to untrained items, although there were exceptions. However very little generalisation occurred to untrained sentence forms and maintenance of trained sentences was highly variable. There was also no generalisation to spontaneous production. Furthermore judges' ratings of communicative adequacy pre and post therapy did not improve.

### 6.3 Locative Training

Thompson, McReynolds and Vance (1982) attempted to train the production of 'beside' and 'behind' prepositional sentences with two chronic Broca's dysphasics. Both had relatively intact auditory comprehension, naming and repetition, with reduced phrase length and poor melodic line.

The therapy employed 36 line drawings illustrating the target locatives. These were grouped in four matrices, eg:

	BIKE	TREE	RAKE
Behind Tent	A	B	C
Behind House	D	E	F
Behind Fence	G	H	I

Thus picture A showed a bike behind a tent, picture B a tree behind a tent and so on. The subjects were trained on one 'beside' and one 'behind' matrix. The other matrices were used to test generalisation. Baseline measures were taken in spontaneous speech and picture description.

Therapy consisted of modelling the target sentence, forward chaining, in which the patient is cued with decreasing portions of the sentence and 'response contingent verbal feedback' which presumably informed patients if they were correct and explained any errors.

Results showed improved picture description using the trained locatives. There was generalisation to items not specifically trained in therapy and maintenance was good. However, only one subject showed carryover to spontaneous speech and neither showed any benefit with other untrained locatives.

#### 6.4 Training of Question Production

Thompson and McReynolds (1986) evaluated two different approaches to the treatment of question production. One was a behavioural 'direct production therapy'. The other was 'stimulation therapy', based on the ideas of Schuell. The study involved 4 agrammatic subjects, who were at least 15 months post onset. None could produce 'wh' forms, although their comprehension of these questions was good.

The treatment stimuli consisted of 30 line drawings which were used to elicit 'what', 'where', 'why' and 'who' questions. The direct

production therapy required the subjects to produce questions in response to modelling, forward chaining and feedback. The other approach also involved production, although here cued by repetitive, multi modal stimulation.

Baseline measures were taken on all 30 treatment pictures.

'Spontaneous' question production was elicited using a variety of compound pictures, such as the Cookie Theft. In the first treatment phase subjects were trained on 'what' and 'where' questions, either using the direct production or stimulation therapy. In the second phase the alternative approach was used to train the other two 'wh' forms. Maintenance probes continued to assess performance on 'what' and 'where' production.

Results were disappointing. Stimulation therapy was almost entirely ineffective. Direct production therapy succeeded at training target structures, and there was generalisation to untrained items. These gains were maintained during the second phase of therapy. However there was no generalisation to other question forms. In other words training 'what' and 'where' did not benefit 'why' and 'who' production. There was also no generalisation to spontaneous speech, as measured by the compound pictures. The authors conclude that people with dysphasia need more than stimulation to produce syntax. Guided practice and feedback is also necessary. From the lack of generalisation across forms they argue that dysphasia impairs the rules for generating syntax. As a result each structure needs to be trained separately.

#### 6.5 Auxiliary and Copula Verb Training

A behaviourist approach was also adopted by Kearns and Salmon (1984). They attempted to train 'is' with 2 Broca's dysphasics. Both subjects were over 2 years post onset and lacked grammatical morphology in their output. The authors were interested in whether training 'is' as an auxiliary (eg 'the woman is washing') would

enable the subjects to produce 'is' as a copula (eg 'the woman is scared').

First the subjects were trained to produce the auxiliary 'is', using modelled picture description and token rewards. This was followed by a reversal phase, in which subjects were trained to produce their former telegraphic structures. Auxiliary retraining followed, with subsequent maintenance probes. At all stages measures on untrained copula structures were taken.

Both subjects acquired auxiliary production, at least in picture description. Reversal training also 'worked', in that it successfully eliminated the auxiliary, which was then re-established in retraining. There was some generalisation to copula production. Both subjects produced copula + adjective structures. In addition subject 2 produced some copula + noun structures. Neither progressed with copula + prepositional structures. Although treatment gains were maintained, there was no carry over to spontaneous speech.

## 6.6 Discussion of the Non-Psycholinguistic Studies

The reviewed approaches share a number of features.

- Very little information is provided about the subjects, beyond a general syndrome diagnosis and, possibly, a sketch of their language skills. The motivation for investigating the subjects further is thin, given that they are to be offered broadly the same therapy. Any variation that is present is usually to satisfy experimental requirements, rather than individual differences. The studies seem underpinned by the assumption that subjects share the same deficit and will therefore benefit from the same treatment. Given what we know about the heterogeneity of agrammatic people, this assumption is questionable.

- The rationale of treatment is barely discussed. Therapy tends to focus on structures which are absent in the patients' output. There is very little analysis about why these structures are difficult for the individuals involved. Indeed their production is probably failing for different reasons. The authors also rarely discuss whether acquiring these structures will substantially benefit their subjects. The patients in Thompson and McReynolds may have had functional methods of asking questions, even though they could not access their syntax. Similarly it is difficult to see how 'is' could extend the communicative range of the Kearns and Salmon subjects.
  
- Therapy tasks tend to focus the production of 'surface structures'. In most instances the patient's role is quite passive. He or she is required to produce a target form, in response to a variety of cues, techniques and rewards (although it is possible that the accounts of therapy fail to convey some of the complexities).
  
- There is little or no discussion about exactly how therapy influences language performance and indeed the outcomes are often very difficult to interpret. Take the Kearns and Salmon study. The authors comment that the auxiliary and copula 'is' are linguistically and developmentally different. It is therefore difficult to explain why training on one should help the other. Furthermore, responses with copulas differed according to context. Copulas combined with adjectives were facilitated by the auxiliary therapy, while, at least for one subject, noun and prepositional copulas were not. Accounting for this discrepancy is difficult. The Thompson and McReynolds study raises similar questions. Why should training on one type of 'wh' question benefit another, given that these forms are syntactically and conceptually quite different? (see Thompson, Lewis, Shapiro and Roberts 1993 for further discussion).

- Most striking is the limitation of effects. Generalisation is poor, both to untrained structures and to spontaneous speech. Also none of the studies reports cross modality effects, eg training production does not seem to benefit comprehension. (for other studies showing limited generalisation see Holland and Levy 1971; Holland and Sonderman 1974; Davis and Tan 1987; Doyle, Goldstein, Bourgeois and Nakles 1989; and see Byng and Lesser in press for review). These limitations have led one commentator to suggest that widespread generalisation in dysphasia therapy is unattainable (Thompson 1988).

## 6.7 Psycholinguistic Therapy Studies

Psycholinguistic investigations of therapy differ from the above studies in a number of respects. A detailed cognitive analysis of the patient is conducted which aims to generate hypotheses about which aspects of language processing are either impaired or intact. Therapy is developed in the light of these hypotheses. For example it may aim to re-instate lost skills, restore access to a blocked level of processing, or exploit functioning areas of the system. As this suggests, therapy tends to be designed for individual, rather than groups of patients. The theoretical bias should enable the clinician to speculate about how therapy will affect the processing system. This in turn will generate outcome predictions, which can be evaluated in post therapy testing. Thus measures of outcome may contribute to the theoretical debate about the nature of the patient's deficit and even about sentence processing itself.

The focus of therapy also tends to be different. Rather than simply producing the target forms, patients are often invited to develop new insights about language. Indeed, some studies remove the production element altogether.

Although psycholinguistic studies offer more discussion about the connections between the patient's deficit and the treatment, that relationship is still opaque. For example it is often impossible to

conclude that treatment has induced the predicted psycholinguistic changes, even if benefits occur. Therapy failure is even more difficult to interpret. This may suggest that the original hypothesis about the patient's deficit was wrong, or it may equally reflect practical shortcomings in the therapy, psycho-social factors etc. The problems of therapy interpretation may be helped by replication studies. If patients with similar processing disorders respond in the same way to a therapy, the original theoretical assumptions behind that therapy receive considerable support. However the converse may happen. Apparently very similar patients may produce different treatment effects, in which case the problems of interpretation are further confounded. I shall return to these issues in the following review and in Chapter 12.

The following sections review a selection of psycholinguistic sentence therapy studies.

#### 6.8 Remediation of Mapping Deficits (Jones)

Jones (1986) describes a patient (BB) who was 6 years post onset. He had received considerable speech therapy, which included hierarchical production of words, phrases and sentences and specific work on function words and inflections. Despite this, speech was still limited to single noun phrases with no verbs or grammatical morphology.

Where was BB's production breaking down? Assessment showed that he could access single verbs, at least in naming tasks. Also his production did not improve when a verb was provided, all of which suggested that his problems were not due to a verb retrieval deficit. However BB could not order nouns around a verb. In one task he was asked to arrange three SVO sentence fragments to describe a given picture (eg the fireman / the policeman / follows). BB was very poor at this task and often produced quite bizarre orderings, such as SOV and VOS. He had similar problems with word order on input. He scored at chance on the Jones Test of simple reversible active

sentences. Yet BB's input processing was not totally asyntactic. A written sentence segmentation task showed that he could identify phrase boundaries even in quite complex structures. It seemed that BB retained some awareness of syntactic structure, but could not interpret it.

Jones concluded that BB had a mapping deficit, in which he could not relate verbs' thematic roles to their syntactic positions (see section 3.2). Thus his problems were more at Garrett's functional level, where meaning relations are computed, than at the positional level. Therapy was based on this hypothesis and aimed to develop new insights about the relationship between sentence form and meaning. BB was asked to analyse a series of written sentences. Firstly he had to identify the verb, then find the agent, and subsequently the theme. Later stages included additional roles such as goal and location and introduced complex, non-canonical structures. Throughout therapy, which spanned 8 months, BB was forbidden to say the sentences.

After therapy BB improved considerably on both the Jones Test and the Test of the Reception of Grammar. In addition, his output displayed more structure and grammatical morphology, even though this had not been targeted in therapy.

Jones suggests that these improvements occurred because therapy focussed on the right level of processing. Previous treatments emphasised the production of surface structures. In terms of Garrett's model it was targeting the positional level. Jones, in contrast, had aimed to develop functional level skills, or the awareness of the relationships between a verb and its arguments. The spontaneous emergence of function words and inflections may indicate that the positional level was never impaired. Once functional level abilities were restored its skills could re-emerge.

Of particular interest were the parallel gains in speech and understanding, even though production was inhibited during therapy.

This outcome is consistent with the view that the mapping processes are common to comprehension and production (and see section 5.5).

Jones's study has been partially replicated (Le Dorze Jacob and Coderre 1991). The subject in this study (MG) had similar problems to BB. Speech was structurally impoverished with an almost total absence of verbs. As with BB, verb cues did not improve output and reversal errors were seen in comprehension.

MG was given a short version of the Jones programme. Following therapy the production of verb/noun structures increased, both in picture description and spontaneous narrative (although the narrative gains were not maintained). Noun production and performance on a control reading task remained stable, suggesting that the gains were specific to therapy.

There were some important differences between this study and the original Jones paper. Firstly the patients' deficits were not the same. Unlike BB, MG had a verb retrieval deficit (he scored 17/40 on an action naming task). Secondly the therapy was different. MG could not read and therefore could not use written therapy materials. Instead 'pictorial sentences' were used, in which separate drawings represented the agent, theme and verb.

These differences make the interpretation of the therapy problematic. It is difficult to see how the 'para-linguistic' materials used by LeDorze et al could represent the relationship between verbs' thematic roles and syntax. It is possible, therefore, that their therapy was generating a different type of insight. It may be that the pictorial sentences encouraged MG to conceptualise events in a more structured way. Once this was achieved, verb access and functional level representations were facilitated and production improved.

Another replication of Jones's therapy has recently been conducted by the original proponents of the mapping hypothesis (Saffran, Schwartz,

Fink, Myers and Martin 1994, and in press). This involved 6 non-fluent patients (2 additional subjects failed to complete the programme due to recurrent strokes). Four of the subjects displayed typical signs of a mapping impairment in their comprehension, eg they performed well on grammaticality judgements but produced reversal errors in comprehension tests. One of the exceptions had a more global comprehension impairment and the other was close to ceiling on input tests. Three of the subjects had typical 'agrammatic' speech, with structural poverty, reduced verb production and impaired grammatical morphology. The others had more variable output. Even before therapy, two of the patients displayed some intact structure. They had normal noun/verb ratios and over 70% of the words they produced were in sentences.

Therapy involved the sentence analysis tasks devised by Jones. In the first phase, the sentences used action verbs with SVO canonical orderings (although the basic structure was padded with modifying material). In the second phase verbs expressing psychological and sensory states were introduced (eg 'know' and see') again within canonical structures. The final phase returned to action verbs although in moved argument structures. Patients attended therapy 4 times a week for up to 4 months. Outcomes were measured on narrative tasks, sentence comprehension and anomaly tests and written and spoken naming tests.

Outcomes varied. Two of the subjects failed to benefit, which is attributed to the severity of their initial disorder and the fact that they had difficulties carrying out the therapy task. Two improved on production, but not comprehension (although one, FO, had no initial comprehension impairment) and two showed gains in both modalities.

It is difficult to interpret these varying gains. For example one of the patients, FO, did not have a mapping deficit (his output displayed some structure prior to therapy and he had no comprehension impairment). Nevertheless his speech benefited from the programme.

It seems unlikely that therapy was righting a deficit. How then was it effective? The authors offer two suggestions. Therapy may have enabled FO to exploit his intact mapping knowledge better in production, or the emphasis on structure may have encouraged him to drop an adaptive telegraphic style. A second patient, EW, appears to be the model 'mapping patient'. Prior to therapy her output was typically 'agrammatic' and she made several reversal errors in comprehension. Like BB, EW showed treatment gains in both comprehension and production. Yet she also improved on measures of naming and reading, which were beyond the scope of the programme. This challenges the view that her output improved because of enhanced mapping skills. Although therapy was clearly effective, it is difficult to know why.

The studies reviewed in this section involved patients with different problems and skills. Unsurprisingly they also showed different therapy effects. Yet there is no clear relationship between the nature of the deficit and the effects of treatment. This is most striking in the case of FO, who apparently did not have a mapping disorder but still benefited from the mapping programme. This finding confirms what most clinicians already know - namely that the language diagnosis does not prescribe the therapy (see section 6.11 for further discussion). Other complexities are suggested. Some patients showed similar gains. For example BB, MG, and FO all produced more verb argument structures following therapy. Yet we cannot be sure that these gains were consequent on the same psycholinguistic changes, especially as the therapies used in the studies were all subtly different. Thus BB may have re-acquired mapping procedures, MG may have developed improved event perception and verb retrieval skills, and FO may have been better able to exploit skills which were already within his system. Despite these unanswered questions these studies do suggest that therapy which encourages the conscious analysis of verb argument relations may bring about generalised gains in both dysphasic comprehension and production.

## 6.9 Remediation of Mapping Deficits (Byng)

Byng (1988) described two subjects with symptoms of a mapping disorder. Both made reversal errors in comprehension and produced limited verb argument structure in their speech. In addition they were poor at comprehending reverse role verbs (such as 'buy' and 'sell') in a verb video test. This suggested that they had reduced information about the thematic structure of verbs, a problem which probably contributed to their mapping disorder (see section 5.4).

The first subject, BRB, was particularly poor at understanding reversible locatives. Therapy focussed on this type of sentence. It was designed for solitary practice, since BRB could not attend clinic more than once a week. Twenty reversible locative sentences were devised involving four different prepositions. Each sentence was accompanied by two pictures - the target and the reversal. BRB was required to match the sentence to the right picture. A number of cues were provided. One was a 'meaning card', which illustrated the relationship between the two nouns in the sentence. Figure 6.1 illustrates the meaning card for 'the pan is in the jug'.

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Figure 6.1 Examples of therapy materials from Byng 1988

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picture



meaning card

Materials were also colour coded. For example the first noun phrase was written in red and the second in blue, and these colours corresponded to those in the picture and meaning card. All the cues emphasised the relationship between the sentence word order and the configuration in the picture. They also enabled BB to detect and correct his errors independently. A second stage of therapy involved materials which were not colour coded. Therapy spanned just two sessions with intervening home work.

After this very short programme BRB showed astonishing gains. He was now faultless in comprehending active reversible sentences and reversible locatives. The previous reverse role errors in the verb video were eliminated. Output also improved, in that he produced more verbs and verb argument structure. Progress was specific to the content of therapy. Control measures of abstract word comprehension were unchanged (although these did respond to a subsequent, abstract word, therapy programme).

This study might be contrasted with Thompson et al (1982), which also describes a prepositional programme with 'agrammatic' subjects (see section 6.3). Their therapy yielded only very specific effects, eg production of trained locatives improved, while untrained ones did not and only one subject showed any carry over to spontaneous speech. There could be numerous reasons for the greater generalisation achieved in the Byng study. BRB's impairments may have been less severe, his motivation greater, his home environment more supportive. However the different results might also reflect differences in the programmes. Thompson et al effectively drilled production of two locatives, by providing facilitory cues and feedback. Mechanisms for generalisation are not discussed, and indeed it is unclear why such practice should generalise either to other sentence forms or spontaneous speech. Byng's therapy had different aims. The prepositional sentences were primarily a medium through which she aimed to convey generalities about the mapping process. The cues provided in her therapy did not aim to stimulate correct production of a surface form, as in Thompson et al. Instead they encouraged BRB

to reflect, consciously, on the connections between word order and meaning. The results suggest that BRB recovered, or reaccessed, these mapping procedures. As a result both his comprehension and production of a number of predicate argument relationships improved.

Byng's second subject (JG) had a more profound mapping impairment. He made more reversal errors in sentence comprehension and his verb production, in both spontaneous speech and naming tasks, was significantly worse than his noun production. Despite these differences, Byng attempted the same therapy with JG, although the administration was modified. After 6 weeks of treatment it was clear that JG was not benefiting and accordingly therapy was changed. The new programme used a picture description paradigm. JG was asked to identify the agent and theme in a number of action pictures. He then had to select their labels and map them onto positions within a provided SVO sentence frame. The therapist's explanations and comments aimed to emphasise the relationship between the nature of the event and the position of the nouns in the final sentence.

This treatment did bring about progress, although it was less marked than with BRB. Verb and predicate argument production improved, both in picture description and spontaneous speech. There were some gains in comprehension of active declarative sentences, although these were only significant on one-tailed tests. Performance on the verb video also improved, although again this was not significant, probably because of the small number of items. Understanding of reversible locatives was essentially unchanged.

Both BRB and JG showed generalised benefits from the mapping programmes. However the theoretical implications are still unclear. BRB seemed to reacquire a general mapping procedure, which improved his comprehension and production of a variety of semantic relations. Yet testing prior to therapy showed that reduced access to verbs' thematic role information was contributing to BRB's mapping deficit. Therapy did not obviously reinstate this knowledge, given that it focussed purely on locative relations. It is therefore hard to

explain how BRB achieved such generalised gains. Byng suggests that mapping information was never lost, merely inaccessible. Therapy enabled him to reaccess what was already there.

JG apparently learnt to map agents and themes onto certain syntactic structures, but not the roles expressed in locatives. This suggests that different sets of thematic roles may be served by different components of the mapping mechanism, although BRB's results would counter this claim. Another possibility, offered by Byng, is that locative predicates are particularly complex and therefore difficult to process.

JG's therapy was replicated with three subjects with apparently similar language problems (Nickels et al 1991; Black et al 1991; Byng in press). One subject's response to therapy was very like JG's, but the other two benefited less. The authors suggest that this was because they had additional deficits. One had a short term memory problem, which impaired the retention of word order and the other was poor at comprehending representations of events (see section 3.4). This latter patient might have preferred a more non-verbal therapy which emphasised the nature and structure of events, rather than the mapping programme.

#### 6.10 Remediation of Verb Deficits

It has been argued that some dysphasic mapping disorders arise from impoverished verb representations which fail to supply the thematic information needed for mapping (see sections 3.2; 3.3; 5.3). Many of the subjects in the above studies showed evidence of reduced verb knowledge. Verb production was often impaired and Byng's subjects displayed particular problems with reverse role verbs in her Video Test. This suggests that, when therapy was effective, it may have helped subjects to recover the full lexical-semantic specification of verbs. It also indicates that therapy specifically promoting verb retrieval might help both sentence production and comprehension.

This hypothesis was pursued by Mitchum and Berndt (in press). Their subject, ML, was a fluent dysphasic. His verb production was reduced, both in spontaneous speech and naming (see section 3.3). He displayed an over dependence on frequent, non-specific verbs, the use of nouns as verbs, and semantic errors with verbs. Production did not improve when verbs were provided, which suggested that verbs were failing to supply the thematic and syntactic information needed for sentence generation. Furthermore ML tended to omit verbs' grammatical morphology, although noun inflections and articles were often realised. The authors concluded that ML's primary deficit was impaired verb retrieval, and this formed the basis of their first intervention programme.

Eight transitive verbs were trained over 4 one hour sessions. The therapy employed 7 different depictions of each target. For example the stimuli for 'pour' showed a boy pouring orange juice, workmen pouring cement, a girl pouring water over another girl etc. Multiple pictures were used to avoid a simple stimulus/response association. Each session targeted two verbs. The task consisted of repeated naming of each action picture. Initially just one verb was practised then targets were presented randomly. Errors were corrected by providing the target word. Sentence production was not practised or modelled in any way.

The treatment improved ML's naming of the target verbs (when tested on novel depictions). However his ability to construct sentences with these verbs did not change.

The authors therefore conducted a second therapy, which was based on the hypothesis that sentence construction was further undermined by poor accessibility to the grammatical elements of the verb phrase, such as auxiliaries and inflections. They specifically focussed on the morphological elements expressing tense. Six sets of sequence pictures were used. Each set showed an activity which was about to happen, on-going, and completed. ML had to place the pictures in order and then describe them, using the appropriate auxiliary and

inflection. A mixture of regular and irregular verbs were used. The programme spanned 10 two hour sessions.

After this therapy ML's use of tense in picture description improved. This generalised to untreated picture sets and was seen with both regular and irregular verbs. His ability to produce sentences from provided nouns and verbs also improved. However few changes were seen in narrative speech.

ML's therapy was partially replicated with a second subject (Mitchum, Haendiges and Berndt 1993), although here in the written modality. The subject, EA, was apparently quite different from ML, since he was non-fluent. However his processing of verbs was similar. Nouns were significantly better than verbs in written naming. Written sentence production also showed the omission of main verbs and odd verb constructions, eg:

'the horse is the fence' (target: the horse is jumping a fence)  
'the man is the woman fled his hand' (target: the man is pushing a woman)

Spoken verb production was also impaired although the patterns were different. For example when writing sentences EA tended to depend on non-lexical verbs, such as 'is', even when the verb had been provided. Whereas in speech, he used provided verbs were used more often. However they tended to be uninflected, and were often poorly integrated (semantically) with the nouns of the sentence.

Like ML, it seemed that EA's production was undermined by an inability to retrieve the main verb. Once again this hypothesis was tested via a treatment programme aiming to facilitate verb access. There were some differences. The programme was longer (18 hours) and trained twice as many verbs. The therapy task also involved repeated written, rather than spoken, naming. However the effects were similar. Verb retrieval improved, but there were no benefits for sentence construction, either in picture description or when asked to build sentences from provided nouns and verbs. Accordingly the

authors went on to administer the morphological programme, although again in the written modality.

