"Undoubtedly there are all sorts of languages in the world, yet none of them is without meaning."

1 Corinthians 14, v 10

Table of Contents

List of Tables

List of Figures

Acknowledgements

This thesis would never have been completed without the help and support of many people. I would like to thank the following in particular.

Thank you to LT for his enthusiastic participation in the study and for completing so many naming tasks with such good humour. Thank you for making the work such fun and for teaching me so much about jargon aphasia. Thank you to Mrs LT for enduring the weekly disruption.

Thank you to Mum and Dad, for your ongoing support of every kind in this and all projects. Special thanks to Mum for coping so admirably with the hysterical phone calls.

Thank you to Hilary, for making me laugh on Sunday evenings and to Adrian for his unshakeable calm in the face of every technical crisis.

Thank you to all the friends whose love and support have been so invaluable throughout the process. Special thanks to Louise, Jo, Sarah and Rosie. Thank you to Father Paul, for putting everything back together on a number of occasions and particular thanks to Jan, who lived with it.

Last, but most important of all, thank you to Tim Pring, Jane Marshall and Shula Chiat. Thank you for your tireless assistance and unfailing enthusiasm. You have offered so much more than supervision, thank you.

The thesis was written while the author was supported by grant G9231810N from the Medical Research Council.

Abstract

This study investigates a jargon speaker, LT, whose connected speech is composed almost entirely of neologisms. Despite the general intelligibility of his speech, LT is able to produce discrete responses in picture naming tasks. Neologisms were investigated for their phonemic content. Non word responses maintained the normal English distribution of phonemes. Importantly, they also showed greater than chance levels of target relatedness. Analysis of LT's responses to a set of stimuli controlled for their consonant content allowed more detailed investigation of the nature of target and error phonology. A strong influence of phoneme frequency was identified. Higher frequency consonants showed a pattern of frequent but rather indiscriminate use. They often appeared in target related contexts but were also frequently misused in contexts where they were not required by the target phonology. Lower frequency consonants were realised less often. However, their use was restricted to target related contexts and they seldom appeared as error phonology.

Further investigation showed that LT's ability to realise target phonology was influenced by the nature of the output task. A semantically primed reading condition resulted in a significant increase in the number of correct responses. Neologistic output showed a significant increase in the ability to realise target phonemes. Patterns of individual consonant use also showed significant changes. High frequency consonants showed a more refined distribution, appearing less frequently as error phonology. Low frequency consonants increased their rate of use but continued to be restricted to target related contexts.

The findings of the investigations are discussed. The results are best explained by theories of neologism production which maintain a direct relationship between target and neologistic phonology and which propose a single mechanism underlying the production of both target related and abstruse neologistic output. Interactive activation accounts of lexical processing appear to be well placed to explain LT's output and a preliminary account is offered. Recommendations for the future investigation of neologistic output are made.

1. Introduction

Background

Aphasic speech which is characterised by the production of non word forms has been known of for some time. Wernicke (1874) is popularly cited as being the first to describe the association of rapid paraphasic speech errors with fluent production and poor error awareness, symptoms which were later taken to be characteristic of Wernicke's aphasia (Kertesz and Benson 1970, Brown 1972). Nevertheless, an earlier account in the literature (Osborne 1833, referred to by Perecman and Brown 1981) described how the speech of a young patient following a stroke consisted almost exclusively of meaningless strings of sounds, "which caused him to be treated as a foreigner".

A number of further examples of the aphasic language disturbance which came to be known as jargon aphasia were described in the subsequent medical literature (see Perecman and Brown 1985 for a review). Increasingly, these studies identified that the characteristics of jargon output may vary across subjects. While the production of non lexical forms (neologisms) may be the principal feature for some speakers, for others the jargon draws more heavily on real words. Alajouanine (1956) therefore proposed a classification system based on the nature of the spoken output. In paraphasic jargon (or semantic jargon, Brown 1972, 1981), speech is characterised by the use of real word items in semantically anomalous combinations. Thus although real words predominate, the speaker's intention is obscure to the listener. This is amply demonstrated by the following examples;

"Well, it has been suggested that there were certain oddities and restrictions, technically the action of the student body, so to speak"
(reported by Weinstein 1981, the speaker had been asked about his health)

"Hangs around the place ... got two horses and a tail and the mouth changes from various aspects of the bird"
(speaker RG, reported by Marshall, Pring, Chiat and Robson 1996, describing a dog).

In contrast, undifferentiated jargon (also called phonemic jargon, Perecman and Brown

1981) is characterised by an almost complete absence of recognisable words. Spoken output consists of streams of phonemes in which it is difficult to detect real word items or even identify discrete non word utterances. Spoken output is therefore almost totally unintelligible, for example;

"Yes /ˈbʌtə gɪd ə maɪn aɪ ˈdɔt ˈɪgədəmanɪ ˈnɔtaɪ wʌn ˈgʌdəmɪni ˈmɪdi dəˈmʌnaɪt/."

(speaker RMM, reported by Robson, Pring, Marshall, Morrison and Chiat, in press, discussing an art exhibition which she had recently visited).

Asemantic jargon (labelled neologistic jargon by Kertesz and Benson, 1970) is also characterised by the presence of fluently produced non word items. However, these can be identified as discrete items within the output stream and usually occur within the context of some real word output. For instance, speech may preserve function words and contain some high frequency nouns (Ellis, Miller and Sin 1983) and there may be islands of preserved speech (Perecman and Brown 1985). Neologistic speech may also show preserved grammatical processes such as appropriate English morphology both for neologisms and real word items (Buckingham and Kertesz 1976, Butterworth 1979, 1985). However, the frequent use of non word items typically in place of content words (Green 1969, Lecours and Rouillon 1976, Buckingham and Kertesz 1976) will often obscure the speaker's intended meaning. For example;

"A /bʌn bʌn/ a /bʌk/ is er.../ˈtʃɜtʃɪŋ/ a boy or /skɜt/."

(speaker RD, reported by Ellis et al 1983, describing a pictured scene in which a boy scout is being chased by a bull).

While providing a useful descriptive framework, the classification system offered by Alajouanine (1956) makes little contribution to understanding the mechanisms underlying the disordered output or the relationship between the subcategories. Indeed much debate has focused on whether the categories represent discrete syndromes with differing underlying causes or whether the classification system serves only to describe different surface presentations of the same deficit.

Perecman and Brown (1981) argue that undifferentiated and neologistic jargon are distinguished by both anatomical and linguistic differences. This conclusion is challenged by longitudinal studies which have monitored the pattern of language recovery in jargon aphasia. Speakers who initially present with undifferentiated jargon have been shown to evolve to a more neologistic presentation over time (e.g. Simmons and Buckingham 1992). These observations have led to the proposal that undifferentiated jargon represents the severe end of a continuum of neologistic output (Simmons and Buckingham 1992).

Alajouanine (1956) argued that in fact all three categories of jargon lie on the same continuum. This claim is supported by recovery patterns which show a further progression from neologistic to semantic jargon (Kertesz and Benson 1970, Peuser and Temp 1981). Peuser and Temp (1981) describe the semantic jargon of their subject as, "characterised by repetition and slight variation of one sentence model". This might be better described as empty, stereotyped jargon and is certainly in marked contrast to the surprising lexical and syntactic skills demonstrated by other speakers of semantic jargon (for examples see Weinstein, Lyerly, Cole and Ozer 1966, Marshall et al 1996, Marshall, Chiat, Robson and Pring 1996). Moreover, some neologistic speakers are observed to evolve towards a pattern of empty, anomic speech without ever exhibiting the characteristics of semantic jargon (e.g. Panzeri, Semenza and Butterworth 1987). This casts some doubt over the existence of a continuum between the two forms of output. While this aspect of the single syndrome hypothesis remains in doubt, it seems likely that undifferentiated and neologistic jargon may exist as points along a continuum of non word production.

Neurology

It has been observed on a number of occasions that jargon symptoms may be more prevalent among older aphasic speakers. Perecman and Brown (1985) suggested that all forms of jargon aphasia are rare in younger patients while Lecours, Osborn, Travis, Rouillon and Lavallee-Huynh (1981) argued that undifferentiated jargon is particularly associated with an older age group. Coppens (1991) reviewed a number of studies which report a general age difference between Wernicke's and Broca's aphasia. He cautioned that while there is general agreement that this age difference exists, it may arise from artifacts such as selection biases rather than representing a genuine difference between the two aphasic populations.

Other studies have noted a tendency for the symptoms of jargon aphasia to be associated with bilateral neurological damage. Lhermitte, Lecours, Ducarne and Escourolle (1973) report that autopsy revealed bilateral lesions in their jargon speaker, despite the fact that only left hemisphere involvement was indicated clinically. Similarly, Cappa, Miozzo and Frugoni (1994) report a speaker whose neologistic jargon worsened significantly following a subsequent right hemisphere lesion. In addition, bilateral lesions have been associated with the symptoms of semantic jargon (Weinstein et al 1966), while Perecman and Brown (1981) specifically argue that the extent of the right hemisphere lesion determines the presence of phonemic jargon.

Where jargon aphasia has been attributed to lesions of the dominant hemisphere, it is generally agreed that this consists of damage to the posterior superior temporal region (Kertesz and Benson 1970, Brown 1972, Buckingham, Avakian-Whitaker and Whitaker 1978). Kertesz (1981) suggests that persistent and severe neologistic jargon aphasia is typically associated with larger dominant hemisphere lesions involving temporal, parietal and occipital damage.

Phonological properties of jargon

A number of studies have attempted to characterise the phonological properties of jargon. In particular, these have attempted to identify the preservation of normal phonological information in the jargon speech.

Non word output has consistently been associated with normal intonation and prosody (Buckingham and Kertesz 1974, Duchan, Stengel and Oliva 1980, Hanlon and Edmondson 1996). Investigations of the phonemic properties of neologisms have led to general agreement that neologistic productions utilise the full phonemic inventory of the speaker's native language and tend to show some perseveration in their use of phonemes (e.g. Green 1969, Buckingham and Kertesz 1976, Perecman and Brown 1981, Peuser and Temp 1981). Perseveration of syllables (Hanlon and Edmondson 1996) and other linguistic units such as consonant clusters have also been noted (Buckingham et al 1978, Lecours et al 1981). There is rather less concordance as to whether the distribution of phonemes in neologisms corresponds to the normal frequency distribution for the speaker's language. Peuser and Temp (1981) analysed the jargon output of two speakers, one classified as a semantic jargon speaker and the other presenting with neologistic speech. These authors concluded that both forms of jargon showed an atypical frequency distribution in their use of phonemes. Similarly, Perecman and Brown (1981) conducted a detailed analysis of the undifferentiated jargon of a single speaker and found that while this covered the full phonemic inventory, the frequency with which sounds were used differed from normal speakers. These authors argued that a normal phoneme frequency distribution would only ever be demonstrated by excluding neologisms from the analysis. In contrast, investigations of other jargon speakers have indicated a normal phoneme frequency distribution in neologistic output. Green (1969) found that while stereotypic patterns of alliteration and assonance were evident in jargon episodes, all but one of the English phonemes were present and in a frequency distribution consistent with normal speech. In a recent replication, Hanlon and Edmondson (1996) found an intact phonemic inventory and normal phoneme frequency distribution in the undifferentiated jargon of a subject who presented with almost no real word output at all.

A further issue centres on whether the phonemic inventory is expanded in jargon by the presence of non native phonemes. A number of authors have identified non native sounds in jargon speech (e.g. Peuser and Temp 1981, Cappa et al 1994) while others have found the phonemic inventory to be limited to the sounds of the speaker's native language (e.g. Buckingham and Kertesz 1976, Hanlon and Edmondson 1996). Similarly, differences exist as to whether neologistic jargon is restricted by the phonotactic constraints of the speaker's premorbid language. A number of studies have shown that non word items are generally phonotactically regular (Green 1969, Buckingham and Kertesz 1976, Duchan et al 1980, Hanlon and Edmondson 1996). Christman (1992) investigated the syllabic structure of neologisms and concluded that these matched both the syllable shape and sonority parameters of normal English words. However, some authors have noticed a heavier than normal reliance on atypical phonemic combinations (Perecman and Brown 1981, Lecours et al 1981) and clear violations of phonotactic constraints have been noted in other jargon speakers (Peuser and Temp 1981, Cappa et al 1994).

Non linguistic accounts of neologism production

Other work has focused more specifically on attempting to identify the underlying source of non word production. Some early theories argued for the presence of a primary impairment outside the language processing system. For instance, Bay (1964, in Kertesz and Benson 1970) suggested that jargon aphasia was principally a behavioural disorder independent of linguistic disturbance. Similarly, Rochford (1974) argued that jargon speakers do not present with an aphasic language disturbance. He viewed the language symptoms as occurring within a wider syndrome arising from a, "primary and comprehensive state of pathological arousal and lack of control". Other authors have argued that while a central aphasia is present, other factors such as premorbid personality are necessary for the presentation of a jargon aphasia, (Weinstein and Lyerly, 1976). Authors who attributed all the features of jargon aphasia to a primary linguistic deficit nevertheless differed in their opinion about the precise nature of the deficit; Wernicke (1874) argued for a loss of sensory word images while Brain (1965) viewed jargon as arising from central aphasia combined with pure word deafness (both in Kertesz and Benson 1970).

A number of other studies commented on the apparent fluency of neologistic production. Kinsbourne and Warrington (1963) proposed that neologistic output represents the speaker's first attempt at language production and, in the absence of attempts to correct or modify this output, reflects the disordered nature of his inner speech. Others saw the fluency of neologistic output as a behavioural adaptation employed to conceal the speaker's own uncertainty in his use of language (Weinstein et al 1966).

Language processing accounts of neologism production

Other attempts to explain neologism production have viewed non words as arising from processing impairments occurring within the normal language system. Initially, these accounts adopted a serial approach to language processing, assuming that language production is achieved by a series of discrete processing stages. These accounts, which have frequently been used to offer plausible accounts of non fluent type speech errors, encounter more difficulties in explaining the bizarre productions observed in jargon aphasia. More recently, non serial or interactive accounts of language processing have been appealed to in an attempt to capture the complex interactions within the impaired linguistic system which may give rise to non word production.

Dual impairment theories of neologism production

Pick (1931, in Butterworth 1979) argued that the fluency typically observed in neologistic output arose from disinhibition operating within the language production system. Disinhibition could occur at any of six processing stages involved in converting a thought into verbal expression. Neologistic responses, according to Pick, arise from the effects of disinhibition on the processes of word selection and on the sound-sequencing mechanisms. Thus neologisms represent the selection of inappropriate words followed by the subsequent phonemic distortion of these errors.