The effects of this second programme were complex. Written picture descriptions showed syntactic improvements, with better realisation of the grammatical elements of the verb phrase. Written narrative descriptions (supported by pictures) also showed syntactic gains and improved lexical content - with enhanced retrieval of main verbs. However there were limitations. Written Sentence formation from provided nouns and verbs improved syntactically, but not semantically. In other words many of EA's post therapy attempts were still anomalous (eg: 'The boy is eating the drink' & 'The man is loading the shovel'). Also written narrative descriptions without pictures showed only negligible changes. The effects on spoken output were slightly different. The lexical content of spoken picture descriptions improved and his responses to noun and verb cues were semantically more coherent. Narrative speech showed no changes.

Neither of these subjects was helped by a programme solely directed at improving verb access. It was only when therapy incorporated work on the syntactic components of the verb phrase that sentence production improved. This effect was independent of modality, and indeed the study with EA suggests that working in one modality can benefit the other. Interpreting their therapy the authors suggest that their original patient diagnoses may have been wrong. In other words the primary deficit was not inadequate verb retrieval. Instead these patients were apparently more handicapped by an inability to specify the structure of the verb phrase at the positional level. The second treatment programme targeted this ability. The fact that it was effective in both modalities suggests that the positional level is not purely phonological in form.

However this interpretation could be challenged. Both ML and EA seemed to lack information about the semantic and thematic properties of verbs, as shown by their production errors, eg:

ML 'The woman is hugging the boy' (target: kissing)  
'The lady is shoving her boy' (target: a man pushing a woman)

EA 'The boy is eating the drink'  
'The man is loading the shovel'

The initial verb therapy simply drilled the phonological or orthographic forms of a batch of verbs. It is difficult to see how this therapy could boost sentence production, given that it did nothing to enhance the patients' knowledge about the thematic and semantic properties of these verbs. Furthermore the cued production task had already shown that neither subject could make use of a given verb form. Therefore there was little reason to suppose that acquiring some verb forms through therapy should benefit production. Also it might be argued that the single word naming task was quite different from normal verb production, since it did not necessarily entail retrieval of the verb's argument information.

It is possible that these patients would have responded better to a verb facilitation programme with a greater semantic component. The second treatment arguably incorporated this missing element. Here the patients were required to consider an extended representation of an event, in the form of a picture sequence. They then had to describe that event, using an appropriately tensed sentence structure. In order to carry out this task they had to analyse the depicted event and access the semantic and syntactic properties of the verb. Therefore the therapy involved a much more profound contemplation of verb representations. It may have been this element, rather than the morphological factor, that brought about the changes in production. Some of the results would support this interpretation. For example, following therapy EA's spoken production showed enhanced verb retrieval and semantic content. It is not clear why a morphological therapy should bring about these gains. Instead they may derive from the enriched verb access demanded by the task.

Two contrastive verb retrieval therapies were evaluated by Fink, Martin, Schwartz, Saffran and Myers (1991). The subject involved in this study (GR) had taken part in the mapping programme described in section 6.9 (Saffran et al 1991). Following this programme his production improved, but still showed marked verb omission. For example he would describe a picture using a full sentence but signal the verb with a tongue click or gesture. The fact that he could order nouns around this missing verb, and that he responded well to phonological cueing, suggested that he had reduced access to verbs' phonology.

Phonological access of verbs was targeted with two procedures, Direct Verb Training and Verb Priming. In Direct Training the subject had to name a depicted action, report who or what is the agent and theme and then compose a sentence incorporating these elements. In Verb Priming he had to repeat a sentence and then describe a picture using the same verb.

Prior to therapy verb access was tested with 28 action pictures. From these 10 verbs were selected for therapy - all of which GR could not name. Five were treated using Direct Verb Training and five on Verb Priming. The latter set was subsequently treated with Direct Training.

Direct Training was the most successful, although priming did produce some short term effects. There was a level of generalisation to the untrained pictures, in that after therapy GR was able to access more acceptable alternatives to these targets. The treatment also continued the gains in sentence production, which had begun with the mapping programme, possibly because now GR has some verb forms around which to assign thematic roles.

This study is marred by the design. Fink et al only selected verbs which GR had failed to name for therapy. This artificially increased the likelihood of achieving significant results on the McNemar Test, since it eliminated the possibility of regression. The number of

items used is also extremely small. Yet even with this reservation the study does suggest that verb therapy incorporating a semantic element, in this case the explicit identification of agent and theme, is more helpful than a purely phonological procedure.

#### 6.11 Discussion

Most of the reviewed psycholinguistic studies achieved some level of generalisation. The mapping procedures developed by Jones (1986) and Byng (1988) brought about improvements in both sentence production and comprehension which extended beyond formal therapy or assessment tasks. These improvements have been at least partially replicated with similar subjects (Le Dorze et al 1991; Saffran et al in press; Nickels et al 1991). The verb programmes described in 6.10 were less far reaching in their effects, although again generalisations to different tasks and modalities were seen. These effects contrast with the quite limited gains observed in the non-psycholinguistic studies, where progress was almost entirely confined to structures specifically trained in therapy with little or no carry over to spontaneous production.

Results such as these have encouraged the view that cognitive neuropsychology can significantly advance the practice of aphasia therapy (eg Lesser 1987; Howard and Hatfield 1987; Mitchum and Berndt 1992; Lesser and Milroy 1993). It is argued that cognitive analysis enables the clinician to develop detailed hypotheses about a patient's deficits and skills, and thereby target therapy more accurately. Processing models can also help clinicians to devise therapies which are likely to promote generalisation. For example the mapping process seems common to comprehension and production. Therefore a therapy which enhances mapping skills should promote cross modality effects. Similarly verb retrieval is thought to entail several levels of processing. Message procedures analyse the event and determine the roles of the participants. Semantic procedures access representations with appropriate argument structures and positional level processes retrieve the phonological

form of the verb and its morphosyntactic features. This suggests that, if therapy is to bring about generalised improvements in verb access, it should stimulate the early levels of verb processing as well as (or instead of) just phonological production. By offering a theoretical basis on which to predict outcomes, processing models also contribute to the evaluation of therapy. Clinicians are able to anticipate which language functions should benefit from their intervention, and which should remain unchanged. These different areas can then act as dependent variables and control measures.

Other commentators are less enthusiastic about the contribution made by cognitive neuropsychology to aphasia therapy (eg Caramazza 1989; Hillis 1993). A number of arguments are put forward. It is suggested that the processing diagnosis does not specify which treatment should be used. For example contrastive therapies may be effective for the same deficit, even though they apparently target different levels of processing, and patients with different skills and deficits may nevertheless respond well to the same treatment. Furthermore some therapies which are ostensibly underpinned by cognitive neuropsychological theory might equally arise from a different type of analysis. Caramazza (1989) cites the example of treatment for a spelling deficit. Cognitive analysis might suggest that the deficit is due to a malfunctioning graphemic output buffer, which might stimulate a treatment encouraging segmentation strategies for spelling. Yet the simple observation that the patient spelt short words much better than long ones could equally engender the same approach. Finally Caramazza argues that the links between theory and therapy remain opaque principally because the processing system itself is still so poorly understood. In particular we do not know how each component of the system approaches its task and therefore cannot theorise about how therapy might influence this.

It could be argued that some of the above charges fail to observe the complexities of the therapeutic process. For example clinicians do not seek a therapy prescription from the processing diagnosis. They know that numerous other variables have to be taken into account,

such as associated neurological disorders, the patient's current strategies and problem solving skills, the support available in his/her environment, and personal interests and motivations (eg Byng 1990). The diagnosis is just one lead in a complex trail.

Similarly the criticism that many therapies are only 'pseudo' psycholinguistic is not justified for all studies. Jones and Byng's mapping therapies (sections 6.8 and 6.9) are informed by psycholinguistic theory at every stage. The diagnosis is theoretically based, as is the therapeutic task. These therapists also had a clear conception of the type of processing skill which they are aiming to impart, and this informs their interactions with the patients. It is this aspect, rather than the analysis or the task, which makes these therapies truly psycholinguistic. Other apparently psycholinguistic studies might have more problems answering this charge. The verb retrieval therapy described by Mitchum and Berndt (section 6.10) is not obviously related to the precise nature of ML's verb deficit, and arguably fails to take account of the complexities of normal verb processing.

Caramazza's principal point, that we do not understand how therapy influences cognitive mechanisms, calls for a theory of intervention. Hillis (1993) suggests that as a minimum this theory should include: detailed individual analyses of the pre and post therapy functioning of the cognitive mechanism, discussion about how any change was induced, and determination of other factors, such as associated neural damage, which influenced the response to therapy. Clearly if we are to advance our understanding of the therapeutic process, we need a body of theoretically motivated treatment studies which meet these requirements. The three cases presented in this study aim to contribute to this enterprise.

## Chapter 7 Summary of the Literature Review and a Return to Some Theoretical Questions

### 7.1 Introduction

The discovery of dissociations between apparently similar aphasic subjects has cast doubt on syndrome classifications such as 'agrammatism' and 'paragrammatism' (Chapter 1). The decline of these classifications has transformed the investigation of aphasia. In particular it has encouraged more single case studies in which individuals' sentence production and comprehension disorders are interpreted against normal processing models. One difficulty here is the preliminary and disputed nature of the models. Chapter 2 reviewed the debate about normal sentence production and Chapter 3 related the proposed models to production disorders in aphasia. Theories of sentence comprehension were reviewed in Chapter 4 and their applications in aphasia were discussed in Chapter 5.

Cognitive theories do not simply aid the investigation of aphasia, they can also inform therapy. The review of sentence therapies in Chapter 6 argued that processing models can help identify a 'target' for intervention and guide evaluation of its effects. Such theoretically informed evaluations can, in turn, contribute to the understanding of the patient's deficit and even to sentence processing itself.

Although useful, many aspects of these models remain unresolved. Their precise architecture and workings are still debated and as a result their explanatory power in aphasia remains limited. Above all we do not understand how (or if) the functioning of the models is modified through therapy.

This chapter will re-introduce some tentative models of language production and comprehension. Issues raised by the models are discussed briefly, with reference to preceding chapters. I shall also highlight some key questions and suggest how these might be

illuminated by studies of dysphasic subjects. These questions will be returned to in the final discussion (Chapter 12).

## 7.2 A Model of Language Production

Figure 7.1 illustrates a Garrett-type model of language production. It attempts to incorporate some of the elaborations offered by other commentators (see section 2.9 and Chapter 2). In particular several connections have been added:

### Route (a)

This is an interactive route between the systems which retrieve the semantic and phonological representations of words. This route permits some phonological influence over semantic access, and is consistent with the finding that semantic errors are often phonologically related to their target (Dell and Reich 1981 see Section 2.3)

### Route (b)

This interactive route connects the system which retrieves lexical phonologies and the processes which compute syntactic structures or planning frames. This route allows syntactic forms to influence the selection of lexical phonologies, particularly in terms of the order of their retrieval (Stemberger 1985, see section 2.7). It also accords with the view that the generation of syntax is partly driven from the lexicon (Bock 1987, see sections 2.7 and 2.8).

### Route (c)

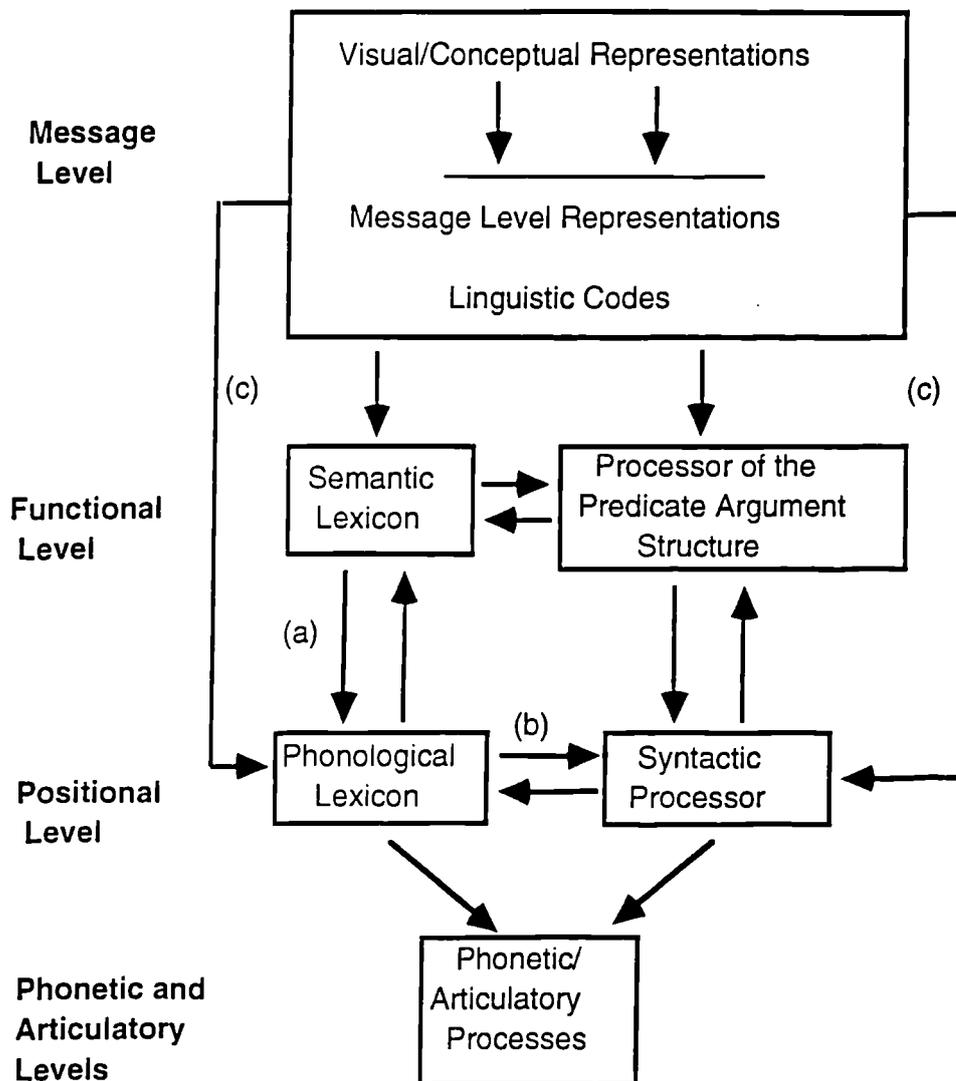
This route enables the message level representation to influence directly both the phonological retrieval of content words and the syntactic structure of the sentence. It is consistent with the finding that topic information, which is encoded at the message level, determines which nouns occupy prominent positions in the

surface form (Tannenbaum and Williams 1968; Bock and Warren 1985; see section 2.6). The effect is specific to syntactic positions, such as subject, rather than thematic properties. It does not, therefore, seem to be mediated through the functional level.

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Figure 7.1 A Garrett-Type Model of Language Production

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Clearly many aspects of this model remain poorly defined, such as the nature of the different representations and their interconnections. Some of these theoretical questions may be illuminated by the performance of dysphasic subjects. In the following sections I shall consider 3 issues and discuss how patient assessment and therapy data might help us resolve them.

### 7.3 The Nature of the Message Level

The model suggests that message level representations depend on 'linguistic codes'. These codes are propositional; they have an argument and thematic structure; they express perspective; and they are lexically sensitive, or contain concepts which can be mapped directly onto lexical semantics (see section 2.6). Thus, while general thinking need not be determined by language, the conceptual preparations for speech may be:

'Whorf was surely wrong when he said that one's language determines how one conceptualizes reality in general. But he was probably correct in a much weaker sense: one's language does determine how one must conceptualize reality when one has to talk about it' (Pinker 1989, p 360).

The psychological reality of these 'linguistic codes' at the message level is clearly difficult to confirm. However if we could identify a dysphasic subject who displays language specific conceptual problems their existence might be supported. Deriving such evidence will demand new assessments which are capable of probing language specific concepts. In the following chapter, two new procedures are described which attempt to meet this requirement (sections 8.2 and 8.3).

Further evidence might be offered through a therapy study. The model suggests that sentence production may fail because a patient is unable to formulate appropriate codes at the message level. If this were the case therapy encouraging the generation of such codes might

be effective. In other words if we can show that treatment focussing exclusively on the conceptual underpinnings of language improves a subject's output, we might further support the psychological reality of this level of processing.

#### 7.4 The Nature of Verb's Representations

Although theories of verb representation differ, most commentators agree that verbs encode a constellation of semantic and syntactic information. This includes the number of arguments commanded by the verb, the thematic role of those arguments and information about how those arguments are mapped onto syntactic positions (see section 2.8). These aspects of meaning are clearly linguistic, in that they determine the structures employed by the verb. However not all aspects of verb meaning are grammatically relevant. Verbs also encode numerous 'real world' features, such as environmental information ('swim'/'skate'), information about the rate and direction of the action ('sprint'/'jog'; 'rise'/'fall'), or properties of the object ('drink'/'eat'). Pinker (1989) termed such non-grammatical aspects of verb meaning 'idiosyncratic'. It has also been suggested that some of these features may be represented in 3 D visual models, rather than linguistic or semantic codes (Jackendoff 1987).

Thus Pinker and Jackendoff suggest that verbs encode two types of semantic information. One captures the grammatically relevant properties of the verb, such as the number of arguments it takes and the thematic roles of those arguments. This type of semantic information is derived from a finite set of primitives. The other type of verb meaning draws upon a virtually limitless array of idiosyncratic properties. This distinction is illustrated by the verbs 'kill' and 'assassinate'. In terms of their grammatical information these verbs are synonymous. Both express causation of death and hence entail two arguments with the roles of agent and patient. Yet their idiosyncratic properties differ, in that

'assassinate', unlike the blander 'kill', requires a politically prominent victim.

Support for this representation of verb meaning may be derived from dysphasic subjects. In particular we might anticipate dissociations between the different types of semantics. For example some subjects may have lost access to the grammatically relevant components, while preserving idiosyncratic features. Clearly such dissociations will only be identified if testing is sensitive to the different aspects of meaning. In the following chapter a number of verb assessments are presented which aim to manipulate these different factors.

## 7.5 The Role of Verb Information in Sentence Generation

Chapter 2 argued that much of the information needed for sentence generation is supplied by the verb (section 2.8). This view is supported by remediation studies which suggest that sentence production can be enhanced through therapies which promote verb retrieval and improved access to the thematic and mapping properties of verbs. (see sections 6.8; 6.9; 6.10).

The model in figure 7.1 provides for a strong lexical influence. At the functional level the semantic lexicon inputs to the processes which compute the predicate argument structure. This predicts that the composition of the functional level structure depends upon the integrity of the semantic lexicon. Dysphasic subjects might help us to test this prediction. Subjects with a semantic lexical disorder should also display impaired predicate argument structure in their output, particularly if they have lost access to the grammatically relevant aspects of verb meaning. Evidence of good predicate argument skills in the presence of impaired verb semantics would be problematic for the model.

The phonological lexicon is also connected to the syntactic processor at the positional level. Thus the model claims that the generation of syntactic forms is governed by two inputs: predicate argument

information from the functional level and phonological information from the lexicon. Again verb representations may play an essential role here, in that their phonological entries might provide information about the lexical form of the verb and the 'phonology' of the entire verb phrase. This phrasal information may consist of the prosodic structures which are permitted by the verb.

Once again, these possible inputs to the syntactic processor might be illuminated by aphasia research. The claim that semantic or functional level information drives phrase structure could be investigated through a subject with unimpaired verb semantics but poor phonological retrieval. If this subject could nevertheless produce good phrase structures, minus the verb, it would indicate that syntax can be driven purely from the predicate argument structure without the mediation of lexical phonology. If syntax were also impaired this might suggest that verb's phonological information is essential to the syntactic generator (although such associative evidence is always difficult to interpret). This latter claim might be supported if we could show that therapy aiming to improve phonological retrieval also brings about gains in syntax.

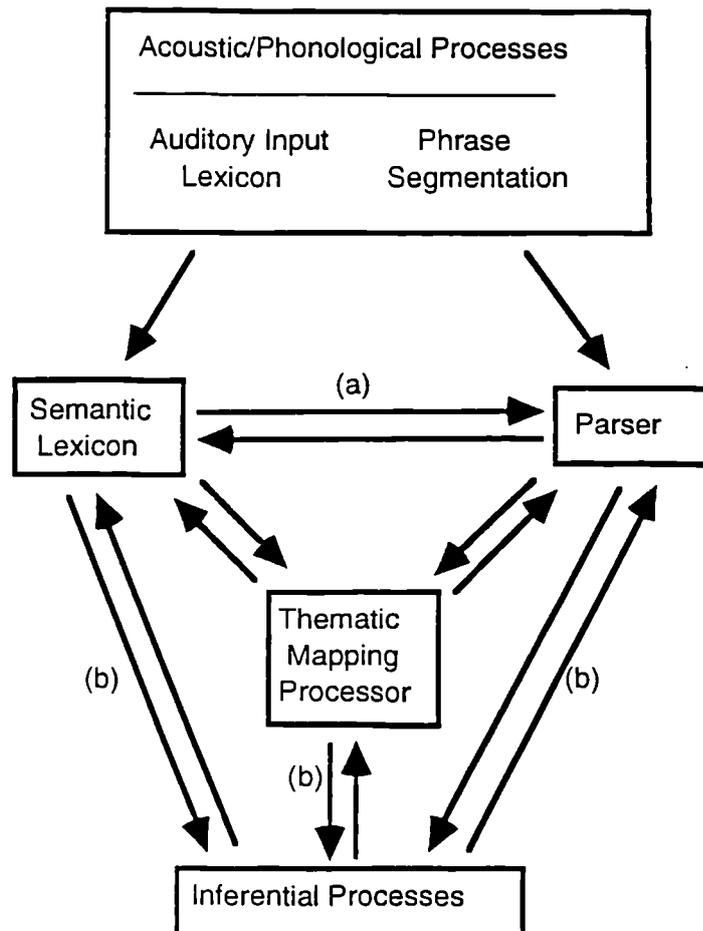
Further evidence might be derived from a subject with impaired verb semantics and poor predicate argument skills. Such a patient might nevertheless produce some verbs, eg in the process of making semantic errors. Suppose these verbs are accompanied by appropriate phrase structures. How might these structures be achieved? Clearly they cannot be driven by the predicate argument representation, since this is impaired. Therefore they may be supplied directly from the phonological form of the verb.

## 7.6 A 'model' of Sentence Comprehension

Figure 7.2 outlines the processes involved in the auditory comprehension of sentences (see sections 4.1 and 4.6). Phonological processes identify word and phrase boundaries and access the auditory input lexicon. This lexicon then inputs to the semantic system which

determines the meanings of the content words. The prosodic phrases identified at the 'phonological level' are fed to the parser which analyses their syntactic structure. This information is integrated with lexical semantic information via the mapping processes. The final 'level' involves inferential processes which apply real world and discourse knowledge to the interpretation of the sentence. Evidence from dysphasia suggests that comprehension problems can be broadly attributed to the malfunctioning of these separate processing components. For example subjects have been identified with discrete phonological disorders, parsing problems and lexical semantic deficits (see Chapter 5).

Figure 7.2 A 'Model' of Sentence Comprehension



While this 'model' suggests that comprehension is accomplished by several discrete components the inter connections between these components are complex. Some of these connections are discussed below:

#### Route (a)

This interactive route connects the semantic lexicon with the parser. It is consistent with the experimental findings outlined in Chapter 4 showing that lexical information influences parsing (Tyler 1989; Tanenhaus and Carlson 1989; see section 4.2) and that the developing syntactic representation of the sentence facilitates lexical access (Tyler 1982; see section 4.3).

#### Routes (b)

Three interactive routes connect the inferential processor to the parser, mapping processes and the lexicon. These routes allow real world knowledge to influence 'linguistic' operations, even during on-line processing, and again accord with many of the experimental findings discussed in Chapter 4 (eg Tyler and Marslen-Wilson 1977; Tanenhaus and Carlson 1989 see sections 4.2 and 4.4). The route between the parser and the inferential processor acknowledges that syntactic structures themselves carry meanings which influence the interpretations of sentences (eg Black et al 1991; Pinker 1989).

As in production this model suggests that comprehension is highly dependent on information derived from the verb. Without this information the mapping processes cannot function and, as a result, the parse will be uninterpretable. Dysphasic subjects with impaired verb semantics should therefore also display severe problems in sentence comprehension, although they might be able to perform pure grammaticality judgements (Linebarger et al 1983).

## 7.7 Dissociations between Production and Comprehension

Separate models of sentence production and comprehension have been presented, which is consistent with the observed dissociations in dysphasia (eg Caramazza and Hillis 1989; Berndt 1987). However components of the models may be shared. It seems reasonable to suggest that both call upon the same lexical semantic system. This anticipates that subjects with lexical verb disorders will show severe problems in both the generation and interpretation of predicate argument structure. It also suggests that therapies focussing on the lexical-semantic properties of sentences may produce generalised effects across input and output (Jones 1986; see sections 6.8 and 6.9).

Other elements of the models may also be shared. For example the same syntactic processor may parse speech input and generate the planning frame for output. However evidence that parsing abilities may be preserved despite asyntactic output would argue against this (eg Linebarger et al 1983). Also, it seems that treatment focussing on syntax rarely generalises across input and output (see sections 6.2 and 6.6), although interpreting such 'negative evidence' is problematic.

Finally we may speculate about the status of the inferential processor. Does this draw upon the same processes which formulate the message level representation for output? One role of this processor is to determine the message of the speaker. Therefore it seems reasonable to suggest that it should apply the same structured/linguistic codes which are used at the message level. Again people with dysphasia may offer some insights here, particularly if we can identify a subject with language specific conceptual problems. If inferential and message processes are shared we would expect this disorder to create difficulties in output and in the person's ability to make inferences during input.

## 7.8 Summary

This chapter presented 'models' of sentence production and comprehension. These models aim to accommodate the theoretical and experimental data presented in chapters 2 and 4. Furthermore they are broadly consistent with the performance of some dysphasic subjects (chapters 3 and 5) and have informed previous therapy studies (chapter 6).

Several theoretical questions were raised from the models, such as the nature of the different representations, the interconnections between 'levels' and the relationship between the comprehension and production systems. I suggested that these questions might be illuminated by data from dysphasic subjects and shall return to them in the final chapter.

The models offer new departures for the assessment of dysphasic subjects. For example, new procedures might investigate language specific conceptual skills, and the different types of verb semantics. The following chapter presents tasks which aim to meet some of these requirements and which may provide tools for further enquiry into the above theoretical questions.

## Chapter 8 Assessments of Verb Competence

### 8.1 Introduction

Chapter 7 outlined the possible components of sentence production and comprehension 'models'. Both emphasised the centrality of verb processing. For example, semantic verb information feeds the processor of the predicate argument structure on output and the mapping processor on input; and verbs' phonological representations may even contribute to the generation of syntax.

It seems that uncovering patients' verb competence is crucial to the assessment of their sentence disorder. However few current assessments explore verb processing in any depth (although see Jones 84; Byng 88; Black et al 1992 and Kay, Lesser and Coltheart 1993). This study generated several procedures aiming to investigate different aspects of verb knowledge. These are presented in the following sections. Where relevant, pilot information is also provided and discussed.

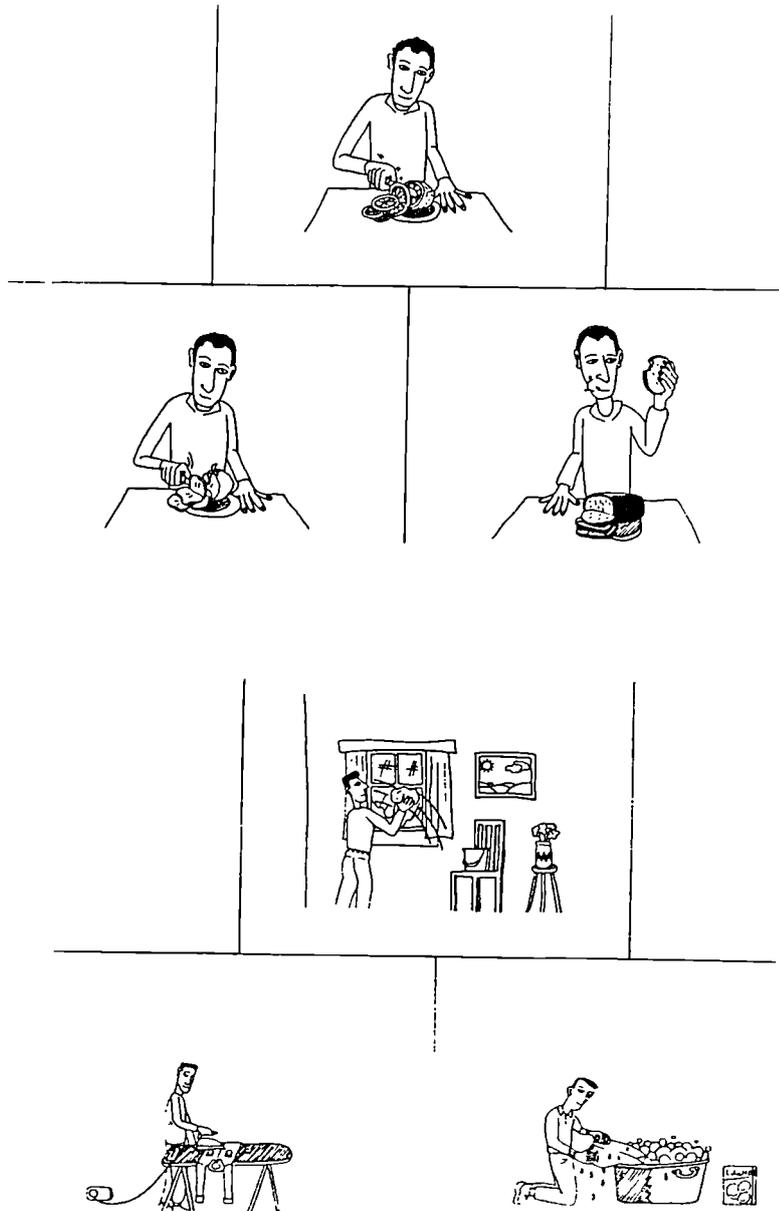
### 8.2 The Event Perception Test

Section 2.6.1 argued that the relationship between verbs and their referents is non-obvious and that verb access depends upon an ability to construe events in linguistically relevant ways.

This test probes subjects' ability to adopt a 'linguistically driven' perspective over events. Specifically the task entails the matching of two representations of the same verb, in the presence of a distractor (see Figure 8.1 for examples and instructions).

The test comprises 60 items (and 3 introductory examples). Subjects are required only to point to the correct picture; no output is demanded. As the examples illustrate, success depends on the ability to focus on the nature of the event, rather than the objects involved.

Figure 8.1 Examples from the Event Perception Test & Instructions



Instructions:

Example: 'Look at this picture (top). The man is slicing an orange. Look at these two pictures. Here he is also slicing something. So this picture goes with the top one.'

Test Stimuli: 'Look at this picture (top). Think about what is happening. Here are two more pictures. Which one shows the same type of action?'

Each target 'verb' appears three times, once with a gross distractor, once with a semantic/structural distractor and once with a semantic/idiosyncratic distractor. Each instance uses different pictures to prevent learning effects. Order of presentation is random.

**Gross Distractors (20 items)**

These are unrelated to the target. For example the gross distractor for 'peel' (a change of state event) is 'eat' (an action event).

**Semantic Distractors - Structural (SS) (20 items)**

These are of the same semantic class as the target event, but differ in one semantic 'component'. For example the SS distractor for 'peel' is 'cut'. Both are change of state events. However 'cut' focuses principally on the manner of the action, while 'peel' focusses on the effect.

These distractors are termed 'structural' because the semantic differences between the events have consequences for the syntactic behaviours of the verbs which describe them. Thus 'peel' and 'cut' differ in their ability to subcategorise prepositional structures:

He cut/peeled the orange.

\*He peeled round/about/into the orange

He cut into/through/at the orange.

Pinker (1989) argues that such syntactic effects are not accidental. Prepositional structures express information about the process of the action. They are therefore compatible with manner verbs (like 'cut') but not effect verbs (like 'peel').

Another structural difference relates to causality. For example the SS distractor for 'wash' is 'dry'. Both verbs express change of state. However 'wash' has a strong manner component which is absent in 'dry'. This focus on how the change of state was brought about makes 'wash' exclusively causative and as a result it only

subcategorises transitive forms. 'Dry', on the other hand, is neutral about manner and can therefore alternative between forms:

He washed/dried his clothes.

His clothes \*washed/dried.

#### **Semantic Distractors - Idiosyncratic (SI) (20 items)**

These distractors are semantically and syntactically related to the target. For example the SI distractor for 'peel' is 'mash'. Both events involve a change of state, with a focus on effect. Their verbs also share the same syntactic privileges:

He peeled/mashed the potato.

\*He peeled/mashed into the potato.

The potato is easy to peel/mash.

\*The potato mashed/peeled.

The events differ only in the exact nature of the effect, with 'peel' resulting in the removal of a skin and 'mash' a puree/blend effect. Pinker (1989) terms such differences 'idiosyncratic' (see section 7.4).

The main difference between 'idiosyncratic' and 'structural' features of meaning is that the former carry no implications for the verb's syntactic behaviour while the latter do. They also vary in scope. Idiosyncratic features are virtually limitless, while structural features are drawn from a constrained sub set, such as effect, manner, path, and cause (Pinker 1989).

The two different types of semantic distractor are used to investigate whether subjects' ability to categorise events is influenced by the linguistic features of those events. In particular they enabled us to explore subjects' sensitivity to these two different types of meaning.

(for further examples of stimuli and analyses see appendix 8.1)

Pilots:

Any non-verbal test is problematic, owing to normal variations in picture interpretation. Piloting was therefore conducted with 10 non-dysphasic subjects. Details and results are presented in Table 8.1.

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Table 8.1 Results of Piloting of the Event Perception Test with 10 Non-Dysphasic Subjects  
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Subject	Age	SLA	G Items	SS Items	SI Items
JMCM	54	15	20/20	20/20	17/20
RMcC	27	16	20/20	20/20	17/20
MRSP	64	14	20/20	20/20	17/20
DN	57	18	20/20	20/20	17/20
MM	63	17	20/20	20/20	17/20
AC	37	17	20/20	19/20	18/20
AS	48	16	19/20	19/20	20/20
EP	69	15	20/20	20/20	18/20
TB	38	18	20/20	19/20	19/20
JM	39	16	20/20	20/20	19/20

Mean Age: 49.6; Mean School Leaving Age (SLA): 16.2

Total Errors: 25  
G Item errors: 1  
SS Item errors: 3  
SI Item errors: 21  
-----

The non-dysphasic subjects all made 3 errors or less - which was similar to the results obtained in piloting the Pyramids and Palm Trees Test (Howard and Patterson 1992). Most of the control subjects' errors occurred on items with SI distractors. Some of these seemed due to rogue items, such as 'open' vs 'close' and 'fall' vs 'rise'. Overall just 12 items were responsible for all the non-dysphasic errors. (Items which incurred more than one control group error were later replaced or altered).

The test was also administered to 12 dysphasic subjects (Table 8.2). The figures in the 'Verb Production' column record the subjects'

ability to name the 20 target items from the test. This was measured on a separate occasion, after they had completed the non-verbal test.

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 Table 8.2 Results of Piloting with the Event Perception Test with 12  
 Dysphasic Subjects  
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Subject	Age	SLA	G Items	SS Items	SI Items	Verb Prod
MM	64	14	18/20	16/20	16/20	7/20
EM	53	16	20/20	20/20	17/20	11/20
PB	53	18	20/20	15/20	19/20	9/20
SW	53	16	20/20	20/20	19/20	19/20
DG	50	18	20/20	18/20	19/20	20/20
DL	29	16	20/20	19/20	18/20	15/20
DO	46	16	20/20	17/20	17/20	8/20
MC	57	16	19/20	19/20	14/20	4/20
LO	66	16	19/20	16/20	15/20	7/20
AD	62	18	20/20	18/20	14/20	8/20
NB	31	18	19/20	16/20	13/20	0/20
RS	63	15	19/20	17/20	16/20	13/20

Mean Age: 52.25 Mean SLA: 16.41

Total Errors: 78  
 G Item errors: 6  
 SS Item errors: 29  
 SI Item errors: 43  
 -----

The dysphasic subjects were screened using the Pyramids and Palm Trees Assessment. All scored 5 errors or less, which suggested that their general picture recognition skills were good.

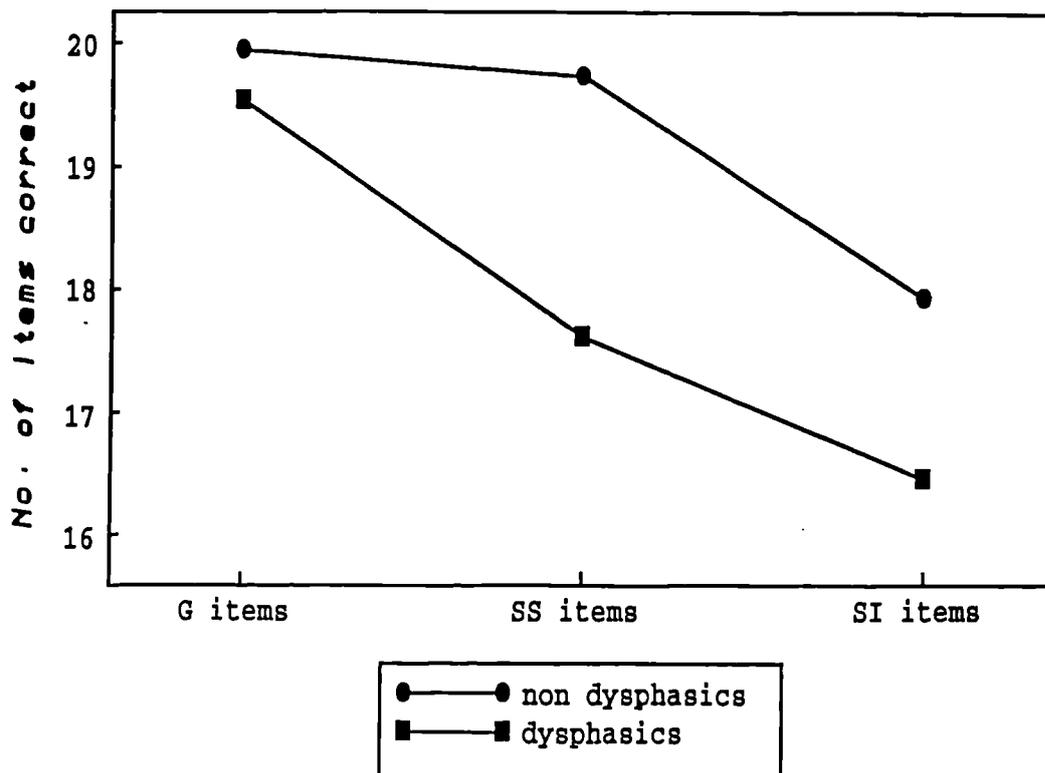
Overall the dysphasic group performed worse on the Test of Event Perception than the non dysphasics/controls ( $F(1,20) = 13.075$ ;  $p < 0.01$ ). The test condition, or distractor type, was also significant ( $F(2,40) = 26.231$ ;  $p < 0.001$ ). A Newmann-Keuls test was used to compare the three test conditions and showed that each was significant at  $p < 0.01$  level. Thus SI distractors were significantly more problematic than SS distractors and SS distractors significantly more problematic than G distractors.

The visual representation of the results (fig 8.2) suggests that the main source of the difference between the two groups might have been the SS items, since the dysphasics seem to have found these markedly more problematic than the controls; indeed the non-dysphasics are still virtually at ceiling on these items. However the interaction between subject type and test condition just falls short of significance ( $p < .06$ ). Independent t tests confirm that the dysphasics are worse than the controls with both the SS and SI items. It is important to note that 4 of the dysphasic subjects are similar to the controls since they made just 3 errors or less.

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Figure 8.2 Graph of the Mean Performance of the Dysphasic and Non-Dysphasic Pilot Subjects on the Event Perception Test

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How did the dysphasic and non-dysphasic subjects carry out this task? We might explore this by considering one item from the test in some detail (Figure 8.3). In this item two representations of 'pour' have to be paired. The distractor is 'spray' (SS).

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Figure 8.3 Example Stimulus from the Event Perception Test  
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Presumably subjects explored the pictures to identify common features. Here are some of the factors which might be identified:

top picture (T):

transferring liquid from one container to another with a continuous gravitational manner of motion

a purposeful action which brings about an effect on the jug

human agent

bottom left picture (BL):

transferring liquid from a container to a surface with a pressurised and dispersed manner of motion

a purposeful action which brings about an effect on the car  
human agent

bottom right picture (BR):

transferring liquid from a container to a surface with a continuous gravitational manner of motion

a purposeful action which brings about an effect on the bucket  
human agent

None of the features precisely match, although there are shared elements. For example (T) and (BL) share the manner of motion while (T) and (BR) both bring about an effect on the goal, although the nature of that effect is different. How, then, is selection achieved? The non-dysphasic subjects made no errors on this item. It seems that for them the manner of motion was most salient, possibly because this feature could be linked to the common verb 'pour'.

This suggests that non-dysphasic subjects may have used verb labels when carrying out this task, even though they were asked not to name the pictures. In other words they may have analysed the pictures for key semantic components and then noted which shared components could be attached to common verb labels. Some of their comments in response to problem items would support this. For example: 'I'm not sure whether this is opening or closing' and 'these are both flying' ('fall' vs 'rise').

Four of the dysphasic subjects made errors on item 25 (fig 8.3). This suggested that they may have been approaching the task differently. One obvious difference is that many of these subjects did not have access to verb labels (see 'verb production' Table 8.2). Two of the subjects displayed virtually unimpaired verb production (DG and SW). They also made very few errors on the Test of Event

Perception. As event perception skills are assumed to underpin verb production and since these subjects could presumably engage their verb naming skills to help them in the test this is an unsurprising result. All the other dysphasic subjects had difficulties with verb production, which suggested that on many occasions they would have to judge the pictures without recourse to the verbs which describe them.

While helpful in this task, verb naming is clearly not essential. Two of the dysphasic subjects, EM and DL, performed within normal limits despite impaired verb retrieval. Furthermore all the other subjects were well above chance. It seems that at least some subjects may retain the ability to analyse and categorise the properties of events, despite difficulties in accessing labels for those properties.

Why might dysphasic people make errors on the task? One possibility is that they failed to derive the type of semantic information listed above. Instead they may have simply looked for shared visual characteristics between the pictures. Yet item 25 would contradict this. This stimulated 4 dysphasic errors, despite the perceptual similarity between the target and its match. It seems that these subjects were processing the pictures at a deeper level than just visual similarity. Also the pattern of errors across the test showed that subjects were most vulnerable when events were semantically related. If subjects were not processing semantically, this would not have been the case.

A second account of the dysphasic errors suggests that although they were performing semantic analysis, this was in some way underspecified or inadequate. For example in the above item they may have failed to note the manner of movement of the liquid. Alternatively it may be difficult for them to judge the comparative saliency of the different semantic features. Thus some subjects may have found the effect of the action more salient than the manner. This might encourage them to pair the items which bring about an effect on the goal, even though that effect is different.

The Dysphasic subjects showed some insensitivity to all semantic properties of events, since they are worse than controls with both the SS and the SI items. Their performance with the SS distractors indicates that they may be failing to discriminate some of the broad semantic features of events, such as manner and effect, which eventually determine verbs' syntactic privileges. Errors on the SI items suggested that they failed to note some of the fine differences, such as the directional information in 'roll' and 'spin' and the environmental information which separates 'drop' and 'sink'. These fine differences induced the most errors, suggesting that, as a group, dysphasics find the idiosyncratic features of events the least salient (although there were also non-dysphasic errors on these items).

#### Conclusion

Piloting indicated that normal variations in picture interpretation should account for only a small number of errors on this test (3 or less), and with the subsequent revisions this number should be reduced. It also identified 4 dysphasic subjects who scored within normal limits, which showed that the test was not intrinsically problematic for a brain damaged population. Deriving more specific conclusions from group results requires caution. However there was an indication that, as a group, dysphasic subjects might have some insensitivity to both the broad syntactically relevant features of events and the finer, idiosyncratic aspects. The piloting also suggested that there was a relationship between performance on this test and verb production. There was a strong positive correlation between the verb naming score and the number of errors produced on the Event Perception Test (.85,  $df=10$ ,  $p<.001$ ). Thus patients with unimpaired verb production performed normally on the test. This was unsurprising. Indeed the assumptions behind the test would be severely challenged if subjects with good verb production were to fail it. While most subjects with impaired verb naming made more errors, there were exceptions. EM named just 11 verbs, but scored within normal limits on the test. It seemed that, despite the

general trend, there may be some subjects with poor verb naming but intact event perception.

There are problems with this test. All the non-dysphasic subjects made some errors. While obvious rogue items have been replaced, it is difficult to anticipate how a picture might be interpreted and 'normal errors' remain possible. Also the test seems quite insensitive to differences between dysphasic subjects. For example none made more than 12 errors. This may indicate that profound difficulties in event perception are rare in dysphasia, or that the test is failing to tap the full subtleties involved. Finally it is very difficult to conclude why a dysphasic subject might make errors. Some errors may reflect genuine problems in event analysis, such as a failure to uncover all the properties of the event or an inability to focus on particular features such as manner or effect. However other errors may have more 'trivial' sources. Subjects may be seduced by a chance visual similarity between the pictures or some esoteric connection between the objects involved. Therefore unless very powerful patterns are seen in the data it is difficult to use the test to make strong statements about a subject's event perception skills. This task must be viewed as a preliminary attempt to explore some of the pre-verbal processes in dysphasia.