The view that neologisms arise from the dual impairments of lexical selection plus phonemic distortion has received support from more recent sources (Brown 1972). Brown suggests that neologisms arise from the phonemic distortion of severe verbal paraphasias, although he remains open to the possibility that some neologisms may also arise from the phonemic distortion of target words. In a later paper he argues that neologistic jargon represents the combination of semantic jargon and phonemic aphasia with both semantic and verbal paraphasias able to form the basis of the phonemic distortion (Brown 1977). In support of this, Perecman and Brown (1981) argue that neologistic jargon is created by a combination of phonological and semantic deficits. They suggest that this explanation is consistent with studies associating neologistic jargon with lesions involving both Wernicke's area and the surrounding temporo-parietal cortex. Damage to Wernicke's area produces the phonemic aphasia while the temporo-parietal damage is responsible for the semantic level deficit. Perecman and Brown (1981) argue that, in contrast, semantic skills are preserved in undifferentiated jargon aphasia and associate this presentation with lesions to the posterior superior temporal convolution. Obviously, this explanation is inconsistent with attempts to place both forms of non word jargon along a single continuum. Indeed, Perecman and Brown (1985) specifically argue that phonemic jargon should not be viewed as a deteriorated neologistic jargon.

Further support for the dual impairment theory was offered by Buckingham and Kertesz (1976). These authors suggested that neologisms resulting from the phonemic distortion of verbal paraphasias are particularly prevalent in the acute stages of neologistic jargon. Over time the severity of the phonemic distortion diminishes, allowing the underlying verbal paraphasias to become more evident. In later stages, verbal paraphasias decline leaving a pattern of empty, anomic speech characterised by hesitations, pauses and circumlocutions. Buckingham and Kertesz argue that this proposed evolution of the deficits underlying neologism production is consistent with the recovery pattern described by Kertesz and Benson (1970). These authors noted that neologisms tend to give way to semantic paraphasias followed by an increasingly anomic presentation. This recovery pattern lends support to the claim that original non word errors may have arisen from a combination of processing deficits.

Buckingham and Kertesz (1976) and Buckingham et al (1978) argued that on some other occasions the system is unable to retrieve any lexical form at all. In these instances phonemic material is perseverated from the preceding context to 'fill in' the gap left by the lexical selection deficit. This accounts for the alliteration and assonance frequently noted in neologistic output.

The presence of an underlying anomia in jargon aphasia

Both of the above explanations consider word retrieval difficulties to make a significant contribution to the production of neologisms. In the dual impairment hypothesis a lexical selection error precedes the phonemic distortion. On other occasions no lexical form can be retrieved at all. Indeed Buckingham and Kertesz (1976) specifically argue that despite the different manifestations which jargon speech may take over time, a severe word finding difficulty is common to all stages. The observation that subjects typically evolve to a more empty, circumlocutory pattern of speech as language function recovers (Kertesz and Benson 1970) was taken as evidence for the presence of an underlying anomia in jargon aphasia.

Further studies monitoring the evolution of neologistic jargon aphasia have lent support to the hypothesis of an underlying anomia. These studies have drawn attention to the fact that speech behaviours associated with word finding difficulties typically emerge as the neologistic content of speech declines. For instance, Green (1969) found that the progressive reduction in the number of paraphasic and neologistic nouns failed to be associated with a corresponding increase in the production of content nouns. Instead, the speaker showed an over reliance on the use of indefinite noun phrases. Green therefore argued that the anomia becomes evident as the speaker becomes increasingly able to avoid neologistic productions. Similarly, Lecours and Rouillon (1976) observed that spoken output becomes increasingly characterised by the repetition of articles and prepositions and the use of semantically weak words. Hesitations and pauses become more frequent, providing evidence for an underlying anomia and supporting their claim that the neologisms produced in earlier stages serve to mask the underlying word finding difficulties. Weinstein and Puig-Antich (1974) pointed to the over reliance on stereotyped responses or clichés as indicative of word finding difficulties.

Lecours and Joanette (1980) examined the recovery pattern of a subject who experienced transient aphasic episodes associated with epileptic seizures. At the point of maximum impairment, verbal expression comprised neologistic jargon. Recovery was marked by a progressive decline in the production of neologisms, the emergence of phonemic deviations of target words and the production of semantic paraphasias. Indications of anomia such as circumlocutions and repeated word finding attempts also became increasingly apparent.

Recovery patterns therefore provide significant evidence to suggest that an underlying anomia is revealed as the non word output shows some recovery. However, the proposal of an anomia in jargon aphasia appears to be inconsistent with the suggestion that neologistic speakers, at least initially, produce speech fluently and often with logorrhea or a 'press of speech' (e.g. Kertesz and Benson 1970, Brown 1972). One might expect to find that the anomia is indicated by a degree of hesitancy even before other features of the anomia become apparent. Evidence for the presence of such hesitancy in neologistic speech was initially demonstrated by Butterworth (1979). An interview with a neologistic jargon speaker, KC, was analysed for the subject's speech rate and for the distribution of pauses in his speech. Butterworth found that at 109 words per minute KC's speech rate was well within the normal range and that pauses showed a normal pattern of distribution with respect to syntactic boundaries. The analysis was thus able to demonstrate that KC's output was not hyperfluent. Further analysis revealed that in fact a level of hesitancy was associated with KC's production of neologisms. The analysis considered only those pauses of more than 250 msecs duration which Butterworth argues are longer than can be attributed to the effects of articulation alone. Comparing real and non word items Butterworth found that neologisms were significantly more likely to be preceded by a pause than real words. This pattern persisted when the grammatical class of items was controlled; neologisms occupying noun positions were significantly more likely to be produced after a pause than real noun items. Butterworth argued that just as pauses in normal speakers can be taken to indicate delays in retrieving items from the internal lexicon, so pauses prior to KC's neologisms suggest difficulties in lexical retrieval. This argument was supported by the observation that those real word items which KC did retrieve successfully were drawn from a small set of high frequency, rather general nouns. Butterworth therefore argued for an impairment of retrieval from the phonological lexicon in the context of an adequate semantic specification.

In a subsequent paper, Butterworth, Swallow and Grimston (1981) used gestural evidence to support the claim that KC retained intact semantic knowledge of target items. Previous work by Butterworth and Beattie (1978) had shown that normal speakers initiate gestures (but not batonic movements) prior to the onset of the content words to which they are related. Since these iconic gestures reflect the meaning of the upcoming word it can be assumed that they are driven by semantic information but also that this information is available before phonological retrieval is complete. This allows gestural movements to commence before speech production. Butterworth et al (1981) analysed KC's gestural movements and found that he showed a normal rate of gesture production. Moreover, the number of gestures initiated in pauses prior to the production of content words was within the normal range. This suggested that normal semantic lexical processes were available to mediate gesture production. Thus Butterworth et al argued that the lexical retrieval deficits exhibited by KC must arise from failure to retrieve information from the phonological lexicon. The results of the analyses were therefore supportive of the claim that KC produces neologisms in the context of an underlying deficit of phonological retrieval.

While evidence of anomia was demonstrated in KC there might be some reservations about generalising this conclusion to all speakers of neologistic jargon. Firstly, the analyses were carried out on a single subject. Secondly, KC might be considered as representing the less severe end of the neologistic continuum, since he produced only 164 neologisms over 2230 words of speech, about 7% of his total output. Therefore, although still relatively acute (the interview was recorded only two months after the onset of aphasia) it might be argued that KC had already shown some considerable recovery towards the typical late stage anomic presentation.

These objections are ruled out by subsequent studies which have found neologisms to be associated with hesitations in other jargon speakers. Ellis et al (1983) present a neologistic speaker, RD, who shows a slightly higher rate of neologistic output than that shown by KC. In the spoken picture description sample supplied by Ellis et al, neologisms account for approximately 17% of RD's total output. In line with Butterworth, Ellis et al analysed RD's speech for pauses longer than 250 msecs. They found that the mean duration of pauses occurring prior to non word items was significantly longer than the average pause length before real words. Furthermore, they were able to demonstrate a significant effect of frequency on RD's noun production in picture naming tasks. Ellis et al therefore argue that the results are consistent with a lexical retrieval deficit underlying neologism production.

A further replication of the Butterworth finding is supplied by Panzeri et al (1987). They followed the recovery of a neologistic speaker over the first three years of his aphasia. At three months post onset almost half (49%) of his conversational speech consisted of non word output. Nevertheless, pause analysis at this time revealed that non words showed a significant tendency to be preceded by a pause and that those pauses occurring before non words were significantly longer than those occurring before real word items.

The finding that neologisms are associated with hesitancy has thus been replicated on a number of occasions in the literature. Butterworth argued that the longer pauses before neologisms arose from an underlying anomia and indicated some form of extended lexical search occurring at these points. However, as Butterworth points out the presence of anomia fails to explain why the system should respond to the experience of a word finding difficulty with the production of neologism. It should also be noted that the hypothesis of an underlying anomia is dependent on the assumption that the pauses directly reflect processing time expended on lexical search. Increased hesitancy might equally well be attributed to a number of other rather diverse processes which would be unrelated to difficulties in lexical retrieval.

Random generator theories of neologism production

Butterworth (1979) carried out a number of subsequent investigations which pointed to differences within the class of non word items itself. Error responses were assigned to one of six categories: verbal paraphasias, neologisms phonologically related to previous or following words, neologisms phonologically related to the proposed target, neologisms phonologically related to other neologisms, and remaining items which could not be confidently assigned to any of the previous groups. Each group was subjected to hesitation and phonological analyses. Butterworth found that pauses before verbal paraphasias tended to be shorter than pauses before neologisms thus replicating the previous word / non word distinction for pause length. However, there were also differences between the groups of non word responses. Neologisms phonologically related to either the presumed target or to a real word in the near context were associated with significantly shorter pauses than neologisms which showed phonological similarity only to other non word items. This group of neologisms was also distinguished by the results of the phonological analysis. All error categories were found to maintain normal English phonotactic structure. However, differences were seen between error categories in the identity of their response initial phonemes. The mean frequency in the language for these items was calculated and the results compared both across the categories and against normative data. Most error categories were indistinguishable on the measure of initial phoneme mean frequency and were consistent with the data obtained from normal speakers. This suggested that the initial phonemes were distributed in accordance with the normal frequency bias of the phonemes in English. However, the mean frequency of initial phonemes in the 55 neologisms phonologically related to other non words was significantly lower than the value obtained for both the other error categories and the normative data. Butterworth suggested that this lower mean frequency value was consistent with the phonemes having been selected at random from the corpus of possible initial phonemes.

There are a number of difficulties with the data from KC's neologisms as presented by Butterworth. Firstly, he fails to explain why the phoneme frequency analysis was restricted to response initial phonemes, given that the normative data used by Butterworth (Hultzen, Allen and Miron 1964) also provides overall phoneme frequency information. It would be useful to know whether the evidence for the random selection of phonemes was confined to response initial phonemes or was consistent with the random selection of all segments.

Secondly, the normative data supplied by Hultzen et al (1964) include function words in the analysis. This grammatical category shows a particular bias for certain phonemes in English and may well exert a significant influence on the overall distribution of phonemes. This may limit the applicability of the normative data to KC's neologisms which, Butterworth argues, are predominantly used to replace content words. Butterworth attempts to control for these potential difficulties by also analysing the initial phoneme frequencies of KC's first 100 real word items, his first 100 content words and 100 unpredictable content words from normal speakers. His arguments are based on the finding that none of these other groups differed significantly from each other on the measure of initial phoneme mean frequency.

Finally, Butterworth fails to identify the individual phonemes involved in the analyses. It is therefore impossible to establish the range of sounds used in this position. This is particularly problematic for the group of neologisms which are related only to other neologisms and which, therefore, presumably display a level of perseveration in their use of phonemes. The possibility thus remains open that the mean frequency of initial phonemes in this group is influenced, for example, by the perseverative use of a low frequency segment.

Nevertheless, Butterworth (1979) argued that the differences he had identified between the groups of neologisms indicated that non words can arise from different processing sources. Neologisms which showed phonological similarity either to the correct target or to other items in the context were constructed on the basis of real word phonology, albeit not necessarily that of the correct target word. The initial difficulty in retrieving the phonological information is indicated by the increased pause time prior to these items. However, the normal frequency distribution of the initial phonemes signals that these items are based on lexical phonological representations. In contrast, neologisms which are similar only to other neologisms are produced in the context of a complete failure to retrieve real word phonological information. Such neologisms occur after a longer pause since a more extensive but ultimately unsuccessful search has been carried out in an attempt to retrieve lexical phonology. After a fixed period this search is abandoned and an alternative source of phonology is appealed to. Butterworth conceptualises this source as a phonology generating device situated outside the normal lexical retrieval system. He labels the device a 'random phoneme generator' and argues that it consists of a phonological subsystem with a buffer. Phonemes are selected randomly from the subsystem and inserted in the buffer. Insertion of phoneme sequences in the buffer is constrained by the phonotactic rules of the language so that only legal non words can be generated. Hence Butterworth uses the word 'random' to emphasise that phonemes are selected arbitrarily from the subsystem; on the other hand, there is some systemacity in the way in which they are combined into phonological strings. Since phonemes are selected arbitrarily from the store they are not subject to the normal frequency bias of the language and thus fail to show a normal frequency distribution in their use of initial phonemes. When the search for target phonology fails, the sequence of phonemes produced by the random phoneme generator is retrieved from the buffer and inserted into the slot left vacant by the missing real word. Once used, phonemes in the buffer decay gradually before being replaced by new randomly generated phonology. Thus when the generator is called on repeatedly within a short space of time, previously produced random phonology may retain a residual level of activation. This increases its availability for re-use and hence device generated neologisms produced in quick succession will show phonological similarity to each other while remaining unrelated to the phonology of the original target.

Butterworth et al (1981) argued that the subsequent analysis of KC's gestures provided further evidence for the distinctiveness of the different groups of neologisms. Those items which showed no phonological relationship to real words (either in the neighbouring context or to the target word) were significantly more likely to be associated with abandoned gestures than the other groups of non word items. Gestures associated with these other neologisms tended to be completed normally. Abandoned gestures were denoted by actions such as KC returning his hands to a resting position apparently before completing a gesture. (There was high inter-rater agreement between seven naïve judges on a pilot attempt at classifying KC's gestures.) Butterworth et al argued that abandoned gestures reflected the failure to retrieve phonological information from the lexicon and the reliance on the random phoneme generator to produce a device generated neologism. However, they fail to discuss the apparent contradiction between the acknowledgement of the failed lexical search as indicated by the gesture evidence and the continued insistence on producing some form of verbal output. Moreover they fail to explain why the abandoned and completed gestures are associated with different onset times given the assumption that all gestures are motivated by semantic information which is thought to be intact.