### 8.3 The Role Video

The Test of Event Perception explores subjects' ability to relate different representations of the same verb, or sort events into linguistically relevant categories. While this is clearly an important aspect of event analysis it offers no insights about whether subjects are deriving role information from the event, or identifying who is doing what to whom.

The ability of patients to map role information onto syntax receives particular attention in a number of aphasia assessments (eg Jones Test 1984; Reversible Sentence Test, Black et al 1991; PALPA Kay

Lesser and Coltheart 1992). Yet few investigators have considered whether patients are necessarily identifying the role structures of the events themselves (although see Schwartz et al 1980). The Role Video attempts to address this question.

The materials for this test consist of a video of 32 events, each of which is accompanied by 3 still photographs. The events are of 4 types:

- a) non reversible events involving people acting upon objects, eg a woman burning a newspaper;
- b) non reversible events again involving people acting upon objects but with a greater focus on the inanimates, eg a hammer breaking a cup;
- c) reversible events involving animates acting upon each other, eg a woman shooting a man;
- d) reversible events involving change of possession, eg a man selling a camera to a woman;

(see appendix 8.2 for complete test stimuli)

Each category of event is represented by 8 items. Categories (c) and (d) consist of 4 events which are reversed to make up the 8 items. Thus one item shows the woman shooting the man and the other the man shooting the woman.

Subjects are shown the event. They are then presented with the three photographs and the event is played again. After this second presentation they are required to indicate the photo which represents the outcome of what they have seen. The photos are of three types:

The Target shows the correct outcome, for example the burnt remains of the newspaper (a).

The Event Distractor shows the outcome from a different type of event enacted on the same theme or goal, for example the torn fragments of a newspaper (a).

The Role Distractor shows the outcome of a similar event which has been enacted on the wrong theme or goal, for example the burnt remains of a box (a).

The role distractors vary according to the type of event. In categories (a) and (b) they enlist alternative objects which are present in the video, although uninvolved in the event. For example, the box in example (a) is visible in the background while the woman ignites the paper. In categories (c) and (d) they represent a reversal of roles. Thus the role distractor for the examples above show the woman dead on the ground and the man ending up with the camera.

The role distractors aim to explore whether subjects can extract and retain information about who is performing which function in an event. The reverse role items are particularly important, since here judgements cannot be made purely on the basis of who or what is involved. The precise role of the person has to be determined. Category (b) was included to investigate whether the ability to make role judgements is compromised when the focus is less on the people and more on the objects involved. The test also permits comparison between agentive and change of possession events, which involve different roles (although of course the numbers are small). The event distractors aim to identify more generalised problems with the events, for example selection of these photographs might indicate that the subject has not really understood what is happening in the video.

The test was piloted on 5 non dysphasic subjects, all of whom made no errors. Piloting was not conducted on dysphasic subjects. However the test has since been administered to 5 'agrammatic' dysphasic

subjects within our department (excluding those reported in this study). None made any errors.

#### 8.4 Definition Naming Test

The two non-verbal tasks above aim to investigate subjects' skills in event analysis. It is assumed that the products of this analysis form a specification for verb retrieval. Verb access was focussed in a further stage of testing. In particular tests were required which compare verb retrieval with retrieval of other word classes.

The Definition Naming Test was devised to compare subjects' ability to access the phonological forms of nouns and verbs in response to a definition cue, eg:

What men have to do if they don't want a beard (shave)

To die in water (drown)

A leather strap used to keep your trousers up (belt)

A map of the world that looks like a ball (globe)

(see appendix 8.3 for complete test stimuli)

The test comprises 66 items. The targets consist of 33 nouns and 33 verbs which are matched on the basis of their cumulative frequencies and syllabic structure (available in Zingeser and Berndt 1990). Some of the targets cross word class boundaries, for example 'belt' above can be both a noun and verb. These ambiguous items are deemed acceptable since the alternative forms have much lower frequencies than the targets (less than 12%).

Before a test of this kind can be used to compare noun and verb access inherent biases need to be discounted. In particular it was feared that verb definitions might relate in a less obvious way to their targets than noun definitions. If this were the case it would be anticipated that the verb cues would induce a greater variety of

normal responses than the noun cues. To test this a written version of the task was administered to 10 non-dysphasic subjects and all deviations from the target were scored.

Overall the non-dysphasic subjects produced 62 responses which differed from the target, 27 on verb items and 35 on noun items. The 'errors' all arose from 20 items - 10 of which were verbs and 10 nouns. Considered individually, 7 subjects produced most 'errors' on the noun items, and 3 produced most 'errors' with the verbs.

These results indicate that for normal speakers the verb targets are as predictable from their definitions as the nouns, if not slightly more so. The pattern of variation was quite high, with both classes. This can be partly attributed to the mode of presentation, which did not permit the examiner to encourage further attempts if the target had not been produced. It also suggests that when testing dysphasic subjects, close or synonymous responses might be counted as correct.

Anomic subjects tend to name nouns worse than verbs, or perform similarly with the two word classes (Micelli et al 1989; Zingeser and Berndt 1991). The Definition Naming Test was administered to an anomic dysphasic subject who scored 22/33 with the verbs and 23/33 with the nouns. While far from conclusive, this again suggested that the task has no inherent bias in favour of one word class.

Clearly this task imposes quite severe input demands in addition to the output component. Also it was very difficult to control the complexity of the definitions, and still provide appropriate cues for each word. Performance on this test was therefore supplemented with additional naming data, derived from picture description tasks. These are described within the individual case studies.

## 8.5 Noun and Verb Reading

Impaired verb retrieval may arise from different levels of the lexical system. For example some subjects show evidence of a

category specific semantic disorder, while others have deficits confined to phonological access (see section 3.3). Naming tasks cannot, in isolation, diagnose the source of the retrieval problem. Comprehension tests are important here, since they provide evidence about the status of the semantic system (see sections 8.6 and 8.7). Single word reading data are another resource. Reading aloud engages alternative routes to phonology, eg semantically mediated access or direct access from the visual word recognition system (Ellis 1984). The availability of these alternative routes may produce different reading and naming performances. For example a pure semantic deficit may be bypassed by the direct reading route, resulting in better reading over naming. Comparing naming and reading may therefore help to differentiate between semantically based and phonologically based retrieval problems.

32 of the frequency matched verb/noun pairs used in the Definition Naming Test provided one set of reading stimuli ('bow' and its partner were excluded since this written form is ambiguous). However these items were not matched for imageability, which is known to influence reading performance. Accordingly 34 additional frequency matched verb/noun pairs were identified, making a complete set of 66 items. Of these imageability ratings were available for 34 (Pavio, Yuille and Madigan 1968). Imageability ratings for the remaining 32 items were obtained from 20 subjects, all of whom were university undergraduates. The instructions and design of the rating task were derived from Pavio et al (1968) and are provided in appendix 8.4. From these data it was possible to derive 22 noun/verb pairs which were matched for both frequency and imageability (see appendix 8.5).

## 8.6 Test of Verb Comprehension

Impaired verb naming may reflect a verb specific semantic impairment. Assuming that one semantic system subserves both input and output, this would be supported by evidence of impaired verb comprehension.

This test aims to evaluate subjects' comprehension of verbs' core meaning. It comprises 100 items. In each the subject is shown a single picture and asked a yes/no question, eg:

picture	stimulus:
a man peeling an orange	is this peeling? (T)
a man covering a car	is this loading? (SS)
a man pushing a car	is this pulling? (SI)
water being poured into a glass	is this breaking? (G)

The spoken stimuli are of four kinds. 40 offer the target verb (T); 20 offer verbs which are grossly different from the target (G) and 40 offer verbs which are semantically related to the target. Of these 20 are semantically related but syntactically different (SS). Thus the syntactic privileges of 'cover' and 'load' differ in the following ways:

He loaded the sacks into the lorry.  
\*He covered the tarpaulin onto the car.  
He loaded the lorry/the sacks.  
He covered the car/\*the tarpaulin.

20 of the semantic distractors are both semantically and syntactically related. These differ purely by fine, idiosyncratic features (SI). Thus 'push' and 'pull' both express the causation of movement with a path component. They diverge only in the direction of the path, eg 'pull' expresses a towards direction and 'push' away. This difference does not affect the syntactic behaviour of the verbs, which is identical:

He pushed/pulled the pram to George.  
\*He pushed/pulled George the pram.  
(compare: He threw George the pram)

The different semantic distractors are used to test subjects' sensitivity to different types of verb information. (SS) distractors

can be differentiated from the target via the broad, syntactically relevant features of verb meaning. For example 'cover' differs from 'load' partly because it has a stronger effect component (it is possible to load sacks into a lorry leaving it half loaded, while it is not possible to cover a car with a tarpaulin leaving it half covered). (SI) distractors require access to the finer, idiosyncratic, features of verb meaning which do not carry syntactic implications.

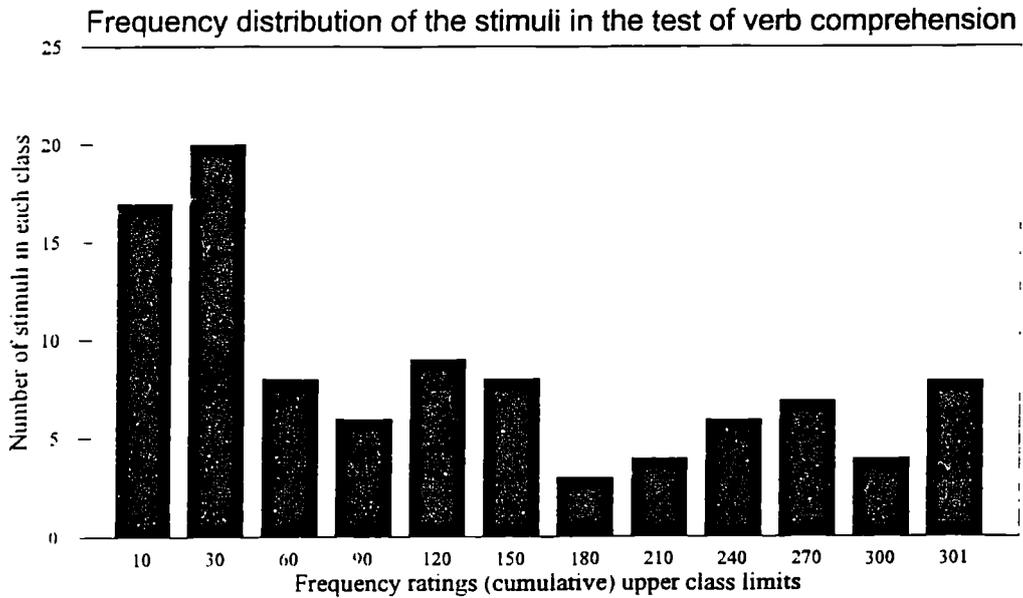
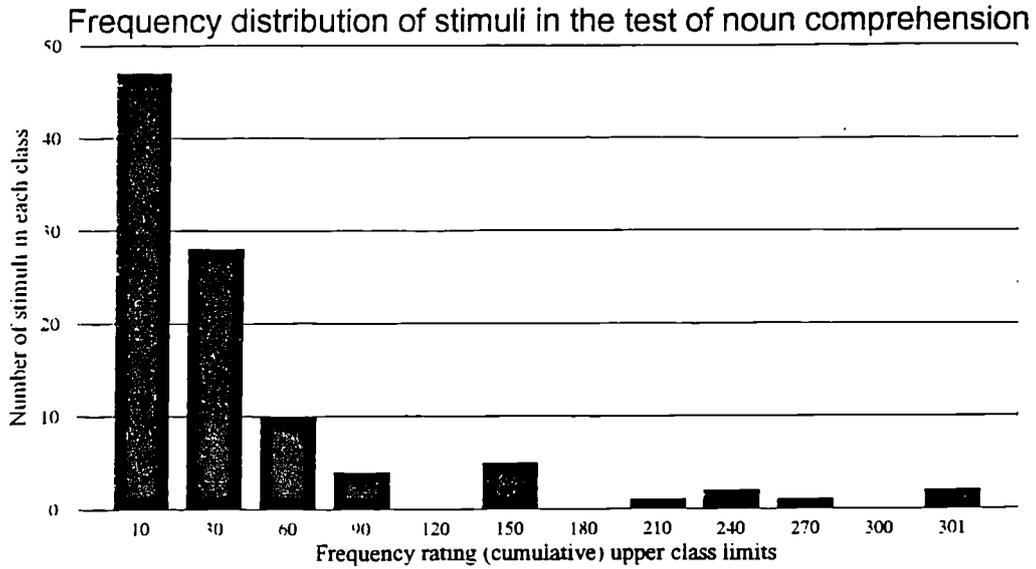
### 8.7 Test of Noun Comprehension

Subjects with a category specific semantic impairment with verbs would be expected to make more errors in a test of verb comprehension than a test of noun comprehension. However it is difficult to compare the results of the above test with existing measures of noun semantics, as the criteria for success are different. For example the word/picture matching tests now available in the PALPA (nos 47 & 48) require the subject to match a spoken or written word to one of 5 pictures. Therefore a chance result would be 20% - unlike the above test where it is 50%. It is also possible to make a semantic error on every item in the PALPA tests, unlike the above task where only 40 items offer semantically related distractors.

The PALPA stimuli were 'reworked' to produce a test which is similar in format to the above. The test of Noun Comprehension also has 100 items. As above, the subject is shown a picture and asked a yes/no question:

picture	stimulus
an axe	is this an axe? (T)
braces	is this a belt? (CS)
a parachute	is this a plane? (DS)
a wheel nut	is this a fish? (G)

Figure 8.4 Frequency Distribution of the Stimuli in the Tests of Noun and Verb Comprehension



As in the verb test 40 of the stimuli offer the target word (T); 20 offer a noun which is grossly different from the target (G); and 40 offer a semantically related noun. Of these 20 are close semantic distractors (CS) and 20 distant (DS). These distractors are the same as those used in the original PALPA tasks.

Although this task is similar in format to the verb test direct comparisons are compromised by differences in frequency. Figure 8.4 illustrates the frequency distributions of the stimuli in the two tests. Clearly the nouns are lower in frequency than the verbs. For example 47 of the noun items have frequency ratings of 10 or below, while only 17 of the verbs fall into this band. This makes a verb>noun performance difficult to interpret, since it could reflect either the frequency advantage or a word class effect. However a worse performance with the verbs is less problematic, since this is clearly not due to frequency. Here a specific word class effect is suggested.

#### 8.8 Sentence Anagram Task with Distractors

Some dysphasic subjects seem able to access verbs' core meanings but not their grammatical properties (eg Saffran et al 1980; Jones 1986; Byng 1988). The Sentence Anagram Task was devised to investigate whether subjects can access and employ the thematic and assignment information attached to verbs.

The task involves the composition of sentences from provided fragments, which suggests that it engages production processes. However the comprehension element is probably greater. Subjects must comprehend the given fragments and retrieve the full thematic and mapping information from the verb. Also many subjects arrange the fragments and then judge the results. Accordingly the task is deemed to be principally one of input. Clearly reading skills are essential, although subjects can be given assistance here if necessary.

In the first level of this task the subject is presented with three sentence fragments which s/he is required to sort into a sensible order, eg:

the man	the trousers	sharpens
the sock	cuts	the man
darns	the woman	the knife

25 of the items involve a person acting upon an object. The exceptions involve people acting upon babies/children, eg:

the baby  
the nurse  
comforts

or people acting upon animals, eg:

the fly  
squashes  
the man

Two items were deemed to be semantically reversible (and therefore acceptable in either form), although in both there was a strong pragmatic bias on favour of one ordering:

the vicar	the horse
the thief	the woman
murders	leads

In all cases the ordering can be accomplished without reference to pictures.

In the second level of the task a distractor fragment is introduced. Now the subject has to eliminate one phrase prior to ordering the sentence. Distractors are of two kinds. Set a (16 items) introduces a second argument which is compatible with the verb's semantics. This argument is either a theme, a goal or an instrument:

the man	the water	the woman
the sock	<b>the glass</b>	<b>the scissors</b>
darns	pours	cuts
<b>the wool</b>	the man	the trousers

Elimination of the additional fragment is achieved through reference to the verbs' argument and mapping information. For example the verb 'darn' maps the goal onto the direct object, in contrast to 'pour' which maps the theme onto this position. The subject must have access to this information in order to know which argument to retain in the three part sentence. The instrument arguments can either be eliminated or, in some cases, mapped onto the subject position. Here success depends on an awareness of how the arguments of agent, theme and instrument are manipulated around the verb.

Set b (16 items) introduces an alternative theme which violates the selection restrictions of the verb, eg:

the man	<b>the hammer</b>
the newspaper	the man
<b>the television</b>	the knife
reads	sharpens

Success with these items does not depend on access to the verb's argument information. Knowledge about the verb's core meaning and selection restrictions will be sufficient to reject the distractor. (see appendix 8.6 for full set of stimuli)

This test permits a number of comparisons. Firstly subjects' performance with and without the distractors can be compared. A subject with poor verb knowledge would be expected to do worse in the distractor condition. However this might simply reflect the increased number of components. Here the different types of distractor are important. A specific loss of verbs' argument information would impair condition (a) but not (b).

A number of criticisms might be levelled at this test. Firstly many of the items in sections (a) permit more than one resolution. Take the following stimuli:

the man	<b>the poison</b>
the jug	the ant
<b>the water</b>	kills
fills	the man

Here the following options are available:

the water / fills / the jug  
the man / fills / the jug

the man / kills / the ant  
the poison / kills / the ant  
the poison / kills / the man

These options increase the possibility of achieving a correct result by chance, which is a potential problem for the test. It is clearly important to observe subject's performance with these items, both to see whether they are aware of the options and to determine whether they are simply ordering the fragments at random. If there are more errors with section (a), despite the chance loading, this would support the hypothesis that these items are intrinsically more problematic for the subject, presumably because they demand specific recourse to verbs' argument information.

Another criticism relates to function word sensitivity. Some of the distractor arguments can follow the verb within a prepositional phrase, eg:

the man / darns / **with the wool**

the woman / drops / **to the floor**

Therefore selection of these items might not reflect a loss of verb argument information per se, but an insensitivity to the syntactic markers which make these forms acceptable. It is clearly important to take account of function word competence when interpreting performance on this test. Subjects who are unable to produce, or comprehend closed class items may make errors on this test because of their function word deficit. Where function word skills are preserved errors are more likely to reflect inadequate verb information.

### 8.9 Sentence Judgement Test

This is an input task which also aims to explore whether subjects can retrieve verbs' thematic and mapping information.

The subject hears 80 sentences, 40 of which are anomalous. S/he is asked to judge whether or not the sentence is acceptable. Half the anomalous sentences violate the verb's argument structure. Five omit an obligatory agent and instead map a likely theme onto the first noun phrase, eg:

\*The dinner eats

Five employ an anomalous agent/patient structure, eg:

\*The thug dies the woman

Five omit an obligatory theme argument and instead map a possible goal after the verb, eg:

\*The woman spills the floor

Five omit an obligatory goal. Here either an obligatory three argument verb is used with just one post verbal noun phrase, eg:

\*The man puts the jam

or a likely theme is mapped onto the direct object, rather than the required goal, eg:

\*The cook stuffs the breadcrumbs

Ten of the verb/argument anomalies violate both the thematic and subcategorisation restrictions of the verb, as in the 'put' and 'die' examples. Ten combine the verb with an acceptable syntactic structure although with inappropriate arguments mapped onto that structure. Thus 'stuff' above can be used with an SVO structure. The anomaly occurs because the theme, rather than goal has been mapped onto the direct object. Therefore although the numbers are small, the task offers some insight into whether subjects can exploit syntactic cues when detecting anomalies.

The remaining twenty anomalies violate either the selection restrictions of the verb, or the relationship between the meaning of the verb and an optional modifier, eg:

\*The man burns the water

\*The man writes the painting

\*The man skates on the water

\*The man bashed the ball gently

The forty correct sentences mirror the structures used in the anomalous items.

(see appendix 8.7 for complete set of stimuli)

This task explores subjects' sensitivity to two types of verb violation, one involving their argument structures and the other their core meaning. Subjects with a selective loss of the structural information attached to verbs might perform well with the pure semantic anomalies, eg those violating verbs' selection restrictions or the relationship between the verb and a modifier, but poorly with the argument anomalies.

One problem with a task of this kind is that it is difficult to prevent verb violations from being multi dimensioned. Take the 'spill' example above. My analysis suggests that the violation results from the inadmissible mapping of the goal onto direct object. However this could also be seen as a selection restriction violation. 'Spill' either requires a liquid object, or a solid, such as rice or sand, which moves in a liquid-like fashion. 'Floor' meets neither of these requirements. A subject who detects this violation could therefore be making use of his or her knowledge about the verb's selection restrictions. Similarly 'breadcrumbs' fail to meet the selection restrictions of 'stuff', which demands an object with some form of cavity. Yet there is a strong relationship between these verbs' selection restrictions and their argument structures. 'Spill' imposes its selection restrictions over the theme, while 'stuff' imposes them over the goal, whether that goal is mapped onto the direct object or following prepositional phrase, eg:

The cook stuffs the breadcrumbs into the turkey.

The cook stuffs the turkey with breadcrumbs.

The nouns which appear in the argument anomalies do meet the requirements for one of the arguments of the verb. Thus although 'floor' violates the selection restrictions for the theme of 'spill' it is a suitable goal. Similarly 'breadcrumbs' are an acceptable theme, but not goal. In order to enlist the selection restrictions of the verbs it is essential to know the relationship between those restrictions and the arguments over which they operate. Simply knowing about the properties of the nouns involved in these events will be inadequate to make the judgement. This is not the case for the pure selection restriction violations. Take the following example:

The woman murders the table.

'Table', being inanimate, does not meet the selection restriction requirements for 'murder'. It is also a highly unlikely instrument

or agent. Therefore 'table' meets the requirements of none of the possible arguments of the verb.

There is the further difficulty that normal language use often violates verbs' selection restrictions, particularly in slang and metaphor, eg:

This car drinks petrol.

The phd student skated over the difficult question.

A subject who is apparently failing to detect selection restriction violations might be responding to normal variations of usage. Yet interestingly when the test was piloted on 5 non-dysphasic subjects none accepted the selection restriction violations. Overall these subjects made 2 errors, both of which occurred with verb argument anomalies:

\*The woman gives the present

\*The boy hands the salt

#### 8.10 Summary and Conclusion

The tests described in this chapter were developed to explore different aspects of verb competence. In conclusion I shall outline how the tests might contribute to the 'diagnosis' of a verb deficit.

One obvious sign of a verb disorder might be reduced verb production. The Definition Naming Test compares the retrieval of frequency matched verbs and nouns. Given the input demands of this task, supplementary data from picture naming and spontaneous speech is essential in order to confirm disordered verb access.

Reduced verb production may originate from a number of causes. Some subjects may be unable to construe events in ways which are compatible with the lexicon. They may be failing to extract the broad semantic properties of events which map onto verb meanings, such as the manner or effect of the action. At a finer level they

may be failing to identify the more idiosyncratic features which are required by particular verbs, such as the directional information in 'push'. The ability to extract the semantic properties of events, and hence match two different representations of the same verb, is explored by the Test of Event Perception. Verb retrieval also depends on the subject's ability to identify the role structure of the event, or who is doing what to whom. This skill is explored by The Role Video.