In essence, Butterworth's account of KC's speech data argues for the presence of two different mechanisms for generating non word output. Neologisms may be constructed on the basis of lexical phonology (either the partial retrieval of target information or the perseveration of phonology from a neighbouring real word). Alternatively, non lexical phonology can be called upon from the random generator to produce a neologism. Butterworth therefore introduces the idea that neologisms with differing phonological characteristics can be attributed to different processing sources. Target related and abstruse neologisms reflect two qualitatively different populations although both types of error arise from the same initial difficulty in phonological form retrieval.

In proposing the theory that abstruse neologisms are 'device generated', Butterworth rejects the hypothesis of a dual process of lexical selection error followed by phonemic distortion, although he concedes that such errors can be observed in aphasic speech (Butterworth 1985, 1992). Butterworth argues that a number of features of neologistic output are inconsistent with the disinhibition account. Firstly, Pick's proposal that the mechanisms of word retrieval have become disinhibited suggests that neologisms should be associated with periods of increased fluency rather than with hesitancy. Secondly, Butterworth argues that the account is inconsistent with the results of the phonological analysis. Since phonemic distortions occur on real word items neologisms should continue to conform to the normal frequency bias in their use of phonemes. In contrast, the initial phoneme evidence from KC's abstruse neologisms suggests a more random use of English phonemes. Finally, Butterworth (1985) argues that the phonological similarity seen in the strings of neologisms runs counter to the disinhibition explanation. In this account each neologism is the product of a unique word selection error followed by a phonemic distortion. Presumably some form of meaning intention mediates the lexical selection error. Since subsequent target words will have a different semantic specification, the lexical error in each case will involve a different substitution and thus there is no reason why successive neologisms should show any phonological similarity.

Butterworth's postulation of a random phoneme generating device has itself been criticised however. Firstly, it is generally accepted that brain damage cannot result in the creation of novel processing systems. The implication is that aphasic language behaviour should be describable in relation to the impairment or preservation of normal language processing capacities (Saffran 1982, Ellis 1985, Ellis and Young 1988).This would in turn imply that the random phoneme generator has a function within the normal language processing system. Secondly, it has been argued that the device, as described by Butterworth, is a rather clumsy mechanism requiring the reduplication of both the phonemic inventory and the phonotactic rules of the language (Buckingham 1981).

Butterworth (1992) goes some way to answering these criticisms by suggesting that incomplete phonological information can be supplemented from within the phonological lexicon itself. In cases of incomplete phonological retrieval, a phonological control process (normally responsible for modulating processing at the phonological lexicon) allows access to 'back up devices'. These provide supplementary phonological information using the default patterns of the speaker's language. For instance, information about a missing segment may be supplemented by the generation of a default segment. This mechanism has the advantage of requiring only a sensitivity to normal language patterns rather than the reduplication of the entire phonemic inventory. It is also seen to arise from the operation of a control process which has a defined role in normal language production. However, it is unclear whether Butterworth holds this mechanism responsible for neologism generation. Later in the same paper he continues to refer to the non words produced in neologistic jargon aphasia as 'device generated'. Interestingly, if the process was adopted as an explanation of neologism production it would predict that non words should show phonological characteristics consistent with default patterns of English phonology. This makes the atypical initial phoneme distribution seen in the 'device generated' neologisms difficult to account for.

Buckingham (1981, 1987) suggests an alternative adaptation to the phoneme generating device. He argues that the criticism directed at the random generator can be somewhat assuaged by considering the device to operate at the level of the syllable. Thus, instead of retrieving single phonemes from the subsystem, pre-coded syllable-size units are placed in the buffer ready for use in the construction of neologisms. Buckingham argues that this obviates the need for the buffer to review its contents against phonotactic constraints. If it is accepted that these constraints are specified within the domain of the syllable then the pre-coded units will already conform to the phonotactic rules of the language. Thus Buckingham argues that the device may more appropriately termed a 'random syllable generator'. In an attempt to simplify the mechanism further he suggests that rather than possessing its own buffer the generator supplies randomly selected phonology direct to the normal operating buffer of the language processing system (Buckingham 1990). This removes the need for the system to contain separate buffers associated with lexical and non lexical sources of phonology.

While the proposed modifications go some way to simplifying the random generator, they still require the reduplication of phonological information in a system external to the normal lexicon. Buckingham (1987, 1990) argues that there are good reasons to assume that this level of representation is present in the normal linguistic system and that it forms the basis of the speaker's abstracted knowledge of the syllable. He cites a number of linguistic theories which postulate a level of representation where such phonological information is stored independently from specific lexical items. Buckingham proposes that although this information may be under-utilised in the normal system, its operation can be detected in a number of normal and pathological speech conditions. For instance, he suggests that normal speakers can draw on this level of representation when inventing new words, for example during voluntary and charismatic glossolalia (i.e. non word production during word games or poetry or when praying in tongues). Lecours (1982) provides a discussion of the similarities and differences between the neologism production of aphasic and non aphasic speakers. In addition to neologistic jargon aphasia, Buckingham suggests that the information is also appealed to in other aphasic productions such as non meaningful recurrent utterances, non source phonemic substitutions, and phonemic jargon. He thus argues that abstract syllable knowledge forms a part of normal cognition rather than representing some device or mechanism created only after brain damage.

In contrast, Ellis (1985) rejects non aphasic neology as being inadequate evidence for the presence of a lexically independent, phonology generating device in the normal system. Buckingham (1990) counter argues that nevertheless an account is needed by which to explain how such output is generated by the normal speech production mechanism. He does however concede that the crucial delay evidence taken to indicate the operation of the syllable generator in jargon aphasia is absent in other neologistic output conditions (Buckingham 1990). Nevertheless, he argues that the random syllable generator, when considered as a metaphor for word neutral phonological knowledge, represents the best account of neologism production.

Butterworth (1979) and Buckingham (1981) consider the random generator to operate when the severity of the lexical retrieval deficit is such that there is a complete failure to supply target phonological information to the speech output buffer. Other authors have suggested that lexical retrieval is unlikely to be 'all or nothing' and that neologisms can therefore be produced from the partial availability of target phonological information (Ellis et al 1983). Admittedly, the previous authors also suggested that in cases of incomplete lexical retrieval, supplementary phonemic material can be obtained for instance by perseveration or anticipation from real words in the surrounding context (Butterworth 1979, Buckingham and Kertesz 1976, Buckingham 1981). However, they maintain the need for a generating device for instances of complete retrieval failure. In contrast, Ellis et al argue that all neologistic productions arise from within the impaired lexical system and reject the need to recourse to a non lexical source of phonology.

Ellis et al (1983) studied the spoken and written naming responses of a neologistic jargon speaker, RD. A number of findings led them to argue that even apparently abstruse neologisms are based on target phonological representations. However, they agree that neologism production originates from difficulties in retrieving the full target phonological specification and provide further evidence in support of this conclusion. Ellis et al demonstrated a significant effect of lexical frequency on RD's ability to produce correctly spoken word forms across a range of tasks. Furthermore, they pointed to the fact that successive attempts at spoken targets were rather inconsistent, with neologisms showing variability in their relationship to the target phonology. These observations led the authors to argue that RD's spoken naming deficit was best viewed as a deficit of lexical retrieval. In other words, in the context of an adequate semantic representation (there were few verbal paraphasias) RD was often unable to fully activate the phonological form for the target. A similar account of only partial successful access to stored orthographic representations was used to explain RD's written naming errors. Spoken neologisms (and written naming errors) were therefore constructed on the basis of this partial information. In support of this claim Ellis et al demonstrated that vestiges of target information were preserved in RD's responses. In the case of spoken responses, there was a significant ability to preserve target length information; neologisms produced in spoken naming and reading aloud tasks showed a significant tendency to contain the target number of syllables. Written naming errors similarly showed some affiliation to target orthography; partially correct responses included instances where appropriate silent letters or less common grapheme to phoneme correspondences were incorporated into the response. On the basis of this evidence, Ellis et al argued that even abstruse non word errors could be viewed as phonological or graphemic approximations of the target lexical representation. This, they argued, removed the need to claim the operation of an external, phonology-generating device in the production of neologistic output.

Subsequent analyses of RD's neologisms confirmed that the phonological proximity they showed to the target was greater than would be anticipated to occur by chance. Miller and Ellis (1987) rated 60 non words produced by RD for the number of target phonemes they contained and for whether they maintained the target number of syllables. The neologisms were then separated from their genuine targets and randomly reassigned to the same set of target words thus creating 60 'pseudo errors'. The analyses for the number of target related phonemes and the maintenance of target syllable length were then repeated. When the genuine and pseudo error pairs were compared on these measures Miller and Ellis found that genuine errors shared significantly more phonemes with the target words than did the pseudo errors. In addition, genuine errors were significantly more likely to preserve target syllable length than the pseudo errors. Thus, when the effects of chance are controlled for by the use of a pseudo error corpus, RD's neologisms are seen to maintain a significant relationship with the phonology of the target.

These subsequent analyses continue to support the hypothesis that neologisms arise from the partial access of target phonological representations (Miller and Ellis 1987). The findings also support the previous assertion that lexical retrieval is not all or nothing (Ellis et al, 1983) and that in situations where the full phonological specification is unavailable a neologism may result. Target related and abstruse neologisms therefore show only quantitative differences and are distinguished by the amount of target information appearing in the phonology of the response. However, Ellis et al (1983) make no specific claims about the precise source of the error phonology used to supplement the partial target information in error responses. Moreover, it might be argued that RD simply presents with a less severe deficit of lexical access than that demonstrated by KC. Despite producing many non word errors in the speech sample provided by Ellis et al (1983), RD's neologisms typically show some obvious phonological relationship to plausible target words. Thus it might be suggested that a greater proportion of his neologisms can be constructed on the basis of partial lexical information without recourse to a random generator of phonology. This would limit the extent to which the results obtained from analysis of RD's output could be applied to abstruse neologism production in general. This criticism would be counteracted by finding that the neologisms produced by a more severely impaired jargon speaker also demonstrate significant levels of target relatedness. In other words, Miller and Ellis' claim that all non word production is based on the partial retrieval of lexical information would be supported if neologisms, which are subjectively more abstruse, are nevertheless on closer examination found to be related to target phonologies.

Phonemic paraphasia theories of neologism production

The argument that all neologisms are based on the partial retrieval of target lexical information places the mechanism of neologism production within the normal processing system and avoids the use of an external device. Phonemic paraphasia accounts of neologism generation (e.g. Lecours and Lhermitte 1969, Kertesz and Benson 1970, Lecours 1982) also view neologisms as arising from within the normal system but identify the processing deficit as occurring later in the lexical retrieval process. In these accounts, target phonological specifications are successfully retrieved from the lexicon but undergo phonemic distortion during subsequent processing. Buckingham (1987) argues that phonemic paraphasias are best viewed as failures of the scan copying mechanism (Shattuck-Hufnagel 1979). In this model, phonological form information is accessed from the lexicon and placed in a short term store. A scan copier mechanism then copies the segments from the buffer into a productive order frame, prior to realisation. Phonemic paraphasias may arise from the derailing of this mechanism, for instance through copying of a target segment to an incorrect slot (transposition errors) or from the selection of an incorrect segment for a particular slot in the frame (substitution errors). Other errors may arise if the phonological representation in the buffer decays before the scan copier mechanism has completed its operation.

As Buckingham (1987) points out, each of the above processing failures is capable of producing non word speech errors. What is in doubt is whether the phonemic paraphasia theory constitutes a realistic account of non word output in neologistic jargon aphasia.

The proposal can been criticised on a number of grounds. It is notable that the account is often based on the analysis of errors obtained from more than one speaker. This raises the possibility of biases influencing the selection of responses for analysis (e.g. Lecours and Lhermitte 1969, Lecours 1982). Other studies have proposed the phonemic paraphasia account in the absence of any phonological analysis of non word responses (e.g. Kertesz and Benson 1970). The phonemic paraphasia theory would thus be strengthened if detailed investigation demonstrated that it could plausibly account for all the non word output from a single neologistic speaker.

Miller and Ellis (1987) point to a number of reasons why RD's data is not consistent with such a theory of neologism production. Firstly, they found that very few of RD's error phonemes could be explained by the mechanism of transposition. In fact, Miller and Ellis argue that the few transposition errors which were evident were likely to be substitution errors which by chance appeared to be a transposition error. Secondly, an effect of phonetic similarity might be expected in phoneme substitution errors. In other words, when making a phoneme selection error the scan copier mechanism is likely to replace a target phoneme with an item that shares a number of phonetic features with the target. Again Miller and Ellis found no evidence to support this claim. Target - error consonant pairs were analysed for the number of phonetic features they shared. This was found to be no greater than the relationship between target and pseudo error pairs in a pseudo corpus, thereby suggesting that any phonological relationship in the genuine substitutions was no greater than could be expected by chance.

Another form of phonemic distortion may occur if there is an impairment in the ability to maintain the target specification in the buffer while it is implemented. This would predict an effect of word position; it might be expected that phonemes occurring early in the target word would have an advantage over phonemes appearing later in the specification. Miller and Ellis (1987) analysed RD's spoken responses for the position of target phonemes in neologism responses. They found no effect of word position, the target phonemes were randomly distributed across word positions. A similar result was obtained for RD's written errors. This argued against an impairment whereby successfully retrieved phonological (or orthographic) specifications decay rapidly from a short term buffer before they can be successfully copied.

Buckingham (1981) suggests that in order to adopt the phonemic paraphasia account neologistic speech must fulfill a number of criteria. Firstly, there should be no evidence of semantic or verbal paraphasias elsewhere in the subject's output since these would raise the possibility that neologisms are distortions of non target words, as in the dual impairment account of neologism production. Secondly, Buckingham argues that the neologistic speech should be free of the indications of anomia since phonemic paraphasias require the successful retrieval of lexical information before it is distorted by subsequent processes.

In a similar vein, Buckingham (1987, 1990) uses recovery patterns in jargon aphasia to argue against the phonemic paraphasia account of neologism production. He points to the increasing emergence of circumlocutions and word finding pauses as non word production diminishes suggesting that these indicate an anomia underlying non word production. Since, as already argued, phonemic paraphasias require that target phonological representations are successfully retrieved, recovery should not reveal underlying difficulties in accessing this information. Rather, recovery should follow a pattern whereby phonemic distortions become progressively less severe and less frequent, giving rise to increasingly target related neologisms. Eventually these should diminish leaving a presentation relatively free of the indications of anomia. Although Lecours (1982) reports anecdotal evidence supporting a progressive increase in the target relatedness of neologisms, Buckingham argues that the recovery pattern is yet to be well documented in the literature. However, as Buckingham (1990) concedes, this proposed evolution would be reliant on the recovery of output processing and would not allow for the possibility that neologisms may be progressively edited out as error awareness increases. Nevertheless, the account would still have to explain why neologisms are replaced by speech behaviours which are so typically associated with anomic type word finding difficulties.