Impaired verb retrieval may reflect a specific semantic problem with verbs. Owing to the centrality of the semantic system it would be anticipated that this would also generate semantic problems on input. The Test of Verb Comprehension assesses subjects' understanding of single verbs. The different types of semantic distractor used in the assessment may identify whether the subject is failing to differentiate the broad, syntactically relevant aspects of verb meaning, or just the finer, idiosyncratic features. Although not strictly matched, the Test of Noun Comprehension might indicate whether semantic difficulties are confined to verbs or shared across other word classes.

The semantic representations of verbs are multi-dimensional (see section 2.8 and 7.3). Some subjects may retain the core meaning of the verb, but lack the additional, grammatically relevant information such as its thematic structure and mapping information. These subjects could still perform well on the Test of Verb Comprehension, which demands only general verb knowledge. The Sentence Anagram and Sentence Judgement tasks were developed specifically to investigate subject's access to the grammatical properties of verbs.

Finally some subjects may be unable to retrieve the phonological forms of verbs. Here reading aloud data is helpful, since this task potentially engages alternative routes to phonology. A list of 22 verb/noun pairs was developed which was matched both for frequency and imageability.

These tests do not constitute a comprehensive 'verb battery'. In all three single cases they are supplementary to other data, such as output samples, tests of sentence comprehension and naming tasks. Some additional tasks were also developed in response to the individuals' profiles, which are described in the single case studies.

My outline of how the tests might be applied was underpinned by a number of assumptions. Firstly it assumed that verb production entails a number of stages. Conceptual analysis identifies the key properties of the event which make up the semantic and role specification for the verb. A semantic search then identifies a verb which can meet this specification. The semantic representation of the verb encompasses its core meaning, thematic structure and mapping requirements and therefore provides much of the information which is needed for sentence generation. A further level of processing then provides the phonological form of the verb. It is possible that verb processing is, in fact, more interactive than this implies. For example a semantic verb disorder may impair earlier conceptual analysis and poor phonological retrieval may compromise semantic processing. This will be discussed further in the light of the evidence from the single cases.

It is also assumed that one central semantic representation serves both verb production and comprehension. Thus impairment in this representation should result in poor verb retrieval and use, comprehension errors and impaired performance on the anagram and judgement tasks, which demand recourse to verb information. Again this assumption can be tested by the evidence of single patients.

## Chapter 9 Case Study 1 EM

### 9.1 The Subject

EM suffered a left CVA in February 1989 when she was 52. Her stroke resulted in severe dysphasia and a hemiplegia, which rapidly resolved. At the time of her CVA she was working as a receptionist in a local sports centre. Prior to that she had held various secretarial posts. EM's husband was killed in a car crash 5 years before her stroke. She has three adult children who all live near her. She was originally from Wales and came to England when she was 18. She is a monolingual English speaker.

Very little information is available about EM's presentation and management following her stroke. A reported Boston Diagnostic Aphasia Examination (March 1990) suggested a Broca's profile, with reduced phrase length, dyspraxia and relatively spared comprehension. Following her CVA she received twice weekly out patient speech and language therapy at her district hospital for approximately 6 months. She was admitted to the City Dysphasic Groups in October 1990. At the onset of this study (January 1991) she was attending two days a week.

Throughout this study (January 1991 - June 1993) EM experienced episodes of depression. Previous reports suggested that she had been depressed even before her stroke possibly because of her sudden bereavement. In October 1992 she attended a counselling service for people with dysphasia.

### 9.2 Informal Observations

The conversation sample (see table 9.1) shows that output was almost entirely limited to single words and phrases. Word finding problems were evident, particularly with low frequency targets, such as 'parsnip' and 'pot pourri' (although a number of low frequency words were achieved). The naming difficulties seemed to incur semantic

errors, such as 'swede' for parsnip, 'perfume' for pot pourri and 'New Year' for Boxing Day. However these were rapidly self corrected and, in the case of perfume, followed by clarifying circumlocution. This evidence suggested that her errors did not arise from a semantic deficit per se. The phonological 'groping' seen in the sample indicated that EM's naming difficulties might be at the level of phonological retrieval. It was hypothesised that the semantic approximations may reflect blocked targets at this level (Caramazza and Hillis 1990) and might have been produced as a strategy for directing the listener to the target. Despite early reports of dyspraxia articulation problems were not evident and EM retained her Welsh accent.

Striking in the sample is the lack of any verbs. Verb information is either conveyed by completing a predicate in the question or through 'it's' phrases, eg 'Paul its um CD' (target: I gave Paul a CD). Despite her word finding problems EM accessed 28 content nouns in the sample (including family terms and proper names) in comparison with no verbs. Although EM's verb production was poor she seemed to understand verb information. For example she responded correctly to 'reversible' questions such as 'did he come to you?' and 'what presents did you give?'

From these observations it was hypothesised that EM had a verb retrieval deficit, although her apparently good comprehension suggested that her knowledge about verbs might be relatively spared. The verb disorder seemed to disrupt her communication more than the general word finding problem, since EM was able to access many nouns and had some strategies for coping with her anomia.

-----  
Table 9.1 Conversation Sample (20.1.92)  
-----

JM: How was your Christmas?

EM: Fine fine fine fine ... um New Year and Christmas .. um Daren

JM: Did he come to you?

EM: No (gestures away from self) .. yes

JM: You went to him. How long did you stay with him?

EM: Well .. its um Christmas and um New Year no .. um /bə / Boxing Day

JM: Were there any others there?

EM: Oh no very .. um mother and father and brother and nan and Beverley and Paul

...

JM: What did you have?

EM: turkey and stuffing .. potatoes /kə / cauliflower sprouts carrots .. swede .. no (draws shape on table)

JM: Parsnip?

EM: Yes

...

JM: What about the presents?

EM: Perfume (gestures to table) .. no

JM: Its something to do with perfume?

EM: yes .. but its room .. air

JM: Pot pourri?

EM: Yes .. um nightdress .. I don't know

JM: What presents did you give?

EM: um Beverley its jumper and trousers and its um Paul its um CD  
-----

Assessment initially explored the hypothesised verb deficit. Spontaneous speech samples were analysed for verb retrieval, predicate argument structure and the morphological aspects of verb phrases. Subsequent naming tasks assessed her ability to retrieve verbs in isolation.

### 9.3 Spontaneous Speech Analysis

The spontaneous production of verb argument structure was investigated through a formal analysis (Byng and Black 1989). Two samples were elicited using the methodology described in Saffran, Berndt and Schwartz (1989). Both involved retelling classic fairy tales. The samples, with analysed utterances shown in bold, are given in appendices 9.1 and 9.2. The analysed corpus only totals 100 words, which is less than the 150 recommended by Saffran et al (1989). However, as EM found the story task so effortful, it was felt that further elicitation was inappropriate.

The results of the analysis are presented in table 9.2.

-----  
 Table 9.2 Number of utterances in each category produced in the pre therapy spontaneous samples.  
 -----

Structure:	No of Utterances
Noun Phrase	33
Verb only	8
NP <sub>1</sub> V	2
V AP/PP/AdvP	1
NP <sub>1</sub> V PP	1
Non Argument XP NP	1
Total number of utterances analysed	46

(XP denotes a phrase of any category)  
 -----

Most of EM's utterances were single noun phrases (72%) and just twelve contained a verb (26%). Even this low number may be an over estimation. While some of the verbs were unambiguous (eg 'sew' and 'sleeps') others may have been nominalisations (eg 'cooking' and 'cleaning') or nouns (eg 'bite'). Of her four utterances which contained predicate argument structure, two were anomalous:  
 'She's prettied up'  
 'the queen is changed as the wicked witch'

and one may have been a noun phrase:  
 'knock on the door'

These utterances, and many of EM's noun phrases showed some ability to realise function words and inflections. The morphological aspects of her speech were included in a second quantitative analysis (Saffran et al 1989). The results of this analysis are presented in table 9.3

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Table 9.3 Quantitative analysis of spontaneous speech samples

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Total number of words analysed	100	
Morphological measures		
Closed class : total narrative words	.32	#
Nouns : pronouns	45	
Proportion of nouns with determiner	.62	#
Proportion of verbs with inflections	.50	#
Aux score	1.6	
Structural measures		
Nouns : verbs	3.46	#
Proportion of words in sentences	.16	#
Proportion of sentences that are well formed	.33	#
Frequency of embeddings	0	#
Sentence elaboration index	1.00	#

# indicates measures which fall within the range of agrammatic speakers in Saffran et al 1989.

---

On most of the quantitative measures EM performed similarly to the agrammatics investigated by Saffran et al (1989). There were some exceptions. Her pronoun use was worse than these subjects. This probably reflects EM's inability to construct a running discourse, since without such a discourse pronoun use is abnormal. Another exception was her 'aux score' which fell within the range of normal speakers. This score records her ability to realise the auxiliaries and inflections of verbs used within sentences. Owing to the quite constricted sentence criteria demanded by this analysis, there were only 3 verbs of this type in EM's corpus. Therefore conclusions from this measure must be guarded. However the score suggests that when EM accessed a verb she had some ability to realise its syntactic form. This was apparently contradicted by the proportion of verbs with inflections, which is well below normal. This measure, unlike the 'aux score', includes all verbs regardless of whether or not they appear in sentences. It has already been suggested that some of these were not genuine verbs. Also in the Cinderella story EM may have been targeting imperative forms. Finally EM's ability to realise noun's determiners was in the upper range of the agrammatic speakers, most of whom scored below .5. It seemed that EM could often produce the function words and inflections required for noun phrases, eg:

'beautiful apples'

'the loveliest woman in the land'

'the wicked witch'

#### Conclusion

These analyses were consistent with the hypothesised verb retrieval deficit. Over 70% of the utterances were single noun phrases (table 9.2) and the noun:verb ratio was abnormal (table 9.3). The fact that 8 verbs were produced in isolation suggested that even when a verb was accessed EM still had difficulties combining it with argument structure (although the ambiguous status of some of her verbs must qualify this statement). Most morphological measures were also

reduced (table 9.3). However a normal 'aux score' suggested that EM retained some ability to employ verb phrase morphology and although her determiner score was 'agrammatic', she often realised the function words and inflections of noun phrases.

The samples also displayed the phonological problems observed in conversation. Several phonological errors were recorded, often when EM was 'groping' for a target, eg:

'/dʒuɛɪm/ rhyme'

'/dʌɪv/ dwarves'

'/wɪmɪ/ no mirror on the wall'

and there were some uninterpretable neologisms:

/(ɔdə/

These further supported the hypothesis that EM's naming difficulties were at the level of phonological retrieval. Her use of the written modality in the Cinderella sample suggested that orthographic access might be relatively spared.

#### 9.4 Verb and Noun Naming (Spoken)

Informal observation and the above analysis suggested that, in spontaneous speech, EM was more able to retrieve nouns than verbs. It was hypothesised that this reflected a category specific naming problem. This was investigated in two spoken naming tasks.

##### Noun/Verb Photos (Byng 1988)

This task uses noun/verb pairs which share phonological forms. For example the noun member of a pair shows a square of butter, and the verb member shows someone buttering bread. With the action pictures the subject is encouraged to produce just the name of the verb, eg 'can you give me a word for what she is doing'. 42 noun pictures

were presented in one session for naming, and 42 verb pictures in another. Presentation was separated in order to avoid priming effects. Informal observation suggested that EM's naming difficulties were at the level of phonological retrieval. This task explored whether EM's ability to access phonological forms was influenced by word class. (It should be noted that for some items this was not possible, since they permitted more than one acceptable target. For example the picture for 'shelving' could equally be described as 'putting books on the shelf').

EM scored 38/42 with the noun pictures (90%). Two of her errors seemed to reflect phonological problems, eg 'spoon' for spool and /pə / for pump. In the other two errors she accessed associated nouns, eg 'orange ... ' for peel and 'water ..' for bottle. These were not classed as semantic errors since EM's intonation contour and continued searching indicated that she knew that she had not reached the target.

The verb pictures were more difficult to score owing to the greater number of acceptable targets. I decided to record any reasonable verb use as correct. Even with this 'liberal' scoring EM achieved only 25/42 (59%), which was significantly worse than her performance with the nouns (chi square = 9.143,  $p < .01$ ).

Despite the instructions, 18 of EM's correct verbs were produced within a complete sentence, eg:

'The man's putting the belt on'

'The baby no .. the lady's changing the baby'

As in her spontaneous samples these responses showed an ability to retrieve function words and inflections. The action pictures also elicited far more verb argument structure than was seen spontaneously and there were promising signs of verb knowledge. The first example shows an awareness of the argument structure of 'put' which requires either two post verbal arguments, or, as in this case, a particle,

and the second example displays a capacity to correct word order errors around the verb.

Errors with the verb pictures were various. Six showed verb omission in the presence of relevant noun retrieval. Indeed in the first three cases the noun derivation of the 'target phonology' is accessed:

'the lady's .... the Hoover'	(hoovering)
'stamp and envelope'	(stamping an envelope)
'the money is .. the pocket'	(pocketing some money)
'the lady is ... microphone'	(taping)
'the lady's ... pastry'	(flouring a board)

Five responses employed inappropriate verbs and verb structures, or in one case a 'pseudo' verb:

'the lady's playing the parrot'	(caging the parrot)
'the woman's helping the books and the case'	(boxing books)
'the lady's trying the blue dressing gown'	(buttoning a dressing gown)
'she's putting the cloth on'	(polishing a table)
'booking the books on the shelf'	(shelving books)

Three responses included related verbs, although in all three EM was aware of the error:

'the lady's er .. write no'	(filing papers)
'the lady's mowing the lawn .. its er dig no'	(hoeing)
'darn'	(threading a needle)

Three responses were aborted at the point where the verb was required, eg 'the lady is ...'. One included 'phonological groping' for the verb:

'/lɔɪ/ .. /dɔɪ/' (dialling). Interestingly EM had achieved 'dial' quite easily with the noun picture.

This last example offered further evidence that EM was having difficulty at the level of verbs' phonology. Some of the other errors seemed to display phonological influences. For example 'mow' is both a semantic and phonological error for 'hoe' and 'booking the books on the shelf' seems an attempt to employ 'put' which has been hijacked by the more dominant noun phonology.

#### Conclusion:

This task suggested that EM was accessing nouns more successfully than verbs, even when the pictures allowed her to produce similar phonological forms across the two word classes. Not only was there a marked disparity between her verb and noun scores, but also her verb responses showed relatively intact noun retrieval. Her errors with the verbs showed omissions, the use of inappropriate verbs and 'semantic errors', although these were detected by EM. A few responses involved 'phonological groping' or phonological errors. Interestingly when correct verbs were produced they tended to appear in complete sentences.

The noun advantage in this task might have been due to frequency (12 of the pairs are matched for frequency, 22 pairs have higher noun frequencies and 8 have higher verb frequencies - Francis and Kucera 1982). However this is confounded by the fact that alternative verbs were possible, many of which have higher frequencies than the strict targets, eg 'wash' for 'shampoo'. I therefore decided to investigate the effects of frequency in a second, more controlled, naming task.

#### The Definition Naming Test

This task required EM to produce either a single noun or verb in response to a definition (see section 8.4). Targets were matched for frequency.

This task presented two scoring difficulties. One dilemma was whether or not to accept reasonable responses which differed from the

strict target. Here I decided to score as correct any variations which had been produced by the 10 non-dysphasic pilot subjects (see section 8.4). This criterion led to the inclusion of 3 non-target responses: 'stealing' (for 'rob'), 'cradle' (for 'crib') and 'garden' (for 'yard').

Another dilemma related to the determination of word class. For example for the target 'write' EM produced 'pen', which could be either a noun or a verb. Here judgement was determined by frequency. Thus 'pen' was judged a noun, since the alternative verb form had a much lower frequency.

Her results are presented below:

nouns 29/33 (88%)

verbs 16/33 (48%)

As in the picture naming task noun access was significantly better than verb access (chi square = 10.06,  $p < .01$ ).

Comparing the two naming tasks it can be seen that EM was slightly more successful with the pictures, especially in the case of the verbs (48% vs 59%). This may reflect the additional input and conceptual demands of the definition task or may be a product of different scoring criteria. With the pictures any appropriate verb phrase was counted as correct, while the definition task demanded a more specific response.

EM's verb errors showed the noun bias observed with the pictures, eg:

'instructor' (teach)  
'fire' (melt)  
'menu' (eat)  
'engine .. boat' (swim)

In two cases noun derivations of the target were achieved, which despite further cuing did not stimulate the verb form:

'decorations' (decorate)

'sharpener' (sharpen)

Other verb errors consisted of repetition of material in the definition (4), no response (2), production of a related but inappropriate verb (1) and production of a non-specific verb (1).

All three noun errors were semantically related to the target: jumper (for shirt), car park (for road), car (for robot) and reading (for books). In all cases EM was aware of her error. The last example was unusual in that a verb has apparently been accessed in preference to a noun. Performance was not obviously affected by frequency. Both noun and verb errors were equally distributed around the median frequency line.

#### 9.5 Written Noun and Verb Production

Written naming was tested using the Byng verb and noun photos.

With the nouns EM scored 38/42, which was identical to her spoken performance (although her error items were different). Her errors consisted of two omissions and two spelling mistakes ('flame' for frame and 'swring' for string).

EM accessed 35/42 verbs which was significantly better than her spoken performance with the same pictures (25/42 vs 35/42; McNemar chi square = 7.143,  $p < .01$ ). Her errors involved omissions (2), the inappropriate use of non specific verbs (2), one semantic error ('puff' for powder) and 2 spelling errors. As in her spoken production she was aware of all her errors.

In all but one of her correct responses EM attempted to produce a complete sentence. Fourteen of these were entirely correct and interestingly used a range of verb morphology, eg:

'The lady whisks the eggs.'

'The lady dresses up.'

'The lady oiled her bike.'

'The man has washed his hair.'

Sixteen of EM's syntactic errors involved the omission of the auxiliary 'is', eg:

'The girl pumping her tyres.'

The other 4 involved the use of uninflected verbs:

'The girl pack the books.'

These examples also show that EM often accessed the morphology required by noun phrases, although she did make 3 errors in her use of possessive pronouns, eg:

'The lady water its plant.'

'The lady polishing his table.'

Despite her good written performance EM made surprisingly little use of this modality. For example although she wrote some nouns in the story retelling task, she did not use her writing to convey verb information. She was also resistant to further written assessments, since she found her written errors particularly painful. This suggested that therapy might help her to exploit her writing more effectively.

#### 9.6 Summary and Conclusion of the Naming Tasks

EM's spoken naming showed a marked noun preference regardless of the type of stimulus. Furthermore, she could access nouns more easily than verbs, even when they shared the same root phonology or were matched for frequency. The distribution of her errors on the definition task also suggested that her naming was not frequency sensitive.

EM's written verb production was significantly better than her speech. Observation during the task suggested that once EM had written the verb she could often read it aloud. She rarely spoke the verb before writing it.

The model of sentence production (figure 7.1) suggests that EM's poor verb retrieval may be due to a number of deficits:

- i) A deficit in the message level processes which extract the semantic properties of events.
- ii) A category specific impairment in the semantic lexicon affecting verbs.
- iii) A deficit in the processes which retrieve verbs' phonological representations (route a)
- iv) A loss or degradation of verbs' representations within the phonological output lexicon.

The better written over spoken performance suggested that the problem was principally at the level of phonology. This was also supported by informal observations, eg the evidence of EM's phonological errors and her rejection of semantic errors. Furthermore EM's ability to read aloud her written production suggested that verbs' phonological representations might be intact and accessible from the written form. These early hypotheses needed confirmation through further testing.

#### 9.7 Investigations of Event Analysis

EM's ability to extract the semantic properties of events was tested with two non-verbal assessments. The Event Perception Test explored her ability to match two representations of the same event in the presence of related and unrelated distractors; and the Role Video investigated her appreciation of the role relationships within

different types of events. The tests are fully described in sections 8.2 and 8.3.

EM made 4 errors on the Event Perception Test. This was very close to the performance of non-dysphasic pilots and was therefore judged to be within normal limits (see section 8.2). She made no errors on the Role Video.

These results suggested that EM could still analyse the properties of events. It was therefore concluded that her naming deficit was not due to poor message level skills.

#### 9.8 Investigations of Noun and Verb Semantics

EM's poor verb production might be due to a semantic deficit. Although separate production and comprehension models have been presented it is presumed that the semantic lexicon is common to both. As a result a category specific semantic impairment should manifest itself in poor verb understanding. This was tested in two single word comprehension tasks.

In these tests EM was shown a single picture and asked a yes/no question, eg:

picture	question
a man peeling an orange	is this peeling? (verb test)
a man pushing a car	is this pulling? " "
an axe	is this an axe? (noun test)
a parachute	is this a plane? " "

The questions either offered the target word, a semantic distractor, or a gross distractor. The tests are fully described in sections 8.6 and 8.7.

EM made just one error across both the noun and the verb tests (nouns: 100/100; verbs: 99/100) which suggested that her semantic knowledge about both classes of word was intact.

However this task only assessed knowledge about the core meanings of verbs. It is possible that EM no longer retained the grammatically relevant aspects of verb meaning, such as their thematic role structure. A second single word task explored this aspect.

### 9.9 Comprehension of Reverse Role Verbs

In this task EM was shown a picture of a transaction taking place between two people, such as a woman selling a car to a man. She was then asked to point to one of the participants in response to a spoken question, eg: 'which one is selling?'. The task requires complex processing of the stimulus verb. In particular the verb's thematic and focus information must be retrieved. All of the verbs used in the task specify the roles of goal and source. However their focus differs. For example 'sell' focuses source (and as a result maps source onto the subject in all canonical structures), whereas 'buy' focuses the goal. This focus information determines which participant should be identified in response to the question. Analysis of the picture then compares the verb role information with the roles of the people in the event.

EM was virtually faultless on this task (19/20). Her one error was with the verb 'lend' (when she pointed to the borrower). It is possible that this reflected her dialect, since 'lend' and 'borrow' are used interchangeably by many speakers.

This task offered further evidence of intact semantic abilities. It seemed that EM retained information both about the core meaning of verbs and their thematic structures.

The following assessments investigated her ability to exploit verbs' semantic and grammatical information in a number of sentence level tasks.

#### 9.10 Sentence Judgement Task

In this task 80 sentences were read aloud to EM, half of which contained violations. Twenty of the anomalies were purely semantic, in that they violated either the selection restrictions of the verb, or the relationship between the verb and an optional modifier, eg:

The woman murders the table.

The man bashed the ball gently.

The other twenty anomalies violated the verb's argument structure, eg:

The thug dies the woman.

The woman spills the floor.

The test is fully described in section 8.9.

EM scored 76/80 on this task. Three of her errors involved verb argument violations and the other entailed the rejection of a correct sentence.

Her score suggested that she retained knowledge about both the semantic and structural properties of verbs. This was further supported by her ability to correct the anomalous sentences during the task. For example she corrected 'the woman spills the floor' to 'the woman spills the water on the floor' and 'the cook stuffs the breadcrumbs' to 'the cook stuffs the chicken with crumbs'.