In earlier criticisms of the phonemic paraphasia account, Buckingham and Kertesz (1976) and Buckingham (1977) raise additional objections. Firstly, they argue that the phonemic paraphasia account is unable to explain the tendency for neologisms to occupy noun slots. Since phonemic distortions occur after lexical selection, these authors argue that all word classes should be equally affected. Secondly, they point out that the phonemic paraphasia explanation predicts the presence of a continuum of target relatedness in any single (rather than longitudinal) sample of neologisms. Since the preservation of target phonology is determined by the extent of the phonemic distortion and since phonemic distortions can presumably occur on any scale, neologisms should evidence a range of target relatedness. Buckingham and Kertesz (1976) argue that this is not the case. Non words tend to polarise into two groups: abstruse items and those which show a close proximity to the phonology of the intended item. More recently, Christman and Buckingham (1989) argued that the atypical phoneme frequency distributions and the longer pauses associated with abstruse neologisms (Butterworth 1979) serve to distinguish these as a distinct group of speech errors. Buckingham (1987) thus argues that phonemic paraphasias and abstruse neologisms form two qualitatively different response types arising from differing processing sources. Accordingly, he suggests that the term 'target related neologism' should be avoided.

In contrast, O'Connell (1981) presents an analysis of the spoken errors of a single jargon speaker and argues that a number of similarities exist between phonemic paraphasias and neologisms. In particular, O'Connell identifies phonemic paraphasias which show varying degrees of target relatedness and argues that paraphasias of moderate complexity occurred frequently in the subject's output. The categorisation of responses as either paraphasic or neologistic was therefore often questionable with the distinction between the two error types difficult to determine. O'Connell thus questions the proposal that phonemic paraphasias and neologisms necessarily originate from different processing mechanisms.

Theories of neologism production identifying interactions between different levels of phonological processing

Other authors have suggested that neologisms may arise from either the partial activation of target phonological representations or from errors occurring during phonemic planning. However these will be distinguished by differing phonological characteristics (Kohn and Smith 1994a, 1994b, 1995). In addition these authors propose a greater level of interaction between the stages of phonological retrieval and phonemic planning whereby the later stage of phonemic planning is able to compensate to some extent for earlier deficits in phonological retrieval.

In the model presented by Kohn and Smith (1994a) phonological encoding occurs across a number of stages. Following Butterworth (1980, 1981, 1989), Kohn and Smith suggest that successfully retrieved entries in the semantic lexicon supply a phonological address. This information is used to guide the search for the target entry in the phonological lexicon. The phonological address contains some basic form information about the target representation and entries in the lexicon are checked against these requirements. Once successfully located, the target phonological specification must be activated. This involves the retrieval of information from two layers in the phonological lexicon. The syllabic plane stores target syllable structure while the melodic plane stores information about the phonemic content of the target word. Phonological representations are abstract encodings of the target form and are not fully specified, failing to stipulate information which could be obtained at a later point, for example through the application of the redundancy rules of the language. The mechanism for activating phonological representations is such that phonological neighbours also receive some input during the process of retrieval. Once fully activated, the abstract phonological representation is subjected to a final stage of phonemic planning. At this point redundancy rules are utilised to generate a fully specified segmental and structural description of the target word.

Phonological encoding can be impaired at each of these processing stages giving rise to different error patterns. Location deficits arise when the system fails to locate the identity of the target representation in the phonological lexicon. This may occur for two reasons. First, the phonological address associated with the entry in the semantic lexicon may be corrupted. When the address is completely unavailable, no access to the phonological lexicon is possible and anomic word finding blocks result. On other occasions the phonological address may be partly accessible. In this situation sufficient information may be available to gain access to the phonological lexicon but a non target word activated. The strength of the phonological relationship preserved between the error and the original target is dependent on the extent to which the phonological address was corrupted. Thus location deficits result either in word finding blocks or in phonologically related real word substitutions. Kohn and Smith (1994a) argue that non words should not be produced in response to these deficits.

In contrast, non word errors are thought to occur in response to activation deficits. Here, the target representation is successfully located from the phonological address but the stored information can only be partially activated. Other phonological representations, which share form information with the target also receive activation and on some occasions may attain a higher level of activation than the target item. In this situation a phonic verbal paraphasia (phonologically related real word substitution) may be produced. However, on other occasions no single lexical phonological representation will receive sufficient input to become fully activated. Here, two compensatory mechanisms (collectively termed phonological reconstruction) allow a non word to be produced on the basis of the partially activated phonological information. The severity of the activation deficit determines the amount of response phonology derived from the target representation and the amount produced via phonological reconstruction. Abstruse neologisms and target related non words (which they label phonemic paraphasias) are therefore distinguished only by their phonological proximity to the target. Subsequently, Kohn, Smith and Alexander (1996) have suggested that in severe cases phonological information may be actually lost from the lexicon rather than being temporarily inaccessible. In these cases non words will show no greater than chance levels of similarity with the target phonology.

In addition to activation deficits within the phonological lexicon, non word responses may arise from errors at the stage of phonemic planning. At this level of processing, difficulties may occur in transforming a properly activated, abstract phonological representation into a complete phonemic specification ready for output (Kohn and Smith 1994b). The degree of similarity shown between the target and the non word response will be dependent on the amount of information which can be successfully obtained from the phonological representation. Thus, non words occurring at this level may also exhibit varying degrees of target relatedness.

Kohn and Smith propose two compensatory mechanisms which operate in the context of an activation deficit to allow the system to produce some output phonology. These mechanisms operate at the level of activation of entries in the phonological lexicon and at the subsequent stage of phonemic planning.

As already stated, the organisation of the phonological lexicon is such that information is distributed across two tiers. Lexical representations which share information at either level are interconnected and receive some input during the activation of a phonologically related target. Kohn and Smith suggest that this organisation allows for the construction of novel phonological representations. In the context of an activation deficit, partially activated neighbours provide phonological information which can supplement the incomplete target representation. This allows a viable, novel phonological representation to be constructed and made available for phonemic planning. Kohn and Smith argue that in the normal system this mechanism allows non words to be read via their analogy with real words.

Operational properties at the subsequent stage of phonemic planning give rise to the second compensatory mechanism. Under normal conditions, the representation supplied to this stage provides only minimal phonological information with the fully specified representation being generated during phonemic planning, for example through the application of redundancy rules. Thus phonemic planning is specifically designed to generate the missing information in phonological representations. Kohn, Melvold and Smith (1995) suggest that normal, rule governed phonological processes such as consonant harmony may also contribute to the compensatory mechanisms by which partial lexical phonological information can be expanded to create a complete phonemic specification during this phase of planning. Phonological reconstruction of partially activated representations is therefore simply an extension of the normal phonological processing occurring at this stage (Kohn and Smith 1994a).

The proposed mechanisms of phonological reconstruction allow non word phonology to be generated from within the normal processing system. In cases of a partial activation deficit, reconstruction supplements the partial phonological representation. In more severe cases, Kohn and Smith claim that reconstruction is capable of generating a phonemic specification in the absence of any target phonology. Thus the account proposes a single mechanism for construction of both target related and abstruse neologisms. Since the mechanism lies within the normal processing system the adherence of non word responses to phonotactic constraints is readily explained.

Kohn and Smith argue that the account is not in conflict with the data used by Butterworth (1979) to support his proposal of a random phoneme generator. Phonological reconstruction may require some additional time, thus potentially creating longer pauses before neologisms than real words. Target related neologisms, where relatively little reconstruction is necessary would be associated with shorter hesitations than abstruse neologisms. Here, the almost complete failure to activate the target phonological representation would necessitate more extensive reconstruction, thus requiring a longer pause prior to the production of the non word. Furthermore, Kohn and Smith maintain that the abnormal phoneme distributions found by Butterworth (1979) in the abstruse neologisms can be explained by the over reliance on a few segments during the process of reconstruction. However, they fail to discuss the possibility that phonological reconstruction may actually predict an exaggeration of the normal frequency bias in the use of phonemes. This would occur through the interconnections between phonological representations which Kohn and Smith rely on to allow reconstruction via the phonological neighbours of the target word. Phonemes which are frequent in the language should appear in many of the interconnected representations. These popular phonemes should thus receive a greater amount of activation than low frequency segments which may appear in relatively few neighbouring representations. This should predict that phonological reconstruction will rely more heavily on higher frequency phonemes and hence exaggerate the normal frequency bias rather than obliterating it.

A second criticism of the mechanism of phonological reconstruction as proposed by Kohn and Smith is the selectivity with which it is used to generate non word responses. In the case of severe activation deficits, Kohn and Smith argue that reconstruction can compensate for, "the total failure to activate entries in the phonological lexicon". Nevertheless they argue that location deficits, which similarly fail to identify and activate an entry in the phonological lexicon, can not precipitate phonological reconstruction. Kohn and Smith (1994a) concede that this could occur if they followed Butterworth and Buckingham's proposals of phonemic construction in the absence of access to the phonological lexicon. However, they predict that this would be associated with a recovery pattern where evolving neologisms show no increasing relationship to target phonology since their reconstruction occurs without recourse to target information. This argument however would appear to be at odds with the previous assumption that the phonological address, which may be at least partially available in location deficits, must contain some basic phonological information in order to guide the search through the phonological lexicon. In fact Butterworth (1981) raises the possibility that target form information could be recovered from phonological addresses by conceptualising them as, "not completely specified phoneme strings". It therefore seems plausible that in the context of a severe location deficit this information could be utilised for the purpose of phonological reconstruction at the level of phonemic planning.

A central theme of the current account of neologism production is that the phonological characteristics of non word responses can be used to determine the location of the underlying processing impairment. The characteristics thought to distinguish neologisms produced in response to activation deficits and those non words arising from errors at the stage of phonemic planning are outlined in subsequent papers (Kohn and Smith 1994b, 1995). Neologisms displaying a range of target relatedness can be produced at each level. In addition, both types of neologisms should show an effect of target word length and contain examples where responses simplify the target CV structure. However, only those neologisms arising from an activation deficit can potentially complicate target CV structure. This occurs when structural information is borrowed from a phonological neighbour or where reconstruction processes resort to a default CV structure which happens to be more complicated than that of the target. In addition, 'activation deficit' neologisms may contain greater numbers of non target phonemes (again activated from phonological neighbours) and show relatively fewer target phonemes than 'phonemic planning' neologisms. Activation deficits allow real word responses to occur alongside neologisms when a phonologically related real word neighbour receives sufficient input to replace the target item. Finally, Kohn and Smith (1994b) argue that the production of pseudo words in non word reading should be severely disrupted for speakers with lexical activation deficits. This arises from their proposal of non word production via analogy with the lexical representations for real word items. Kohn and Smith argue that this requires the correct activation of multiple entries within the lexical store and thus is more likely to be disrupted by the deficit of lexical activation. However, they fail to discuss the apparent contradiction that this mechanism, which is now considered to be unavailable for non word reading, can nevertheless be called upon during the process of phonological reconstruction.

Neologisms arising from impaired phonological planning are likely to show a position effect whereby deviation from the target increases through the response. This occurs as the target representation becomes increasingly unavailable as planning proceeds. Consequently, errors may consist of word fragments containing the initial portion of target item. Performance on non word tasks should be similar to real word production since both response types will be equally disrupted by the phonemic level deficit.

In support of these claims Kohn and Smith (1994b, 1995) found the above phonological characteristics present in the predicted combinations in two groups of neologistic speakers. They use this evidence to support their claim that neologisms may arise from two discrete processing impairments and that these will be associated with differing phonological characteristics.

Interactive activation theories of neologism production

The system of phonological reconstruction via interconnections within the lexicon suggested by Kohn and Smith is not dissimilar from the patterns of spreading activation seen in interactive activation networks. Indeed Kohn and Smith (1994a) acknowledge that their lexicon could be potentially interpreted in this way. Similarly, Miller and Ellis (1987) suggested that the partial retrieval of phonological information used to account for RD's errors could be interpreted within an interactive activation model.

Interactive activation models of language processing (for example, Dell and Reich 1980, Stemberger 1985, Dell 1986) conceptualise the language system as a network of simple processing units linked in a complex arrangement of feed forward and feed back connections. Processing units or 'nodes' correspond to linguistic units such as word morphemes and phonemes. Nodes are usually thought to be arranged in layers according to the type of information they represent (for example semantic and phonological levels) although Stemberger (1985) has questioned how far these levels may be strictly delineated. In addition, the precise architecture of the system and the nature of the information encoded at each level varies somewhat from model to model. It is generally agreed, however, that each linguistic unit is represented only once in the system. At rest, the activation level of each node fluctuates randomly around a sub-threshold, resting level of activation. During language processing energy flows through the network according to the principles of spreading activation (Dell and Reich 1980). Each activated node passes input to related nodes at both the subsequent and previous levels of representation. The amount of activation passing from one node to the next is influenced by two factors: the activation level of the originating node (nodes pass on activation in direct proportion to their own level of activation) and the strength or 'weighting' of connections. Increasing the connection strength allows activation to be passed more efficiently, that is to say a greater amount of activation is delivered per unit time (Schwartz, Saffran, Bloch and Dell 1994). All models contain excitatory connections whereby activation passing from one node to the next increases the activation level of the receiving node. Some models also incorporate negatively weighted or 'inhibitory' connections. These may exist between nodes at different levels (e.g. Stemberger 1984, 1985, Dell 1985, Harley and MacAndrew 1992) and between competitor nodes within the same level of representation (e.g. Stemberger 1985, Dell 1985, Harley 1990, 1993, Harley and MacAndrew 1992). Activation passing along an inhibitory connection has the effect of reducing the activation level of the recipient node. During processing, activation cascades through the network so that lower levels of representation receive input even before processing is complete at the previous level (McClelland 1979). However, processing at earlier levels will be nearer to completion. As well as being able to receive activation, lower levels of representation also return input to the previous layer and can therefore influence processing at this level. Activation reverberates through the system via the feed forward and feed back connections between each level. During each time step, the activation level of each node will be increased as a result of the excitatory input received from all related nodes at the previous and subsequent levels. At the same time, a node's activation level will be reduced partly through natural decay and (possibly) as a consequence of inhibition from competing nodes. Over time, input converges on the target node(s) at each level thus increasing their level of activation while competitor, non target nodes become progressively less activated.

Selection or access of a node implies that the unit has achieved sufficient activation to ensure that its related nodes at the next level of representation will also be selected (Stemberger 1985). Selection may occur according to a 'first past the post' system, whereby the first node to achieve a threshold level of activation is selected (e.g. Stemberger 1984). Alternatively, a selection mechanism, initiated after a certain number of time steps, may select the most highly activated node at that time (Dell and Reich 1980, Dell 1986, 1988). There is general agreement that an inhibitory mechanism is then employed to return the selected node to its baseline level of activation, so preventing it from being reselected on the next point of selection. However, as Dell (1986, 1988) points out, the inhibited node is unlikely to remain at baseline for long as it will quickly receive input from partially activated, related nodes through the process of spreading activation.