### 9.11 Sentence Anagram Task with Distractors

In this task EM was given four written sentence fragments, from which she was asked to compose a sensible SVO sentence. In order to do this one of the fragments had to be eliminated. The 'distractor fragments' were of two kinds. One offered an alternative theme, which violated the selection restrictions of the verb, eg:

the man  
the knife  
sharpens  
**the hammer**

The other offered an additional potential argument of the verb. Here success depended on knowing how the verb maps its arguments onto a SVO structure, eg:

the jug	<b>the poison</b>
the man	kills
<b>the water</b>	the man
fills	the ant

The test is fully described in section 8.8.

EM made just two errors on this task (30/32), one with each type of distractor. As in the judgement test EM's comments showed a sophisticated understanding of the mapping principles of the verbs. For example after ordering 'the woman / spills / the ink' (distractor: the desk) she added 'over the table'. The task offered further evidence of her knowledge about the semantic and structural properties of verbs.

### 9.12 Reversible Sentence Test (Black, Nickels and Byng 1991)

This test assesses the comprehension of reversible sentences, including passive forms. The subject hears or reads a sentence which has to be matched to one of three pictures. These show the target, a reversal and a lexical distractor illustrating a different predicate.

The predicate is realised by three word classes: verbs, adjectives and prepositions (or locatives). Two classes of verb are assessed: action verbs which assign roles of agent and theme, such as 'scolds' and 'photographs' and non-action verbs which assign the roles of stimulus and experiencer, such as 'dreads' and 'surprises'.

This task entails a number of processes (see chapter 4 and figure 7.2). The sentence must be parsed and key constituents identified. The semantic entry of the predicate must be retrieved, together with its thematic role and mapping information. This information must then be integrated with the result of the parse, in order to determine who is doing what to whom. In addition the roles of the participants in the the three pictures must be determined and compared with the linguistic information. An ability to carry out this task would offer further confirmation of EM's ability to access and use the semantic and structural information attached to verbs. Failure is more difficult to interpret, since it could be due to any of the processes outlined above.

EM was tested on a written and auditory version of the task. As there were no significant differences between her scores results were conflated:

#### Results on the Reversible Sentence Test

##### Sentence Type

Active agentive eg 'The astronaut scolds the clown'	18/20
Active non-action eg 'The astronaut dreads the clown'	11/20
Passive agentive eg 'The judge is weighed by the pilot'	17/20
Passive non-action eg 'The swimmer is heard by the workman'	12/20
Adjectives eg 'The dancer is exasperated with the cook'	31/40
Locatives eg 'The plane is above the cloud'	19/20
Total	108/140

29 of EM's errors involved the selection of the reversal, and 3 the selection of the lexical distractor. The latter all occurred with non-action verb stimuli.

Some interesting patterns emerge from this data. The distribution of errors suggests that with most of the stimuli EM was making a two way choice between the target and the reversal (the exception was possibly the non-action verbs). This in turn indicates that she was above chance on many sections, eg active action sentences, passive action sentences, adjectives and locatives. Also her performance was not influenced by syntax. Overall her scores with actives and passives were the same: 29/40. However she was affected by verb type. Comparing active and passive scores across the two types of verb shows that non-action verbs were significantly more difficult (35/40 vs 23/40, chi square = 7.59,  $p < .01$ ).

It seemed that EM could map many types of predicative information onto both active and passive structures. The exception was when she was dealing with non-action verbs. Why were these problematic? Non-action predicates are more difficult to illustrate. Therefore EM's problem might have been with picture interpretation. Yet the adjectival stimuli, which impose similar picture demands, were nevertheless above chance. Another possibility is that EM was poor at interpreting abstracts. Here again the adjective sentences, which were equally abstract, conflict with this interpretation. Also subsequent administration of the Coltheart Synonym Test confirmed that there was no significant difference between abstract and concrete word comprehension (abstract words 31/38; concrete words 37/38). The final possibility was that EM's difficulties lay with the grammatical properties of these verbs. The non-action verbs adopt idiosyncratic mapping procedures. Some assign the stimulus to subject, in canonical structures, and some assign experiencer:

The sailor delights the vicar.

(stimulus)

(experiencer)

The sailor notices the vicar.  
(experiencer)            (stimulus)

Interpretation of these verbs therefore requires verb specific mapping information, which might have been unavailable for EM. Here the results with the adjectival stimuli offer some support. Fourteen of these stimuli are similar to the non-agentive verbs in that they encode the roles of stimulus and experiencer, eg 'sad about'. Like the verbs, they vary according to how they assign these roles to sentence positions. The other 6 adjectives were 'agentive', eg 'rude to'. EM scored 20/28 (71%) with the non-agentive adjectives and 11/12 (92%) with the agentive ones, which again suggested that she had more difficulties with stimulus/experiencer predicates.

#### Conclusion

Overall EM performed well on the test of reversible sentence comprehension, even with passive structures. This result was in marked contrast to the many reported subjects with mapping problems (eg Jones 1986; Byng 1988; Nickels et al 1991) and indicated that EM retained considerable information about the thematic properties of verbs. However an island of difficulty was identified with non-action verbs. It was hypothesised that she had lost access to the specific mapping requirements of these verbs. This was tested in a subsequent informal task.

#### 9.13 Sentence Completion Task using Non-Action Verbs

In this task EM was given 22 incomplete written sentences into which she had to insert a non-action verb from a provided list of options. Twelve of the sentences were active and ten passive. The passive sentences all mapped the stimulus onto the prepositional phrase, eg 'Mary Whitehouse was ... by the stripper' (verb target: shocked). Assignments for the active sentences varied, eg:

Trigonometry .... students.

(stimulus) (experiencer)

verb target: confuse; distractors: dread, add, admire

Children .... games

(experiencer) (stimulus)

verb target: enjoy; distractors: entertain, jump, shock)

Each incomplete sentence was accompanied by four verb options. These comprised: the target, a non-action verb which would be appropriate for the reversed word order (or in one case an adjective phrase), an action verb which was semantically associated with one of the sentence nouns and a gross distractor. The gross distractors were non-action verbs which were unrelated to the event. Stimulus example:

Tightrope walkers .... audiences.

target: impress

non-active reversal: admire

active distractor: balance

gross distractor: comfort

With the active stimuli the provided verbs were uninflected (which avoided giving any syntactic cues). With the passives they were in past participle form.

EM performed well on this task (20/22). Her two errors were both with passives and involved the selection of the reversal verb.

In order to carry out this task EM had to first infer the intended meaning on the basis of the two noun phrases and the relations between them. This narrowed the choice to the target and the reversal. For example the likely relationship between audiences and tightrope walkers is captured by either impress or admire. The participant roles had then to be determined, eg tightrope walkers = stimulus, audiences = experiencer. Finally EM had to identify which

verb's assignments were compatible with the given word order. In this example she had to find the verb which assigns stimulus to subject and experiencer to object. Her good performance therefore indicated both an understanding of the meaning of the verbs and an appreciation of their assignment rules.

This task did not support the hypothesis that EM had lost the specific mapping rules of non-action verbs, and suggested that an alternative explanation was needed for her errors in the Reversible Sentence Test. It is possible that her difficulties lay with the number of components in the task. Not only did EM have to understand the sentence but also compare it to her interpretation of three pictures. The non-agentive verbs increased the processing load of several elements of the task, for example they required her to make inferences from the pictures and employ subtle verb interpretation skills. The sentence completion task did not entail pictures. This may have enabled EM to focus more on her verb processing and hence achieve success.

#### 9.14 Summary of Comprehension Tests and a Return to Production

EM's comprehension of single verbs was excellent, even when testing demanded access to their thematic properties. Several tasks indicated that she was able to use her good verb knowledge when dealing with sentences. She could detect violations both of the semantic and syntactic properties of verbs in the judgement task and employ verbs' mapping rules in carrying out sentence anagrams. Furthermore she made few reversal errors on the test of sentence comprehension. Although the Reversible Sentence Test suggested that there was a specific deficit with non-action verbs this was not evident in a sentence completion task which excluded pictures.

These findings suggested that EM's verb production deficit could not be attributed to a semantic disorder. It seemed therefore that the problem was due either to a deficit in accessing phonology or because verbs' phonological representations were lost or degraded.

A loss of verbs' phonological representations would affect all tasks involving the spoken production of verbs. In other words naming and reading aloud would be equally impaired. Furthermore error patterns should be consistent. Retained representations would be produced across both tasks while degraded ones would not. This prediction was tested in a reading aloud task.

#### 9.15 Verb and Noun Reading

EM was asked to read aloud 64 of the frequency matched noun and verb targets from the definition naming task (section 9.4). 'Bow' and its noun partner were excluded because of its ambiguous class status. EM's reading performance is shown below, with the comparative naming data:

	naming to definition	reading aloud
nouns	28/32	32/32
verbs	15/32	30/32

Although EM's noun production was slightly higher in the reading task the difference was not significant (comparing naming and reading noun scores chi square = 2.25). However this was not the case for her verb production, which was significantly better when reading aloud (comparing naming and reading verb scores chi square = 14.67,  $p < .001$ ). Her two reading errors were both derivational ('sharp' for sharpen and 'teacher' for teach), which was a pattern seen in her naming.

In order to draw conclusions from this task about EM's lexical status it is important to consider the possible contribution of the sub-lexical reading route. Firstly EM was able to read the irregular stimuli, which suggested that she was not depending on grapheme to phoneme conversion. Also she scored only 7/24 on a subsequent non word reading task (PALPA test no 36), which can only be accomplished by the sublexical route. This suggested that her grapheme to phoneme

skills were insufficient to account for her near perfect lexical reading, although they might have provided her with some 'phonological cues' which helped her access lexical phonology.

EM's virtually faultless reading suggested that her phonological representations were intact and accessible from the written word. How was she achieving this access? Reading employs two routes to lexical phonology (Ellis 1984). One passes through semantics. This is identical to the naming route. Therefore its sole use would anticipate an equal naming and reading performance. The fact that EM's reading was significantly better than naming suggests that she was able to engage an alternative or additional route to phonology. The second lexical reading route accesses phonology directly from the visual input lexicon. By elimination EM must have been using this route. Of course her good written comprehension (see section 9.12) indicated that she could access semantics from the written word. It is only when the task demanded production that she called upon the direct reading route.

### Conclusion

The reading aloud assessment confirmed that verbs' phonological representations were available to EM, provided they were accessed from the written word. It was concluded that this access was principally achieved by the direct reading route. This indicated that her naming disorder lay in the processes which link phonology and semantics. Her good object naming demonstrated that these processes were largely intact for nouns. It seemed that EM's deficit was specific to the connections between verbs' semantic and phonological representations.

Investigations so far already offered useful indications for therapy. The main obstacle to EM's spoken production seemed to be her inability to retrieve verbs. Only 26% of her spontaneous utterances contained a verb (see section 9.3) and these were often ambiguous in status. Verbs which were produced, eg in the picture naming task,

tended to appear within complete sentences. Comprehension tasks confirmed that EM was aware of the semantic and structural properties of verbs. Therefore it was perhaps unsurprising that once a verb was accessed she was able to use it within a sentence. This offered a strong therapy prediction. If treatment could improve verb access, more structured output should result. This prediction was tested in a final cuing assessment.

#### 9.16 Cued Production

In this task EM was asked to generate sentences from provided written verbs and nouns. The stimuli were the 64 frequency matched nouns and verbs used in the definition naming and reading aloud tests (see sections 9.4 and 9.15). These were presented individually in random order. In each case she read the word aloud before trying to create the sentence.

#### Performance with Nouns

EM produced 11 correct sentences from the 32 noun cues. Two of these exploited a low frequency verb partner and should arguably be excluded, eg:

'the man was belting the trousers' (belt)

'the school ... teacher is .. caning the boy' (cane)

The remaining 9 sentences were created from 8 different verbs: go, clean, sleep (2), bake, open, read, kick and bark.

When she failed to generate a sentence, production was often aborted at the point when the verb was demanded, eg:

'in the autumn the leaves ....' (leaf)

On eight occasions she used either 'have' or 'be' as the main verb, eg:

'the woman is having the shoe' (shoe)

'the lady was flowers in the vase' (vase)

and in three responses she generated a pseudo verb from the noun, eg:

'the man was globing the world' (globe)

#### Performance with Verbs

EM created 27 sentences from the verb cues, which was significantly better than her performance with nouns (27/32 vs 11/32, chi square = 14.57,  $p < .001$ ). In three of her errors she either failed to generate the correct arguments, or could not map them appropriately around the verb:

'pray ... pray for ...' (pray)

'the boy is adding the sums' (add)

'melting the snow ... the snow is melting the sun' (melt)

Two errors resulted from the misuse or omission of function words, eg:

'the children is swimming ... school ' (swim)

'the woman is listening the play on the wireless' (listen)

It might be argued that verbs will inevitably show an advantage over nouns in this task because in many cases they need only be combined with one, high frequency noun to achieve the sentence, eg 'the man is writing'. Yet an analysis of her utterances (Table 9.4) showed that she rarely used such minimal forms.

-----  
 Table 9.4 A Structural Analysis of the Correct Utterances Cued by Verbs  
 -----

Structure	no of utterances
NP + V eg 'the little boy is bleeding'	2
NP + V + NP eg 'the judge hanged the murderer'	19
NP + V + PP eg 'the man is sitting down'	1
NP + V + XP eg 'the girl was drowned in the pool'	2
NP + V + NP + XP eg 'the girl ripped the trousers in the tree' 'the dog follows me all the way home'	3
Total number of correct utterances	27

(XP = any non-argument phrase)  
 -----

Not only did the verbs stimulate a good deal of syntactic structure, they also seemed to facilitate noun production. Excluding general terms, such as 'man' and 'woman', EM produced 36 novel nouns in the utterances cued by verbs. This might be compared with her performance with noun cues, which generated just 9 novel verbs, 20 nouns and 1 adjective.

#### Conclusion

Providing EM with verbs enhanced the structure of her output and seemed to facilitate naming. Noun cues were far less effective, which suggested that the class of the cue, rather than simply the provision of a word, was the vital factor.

EM's response to this task might be contrasted with other reported subjects, whose production did not improve with the provision of a verb (Mitchum et al 1993; & Mitchum and Berndt in press). Why was EM

different? Previous comprehension and sentence tasks showed that she appreciated the semantic and structural properties of verbs. Therefore when she was given a verb she knew the number of arguments it required, which might account for the apparent facilitation of word finding, and what syntactic structures it combined with, which may explain the generation of sentence forms. In other words the verb's semantic information supplied the processor of the predicate argument structure at the functional level, and its phonological form may have facilitated the syntactic generator at the positional level (see figure 7.1). The other reported patients may have been unable to retrieve the verb's grammatical information. As a result simply having the phonology did not help them overcome their difficulties.

#### 9.17 Summary and Discussion of Investigations

EM's ability to produce verbs and verb structures was impaired. Over 70% of her spontaneous utterances were single noun phrases and spoken naming tasks showed that verbs were significantly more impaired than nouns, even when targets were matched for phonological form or frequency.

Despite the poor verb production EM's knowledge about verbs was good. She made virtually no semantic errors in verb comprehension tests, even when the distractors required appreciation of verbs' thematic properties. Furthermore she performed well on sentence judgement and anagram tests, which again indicated an ability to exploit the argument and mapping information attached to verbs. Sentence comprehension was also good, although there seemed to be a specific problem with non-action verbs which assign the roles of stimulus and experiencer. However on a subsequent task she was able to use these verbs appropriately to complete sentences.

Given EM's semantic abilities it was hypothesised that her production deficit lay at the level of phonology. This was supported by evidence of comparatively unimpaired written verb production and the observation of phonological errors. Reading aloud was virtually

faultless, which suggested that verbs' phonological representations were retained. It was concluded that EM had a specific deficit affecting the route between verbs' semantic and phonological representations. This deficit was clearly unusual, especially as the parallel route for nouns was apparently intact.

How might EM's performance be interpreted against a Garrett-type model of sentence production? (figure 7.1). The tests of event analysis suggested unimpaired message level skills (although the embryonic nature of these tests must be acknowledged). She also seemed to retain the resources needed to construct a functional level representation, in that she could still access the semantic and mapping information encoded with verbs. It is important to note that this representation is purely semantic. Phonological realisation occurs at the following positional level, where the syntactic structure and phonologies of the content words are retrieved. EM's inability to access verbs' phonologies would impact here. Although lexical positional level skills were impaired, the syntactic processor might still be functioning, since EM could generate syntactic forms once she was provided with the verb.

EM's deficit was apparently very focal, with much of her production system still intact. Yet there was little evidence of this in her output. It seemed that her verb deficit generated a more widespread structural impairment. This view was supported by an analysis of the relationship between EM's verb production and sentence structure. The analysis was based on 46 spontaneous utterances, 64 utterances which were cued by nouns or verbs and 65 utterances elicited in picture description. The latter included the Byng picture responses (section 9.4) and some additional data which has not been reported elsewhere. Utterances were divided into 4 categories:

i) + Verb + Structure

In these utterances a verb was accessed and produced within a correct syntactic form, eg:

'the lady's pumping the tyres'

ii) + Verb - Structure

These utterances contain a verb, but either no syntax or an anomalous sentence, eg:

'fits'

'the lady's er .... write'

'the lady's playing the parrot'

iii) - Verb + Structure

These are structured utterances which lack a main verb. Instead they employ a pseudo verb, use an auxiliary as a main verb, or contain a 'verb gap' in an otherwise well formed sentence, eg:

'the man is globing the world'

'the lady was flowers in the vase'

'Bethan is (gestures playing) ... the violin'

iv) -Verb - Structure

These utterances lack both a verb and syntactic structure, eg:

'the school ... children .. and its'

A relationship between verb production and structure would be supported by a predominance of utterances within the (i) and (iv) categories and few of type (ii) and (iii). The breakdown (Table 9.5) indicates just such a trend. Over 70% of utterances which contained a verb also contained correct syntactic structure, while just 7% of her utterances contained syntactic structure without a verb. The majority of these latter utterances occurred in the cued production condition which might have encouraged abnormal output. It seems that EM very rarely produced intact sentences minus the verb, despite the fact that this type of output might be anticipated by her deficit. 30 of her utterances contained a verb without syntax, which apparently countered the trend. However this is difficult to evaluate since the class of some of these 'verbs' was ambiguous.

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 Table 9.5 An analysis of 175 utterances exploring the relationship  
 between verb production and structure in EM's output.  
 -----

Utterances + Verb + Structure	
spontaneous	1
cued with nouns	11
cued with verbs	27
picture description	34
Total	73

Utterances + Verb - Structure	
spontaneous	10
cued with verbs	5
picture description	15
Total	30

Utterances - Verb + Structure	
spontaneous	1
cued with nouns	8
picture description	3
Total	12

Utterances - Verb - Structure	
spontaneous	34
cued with noun	13
picture description	13
Total	60

-----

While there seemed to be a relationship verb and sentence production the precise nature of that relationship is difficult to determine. Two accounts might be considered:

- The planning frame may be derived at least partly from the verb. In other words the verb's phonological entry might specify the syntactic and prosodic structures which which it can combine (see section 7.4). Thus an inability to retrieve the phonological form of the verb may directly impair the operation of the syntactic processor.
- The syntactic processor may operate independently of lexical phonology (eg Lapointe and Dell 1989 and see section 2.7). However

the inability to retrieve the verb form might result in computed syntax being aborted.

EM's output contained some syntactic features, even when a complete planning frame was not achieved. Both accounts speak to this evidence. The first suggests that she could construct elements of the planning frame, such as individual noun phrases, but without a verb was unable to integrate those phrases within a sentence level structure. The second would argue that although the verb retrieval deficit aborted the global planning frame some individual noun phrases are salvaged for production. Either way it seems that without a verb EM was either unable or 'unwilling' to realise the full phonological form of the sentence.

The presumed relationship between EM's verb and structural impairment was also supported by the results of the cued production task (section 9.16). This showed that simply providing the verb form dramatically improved the quality of EM's speech, presumably because this supplied the phonological information which she could not retrieve spontaneously. This was also an important prognosticator for therapy. If treatment could make verb forms more available to EM her output should be markedly improved.

## 9.18 The Design of the Therapy Study

The investigations suggested that EM's sentence structure was impaired principally by her inability to retrieve verbs' phonologies. This hypothesis was tested in the first therapy programme, which aimed to improve her access to a group of 35 verbs. It was hypothesised that if therapy was successful it should bring about gains in sentence construction as well as verb production.

### Pre and Post Treatment Assessments

#### Verb Naming

EM's ability to access the 35 verbs was tested pre and post therapy in a picture naming task. In addition she was tested on 35 control verbs which were matched with the treated verbs for frequency and semantic characteristics. The treatment and control stimuli are presented in appendix 9.3.

#### Verb Use

Two stories were composed, one of which employed 14 of the treatment verbs and the other 14 of the control verbs. Both stories were approximately 150 words long. EM was told each story twice, first in its entirety and then in sections. After each section she was asked to try and retell what she had just heard. Then the experimenter asked EM questions aiming to elicit the target verb structures. These were designed to be minimally directive, eg 'What did Bob decide to do?' (answer: drive home for Christmas) and 'What happened in the station ticket hall?' (answer: a thief stole his wallet). The complete stories and questions are provided in appendix 9.4.

EM's pre and post therapy attempts to retell the stories were recorded on video. Her verb argument structure was evaluated using the analysis developed by Byng and Black (1989; and see section 9.3).

In addition her responses to the questions were scored for verb access and structure.

A second procedure aimed to evaluate how effectively EM could communicate the stories to observers. Her recorded attempts were shown to 4 judges. Two (familiar) judges knew EM and were informed about aphasia. Two (naive) had not met EM and knew little about aphasia. The judges were asked to listen twice to EM's version of the story and then recall everything that they had understood. They were encouraged to attend to all features of her output, rather than just speech. Scoring evaluated the number of key propositions from the stories understood by the observers.

In addition to the above story task a post therapy Cinderella sample was taken and analysed.

#### 'Control' tasks

Two measures of spoken abstract word production were taken pre and post therapy. In one, EM was asked to generate a word in response to a sentence completion cue, eg:

'Someone who has to live on unemployment benefit is usually very ...'  
(poor)

In another she was asked to provide a synonym for a given word, eg:  
'can you think of another word for impoverished?'

These evaluations were designed to investigate the extent of therapy changes. A number of positive outcomes were possible, eg:

- a) Therapy might enable EM to access a batch of trained verbs. This would manifest in enhanced naming of the treated verb pictures. The therapy hypothesis predicts an associated improvement in the structure of her picture descriptions when using the treated verbs.

- b) Therapy might improve access to a corpus of verbs and make those verbs more available for spontaneous speech. In this case EM's story retelling should additionally improve, especially on the story which allows her to use the treated verbs. The therapy hypothesis states that both improved verb access and enhanced structure should be observed.
  
- c) Therapy might bring about generalised benefits for verb access, in which case both the treated and the control verbs should improve in picture naming. The therapy hypothesis would also predict generalised gains in structure, eg across both stories and in the Cinderella task.

Evidence of improved verb access without structural consequences would challenge the therapy hypothesis and suggest that an additional factor is inhibiting output.