It has been argued that interactive activation networks offer a number of advantages over serial processing models of language production (see Harley 1993 for a review). In particular, interactive activation models have been used to explain features of normal speech errors which pose difficulties for serial processing models. For example, serial processing models (which assume the unidirectional flow of information between discrete levels of processing) are challenged by the observation that incomplete processing at one level of representation is nevertheless able to influence the outcome of processing at another, possibly earlier, level of representation. In contrast, interactive models are able to accommodate multiple influences on the occurrence of speech errors through the notion of spreading activation. Accordingly, the principles of spreading activation have been used to explain aspects of normal speech errors such as the presence of a lexical bias in the occurrence of phonological errors (Dell and Reich 1980, 1981, Dell 1985), the influence of message external information on speech errors (Harley 1984) and the phonological facilitation of word substitutions (Dell and Reich 1981, Harley 1984).

In general, errors arise within interactive networks when a non target node achieves a higher level of activation than the target node and is thus selected. Non target nodes may achieve this through the presence of random noise in the system. Stemberger (1984) argues that noise arises from the random fluctuation in the resting levels of nodes and from spreading activation along the feed forward and feed back connections. In addition, noise may occur as a result of frequently used nodes having higher resting levels of activation and thus requiring relatively little input before being able to exert an effect over selection from any level. Although alternative mechanisms for encoding frequency in interactive networks have been suggested (e.g. MacKay 1982, Dell 1986) these also predict that higher frequency items contribute to the level of noise in the system and thus influence the occurrence of speech errors.

As well as being used to account for errors in the output of normal speakers, attempts have been made to explain aphasic speech errors in the context of damage to the interactive lexical network. A number of possible processing mechanisms have been suggested to interpret the different error patterns seen in aphasic speech. Stemberger

(1984) argued that a general increase in the level of noise within the system, coupled with an upward shift in the threshold level of activation necessary for retrieval, would account for the effects of frequency commonly seen in aphasic word and syntactic frame retrieval. Martin and Saffran (1992) and subsequently, Martin, Dell, Saffran and Schwartz (1994) interpreted the symptoms of deep dysphasia exhibited by their patient as resulting from a pathologically increased rate of decay whereby nodes receiving input were unable to preserve their increased levels of activation.

Attempts have also been made to explain neologism production within interactive activation frameworks. Ellis (1985) and Miller and Ellis (1987) suggested that RD's neologisms could be interpreted within Stemberger's (1985) model as arising from a reduced 'cascade' or flow of information from the semantic to the lexical level. Although they offer no explanation as to why this processing deficit should occur, they do discuss how it might precipitate RD's speech errors. The reduced flow of activation should disproportionately discriminate against lexical nodes of low frequency items. Given their lower resting levels of activation, weak activation would be unlikely to raise these nodes to a threshold level therefore reducing the probability that these words would be retrieved. High frequency lexical items would not be so disadvantaged. The higher resting levels of activation for these word nodes would mean that the small amount of activation received from the semantic level might well be sufficient to raise the units to threshold level, allowing the word to be retrieved. This would account for the strong effect of frequency in RD's lexical retrieval.

According to the principles of spreading activation, word nodes which have been only partially activated would nevertheless be able to pass on some input to the phoneme level. This would allow some target phonemes to appear in the non word response, therefore accounting for the partial preservation of target phonology in RD's neologisms. Other, non target or 'inappropriate' phonemes will also receive activation through the presence of random noise in the system. Error phonemes will be only weakly inhibited by the partially activated target phonemes and thus stand a good chance of appearing in the response. Interestingly, this account may make some predictions about the identity of error phonemes in RD's responses, for instance that they may show a frequency bias or be associated with lexical competitors to the target. Miller and Ellis do not pursue these issues. They do however argue that the repeated appearance of phonemes across successive neologisms can be accounted for within an interactive model by the weak inhibition of previously activated phoneme nodes which maintain some partial level of activation, this allowing them to appear in subsequent non word items. Christman and Buckingham (1989) concur with this conclusion arguing that the availability of non target phonemes in such a network must arise from their status as previously activated and not yet fully decayed items. This will produce both the absence of a normal phoneme frequency distribution and the perseverative use of neologistic phonology observed by Butterworth (1979).

Schwartz et al (1994) also use an interactive activation model to explain neologism production although they consider a somewhat different processing deficit to be disrupting the normal flow of activation throughout the lexical network. Specifically, Schwartz et al argue that the efficiency of activation flow is reduced by a pathological and global weakening of inter-level connections. Weakened connections supply less input per unit time to their recipient nodes. Thus all levels of processing within the system receive less activation rather than the effect being restricted to the phonological level as proposed by Miller and Ellis (1987). Schwartz et al (1994) nevertheless focus on the effect of reducing the level of activation received by phonological level nodes. They argue that this account is able to explain two central characteristics found in the neologistic output of their speaker: the proliferation of non word forms and the perseverative use of phonemes from earlier in the utterance.

The account of neologism production offered by Schwartz et al (1994) is based on two experimental findings concerning the effect of speech rate on errors in normal speakers. Dell (1986, 1990) showed that both the presence of a lexical bias and the ratio of phoneme anticipations and perseverations are related to speech rate. The lexical bias effect refers to the finding that sound errors result in real word errors more frequently than is predicted by the effects of chance alone (Baars, Motley and MacKay 1975, Dell and Reich 1981). In Dell's (1986, 1990) account, this arises from the feed back of activation from the phonological to the lexical nodes. Partially activated combinations of phonemes which correspond to real word items are able to return activation to nodes at the lexical level and in turn receive further activation from these lexical nodes. In contrast, combinations of phoneme nodes which do not correspond to lexical items are unable to engage in such feedback cycles and consequently become progressively less reinforced. This increases the probability that the combination of phonemes corresponding to a real word item will be produced. The establishment of feedback loops and the reverberation of activation between the two levels however requires processing time and thus the lexical bias takes some time to emerge. Dell (1986, 1990) showed that when speech rate is increased in experimental conditions the effect disappears; at faster speech rates, sound errors are increasingly likely to result in non word outcomes. This pattern is explained by the reduced opportunity for feedback to cycle between the phonological and lexical levels.

With increased speech rate the nature of sound errors also shifts, the ratio between perseverative and anticipatory errors changing so that perseverative errors predominate. Dell (1986, 1990) also attributes this effect to the reduced time available for the system to operate. After selection, nodes are returned to baseline (post selection inhibition) however they quickly become reactivated by spreading activation from related, partially activated nodes. They then decay slowly towards a resting level. Again, this decay takes time. At fast speech rates, previously used phonological segments will retain a significant level of activation at the point of next selection from the phonological level. This increases the availability of these units for reuse. At slower speech rates the previously used items will have undergone a greater amount of decay and will therefore be less available. Additionally, they will offer less competition to phoneme nodes which have been partially activated owing to their presence in upcoming lexical items. The mis-selection of upcoming phonemes therefore becomes more likely and the error ratio shifts to show an increase in the proportion of anticipatory sound errors.

Schwartz et al (1994) argue that the weakening of inter-level connections is analogous to increasing the speech rate in normal speakers; both diminish the amount of time over which activation is able to reverberate through the system. They argue that the production of non words and the predilection for perseverative sound errors shown by their neologistic speaker, FL, can thus be interpreted by a weakening of inter level connections. In support of this claim they offer evidence of the effect of practice in normal speakers. Practice is thought to have the opposite effect, increasing connection strength and thereby allowing more activation to pass across connections per unit time (MacKay 1982). With practice, the speech errors of normal speakers should therefore shift from the pattern associated with weakened connections (no lexical bias, more perseverative errors) towards the pattern associated with stronger connections (lexical bias and a greater tendency for anticipatory sound errors). The effect of allowing normal speakers to practice tongue twisters while keeping the speech rate constant was observed. Normal speakers benefited from practice with the error rate reducing across trials. In addition the profile of errors changed; real word outcomes became more prevalent and perseverative sound errors reduced in frequency thus increasing the proportion of anticipatory sound errors. Schwartz et al (1994) therefore argue that the error pattern associated with neologistic jargon can be explained as arising from a weakening of inter-level connections in the interactive lexical network.

The account proposed by Schwartz et al (1994) offers the advantage of specifying both the nature of the impairment to the interactive network and the implications for normal processing. Schwartz et al concentrate on the effects of weakening the connections between the lexical and phonological levels, although they propose the impairment to be global, affecting all levels of nodes and connections. However, their account fails to discuss explicitly the effects of the weakened connections at other levels. For instance, weak activation at the lexical level raises the possibility of the perseverative use of lexical items in much the same way as the perseverative use of phonemes is accounted for. Schwartz et al do not discuss whether this was a feature of the neologistic speech they investigated. They also fail to discuss the implications of the global processing impairment for other language skills. For instance, the account predicts that auditory input processing will also be hampered by the weakened connections. This requires a necessary co-occurrence of comprehension difficulties with jargon output. However, there is strong evidence that auditory comprehension difficulties and neologistic output can dissociate in jargon aphasia (Butterworth and Howard 1987).

Schwartz et al also fail to discuss the differential effects of weakened connections on nodes associated with differing frequencies of use. Weak activation of the phonological level and the elimination of feedback to the lexical level makes strong predictions about the identity of units successfully retrieved. At the very least it suggests an advantage for higher frequency items given that these my be associated with higher resting levels of activation (Stemberger 1985) or even strengthened connections through the effects of repeated practice (MacKay 1982). Yet Schwartz et al omit to consider an effect of lexical frequency on the successful output of their speaker. More specifically, given their focus on the phonological level, Schwartz et al ignore the possibility that weakened connections may differentially affect phonemes of differing frequencies.

Finally, Schwartz et al's (1994) account centres on the amount of time available for activation to reverberate between the phonological and lexical levels. This predicts that reducing speech rate or increasing the time available for response production should allow the system to compensate for the weakened connections. This arises from the assumption that the weakened connections simply slow the rate of spreading activation rather than resulting in the loss of energy from the system. The account would therefore predict that the accuracy of neologistic speech should increase at slower rates of production or with the imposition of a delay before the production of a response. Currently, there is no evidence in the literature to suggest that this is the case. In fact Miller and Ellis (1987) showed that successive responses produced by RD tended to move further away from the target.

Central to the account of neologism production offered by Schwartz et al (1994) is the explanation for the loss of the normal lexical bias. However, in contrast to the claim that this is a specific feature of jargon output, Nickels and Howard (1995) argue that it is common to all aphasic speech errors. The naming errors of 15 aphasic speakers with varying patterns of presentation were analysed. None showed a significant tendency to produce real word errors once the effects of chance were controlled. In contrast, lesioning the interactive activation model of speech production offered by Dell and O'Seaghdha (1991) produced a significant lexical bias on every occasion. This result implies that the aphasic impairment in each of the speakers investigated has resulted in the loss of feedback from the phonological to the lexical level, thus removing the normal lexical bias. As Nickels and Howard point out, this seems unlikely. They therefore investigated the role of feedback connections in more detail. In the unlesioned model, the presence of feedback connections was found only to increase the probability of errors being produced. Moreover, removing feedback connections from the lesioned models created an error pattern which more closely resembled the aphasic data, reducing the lexical bias to a level which was only just above chance. The removal of the feedback connections in the lesioned models also served to remove a correlation between the lexical bias and the production of semantic errors. This pattern was obtained from the original lesioning of the model (i.e. where feedback connections were present) but was not replicated in the aphasic data. These findings led Nickels and Howard to suggest that speech production (and aphasic language disturbance) may be better investigated through the use of models which avoid between level feedback connections. If this approach is to be adopted then accounts of aphasic language which rely on the loss of feedback connections may also be called into question. Given the traditional reliance on feedback connections in interactive models of language production this claim will require further support before being universally adopted. Nevertheless, the finding that both fluent and non fluent aphasic speakers commonly fail to show a lexical bias casts doubt over explanations which rely on this feature to explain the distinctive error pattern of jargon aphasia.

Experimental evidence calling into question the presence of feedback connections is offered by Levelt, Schriefers, Vorberg, Meyer, Pechmann and Havinga (1991). These authors investigated the effect of a lexical decision task on naming latencies. Auditorily presented stimuli consisted of either the picture name, a semantically or phonologically related item or an unrelated stimulus. When the lexical decision stimulus was presented early in the naming process, a significant effect of the semantically related item was found. Levelt et al argued that this reflected the activation of items at the semantic level during the lexical selection phase of word production. If activation was then fed back to the semantic level following the selection of the lexical node then semantically related lexical decision stimuli should continue to have a significant effect at later stages in the naming process. However this effect was not found. At later presentations, phonologically related stimuli showed a significant effect on naming latencies but the effect of semantically related stimuli was no greater than that found for the unrelated items. Levelt et al (1991) therefore argued that the evidence seriously challenged the assumption that activation spreads through the system via both feed forward and feed back connections.

While Schwartz et al (1994) argued for a global weakening of connection strength throughout the lexical network to explain neologism production, Harley and MacAndrew (1992) propose a more localised impairment. Their account also has the potential advantage of making little use of inter-level feedback connections. Like Miller and Ellis (1987), Harley and MacAndrew (1992) argue that neologisms arise from a reduced flow of activation from the semantic level resulting in the weak activation of lexical nodes. This was achieved in a modelling simulation by randomly lesioning the excitatory, semantic to lexical level connections through the addition of noise to each connection. At the same time the period over which the semantic level can supply input to the lexical level was restricted. Harley and MacAndrew suggested that this reproduces the central features of neologism production. Higher frequency lexical items remain relatively robust, presumably benefitting from their higher resting levels of activation and so requiring less input before they achieve adequate levels of activation. In contrast, lower frequency lexical items showed greater sensitivity to the processing impairment. Harley and MacAndrew argue that this reproduces the frequency effect seen in the real word output of jargon speakers (e.g. Ellis et al 1983). Two further real word effects were produced by the simulation. Firstly, a low rate of semantic paraphasias and secondly an advantage for high imageability words similar to the advantage associated with lexical frequency. The possibility that these effects further characterise real word production in neologistic jargon merits future investigation. Within the model, neologisms arise from the fact that partially activated nodes at the lexical level supply reduced levels of activation to the phoneme nodes. Non target phonemes receive activation from random noise in the system and thus may become sufficiently activated to appear in the response. This explanation predicts an advantage for higher frequency phonemes, both in terms of their ability to appear in target related contexts and in their rate of use as error items. However, this possibility is not raised by Harley and MacAndrew.