Improvements on the 'control' abstract word tasks would suggest that gains are not specific to the content of therapy. Here general factors, such as spontaneous recovery, might be indicated.

#### 9.19 The Selection of Stimuli and Rationale of Therapy

The treated verbs were drawn from 5 'semantic categories':

Non-action verbs which assign the roles of stimulus and experiencer, eg:

'bore' and 'pity' (5 items);

Verbs expressing change of possession and communication, eg: 'buy' and 'learn' (these were grouped together since both express the transfer of an entity between a goal and source) (10 items);

Verbs expressing the movement of an entity to or from a location (locatives and verbs of removal), eg: 'pack' and 'peel' (10 items);

Verbs expressing change of state, eg: 'melt' and 'cook' (5 items);

Verbs expressing different manners of motion, eg: 'spin' and 'drive' (5 items).

The different categories of verbs were used in order to equip EM with a group of predicates which could convey a range of messages. It was presumed that EM would not be handicapped by their varying thematic and syntactic properties, since she displayed impressive verb knowledge during testing.

Investigations revealed a number of residual skills which could be exploited in therapy. Firstly EM retained excellent semantic knowledge about verbs. It was hypothesised that therapy might help her to recruit this knowledge for the purposes of phonological access. This view was supported by previous therapeutic studies which suggest that lexical retrieval can be promoted by semantic tasks, even when the subjects do not have a semantic impairment (Howard, Patterson, Franklin, Orchard-Lisle and Morton 1985; Marshall, Pound, White-Thomson and Pring 1990; Jones 1989). Secondly EM's written verb production was comparatively preserved and she could read aloud virtually without error. It seemed therefore that the written modality offered her a potential route to phonology.

Throughout testing EM was very pessimistic about her performance and constantly surprised by success. This was partly due to her depression, but also suggested that she was unaware of her retained skills. Consistent with this was the observation that she rarely attempted problem solving strategies in response to her verb deficit, such as using writing. It seemed that therapy should aim to make EM's skills explicit to her and encourage her to use them when searching for phonology. Her sensitivity to failure indicated that treatment should employ tasks on which success was virtually guaranteed.

## 9.20 The Therapy Programme

### i) Semantic Tasks

The first phase of therapy encouraged EM to explore the semantic properties of the 35 treatment verbs. This phase spanned ten 1 hour sessions, with intervening home work. The verbs were tackled in categories. Thus each category of verbs was given 2 sessions.

Before introducing the tasks the general properties of the category were discussed. For example with the locatives and verbs of removal the therapist might say:

'These verbs all talk about putting something into a new place, or taking it away. For example when you pack a bag you put your clothes into it. In other words the clothes end up in a new place. On the other hand when you prune roses you take away the dead bits of wood' (explanation accompanied by gesture).

EM was then asked to judge whether the remaining verbs expressed re-location or removal. She was also encouraged to think about what is re-located, or taken away, and whether the goal/source changes because of the action. Any intrinsic manner information was also considered, eg:

JM: 'when you spray a wall, what moves? the wall or the paint?'

EM: 'the paint'

JM: 'yes dumb question really and what changes?'

EM: 'the wall'

JM: 'yup. So the paint moves onto the wall and the wall is changed. How come we say spray what sort of painting is that?'

EM: er (gestures the idea of dispersal) er .. (writes aerosol)

JM: 'yes that's good. It sort of spreads out and its often with an aerosol'.

EM was not deterred by the apparently asinine nature of these exchanges. Indeed she seemed to find this part of the therapy as interesting as the specific tasks.

In the first semantic task EM was given a picture of the target verb which she was asked to label from a list of 5 written options. The options were: the target, two semantic distractors, one phonological/orthographic distractor which wherever possible was also semantically related to the target and a gross distractor. Thus for 'spray' the picture showed someone spraying a car and the options were: spray, polish (semantic), strip (semantic), spread (phonological/semantic) and post (gross). In order to make the semantic component of the task explicit, EM also had to explain why she eliminated the semantic distractors. She often needed cuing to accomplish this. For example the therapist might encourage her to mime the different actions or ask her about different effects. Once the semantic judgements were complete EM was encouraged to read the target verb aloud, although she had often done this during the task. Feedback aimed to emphasise EM's skills, and suggest how she might use them when attempting verb access.

The second semantic task eliminated pictures. EM was presented with three written verbs from which she was asked to select the odd one out. In the first level of the task the judgement was based on manner information, eg:

spray    spatter    flow

In the second level, it was based on thematic information. Thus in the following example 'cover' is the odd one out since the theme is

changed by an entity being moved towards it, rather than away from it:

strip peel cover

EM coped well with both levels. As in the first task she was asked to explain her judgements and read the target word aloud.

The third semantic task also eliminated pictures and involved more production. Here EM was given a written verb and encouraged to think of as many associated nouns as possible. Before attempting this she was invited to imagine an event which could be described by the given verb and then 'look around' to see which objects were involved. Once this was exhausted she was encouraged to think about a different event and repeat the process. This task exploited a behaviour which was already within EM's repertoire, namely the tendency to produce nouns when targeting verbs. It might, therefore, seem an odd therapeutic approach. However it was hoped that the task would enable her to use her facility with nouns more productively when searching for verbs, firstly by connecting each target verb with a group of stimulus nouns, and secondly by encouraging her to link her noun production with the conscious imagining of an event.

All semantic tasks were introduced, in sequence, during the session and several items were practised. EM was then asked either to complete, or repeat, the stimuli at home. Her efforts were discussed in the following session. EM made very few errors during this phase of the therapy, which was unsurprising given her good semantic skills. The tasks were not aiming to regenerate semantic knowledge. Rather they were encouraging EM to focus more on what she already knew about verbs and apply this knowledge to her word finding problem. EM's willingness to perform the tasks and her demeanour during therapy suggested that this rationale made intuitive sense to her.

(The 'control' verbs never appeared as distractors in the therapy stimuli).

ii) Production Tasks

The second phase of therapy involved verb generation.

In the first task EM was given two written noun phrases and was asked to think of a verb which would connect them, eg:

complicated instructions for video recorders (confuse)	Jane
strippers (show)	their legs
graffiti artists (spray)	walls

Two levels of cue were supplied. In the first EM was encouraged to imagine an event involving the given nouns and then think about the properties and nature of that event, eg:

JM: 'Imagine me with the video instructions (EM mimes holding a book). Yes good. What am I doing (EM mimes reading then hurling the book on the floor - both laugh) Yes absolutely. So do I understand what I am reading?

EM: 'no' (laughs)

JM: 'No not a hope. How do I look?'

EM: mimes sad/confused and writes 'baffle'.

JM: Yes that's excellent. Will that do for your word?

EM: (reading) instructions .. baffle .. Jane .. yes.

If this form of cuing was unsuccessful EM was presented with 5 written options - which were the same as those used in the first semantic task - and asked to find the appropriate verb. The list was then removed and EM had to reproduce the target, either in writing or speech. This technique was also used when EM had produced an appropriate synonym but not the precise target word (as in the above example). The target verbs were always elicited so that item specific training could be differentiated from generalised gains in verb access.

In the second production task a situation was described to EM from which she had to generate a verb. eg:

'If you were a very keen gardener and your roses were full of greenfly what would you do?' (spray)

'A tourist is lost in London. He wants to find the Houses of Parliament. He notices a policeman. What might he do?' (ask)

The first level of cuing invited EM to gesture the action. If this was unsuccessful she was again shown the written options and asked to produce the correct target following a delay. As in the first task EM produced several responses which, although appropriate, were not the exact target. Here she was encouraged to think of another word which might apply. Failing this she was invited to select the word from given options. It was always stressed that her alternatives were correct.

It was anticipated that EM would depend on her writing in these production tasks. However this was not the case. It seemed that EM was either unwilling or unable to exploit her writing, despite her apparent skills in this modality. Alternatively the semantic priming provided by the previous tasks may have eliminated the orthographic advantage. Indeed there was evidence that EM was applying the first stage of therapy to the production tasks. For example when searching for a verb she occasionally 'listed' associated nouns in order to cue

herself or produced alternative verbs which were close to the one required. Some of these had been distractors in the previous tasks. For example 'baffle' above had been used in the odd one out task. When EM did write the verb it was emphasised that this was a sensible strategy, which owing to her reading aloud skills, could stimulate the spoken form.

Ten production sessions were offered. The first 5 focussed each category of verbs in turn. The second five targeted all the verbs at random. In addition EM was encouraged to repeat therapy tasks as home work.

In all the first therapy programme consisted of 20 one hour sessions which spanned 14 weeks (the planned regime of 2 sessions per week had to be modified owing to illness).

#### 9.21 Results of the First Therapy Programme

##### **Verb Production - Picture Naming Task**

Table 9.6 shows pre and post therapy performance on the picture naming task. Overall, production of the treated verbs improved significantly following therapy (McNemar chi square = 9.09,  $p < .01$ ). None of the individual verb categories showed significant improvement, which was unsurprising given the small numbers in each and the reasonable baseline performance. Although the untreated verbs showed some improvement this was not significant (McNemar chi square = 1.77).

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 Table 9.6 Pre and Post Therapy Verb Production on the Picture Naming Task  
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	Treated Items		Control Items	
	pre	post	pre	post
non-action verbs	0/5	3/5	2/5	2/5
change of possession/ communication verbs	7/10	8/10	6/10	8/10
locatives and verbs of removal	6/10	9/10	5/10	6/10
change of state verbs	3/5	5/5	2/5	3/5
motion verbs	3/5	5/5	2/5	3/5
Total	19/35	30/35	17/35	22/35

-----

The improvement in verb access was accompanied by an improvement in sentence production. Before therapy EM produced 14 correct sentences with the target verbs - despite the fact that this was a naming task. After therapy 45 responses placed the target verb within a correct sentence and there were only 7 responses in which she achieved the verb but not the sentence.

#### **Story Retelling Task**

EM's pre and post therapy accounts of the two stories are given in appendix 9.5. The utterances were analysed using the procedure developed by Byng and Black (1989) and the appendix gives the analysis of each utterance.

Table 9.7 presents the number of utterances produced within 5 categories. The categories were devised in order to isolate the factors relevant to the therapy hypothesis. They are:

- i) Single phrases, eg 'thirty pounds'

ii) Verb alone, eg 'stained'

iii) Verb + Arguments, eg 'splash paint on the rug'  
(this category included utterances in which not all obligatory arguments are realised)

iv) Arguments minus functions. These utterances combine two or more arguments around a missing verb, eg 'the paint on the carpet'.

v) Conjoined phrases. Here at least one of the linked phrases is not an argument, eg 'back in the garage'.

If the aims of therapy are achieved there should be a decline in the number of single phrases, together with an increase in utterances containing verbs and verb argument structure. The therapy hypothesis states that EM's ability to structure her output is verb dependent. This should be reflected in few 'Arguments minus functions' utterances, both before and after therapy.

EM's post therapy stories showed a slight increase in utterances containing verb argument structure (from 18% to 34%) and a corresponding decline in single phrases. However neither of these changes were significant. There was also no real increase in the number of utterances containing a verb, even with story 2 which enabled her to employ the familiar verbs. There were few utterances combining arguments without a verb both before and after therapy, which supported the view that structure was dependent on verb access.

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**Table 9.7 Pre and post therapy analysis of the story retelling samples**  
 -----

<b>Story 1 (untreated verbs)</b>		
	<b>Number of Utterances</b>	
	<b>pre therapy</b>	<b>post therapy</b>
Single phrases	9	9
Verb only	4	1
Verb + arguments	2	6
Arguments minus functions	-	1
Conjoined phrases	-	-
<b>Total number of utterances</b>	<b>15</b>	<b>17</b>
<b>Story 2 (treated verbs)</b>		
	<b>Number of Utterances</b>	
	<b>pre therapy</b>	<b>post therapy</b>
Single phrases	11	10
Verb only	3	3
Verb + arguments	4	7
Arguments minus functions	-	1
Conjoined phrases	1	-
<b>Total number of utterances</b>	<b>19</b>	<b>21</b>

-----

The following evaluation aimed to determine whether her post therapy stories were more communicatively effective.

#### **Observers' Scores**

The video recordings of EM's pre and post therapy attempts to retell the stories were played, in sections, to familiar and naive observers. After each section the observers were asked to recount their understanding of the story so far and their production was

recorded on audio tape. If necessary sections of the video were replayed, for example if the observers felt they had forgotten something. Only very general, non directive prompts were supplied, such as 'is that all?'. Each observer saw both stories, one pre therapy and the other post therapy (although they were unaware of this). The order was counterbalanced, ie one observer saw the pre therapy story first and the other saw the post therapy story first.

Scoring aimed to identify how many key propositions from the stories were understood by the observers. In story 1 (untreated verbs) there were 17 such propositions and in story 2 (treated verbs) there were 18. While the majority of these propositions used either the treated or the control verbs, some employed general high frequency verbs, such as 'go', 'put' and 'come'. Propositions were marked correct if the observers had understood the meaning, regardless of their exact wording. For example one proposition was: 'his car spun off the road'. Two observers reproduced this as: 'the car's involved in an accident' and 'he skidded' both of which were marked as correct. Observers were also given credit for guesses and propositions over which they were doubtful, such as 'I got the impression that his wife had gone away'. Observers' results are shown in table 9.8.

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 Table 9.8 Observers' ability to understand the propositions from EM's pre and post therapy story attempts  
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	Story 1 (untreated vbs)		Story 2 (treated vbs)	
	pre	post	pre	post
Familiar	5/17	5/17	6/18	8/18
Naive	4/17	8/17	3/18	5/18

-----

Familiar and naive observers performed similarly. Neither pair showed significant improvement in their understanding of EM following therapy.

## Response to Questions

In addition to the retelling task EM was asked questions about each story, which were designed to elicit 14 propositions using either the treated or control verbs (see appendix 9.4). Her responses were scored for verb production and for the number of utterances in which verbs were combined with argument structure. For the structural scoring all obligatory internal arguments of the verb had to be realised in order for an utterance to be correct. For example 'cover in the .. tarpaulin' (post therapy response) was not marked correct. The results of this procedure are shown in table 9.9.

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Table 9.9 Responses to Questions Following the Story Retelling Task  
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	Story 1 (untreated vbs)		Story 2 (treated vbs)		Total	
	pre	post	pre	post	pre	post
Verb Production	6/14	8/14	5/14	11/14	11/28	19/28
Verb + Argument Structure	1/14	6/14	4/14	8/14	5/28	14/28

-----

Over the two stories EM's responses showed significant gains in both verb production and predicate argument structure (verbs: McNemar chi square = 4.08,  $p < .05$ ; verb + argument structure: McNemar chi square = 4.26,  $p < .05$ ). There are no significant changes in her responses to the individual stories.

## Cinderella Task

EM was asked to retell the story of Cinderella. Her utterances are given in appendix 9.6 and the results of the predicate argument analysis are presented in Table 9.10. These have been summarised using the 5 categories outlined above.

-----  
 Table 9.10 Number of utterances in each category produced in the pre  
 and post therapy fairy tale samples  
 -----

	Number of Utterances	
	Pre Therapy	Post Therapy
Single phrases	33	22
Verb only	8	2
Verb + arguments	4	8
Arguments minus functions	-	-
Conjoined single phrases	1	-
total number of utterances	46	32

-----  
 Although EM's post therapy output showed a slight increase in the number of utterances containing verb argument structure the change was not significant (4/46 vs 8/32, chi square = 2.7). There was also no overall gain in verb production. The number of isolated verbs declined after therapy. However since the status of many of the pre therapy 'verbs' was ambiguous it is difficult to interpret this observation.

These findings mirrored the results of the other story telling task. Verb production and structure remained unchanged. Even following therapy EM's output consisted largely of single phrases.

The second analysis applied the quantitative procedure developed by Saffran et al (1989). The results are presented in table 9.11.

-----  
 Table 9.11 Quantitative analysis of the post therapy fairy tale  
 sample with pre therapy comparative data  
 -----

	Pre	Post
Total number of words analysed	100	80
Morphological measures		
Closed class : total narrative words	.32 #	.32#
Nouns : pronouns	45	-
Proportion of nouns with determiner	.62 #	.75
Proportion of verbs with inflections	.50 #	.6 #
Aux score	1.6	.85
Structural measures		
Nouns : verbs	3.46 #	3.2 #
Proportion of words in sentences	.16 #	.33#
Proportion of sentences that are well formed	.33 #	.16#
Frequency of embeddings	0 #	0 #
Sentence elaboration index	1.00 #	.75#

# indicates measures which fall within the range of agrammatical speakers in Saffran et al 1989.

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The quantitative analysis also showed few changes and most of EM's measures remained 'agrammatical'. There was a slight (but insignificant) increase in the proportion of words in sentences, which tallies with the marginal gain in verb argument structure evident in table 9.10. The apparent increase in the proportion of nouns with determiner was not significant.

### 'Control' Tasks

EM's production of abstract words in response to definition and synonym cues was tested pre and post therapy. On the definition task her performance was unchanged (20/36). With synonyms there was a slight, but insignificant improvement (7/36 to 11/36, chi square = 0.66).

## 9.22 Summary and Discussion of the Results of the First Therapy Programme

Therapy improved EM's ability to access the 35 treated verbs, at least in the picture naming task. This task also showed an improvement in sentence formulation, which was consistent with the therapy hypothesis. There was no generalisation to the untreated items.

Although EM had apparently gained access to a corpus of verbs she was unable to use those verbs in open narrative. On the story retelling task she displayed only minimal improvements, both in verb access and structure, even when the narrative was composed largely around the treated verbs. Furthermore her post therapy stories were no more comprehensible to the 4 observers. The Cinderella task also showed only marginal gains.

It seemed that EM showed improved verb access only when production was elicited by pictures. However there was one further sign of progress. EM's responses to questions about the stories showed better structure and verb retrieval after therapy. Unlike the picture task this gain was not specific to the treated items, but was evident when all her responses were considered together.

This last finding is difficult to reconcile with the result of the picture naming task, in that here the training effect was not observed. Also EM's responses often did not employ the trained verbs, even when the questions were targeting those items (story 2). For example she produced 'tail' for 'follow', 'skidded' for 'spun', 'thieving' for 'stole' and 'paid for' for 'buy'. This suggested that the improved verb access might have generalised to verbs which were closely related to the treatment items. Support for this view was offered by a synonym generation task. Here EM was shown an action picture and told the target verb. She was then asked to think of another word which could describe this action or event. All the treated and control verbs were tested, using the same pictures as in

the picture naming task. Two blind judges assessed whether EM's attempts were acceptable synonyms for the target. EM produced significantly more synonyms (or synonymous phrases) for the treated verbs than for the control verbs (treated 20/35, control 8/35, chi square = 7.2). Conclusions from this task must be guarded, since it was not conducted prior to therapy. However, it suggests that EM's facility with the treated verbs might have extended to their close semantic partners. This apparent gain might have been consequent on the semantic component of the therapy. Certainly many of the synonyms produced by EM had been used as distractors in the therapy tasks.

The most optimistic interpretation of these results therefore suggests that EM gained access to a corpus of verbs, and possibly their close semantic colleagues. However her ability to use these verbs was strongly influenced by the nature of the task. She could retrieve when describing pictures and when responding to questions, but not in open narrative.

Were these results consistent with the therapy hypothesis? In one sense they were, since tasks which showed gains in verb production also showed benefits in sentence structure. However the discrepancies between the evaluation tasks are more difficult to explain. EM could apparently access the treated verbs' phonologies in some contexts but not in others. This suggested that an additional factor above the level of phonological retrieval was inhibiting her output. The conditions which facilitated production both focussed her on the target, either by providing a picture or a question. In open narrative this 'focus information' was not available and as a result EM was less able to drive the phonological retrieval of the target verbs. It seemed that the message demands of the task were crucial. When these were reduced, either by providing a picture or question, she was successful. When she was required to generate verbs independently from her own propositional messages, she was not.

This finding stimulated a re-evaluation of EM's deficit. Prior to therapy assessments indicated that her primary problem was impaired access to verbs' phonologies. It was hypothesised that if access could be facilitated through therapy both verb retrieval and sentence structure should improve. The results of the first therapy programme partly supported this hypothesis. However making some verbs' phonologies available to EM did not overcome her problems in spontaneous speech, even when the task allowed her to use the familiarised verbs. Without either a picture or question cue EM was still unable to generate the verbs. One way of interpreting this finding would be to suggest that in open conditions EM was formulating inappropriate higher order representations, either at the level of the message or at the function level, where the semantic relations between the verb and its arguments are specified. These representations provided insufficient information to drive phonological access. The picture and question cues offered additional message and semantic information and therefore facilitated the creation of specific higher order representations. As a result production was achieved.

This reinterpretation of EM's deficit suggested that therapy should adopt different aims. Rather than familiarising groups of verbs, treatment should aim to adapt EM's message concepts and equip her with strategies for translating those concepts into verb structures.

### 9.23 The Rationale of the Second Therapy Programme

EM's production was facilitated by picture and question cues. It was hypothesised that these were effective because they encouraged EM to focus on simple propositions which could be conveyed in single verb phrases. In spontaneous production EM often attempted more complex propositions, which demanded either embedded or conjoined structures. For example when describing baby sitting she produced: 'take ... the cuddle' (take the baby out of the cot and give him a cuddle). When she was prompted to break this up her output improved: 'pick up the baby and cuddle'. This suggested that therapy should promote the

formation of simple concepts at the message level, which would place minimal demands on her language system.

It was also observed that EM was very intolerant of failure. Her output was frequently aborted and was peppered with comments about her inadequacies, eg: 'I don't know' and 'oh dear'. EM's difficulties with phonological retrieval meant that episodes of delay and searching were inevitable. It seemed that therapy should aim to increase her tolerance to these episodes. Two strategies were applied. One was gesture. The other was the use of high frequency, non-specific verbs, which could be applied to a wide range of events and situations. A number of these verbs, such as 'put' and 'go' already featured in EM's output.

Thus the second therapy programme had two aims. The first was to simplify her message level processing so that it was more 'in tune' with her dysphasic language system. The second was to provide her with strategies to deal with phonological searching. Rather than equipping her with a body of verb vocabulary, I aimed to encourage the use of a few general verbs. The other strategy was the use of gesture which would hopefully provide her with a means of holding on to a message concept during the inevitable processing delay. If successful therapy should increase EM's production of verbs and verb structures in both constrained and spontaneous conditions.

#### 9.24 The Content of the Second Therapy Programme

Therapy initially aimed to establish the general verbs. As in the first programme these were selected from a number of semantic categories. These were movement: go, come, leave; change of possession: give, get; removal and location: put, take, bring; change of state: make change. The verbs were introduced in their categories. EM was presented with the written infinitive form of each verb and asked to read it aloud and explain its meaning. A gesture was then generated for each verb. The applications of the verb were then discussed, and EM was asked to use the verb to

describe recent life events. Cuing focussed her on likely targets. For example when working on the locative and removal verbs the therapist invited her to think about dressing (put the clothes on, take them off) and cooking (put the food in the oven, take it out). Additional tasks involved picture descriptions and completion exercises. For example EM was presented with a number of written situations and asked to describe what she would do in each:

'What would you do if someone gave you a Henry Moore statue?'