Specific limitations can thus be identified for each of the attempts to explain neologism production using interactive activation models. In addition, Buckingham (1990) argues that, like the phonemic paraphasia account, interactive activation explanations are hampered by the fact that they necessarily place target related and abstruse neologisms along the same severity continuum. As stated previously this predicts that neologisms should represent a range of target relatedness, a proposal dismissed by Buckingham and Kertesz (1976). Interactive activation accounts might nevertheless accommodate an apparent lack of continuity across non word responses, while still maintaining that they arise from the same underlying processing mechanism. For example, the complex network of interconnections between phoneme nodes may allow sufficiently activated target segments to support the retrieval of other target related phonemes by supplying them with additional input. This would predict a 'tip over effect' during lexical retrieval whereby processing which might initially have produced a highly target related neologism actually results in a correct response. In other words, once a certain proportion of target lexical information is sufficiently activated, realisation of the entire representation becomes possible. This would account for a failure to identify a smooth progression from highly target related neologisms to correct responses. Similar effects might occur during the processing of less successful responses, particularly if a syllable level of representation is incorporated into the lexical network. Again, the suggestion might be that the retrieval of target related phoneme information reaches a threshold at which point the activation of the entire target syllable becomes assured. This would predict the presence of a stepwise progression in the level of target relatedness demonstrated by non words occurring along the proposed continuum between correct responses and abstruse neologisms. Thus, the failure to demonstrate neologisms occurring at every point along a continuum of target relatedness need not necessarily preclude the possibility that these responses all arise from a single mechanism.

A further prediction arising from the single impairment account offered by interactive activation models is that recovery should show that neologisms become increasingly target related with real word responses increasingly frequent. At the same time the recovery pattern should be free from evidence to suggest an underlying anomia (Buckingham 1990). However, these predictions hold true only if recovery is associated with increased ability to realise target phonology rather than the increasingly efficient pre-articulatory editing of speech errors in the context of recovering error awareness.

Recovery data of the type Buckingham is looking for may be supplied by Kohn and Smith (1994a). They monitored the recovery of a neologistic jargon speaker, VN, over the first five months after the onset of his aphasia. Evidence was obtained from picture naming assessments and conversational / connected speech data. A number of positive changes were noted in VN's responses during the picture naming assessment. Firstly, the number of correctly named items increased. Secondly, real word errors shifted from being unrelated to being phonologically related to the target items. At the same time, the proportion of target phonemes produced across sequences of non word errors increased. Kohn and Smith argue that this supports their proposal that non word errors are motivated by lexical phonology rather than being the product of a neologism generating device. In contrast to the recovery seen in VN's picture naming performance, his connected speech remained typically anomic, characterised throughout by the use of empty utterances and non specific content nouns. Kohn and Smith suggest that VN strategically adopted this form of connected speech in an attempt to minimise the need for effortful lexical retrieval during conversation. Importantly, the persisting conversational anomia in the context of resolving lexical retrieval abilities suggests that anomic symptoms may not always accurately reflect the ability of the speaker to retrieve lexical information. This therefore runs counter to Buckingham's assumption that anomic symptoms necessarily indicate an impairment of lexical retrieval. Although Kohn and Smith use VN's recovery pattern to support their serial processing model of neologism production, the data could equally be used to defend interactive activation accounts of non word generation. Indeed, interactive activation accounts offer the advantage of predicting the production of error phonology during impaired lexical processing rather than needing to recourse to additional strategies or mechanisms for the construction of non target phonology.

Finally, the discrepancy between VN's performance in picture naming and conversation highlights the need for studies to consider the nature output tasks used when recording neologistic output. This is not a variable which has previously been controlled when investigating neologism production, either within or across studies.

Neologisms as recurrent utterances

Neologisms can also occur in other forms of aphasia. In particular, the speech automatisms of some globally aphasic speakers may comprise non lexical forms. These appear to share some similarities with the neologistic productions of jargonaphasia. Code (1982) reviewed the reported utterances of a number of speakers whose output consisted of speech automatisms. He identified
that repetitive, non lexical utterances typically conform to the phonotactic constraints of the speaker's native language. However, they may also represent the simplification of articulatory material, consisting of sequences of CV syllables and relying heavily on motorically simple articulations. In line with a number of studies investigating neologisms produced by jargon speakers (e.g. Perecman and Brown 1981, Peuser and Temp 1981), Code found that non lexical repetitive utterances showed a non typical distribution of English phonemes and a significant alteration to the normal consonant:vowel ratio. However, despite the suggestion of some shared features between the non word output produced in both forms of aphasia, some important differences also exist. The neologism produced as a speech automatism may well reflect the total extent

of the speaker's spoken output. It is produced repeatedly within and across every linguistic context and replaces target words of all grammatical categories. This is in marked contrast to the considerable variability displayed in jargon aphasia where, despite the perseverative use of some sounds, individual neologisms may never be repeated and attempts at the same target may yield different responses, both within and across trials. Additionally, a number of studies report that neologisms may reflect the full phonemic inventory of the speaker's native language and show a normal distribution of speech sounds (e.g. Hanlon and Edmondson 1996). Furthermore, neologistic output typically contains non words displaying a range of syllable and CV structures, and, far from simplifying structural information, it has been suggested that neologisms typically complicate the target structure (Perecman and Brown 1985). A further difference concerns the use of intonation. A number of authors have found that there is typically only a very restricted ability to vary intonation in order to increase the communicative value of speech automatisms (Code 1982, 1994, De Bleser and Poeck 1985, Blanken, Wallesch and Papagno 1990). This is in contrast to the repeated observation that intonation and other aspects of prosody are typically preserved in both neologistic and phonemic jargon and can frequently be manipulated by the speaker to enhance the communicative value of their non lexical output (e.g. Duchan et al 1980).

Speakers with speech automatisms are commonly described as globally aphasic (Code 1982, Blanken et al 1990). However, there are indications that they may nevertheless retain some preserved abilities in other areas of language processing. For example, Blanken et al (1990) demonstrated residual writing skills in a number of speakers with recurrent utterances. These subjects showed dissociations in their patterns of performance, indicating the differential preservation of various writing routines. In particular, evidence that writing to dictation in one subject was completed using a lexical, non-semantic route suggested that speech automatisms could occur in the context of some preserved lexical phonological skills (Blanken, de Langen, Dittmann and Wallesch 1989, Blanken et al 1990). This suggestion was supported by the finding that the subject also demonstrated covert knowledge of target phonological forms on tasks such as rhyme judgement, initial phoneme judgement and syllable length judgement (Blanken et al 1989). These findings, coupled with the frequent observation that speech automatisms are almost universally specific to the spoken modality (Blanken, Dittman, Haas and Wallesch 1988, Blanken et al 1990) have led to the hypothesis that speech automatisms arise from deficits at a subphonemic level of processing. In particular, it has been argued that damage to the articulatory or response buffer may prevent this processing component from being programmed with new linguistic material (Blanken 1991, Code 1994). Thus every input to the buffer results in the production of the same recurrent utterance. Blanken (1991) has suggested that, in addition, higher level processing deficits may also limit the control which can be exerted over an otherwise intact articulatory buffer. Nevertheless, the proposal that speech automatisms arise at the level of the response buffer locates the source of speech automatisms at a relatively peripheral level of processing. This is in contrast to the more central lexical-phonological deficits commonly proposed as the source of non word output in jargon aphasia. Code (1994) suggests a preliminary model to account for the initial encoding of the utterance in the articulatory buffer. He suggests that non lexical automatisms arise when the initial utterance is constructed by an 'articulatory formulation' module rather than by a speech lexicon. However, he doesn't make it clear why composition of the utterance should utilise this non lexical module, nor does he explain its function in normal language processing.

In contrast to the extremely limited output of most speakers with speech automatisms, Blanken (1993) reports a subject, TW, who presented with stereotyped neologisms within the context of some real word output and intermittent jargon. Neologistic forms typically occurred in content word slots while function words were relatively well preserved. They were also more likely to be produced in attempts to name low frequency targets. Neologisms were produced fluently and Blanken argues that they were not associated with hesitations or word finding pauses, although this was not demonstrated objectively. In marked contrast to many jargon speakers, neologisms were associated with frequent attempts at self correction, although sequences of responses to picture stimuli were found to become increasingly distant approximations of the target form. In conversation, very few neologisms could be identified as approximations to a recognisable target. A level of stereotypy was observed in the phonological forms of neologisms; more than half incorporated a recurrent phoneme string which appeared to operate as a form of suffix to the neologism. Nevertheless, neologisms also demonstrated some variability, both in the main part of the neologism and in the precise form of the suffix. TW's neologisms failed to reflect a simplification of normal CV structures, containing a bias towards an initial consonant cluster onset. However, there were significant differences in the phonemic content of those neologisms which incorporated the stereotypic suffix and those which failed to contain this form. TW's performance across a number of tasks of silent phonology suggested that he was able to access information regarding the phonological form of words he was unable to produce. Written neologisms showed no evidence of stereotypy and reflected none of the patterns identified in spoken output.

Blanken argued that a primary deficit in lexical retrieval was unable to account for TW's covert phonological knowledge, his self correction attempts and the lack of anomic type word searching behaviour. Furthermore, he argued that an account of neologism production relying on the random generation of phonology would be unable to explain the high level of stereotypy in TW's neologisms. No other explanation for neologism production relying on a lexical phonological retrieval deficit is reviewed for its ability to explain the data. However Blanken does argue that the phonemic paraphasia account is similarly unable to explain how diverse phonological target specifications, once successfully retrieved, could all be distorted to the same stereotyped form. TW's output is also not easily viewed as a form of recurrent utterance. The buffer level encoding difficulties proposed for speakers with more restricted stereotyped output do not predict the part of speech and frequency effects which were found to influence TW's production of neologisms. They are also unable to accommodate the degree of variability seen in TW's output, both in the production of correct responses and in the phonemic content of individual neologisms. Blanken thus proposes that TW's stereotyped neologisms are best viewed as arising from an interaction between deficits occurring at different levels of processing. Thus he regards a higher level deficit in lexical activation as impacting on the operation of subphonemic processes, such that the fluctuating lexical activation deficit creates a temporary failure to encode new linguistic material at the level of the articulatory buffer. In making this claim Blanken argues that, within an interactive lexical network, the impact of processing impairments may not be restricted to the operation of adjacent levels of representation. Rather, he claims that disturbances of processing to one level can have much longer range implications.

Monitoring

People with jargon aphasia frequently appear unaware of the disordered nature of their speech. However, theories attempting to account for this lack of monitoring have typically been distinct from models of neologism production. Similarly, accounts attempting to describe the processing deficits underlying non word generation have commonly failed to explain why these should give rise to non word output rather than no output and why, once produced, the neologism goes undetected. Finally, accounts which have called on increased error awareness to explain the progressive suppression of neologistic output have failed to discuss the precise nature of the relationship between monitoring and neologism production (Panzeri et al 1987).

A number of hypotheses for the failure to monitor non word production have been offered. Some authors have argued that the monitoring deficit arises from denial and may more properly be described as a form of anosognosia (Kinsbourne and Warrington 1963, Weinstein 1981, Lebrun 1987). This proposal is challenged by a number of observations. Firstly, subjects who appear unaware of their spoken errors may nevertheless demonstrate awareness of other neurological impairments. Moreover, dysphasic speakers have been noted to show dissociations in their ability to monitor across language modalities (Peuser and Temp 1981, Ihori, Kashiwagi, Kashiwagi and Tenabe 1994, Robson et al, in press). Finally, monitoring ability has also been demonstrated to vary across output tasks within the same modality (Marshall, Robson, Pring and Chiat, submitted). These findings challenge the proposal that poor monitoring of jargon forms part of a general anosognosia.

Other accounts have attributed the monitoring deficit to processing impairments occurring within the language system itself. For example, Levelt (1983, 1989) has argued that the auditory comprehension system offers two possible mechanisms for monitoring spoken output. External feedback allows speech to be checked for errors following production, while an internal feedback route allows covert repairs to be carried out prior to articulation. However, a number of studies suggest that the relationship between input skills and the ability to self monitor is not straight forward. Nickels and Howard (1995) found no correlation between the ability of aphasic speakers to detect errors in their spoken output (as indicated by self correction attempts) and the degree of competence they demonstrated on three auditory processing tasks: minimal pair judgement, auditory lexical decision and auditory synonym judgement. In relation to jargon aphasia, it has been noted that while auditory comprehension difficulties frequently accompany the disordered output, their severity may vary and they do not form a necessary component of the syndrome (Butterworth 1979, 1985, Butterworth and Howard 1987). Consistent with this, a number of individual jargon speakers have been described who show dissociations between their self monitoring ability and their auditory processing skills. Subjects who fail to monitor their speech despite adequate comprehension abilities (Maher, Rothi and Heilman 1994, Robson et al, in press) appear to be ignoring a potential mechanism for detecting their errors. It has been suggested that in these cases a resource limitation may prevent the processes of speech production and monitoring from operating concurrently (Shuren, Smith, Hammond, Maher, Rothi and Heilman 1995). However, this explanation is unable to account for other jargon speakers who have been reported with good error awareness despite poor auditory input processing skills (Marshall, Rappaport and Garcia-Bunuel 1985, Marshall et al, submitted). These subjects are presumably able to monitor their output via some other mechanism.

The association between the output deficit and the failure to monitor in jargonaphasia have led some authors to suggest that monitoring is accomplished within the speech production system itself. Monitoring thus becomes disrupted by the same processing impairment responsible for the jargon output. There are, however, differences of opinion as to how monitoring might be accomplished by the output system. Laver (1980) and Motley, Camden and Baars (1982) have proposed the existence of specific editor or control modules which are responsible for checking the product of each level of output processing. This proposal has been criticised for requiring the reduplication of linguistic information within the editor (eg Levelt 1989). Interactive activation accounts of language processing have thus suggested that output monitoring may occur arise as a function of feedback between the levels of output processing (Schwartz et al 1994). This account is desirable, as just one hypothesised deficit accounts for both the proliferation of neologisms and for the failure of the system to 'eliminate' those neologisms. However, it is necessarily challenged by claims that interactive activation networks may not incorporate feedback connections (Levelt et al 1991, Nickels and Howard 1995).

Therapy

The literature contains few detailed accounts of therapeutic intervention with jargon speakers. Studies have tended to focus on linguistic analyses of the disordered output and on investigating potential mechanisms underlying its production. There has been little consideration of how the communication impairment might be remediated or how the processing models might inform the design of such intervention. A number of such case studies make passing reference to that fact that the client responded positively to therapy, however they typically fail to specify the precise focus and methods of treatment (e.g. Lhermitte et al 1973, Cappa et al 1994). Other studies comment on the difficulties encountered in establishing significant improvements despite the application of a range of therapy techniques (e.g. Howard and Franklin 1988). A study offered by Jones (1989) thus represents a notable exception, describing in detail the nature of the intervention and reporting positive outcomes of therapy.

It has been observed that the aphasic's insensitivity to the disordered nature of their speech may pose a fundamental obstacle to progress in therapy (Lebrun 1987, McGlynn and Schacter 1989). Thus the application of therapy designed to increase auditory comprehension and self monitoring has been a typical approach with jargon aphasic clients (Martin 1981). This poses a number of problems. First it is uncertain that improving auditory comprehension skills will necessarily facilitate awareness of the speaker's own errors, given the potential dissociation between monitoring and auditory comprehension ability (Nickels and Howard 1995). Secondly, Martin (1981) points out that such therapy is likely to use highly structured tasks where auditory stimuli are presented in isolation. This removes the contextual information which the listener may be using to support their comprehension in communicative situations. Thus therapy makes the process of comprehension more difficult, while possibly offering no immediate benefit to the ability to understand auditory stimuli in functional settings. Both Marshall (1994) and Martin (1981) therefore argue that comprehension difficulties may be more appropriately targeted by therapy which aims to adapt the communication environment, for example by modifying the input from the conversational partner or increasing the availability of non verbal support. Nevertheless, reports of successfully applied, structured therapy for the remediation of auditory comprehension difficulties in jargon aphasia exist. Jones (1989) and Grayson, Hilton and Franklin (1997) both describe therapy regimes which resulted in significant improvements in auditory processing skills. Jones reports that following such therapy, her client showed greater ability to modify the phonological form of his spoken naming errors. Error detection before therapy had been good. Jones does not report any changes in the client's functional understanding but had observed that prior to therapy the subject was skilled at utilising non verbal information to support auditory comprehension. Unfortunately, Grayson et al (1997) offer no comment on the generalisation of the specific gains achieved in therapy to functional comprehension, nor do they cite any observed effects on their client's monitoring of his spoken jargon.

In the context of poor self monitoring it is unlikely that conventional therapy tasks directed at modifying spoken output, for example by facilitating lexical retrieval, will be successful. Intervention designed to facilitate communicative ability may therefore be more appropriately focused at the conversational level and involve attempts to establish alternative communicative strategies (Peuser and Temp 1981). Martin (1981) observes that clinicians are often increasingly able to extract meaning from the disordered speech as they become familiar with the individual characteristics of the jargon. He therefore advocates that therapy should aim to develop the skills of the clinician as a listener and establish turn taking between the two conversational partners. This allows the clinician the opportunity to feed back what they have understood and allows the accuracy of this information to be indicated by the jargon speaker. Similarly, Marshall (1994) argues that therapy directed at training conversational partners is more likely to be a productive strategy than working on the speaker's output in isolation. Jargon speakers whose speech has resolved to a more anomic presentation and who show accurate error awareness may, however, respond positively to specific therapy tasks aimed at facilitating lexical retrieval (e.g. Robson, Marshall, Pring and Chiat, submitted).

Written output may also offer an appropriate focus for therapy, particularly when skills in this modality appear to be better preserved or more amenable to direct intervention, for example owing to better monitoring skills. Therapy studies have therefore investigated the potential of exploiting writing as an alternative strategy for communication. Successful use of the skills acquired in such therapy may however be hampered by a failure to utilise the approach in functional contexts (e.g. Kotten 1982). Robson et al (in press) report a series of therapy programmes carried out with a speaker of undifferentiated jargon. Significant, and potentially communicative written language skills were acquired in therapy. Nevertheless, further specific intervention focused at transferring these skills to functional contexts was required before their spontaneous and communicative use was observed in conversation. Robson et al suggest that the initial failure to utilise written language communicatively may not be wholly attributable to the speaker's insensitivity to their spoken jargon. Rather, specific linguistic impairments may preclude the transfer of a single word vocabulary to conversation. They therefore suggest that establishing the functional use of potentially communicative skills may need to be a specific focus of intervention with jargon speakers.

Problems with theories of neologism production

As illustrated, the literature offers a number of different accounts of neologism production. However, little consensus is reached. Authors disagree about the characteristics of neologistic output, about the relationship between the different forms of jargon, about the classification of non word responses and about the relationship between target related and abstruse neologisms, to identify just a few areas of ongoing discord. Perhaps unsurprisingly therefore, no single account of neologism production has gained general acceptance.

The failure to adopt a single theory of neologism generation may also arise, in part, from the limitations of the proposed models. For example, the accounts typically fail to explain (or even discuss) why the proposed deficits should give rise to neologistic output rather than resulting in more conventional aphasic speech errors. Interactive activation accounts of lexical processing may offer a certain advantage in this respect. Their complex network of interconnections and the possibility of subthreshold levels of activation would seem to predict the proliferation of error phonology which characterises neologistic output. In fact these models may be more challenged by the need to account for non fluent speech errors. Nevertheless, neologistic jargon has yet to be adequately explained using these theories of lexical processing. In particular, future attempts to apply these principles to neologism production need to pursue in more detail the specific predictions made for the phonological characteristics of the non word output.

Accounts of neologism production are typically silent regarding the monitoring deficit which frequently forms part of the jargon syndrome. They also fail to explain satisfactorily why some neologistic speakers demonstrate evolutionary changes in their output while other speakers show no change. Where this difference is identified, it is often dismissed as a function of increased monitoring ability, without detailed discussion of the precise relationship between neologism production and error awareness.

A further limitation of the various accounts of neologism production is their failure to inform language rehabilitation. The theories rarely make specific recommendations for intervention and fail to identify how this should differ from therapy targeting non fluent speech errors. Consequently, accounts of specific, model driven therapy are rare.

The limitations identified for the various theories of neologism production, both individually and as a group, and the lack of agreement in the literature probably reflect the complexity of the issues under discussion. Thus it may be rather unsurprising that, as yet, neologism production has escaped satisfactory explanation. However, it is perhaps the elusiveness of an adequate account which offers neologisms some of their ongoing intrigue.

2. Phonological characteristics of neologisms

There appears to be general agreement in the literature that neologisms bearing a close phonological relationship to target words arise from the distortion of target phonological information during output processing. For instance, even authors who suggest significantly different processing mechanisms for the production of abstruse neologisms allow that some non word items are based on target lexical representations (e.g. Butterworth 1979, Buckingham 1987). Much greater controversy surrounds the production of abstruse neologistic output which appears to bear no relation to real word targets. A number of rather different theories are offered for the genesis of these items. A distinguishing feature between many of the accounts is the nature of the relationship they propose between the phonology of the neologism and the phonology of the target word. This is largely determined by the proposed level of breakdown in the language processing system and creates differing expectations for the phonological characteristics of abstruse neologisms.

The following chapter will identify four main groups among the principal theories of abstruse non word generation. These groups are distinguished by the relationship they propose exists between the target and neologistic phonology. The classification will necessarily be broad and will not attempt to distinguish between individual processing accounts. Rather, it will attempt to draw together some of the general themes present in the literature. The predictions made by each group of theories for the phonological characteristics of abstruse neologisms will be outlined. Although some of these predictions may already have been suggested, and indeed investigated, this has usually been carried out in relation to individual accounts of non word production. In contrast, the current discussion will attempt to identify the general predictions which arise from the different types of theory. Since groups of theories are being considered, the discussion does not attribute the predictions to individual authors. Rather, the discussion represents an attempt to identify the logical predictions made for the phonological characteristics of non words by the different groups of theories of neologism production. In each case, the validity of the predictions made by the theories relies on the assumption that a single mechanism is responsible for the production of all abstruse neologisms. The discussion will be restricted to predictions made for the phonological characteristics of non words and will not discuss other features such as their temporal or grammatical properties.

Partial activation of target phonology

Two groups of theories consider all neologisms to be directly based on the phonological representation of the target word. In the first, neologisms are viewed as arising from disrupted attempts to retrieve the target representation from the phonological lexicon or level. Specifically, the normal process of lexical retrieval is thought to be impaired by an inability to fully activate and retrieve target phonological information. This group of theories includes the activation deficit accounts offered by Ellis, Miller and Sin (1983) and Kohn and Smith (1994a). It also includes attempts to explain neologism production within interactive activation theories of lexical processing, e.g. Miller and Ellis (1987), Harley and MacAndrew (1992), Schwartz, Saffran, Bloch and Dell (1994).

These accounts share the view that neologisms arise from failed attempts to fully retrieve the phonology of the target word. Where the disruption is only minor, a large amount of target phonology is correctly retrieved and the neologism retains a close phonological resemblance to the intended word. As the failure to activate target phonology becomes more severe, responses become less obviously based on the original target. In the case of abstruse neologisms, the failure to retrieve target phonology is sufficient to obscure any obvious relationship between the target and the neologism. However, the accounts argue that even abstruse items are based on the partial retrieval of the target phonological representation. Thus, the production of all neologisms is viewed as occurring along a continuum with the degree of successful activation of phonological information determining the ease with which the relationship between the target and neologism is discerned. In abstruse neologisms the relationship may be initially obscured but will nevertheless still exist.

The claim that partially retrieved target phonology is the starting point for all neologism production makes certain predictions about the phonology of non words. Firstly, it predicts that the relationship between the phonology of the target word and the neologism should be detectable by the presence of greater than chance levels of similarity between the two. This should be true even in the case of abstruse neologism production. One method of looking for this similarity has been to count the number of phonemes common to the target and neologism. This can then be compared with the number of phonemes shared when neologisms are randomly reallocated to target items (e.g. Miller and Ellis

1987). The partial retrieval account predicts that even abstruse neologisms should share significantly greater numbers of phonemes with the genuine targets than with the 'pseudo targets'.

Partial retrieval accounts of neologism production also predict that neologisms should utilise phonemes in a way that reflects their normal patterns of use in English. Thus, non words should not only be phonotactically correct but should also draw on phonemes in similar proportions to which they occur in the normal language. In other words, the phonemes in the neologisms should correlate closely with the normal frequency distribution of phonemes in real words.

The assumption that the retrieval deficit permits the partial access of target phonological information allows for systematic patterns to exist in the way target phonology is preserved in neologisms. For instance, some aspects of the target representation may be more available to the system than others and thus more able to appear in non word responses. The differential availability of target information may arise from variables operating at the phonological level of representation. For example, it might be found that high frequency target phonemes are more easily retrieved than other, less frequently used segments. Such internal inconsistencies in the retrieval of target phonological representations might be particularly well explained by interactive activation lexical networks which are more explicit about the organisation of information stored at the phonological level.

Finally, since partial lexical retrieval accounts view all non words as arising from a common process they predict that neologisms should evidence a range of target relatedness. Target related and abstruse neologisms should be distinguished only by the extent to which they preserve target phonological information and a continuum should exist between the two groups. Moreover, abstruse neologisms should move along this continuum, becoming increasingly target related, as the ability to access target representations recovers. At the same time, improved phonological retrieval should be associated with the increasing emergence of correct responses at the expense of target related neologisms.

Phonemic distortion of target phonology

A second group of theories have argued that the disruption to normal lexical processing occurs subsequent to the successful retrieval of the target phonological representation. In these theories, the target representation undergoes some form of phonemic distortion during the later stages of output planning, for instance during the transformation of the abstract code into a fully defined phonemic specification. Errors occurring at this stage may take the form of transposition or substitution errors as information is copied from one system to another or may arise form the misapplication of redundancy rules and default information. Lecours and Lhermitte (1969), Kertesz and Benson (1970) and Lecours (1982), as well as Kohn and Smith (1994a) have argued that neologisms can arise from disruptions to this level of processing.

Such theories, which might collectively be termed phonemic paraphasia accounts of neologism production, make a number of predictions for the phonological characteristics of non words. Firstly, their hypothesis that a correctly retrieved target representation forms the basic material for the phonemic distortion suggests that neologisms should retain some level of similarity with the target word. Thus they predict that even abstruse neologisms may show greater than chance levels of target relatedness. Furthermore, since the extent of the phonemic distortion determines the extent to which target phonology is disrupted, neologisms should display a range of target relatedness. Phonemic paraphasia accounts therefore agree that target related and abstruse neologisms occur on a single continuum and are distinguished only by quantitative differences. This being the case, the recovery of output processing should be accompanied by a progressive increase in the production of correct responses and target related neologisms with a corresponding decline in the number of apparently abstruse responses.

The proposal that the target lexical representation forms the basis of the phonemic paraphasia leads to the prediction that neologisms will preserve aspects of English phonology. Neologisms might therefore be expected to demonstrate a normal frequency distribution in their use of phonemes. However, the accounts might equally argue for the presence of some kind of systematicity in the way target phonology is both preserved and replaced in neologisms. For instance, substitution errors might well be mediated the presence of a phonetic relationship between the interacting elements. This would predict that error phonemes in neologistic responses would share phonetic features with the target segments they replace. Alternatively, it might be envisaged that certain phonemes are more available to operate as error elements in substitutions than others. This would predict that a relatively restricted set of phonemes might form a large component of the error corpus.

Finally, where phonemic distortion is viewed as arising from decay of the target representation during the process of phonemic encoding, position effects are predicted for the preservation of target phonology. Thus these accounts might expect target phonology to be more evident at the beginning of neologisms, with substitutions and errors increasing across the response. However, this expectation relies on the assumption that phonological encoding occurs in a linear fashion.

Dual impairment theories

Other authors have agreed that a process of phonemic distortion is central to the production of neologisms but have argued that this is secondary to an earlier error in lexical selection. Dual impairment theories therefore argue that neologisms result from a combination of errors occurring at two different processing levels. Initially, a word selection error (possibility mediated by the semantic specification of the target word) results in the substitution of the target word with another real word item. If this were the only process operating, a verbal or semantic paraphasia would be produced. However, subsequent disruption at the phonemic level distorts the lexical phonology, resulting in the production of a non word response. Proponents of this account of neologism generation argue that the combination of errors is sufficient to obscure the relationship between the target and the non word, so leading to the output being labelled as abstruse. Dual impairment theories include the disinhibition account of neologism generation (Pick, 1931) and the accounts offered by Brown (1972, 1977), Buckingham and Kertesz (1976) and Perecman and Brown (1981).

Like the previous explanation, dual impairment theories consider abstruse neologisms to arise from the distortion of lexical phonological representations, although in this case not that of the original target word. Consequently, the theories make rather different predictions about the phonological characteristics of non words.