'What would you do if you found a lost dog?'

Cuing encouraged her to focus very consciously on the event, eg:

JM: 'Imagine yourself with the dog. There he is at your feet (points to the floor). You go and get some string and make a lead (gestures holding the lead). You set off ..

EM: (copies the gesture and moves it away from body) 'Take .. yes take .. take the dog to the house'

If this was unsuccessful EM was given the list of general verbs and asked to compose her answer around one. Interestingly EM's responses to the picture and completion tasks were not confined to the general verbs. For example she suggested that she would 'sell' the Henry Moore and when asked what she would do with a lost cat she offered: 'shoot it'.

Further written completion tasks were provided for home work.

One dilemma in this phase of the therapy was whether to introduce the different tensed forms of the verbs. This was a particular issue given the irregularity of the targets. It was noted that EM usually produced infinitive forms, and conveyed time via supplementary phrases, eg: 'last Saturday, go to Hounslow'. As EM had a functional means of communicating time concepts and since she never produced

regularisations like 'goed' I decided not to introduce the additional complication of the tensed forms.

EM was not handicapped by the diverse argument structures of these general verbs. For example she readily employed two argument or particle structures with 'put'. As before this confirmed her impressive knowledge about the properties of verbs.

Ten one hour sessions were devoted to the general verbs.

The second phase of therapy aimed specifically to alter EM's message structures. The main task entailed recounting clips of commercial videos ('Roxanne' and 'Ruthless People'). Prior to seeing the video clip EM was reminded of her general verbs. This involved giving her the written list and inviting her to generate a few sentences for each. Feedback emphasised the type of event described by the verb, eg:

'Yes you put your make up on. The make up starts in one place and ends up in another. So 'put' talks about moving objects from one place to another'.

It was suggested that she might find these verbs useful in describing the video, although she was not restricted to them. The clips were selected so that at least some of the events could be conveyed using these verbs.

EM was then shown the video clip. Before recounting the events a number of output strategies were introduced and discussed. These were condensed to 3 written tips:

- Think about one event at a time. Do not try to talk about the whole story at once.

- If you can't think of the verb don't give up. Mime it. Look at your mime and see if you can think of a word for that action.
- See if your general verbs help.

Most of the cuing during the task focussed on the first two strategies. These seemed to provide EM with a means of tackling the task, eg:

EM: oh dear ... no

JM: Ok. He's got to the door. Think about what he does next. Just the first thing. Try acting it out.

EM: (mimes putting something on the floor) put the bag in the ground ..(mimes opening it) open the bag .. (mimes reaching in) pick up the credit card ... oh no

JM: (mimes inserting the card into the door)

EM: put the card in the ... crack (both laugh)

Of course it is impossible to know exactly how gesture facilitated production here (if at all). It may have acted like a picture cue and focussed EM on a specific, unitary proposition. Alternatively the gestures may have provided EM with a delay in which to accomplish phonological search and helped her to retain semantic level information during this delay.

Feedback after EM's attempts recalled her successful production and emphasised the strategies that she had used. In addition EM was videoed during the task and the tape was replayed to her. This enabled her to observe her use of gesture and see how it stimulated output.

The video task was made progressively more demanding by increasing the length of the clips. Two supplementary tasks were used to encourage the use of the output strategies in different contexts. In one EM and I walked around the therapy area observing people in action. Periodically we would stop and focus on one person. EM was encouraged to copy or mime their actions and then describe them. In the other task, EM was required to apply the strategies to a description of events in her week. This phase of therapy occupied ten 90 minute sessions. In all the second therapy programme comprised 20 sessions.

#### 9.25 Results of the Second Therapy Programme

##### **Verb Production - Picture Naming Tasks**

The 70 verb pictures were readministered after the second therapy programme. With the previously treated verbs EM scored 28/35, which was still significantly better than her baseline score (19/35 vs 28/35, McNemar chi square = 7.11,  $p < .01$ ). On the untreated control verbs EM scored 24/35, which was not significantly different from baseline (17/35 vs 24/35, McNemar chi square = 2.76). This result suggested that the benefits of the first therapy programme had been maintained, with no generalised improvement in verb access.

This was evaluated further by re-administering the Byng verb photographs, none of which had been specifically focussed in therapy (see section 9.4). Prior to therapy EM had scored 25/42 with these pictures. After the second programme her score rose to 37/42, which was a significant improvement (McNemar chi square = 10.08;  $p < .01$ ).

The two picture tasks produced different results. The first showed maintenance of the training effect seen after the first therapy programme, with no gains in the untreated controls. The second suggested that verb access might have generally improved. This discrepancy may have been due to differences between the stimuli. The first set of pictures targeted specific items, which were not

easily substituted by EM's general verbs, whereas with 8 of the Byng photos EM could and did make use of her non-specific verbs.

### **The Story Retelling Task**

The utterances produced in the Story Retelling Task after the second programme of therapy are given in Appendix 9.7, together with their analyses. Table 9.12 shows the number of utterances falling within 5 broad categories (see section 9.21), with comparative pre therapy and post therapy<sub>1</sub> data. As there were no significant differences between the two stories they were analysed together.

Comparing pre with post therapy<sub>2</sub> data shows a significant reduction in the proportion of single phrases (20/34 vs 16/48, chi square = 4.25,  $p < .05$ ) and a significant rise in the number of utterances with verb argument structure (6/34 vs 23/48, chi square = 6.68,  $p < .01$ ). Although there were more utterances containing a verb, this change was not significant.

Unlike the first therapy programme, therapy<sub>2</sub> produced significant changes in EM's spontaneous output, particularly in terms of verb argument structure. The achievement of structure seemed dependent on the verb, since the number of utterances combining arguments without a verb (arguments minus functions) remained low. Overall her verb production did not increase significantly, which apparently contradicts the therapy hypothesis. However prior to therapy over half of EM's 'verbs' were produced in isolation and were often ambiguous in status. It is therefore likely that the pre therapy verb production was overestimated.

In order to reduce the amount of testing the story questions were not readministered.

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 Table 9.12 Analysis of the pre therapy, post therapy<sub>1</sub> and post  
 therapy<sub>2</sub> story retelling samples  
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	Number of Utterances		
	pre therapy	post therapy <sub>1</sub>	post therapy <sub>2</sub>
Single phrases	20	19	16
Verb only	7	4	3
Verb + arguments	6	13	23
Arguments minus functions	-	2	5
Conjoined single phrases	1	-	1
Total number of utterances	34	38	48

-----

#### Observers' Scores

Video recordings of EM's pre and post therapy<sub>2</sub> stories were played to 2 familiar and 2 naive observers (obviously these were not the same observers as used previously). After viewing the tape the observers were asked to recall everything that they had understood and their comprehension of the key propositions was scored (see section 9.21). Table 9.13 presents their results.

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 Table 9.13 The number of propositions comprehended by observers from  
 EM's pre and post therapy stories  
 -----

	Story 1		Story 2	
	pre	post therapy <sub>2</sub>	pre	post therapy <sub>2</sub>
Familiar Observers	6/17	12/17	6/18	12/18
Naive Observers	6/17	10/17	4/18	12/18

-----

Both pairs of observers comprehended significantly more propositions from EM's post therapy<sub>2</sub> output (Familiar: pre 12/35 vs post 24/35, chi square = 6.92,  $p < .01$ ; Naive: pre 10/35 vs post 22/35, chi square

= 6.96,  $p < .01$ ). Also considered individually, significantly more propositions were understood from each story following the second phase of therapy (Story 1 pre 12/34 vs post 22/34, chi square = 4.76,  $p < .05$ ; Story 2 pre 10/36 vs post 24/36, chi square = 9.42,  $p < .01$ ).

EM's stories after the second therapy programme were clearly more comprehensible to these observers than her pre therapy versions. It is difficult to determine the source of this change. The observers may have benefited from the greater volume of her output (EM produced 157 words after therapy<sub>2</sub> compared with 69 pre therapy). However EM's volume also increased after the first period of therapy (to 115 words). Yet then there was no improvement in the observers' understanding. Also the utterance analysis above showed that the increased word count occurred mainly because EM was producing more verb argument structures following therapy<sub>2</sub> (the number of single phrases declined). This suggests that the quality, rather than volume of her output, may have been the crucial factor.

### **Cinderella Task**

In addition to the above story task EM was asked to retell the story of Cinderella. Her utterances and analyses are given in appendix 9.8. Table 9.14 presents the results of the predicate argument analysis, with comparative pre therapy and post therapy<sub>1</sub> data.

After the second therapy programme EM produced significantly more utterances with verb argument structure than at baseline (4/46 vs 15/31, chi square = 13.62,  $p < .001$ ). There was corresponding reduction in the proportion of single phrases (33/46 vs 10/31, chi square = 10.14,  $p < .01$ ). EM's production had also improved since the first therapy programme. A comparison of the results of the first and second therapy programmes shows a significant reduction in single phrases (22/32 vs 10/31, chi square = 7.00,  $p < .01$ ) and increase in the number of utterances containing a verb (10/32 vs 19/31, chi square = 4.55,  $p < .05$ ). The comparison of the number of structured

utterances after the two therapy programmes fell short of significance.

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 Table 9.14 Number of utterances in each category produced in the pre, post therapy<sub>1</sub> and post therapy<sub>2</sub> fairy tale samples  
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	Number of Utterances		
	pre therapy	post therapy <sub>1</sub>	post therapy <sub>2</sub>
Single phrases	33	22	10
Verb only	8	2	4
Verb + arguments	4	8	15
Arguments minus functions	-	1	2
Conjoined single phrases	1	-	-
Total number of utterances	46	32	31

-----

The quantitative analysis (table 9.15) also revealed some changes. Almost half the words in the post therapy<sub>2</sub> sample appeared in sentences, which was a significant improvement from baseline (pre therapy 16/100 vs post therapy<sub>2</sub> 56/117, chi square = 23.22, p<.001). The noun:verb ratio was also substantially improved, although the change here was not significant.

There were no significant changes in the morphological measures. However the proportion of inflected verbs now fell outside the 'agrammatic' range, which probably reflected the fact that most were produced within argument structure. EM retained her high aux score, which measures verb phrase morphology within sentences. At baseline her score was 1.6, which was within normal limits. However as she had only produced 3 sentences the score was difficult to interpret. The post therapy<sub>2</sub> aux score was derived from 10 sentences and therefore offered a much more convincing measure of EM's ability to realise the syntax of verb phrases.

Table 9.15 Quantitative analysis of the post therapy<sub>2</sub> fairy tale sample, with comparative pre and post therapy<sub>1</sub> data

	Pre	Post <sub>1</sub>	Post <sub>2</sub>
Total number of words analysed	100	80	117
Morphological measures			
Closed class : total narrative words	.32 #	.32#	.41 #
Nouns : pronouns	45	-	117
Proportion of nouns with determiner	.62 #	.75	.72
Proportion of verbs with inflections	.50 #	.6 #	.88
Aux score	1.6	.85	1.4
Structural measures			
Nouns : verbs	3.75 #	3.2 #	2 #
Proportion of words in sentences	.16 #	.33#	.47 #
Proportion of sentences that are well formed	.33 #	.16#	.4 #
Frequency of embeddings	0 #	0 #	0 #
Sentence elaboration index	1.00 #	.75#	1.3 #

# indicates measures which fall within the range of agrammatic speakers in Saffran et al 1989.

### **'Control' tasks**

The abstract word production tasks were re-administered after the second therapy programme and again showed no improvement.

#### **9.26 Summary and Discussion of the Results of the Second Therapy Programme**

Evaluations of the second therapy programme showed promising gains in open narratives. The two story narratives revealed more structured utterances with an associated decline in the number of single phrases. These gains were also observed in the Cinderella task, together with a significant improvement in verb production. The linguistic changes in EM's speech seemed communicatively important. Familiar and naive observers found EM's post therapy<sub>2</sub> stories more comprehensible than her pre therapy attempts.

Changes in verb naming were more difficult to evaluate. One picture naming task suggested that only the effects of the first therapy programme had been maintained, since the previously treated verbs were still significantly better named than at baseline, while the untreated items were unchanged. However a second picture task indicated a general improvement in verb naming which was not confined to treated verbs, although here EM made use of the non-specific verbs focussed in the second programme of therapy.

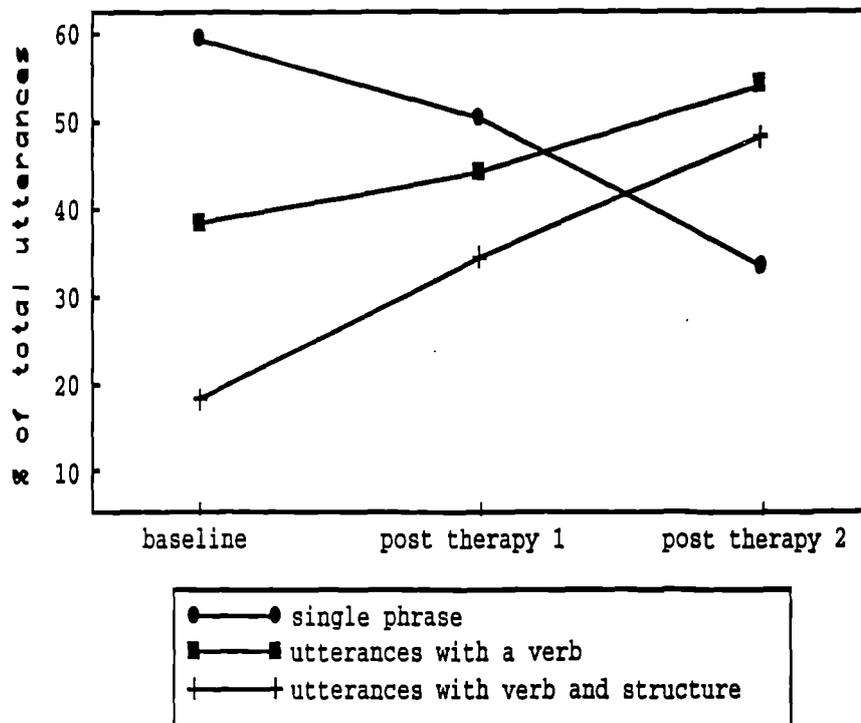
The results of the second therapy programme were considerably more encouraging than those of the first. Then gains occurred only in constrained tasks, such as picture naming and question responses, with no carry over to more open conditions. Unsurprisingly observers also failed to register an improvement. It seemed that equipping EM with a corpus of familiar verbs was insufficient to overcome her difficulties in narrative conditions, even when she could rely upon the treated verbs.

Why was the second programme more effective? It is possible that EM was simply benefiting from more therapy, rather than the different type of treatment. Here an examination of the trend in her improvements may be helpful. Figure 9.1 displays the results of the story retelling task across the three evaluation periods. It reveals a remarkably steady increase in the two verb related measures, together with a consistent decline in the production of single phrases. These results might support the view that the extent, rather than the nature of therapy may have been important. However the Cinderella performance was different (see figure 9.2). Here there was a significant 'take off' in verb production between periods B and C, together with a significant decline in the number of single phrases. The trends on this task indicate that the second period of therapy particularly facilitated EM's output, presumably because of its specific content.

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Figure 9.1 Results of the Story Retelling Task across the two Therapy Programmes

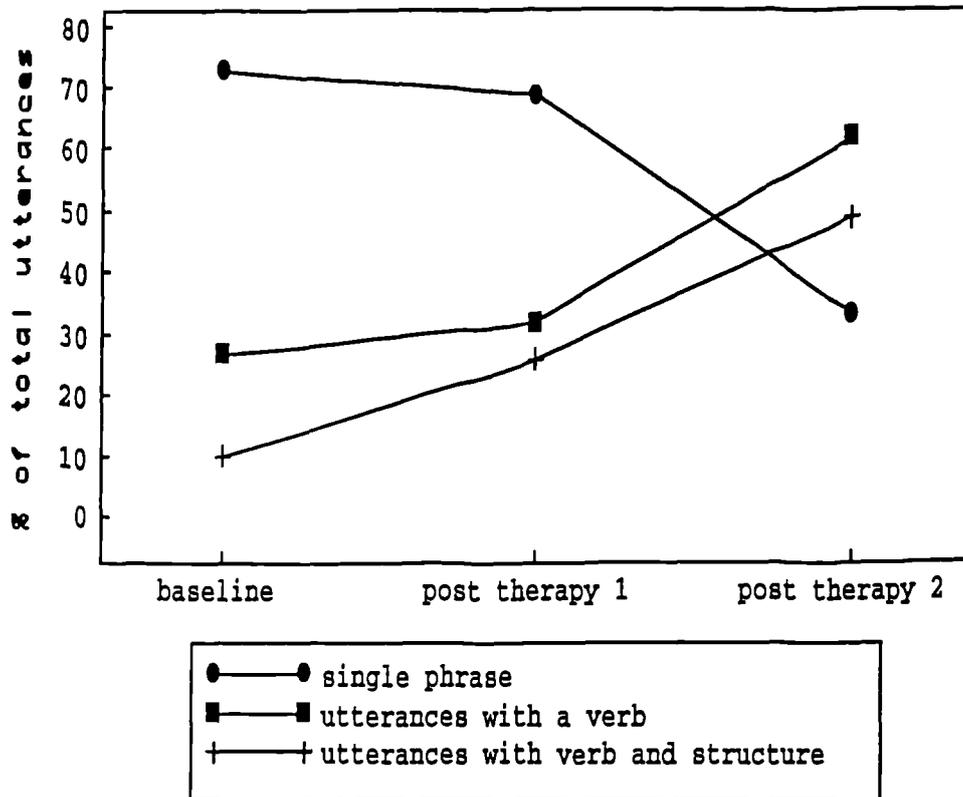
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Figure 9.2 Results of the Cinderella Task across the two Therapy Programmes

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One aspect of the second therapy programme encouraged EM to exploit a small group of general verbs, such as 'go', 'come' and 'put'. It was hypothesised that these might be useful since they apply to a range of message structures and because EM was already showing some ability to access them. Yet there was little evidence that these verbs were responsible for the gains in EM's production. Although they were used quite heavily in one of the picture naming tasks, they appeared only 7 times in all the post therapy<sub>2</sub> narratives. In retrospect this therapy hypothesis might be questioned. Verbs like 'take' express a wide variety of meanings, which are determined largely through the structures employed with the verb, eg:

'take the pill'  
'take the child to the dentist'  
'take the knife from the child'  
'take over'

These very diverse meanings and structures suggest that each sentence is employing a different (although homophonic) verb. In other words there may be several representations of 'take' each with its own semantic and subcategorisation properties. This in turn suggests that therapy will have to train each version of these general verbs separately. Simply familiarising the phonological form of the verbs will be insufficient to ensure their use.

Another therapy component involved the use of gesture. This did not entail 'teaching' gesture, since EM's previous group therapy had already established this medium. Instead treatment encouraged her to use her gesture consciously as a verb cue. There was some evidence that this strategy was employed in the two post therapy<sub>2</sub> story tasks. Seventeen of EM's verbs and verb phrases were either preceded or accompanied by explicit gestures (65%) and on several occasions she repeated and refined a verb gesture until production was achieved.

It is difficult to determine the role played by gesture in EM's output. The therapy hypothesis stated that gesture encouraged EM to create highly focussed message structures which facilitated verb access. In other words they acted like a picture cue. Alternatively the benefits may have been 'psychological', for example gesture may have relaxed EM and given her time in which to accomplish verb search. However, as indicated above, gesture was not a new skill and EM's pre therapy story attempts showed considerable use of this medium. It is only after the second therapy programme that she could 'convert' her gestures into spoken output.

It seemed that providing EM with a strategy for assisting verb access, in this case gesture, constituted the most useful element of therapy. Familiarising groups of verbs improved her performance with

pictures, but not her open narrative, even when the 'trained' verbs had potentially widespread usage. However this conclusion is necessarily guarded. The work on specific verb targets may have contributed to the development of a verb strategy and certainly many of the cues used during this therapy encouraged EM to focus on the event and use gesture.

Evaluations of both therapy programmes revealed a relationship between verb access and sentence structure. Tasks showing improved verb access also showed gains in structure and EM's attempts to combine arguments without the verb remained limited. Furthermore improved structure was achieved without any specific work on either syntax or mapping. In both programmes the emphasis remained purely on verb access. These findings were consistent with the initial therapy hypothesis which stated that EM's sentence output was hampered principally by her verb retrieval deficit. Once verb retrieval was facilitated output improved.

Here the study might be compared with other reported verb therapies which failed to enhance sentence formation (Mitchum and Berndt in press; Mitchum et al 1993, see section 6.10). These subjects required a second programme of treatment which focussed specifically on the syntactic properties of the verb phrase before structure was improved.

Why were different results achieved with EM? Firstly it is probable that her deficit was different. Prior to therapy EM revealed striking verb knowledge. Her comprehension of verbs was unimpaired and she could detect subtle verb violations. Furthermore verb cues stimulated a dramatic improvement in her production. In this respect EM was different from the patients described in the above studies. They seemed to lack verb information and could not benefit from verb cues. It might be concluded, therefore, that the prognosis for a verb naming therapy with these subjects was poor, given that prior to therapy verb availability did not seem to enhance their production.

Indeed after the first therapy programme the authors concede that the verb retrieval deficit was probably not their primary impairment.

Secondly the therapies were different. The treatment used by Mitchum and Berndt (in press) involved repeated verb naming of different pictures. Errors were corrected by supplying the target. There was therefore minimal semantic content and it could be argued that the treatment was training only a pseudo 'action name', rather than a genuine verb. EM's therapy was more semantically loaded. It included associative and odd one out tasks and production was cued by providing a list of related options. In the second programme EM was encouraged to begin production with a conscious consideration, and mime, of the event. It is possible that this semantic element ensured a more profound level of verb processing.

This study described a subject with a specific verb access deficit. The deficit seemed confined to phonological retrieval, since written verb production was relatively unscathed and since her performance on a range of semantic tasks with verbs was good. Furthermore spoken sentence production was markedly improved when verbs were provided, which suggested that there was a productive relationship between the verb impairment and her 'agrammatism'. The first therapy programme aimed to facilitate access to a group of verbs. It was hypothesised that enhanced verb retrieval should stimulate improved structure. The results partially supported the hypothesis, since the improved verb naming achieved in picture and question tasks was accompanied by gains in structure. However there was no generalisation to untreated verbs (although items related to the treated set may have improved) and production was still impaired in open narrative, even when EM could depend largely upon the familiar verbs. This stimulated a re-evaluation of EM's deficit, since the message demands of the task seemed crucial to success. It was hypothesised that EM's production depended on the formation of highly focussed, unitary messages which were 'in tune' with her dysphasic language system. This was promoted in a second therapy programme, which encouraged EM to use simple gestures as a verb cue. This programme also aimed to equip her with

a small group of non-specific verbs which could be applied to a wide range of propositions. Evaluations showed enhanced verb production and structure even in open narrative. Determining the active component of therapy was difficult. However there was some indication that the gestural strategy, rather than the general verbs, was responsible for the change. Despite the difficulties in interpretation the study suggested that therapy promoting verb access can stimulate structure, although comparisons with other subjects suggested that this was only the case because of EM's preserved verb knowledge.