The failure of the process to base the neologism on the phonological representation of the original target word means that there should be little similarity between the phonology of the neologism and that of the original target. For example, the target and neologism should share no more phonemes than could be expected to occur by chance. Obviously, the accounts predict that if the identity of the original target could be determined then the phonology of the neologism should show a significant resemblance to this. However, given the enormous number of potential substitutions it is unlikely that this item could ever be reliably identified. The accounts also predict that there should be no continuum apparent in the levels of target relatedness exhibited by neologisms since they should never show more than chance levels of proximity to the target phonology. Neologisms should therefore be consistently classified as abstruse items. This also leads to the prediction that non word responses will be unable to show a gradual recovery towards the target phonology without a change in the underlying mechanism responsible for their production.

The lack of a direct relationship between the phonology of the original target and that of the neologism predicts that no particular patterns should be evident in the way target phonology appears to be preserved or distorted. No consistency is therefore expected in terms of which aspects of target phonology are preserved in neologisms and no systematic relationship predicted between the error and target phonology.

However, the fact that a lexical representation forms the basis for the non word does lead to the prediction that neologisms should preserve some normal features of English phonology. For instance, neologisms might be expected to utilise phonemes in proportions according to their normal English frequency distribution.

Non lexically derived phonology

A final group of theories consider that abstruse neologistic output is not based on lexical phonological information at all. These theories suggest that access to target phonological representations is so impaired that no lexical information is available to the system. In these situations, phonology is derived from a non lexical source, for instance through the operation of an external device or by the selection of phonology from a lexically independent, abstract level of representation. These mechanisms provide arbitrary phonological information which is used to construct a neologistic response. Theories of this type include the random phoneme generator (Butterworth 1979, 1985) and random syllable generator accounts (Buckingham 1981, 1987, 1990).

Non lexical accounts create quite different expectations for the characteristics of abstruse neologisms. Since non word production is not based on the target lexical representation, no significant relationship is expected between the two. The number of apparently target related phonemes in the neologism should therefore be no greater than could be accounted for by chance, given that the non lexical source of phonology is restricted to the phonemic inventory of the speaker's language. Without a change in the underlying mechanism of neologism production, non words should consistently exhibit no greater than chance levels of target relatedness and should show no progression towards the target with recovery.

Neologisms should also fail to show any systematic patterns in the way in which they preserve target information since this is only present in the response by chance. For the same reason the relationship between target and error phonology should be found to be random. For example, analysis of phoneme substitutions should indicate that phonemes are randomly replaced by error segments in neologisms.

Finally, the dissociation of neologistic phonology from lexical sources predicts that non words may fail to reflect aspects of normal lexical phonology such as the normal frequency bias in the use of phonemes. These normal features should disappear since it is difficult to imagine how they could be encoded in a level of abstract phonological knowledge without making reference to lexical representations. Therefore, device generated phonology might be expected to display rather atypical phoneme distributions. For instance, if each phoneme is the result of a completely arbitrary selection from the phonemic inventory then a random distribution of phonemes might be expected. However, phoneme selection from the non lexical source may be influenced by factors such as the identity of the previous selection. This raises the possibility of the perseverative use of phonemes. Alternatively, the phonotactic constraints of the speaker's language may restrict later selections to the set of phonemes which could legally appear in conjunction with the previous phoneme. Since some phonemes are able to appear in greater numbers of combinations than others, this predicts a disproportionate reliance on such segments. Nevertheless, the theories predict atypical phoneme distributions to be evident in the neologistic output. Obviously, these predictions are somewhat altered if the unit of selection is the syllable, although the possibility remains that neologisms will show an atypical distribution of English syllables.

Conclusions

The four broad groups of theories presented here rely on different mechanisms to explain neologism production. They generate different predictions about the phonological characteristics of non words and the relationship expected between neologisms and target words. The predictions made by the four groups of theories are outlined in Table 2.1. As can be seen from this table, the predictions are not necessarily specific to the individual groups of theories, nor would they independently distinguish between the competing accounts of non word production. Moreover, in some cases the theories predict that certain characteristics may be present without requiring this to be a necessary feature of the neologistic output. Nevertheless, it is predicted that the phonological characteristics of neologisms should inform the debate concerning the mechanisms underlying their production. In the following chapters the non word output produced by a neologistic speaker, LT, is investigated in relation to these predictions. The results of the analyses will be reviewed for the support they offer to the different accounts of non word generation.

Table 2.1 Predictions for the phonological characteristics of neologisms made by the four groups of theories of non word production

	Partial activation of target phonology	Phonemic distortion of target phonology	Dual impairments of lexical selection and phonemic distortion	Non lexically derived phonology
Greater than chance levels of target relatedness	Yes	Yes	No	No
Normal frequency distribution of phonemes	Yes	Yes	Yes	Predict atypical or random phoneme distributions
Systematic patterns in the preservation of target phonology	Possible, where this reflects differential availability of target info.	Yes	No	No
Position effects in the preservation of target phonology	No	Possible, where decay of target information causes the distortion	No	No
Single continuum for target related and abstruse neologisms	Yes	Yes	No	No

3. Response Classification

An initial problem confronting investigations of neologistic jargon is the need to identify the nature of the various errors produced by the speaker. A number of difficulties complicate the classification of response types and these are not alleviated by the fact that throughout the literature authors have adopted differing solutions. Consequently there is little agreement regarding the terminology, criteria or categories used. One of the primary difficulties is that the process of classification may necessarily involve the application of preconceived ideas about both the source of individual errors and the nature of the mechanisms being investigated (Butterworth 1985). This can result in the categorisation becoming increasingly explanatory and can potentially influence the outcome of any analysis.

Target related and abstruse neologisms

Central to a number of theories of non word production is the proposal that abstruse and target related neologisms represent distinct groups of speech error, associated with differing phonological characteristics and arising from different processing sources (e.g. Butterworth 1979, Buckingham 1987). This premise has important methodological implications since it suggests that abstruse and target related non word responses should be assigned to separate groups at an early stage in any investigation. Other authors subscribe to the view that all neologisms, however abstruse, arise from the same processing source (e.g. Miller and Ellis 1987). This position requires the group of non word items to be analysed as a whole.

A further difficulty arises when using the terminology of abstruse and target related neologisms. A number of authors have used these terms to identify discrete classes of non words and have therefore established specific criteria for their use. Nevertheless these criteria typically differ across studies. Other authors have used the terms more descriptively to distinguish neologisms which are obviously target related from those which show no close resemblance to the target phonology. In these cases, precise criteria for the different types of non word are not established. Finally, it is not always indicated whether the term 'abstruse' specifically excludes the possibility of a relationship between neologistic and target phonology or merely identifies that this relationship is not immediately apparent.

Jargon homophones

Another methodological issue concerns the categorisation of real word errors which apparently bear no relation to the context in which they are produced. While these may reflect verbal paraphasic errors, Butterworth (1979) points out that they may also be non word productions which happen by chance to resemble real words. In other words, given the restricted set of possible phoneme combinations, the mechanisms for neologism production may assemble a phonological string which corresponds to a real word item. Butterworth labels these items 'jargon homophones' but opts to include them in the class of verbal paraphasias given the difficulties in arriving at positive identification with any reasonable degree of confidence. Lecours (1982) also argues that they should not be included in the category of neologisms. Other authors have responded to the problem differently. For instance, both Buckingham and Kertesz (1974, 1976) and Ellis, Miller and Sin (1983) include in the set of non word responses those errors which they considered to be real words only by chance.

There are a number of arguments for assigning possible jargon homophones to the category of neologisms. Green (1969) investigated real word items which bore no semantic or phonological relationship to the target and often had no certain grammatical function. Green identified that these errors differed from neologisms by being real words and by being shorter in length. Nevertheless they shared the same stereotypical pattern of phoneme use which was evident in neologisms but not seen elsewhere in the subject's speech. This suggests that these items were in fact jargon homophones although Green allocated them to a separate category of unrelated verbal paraphasias. However, he raised the possibility that they are governed by the same principle as neologisms and occur as real words only by chance.

Nickels and Howard (1995) include apparent jargon homophones in the class of neologisms and offer two lines of defence for this decision. Firstly, they show that real word errors are more likely to occur in response to short targets. Since phonological neighbourliness increases as word length decreases, phoneme substitutions in shorter responses have a greater likelihood of creating a real word by chance. Thus the suggestion that jargon homophones arise by chance is consistent with the finding that these are more prevalent amongst responses to shorter targets. Secondly, by employing a randomisation procedure, Nickels and Howard demonstrated that the number of real words was consistent with the number which would be expected by chance. They therefore argue that phonologically related real word errors are best considered as jargon homophones.

Finally, a footnote in Lecours and Rouillon (1976) refers to the result of a computer simulation designed to produce phonemic paraphasias (Lecours, Deloch and Lhermitte, 1973). The simulation experiment resulted in the production of a number formal verbal paraphasias in the absence of specific instructions to this purpose. Lecours and Rouillon conclude that phonemic paraphasias and formal verbal paraphasias may arise from the same processing deficit, therefore allowing them to be considered as a single group of errors.

Classification in the current study

The current study adopted a broad classification system in an attempt to apply a minimal number of assumptions to the data.

Non word forms were assigned to the category of neologisms, irrespective of their degree of target relatedness. That is to say the analysis did not distinguish between non word responses which in other studies might have been distributed among the categories of form based paraphasias, target related neologisms and abstruse neologisms. The study also included in the category of non words those items which were deemed to be jargon homophones. Thus the study remained open to the possibility that each of these response types may arise from the same processing source. Later investigations analysed potential subgroups within the class of non words. As will be demonstrated, the results supported the initial approach of considering these items to be a single group of responses.

Semantic level processing deficits were demonstrated by LT's performance on tasks such as spoken word to picture matching and the Pyramids and Palm Trees assessment (Howard and Patterson 1992), see Chapter 4. It might therefore be predicted that some of LT's output errors will be predominantly semantically based. Real word errors which were semantically related to the target were therefore classified as semantic errors. This left a small proportion of errors where a non word form appeared to be the phonological distortion of a semantic error. Dual impairment accounts of neologism production (e.g. Pick 1931, Buckingham and Kertesz 1976) principally rely on the phonological distortion of an unrelated word substitution to obscure the identity of original target and generate an abstruse neologism. Since a potential target could be identified for the combined semantic and phonological errors the items were not included in the category of neologisms but rather assigned to a specific group labelled semantic + phonological errors. These formed a relatively small proportion of LT's error responses.

Four categories for the classification of LT's responses were therefore defined as:

1. Correct responses — Correct productions of the target word.

2. Semantic errors — Real word responses which were closely related to the meaning of the target picture name. For example the real word response "hand" to the target picture <u>foot</u>. On occasions visual similarity between objects may also have played a role in the production of the error, for instance the real word response "watch" to the picture stimulus <u>belt</u>.

3. Semantic + phonological errors — Non word responses which appeared to be based on the phonology of a semantic relation to the target e.g. the non word /ˈdɒŋkɪŋ/ to the target word <u>horse</u>.

4. Neologisms — All other non word responses. This category includes items where the non word response appears to arise from a relatively minor corruption of the target phonology, e.g. / θʌb / for the target <u>thumb</u>. For other items there was no such obvious relationship between the target phonology and the phonology of the neologism. Items occurring within the category of neologisms

will on occasions be described as 'target related' or 'abstruse'. However, these terms are used only to indicate the presence or absence of an obvious relationship with the phonology of the target word, and (unless stated otherwise) no specific criteria are set for their use. Moreover, the use of the term 'abstruse' does not exclude the possibility that significant levels of target relatedness may be present within responses which superficially appear to be unrelated to the target phonology.

The category of neologisms also included responses where the phonology equates to that of a real word but one with a meaning so far removed from that of the target as to suggest that the item occurs as a jargonhomophone, e.g. / 'tʌŋ / for the target word <u>iron</u>.

In assigning items to these categories no formal criteria were used, for instance regarding the degree of phonological similarity required for a response to be considered a distortion of a semantic error. In adopting such a broad and subjective classification procedure it is possible that some responses will be incorrectly categorised. The investigations of LT's output considered multiple naming trials. It is hoped that the scale of these studies will counteract the potential noise created by errors of classification. The potential presence of this noise should also serve to strengthen the validity of any patterns found to be present.

4. Introduction to LT

LT, a right handed, monolingual English speaker, worked as a chartered accountant in the civil service until his retirement in 1976. He remained active and involved in a number of local charitable concerns until suffering a stroke in July 1994. This resulted in a left upper limb weakness, left sided facial weakness and dysarthria. LT was hospitalised for four days during which time all symptoms fully resolved. A subsequent transient ischaemic attack in August 1994 also resulted in left sided facial weakness and dysarthria but resolved within 24 hours. Eight months later, in March 1995 and at the age of 83, LT suffered a further stroke resulting in a severe jargon aphasia. No physical symptoms accompanied the aphasia and LT was not admitted to hospital. Initial assessment suggested a right homonymous hemianopia although this is no longer evident. A CT scan performed in April 1995 revealed an area of damage in the left parietal region consistent with a left middle cerebral artery infarct. Atrophy was consistent with age. Although no residual damage from the two earlier neurological episodes was reported, LT's neurological history would appear to be consistent with the suggestion that jargon aphasia may be associated with bilateral damage (e.g. Lhermitte et al 1973, Cappa et al 1994).

Following the most recent stroke LT was noted to be suffering from fatigue, breathlessness and poor circulation and was fitted with a pacemaker in early 1996. LT recovered well from this and has remained in good health since. He lives at home with his wife.

LT presents with a severe receptive and expressive aphasia which makes all attempts at communication difficult. His ability to understand via the written modality, at least in functional contexts, appears superior to his auditory comprehension. Written information is therefore often able to facilitate communication. LT produces speech copiously, fluently and apparently effortlessly. His spoken output is composed almost entirely of neologistic jargon. Real words occur rarely. LT's speech is accompanied by appropriate sounding intonation, gesture and pointing. He is unable to produce any meaningful written output spontaneously.

LT appears unable to detect the disordered nature of his speech. It is difficult to suppress his output and he continues to rely principally on this modality for communication.

Requests for clarification from the listener are frequently met with incredulity that he hasn't been understood and with further spoken output, often simply produced at a louder volume. On occasions LT demonstrates some considerable resourcefulness in attempting to illustrate his meaning, for instance by finding a book on the subject he is discussing or by pointing to things around the room. Considerable therapy time has been spent encouraging LT to support his meaning with simple, iconic gestures. Although LT is rather good at this in structured tasks and derives some enjoyment from the activity, he consistently ignores the strategy in conversation.

On questioning LT asserts that he speaks "perfectly well" (a rare real word phrase) although he has noticed that others often fail to understand him. He has carried out the many naming activities reported in this study with unfailing good humour. Although reluctant to rate his performance on such tasks, LT will sometimes enquire about their purpose. He remains sceptical of answers that explain his errors are analysed for the patterns they might reveal. Although time has been spent discussing the fact that while sounding clear to him, his speech is "muddled" to others, LT remains mystified by this assertion.

LT has received considerable input from his local Speech and Language Therapy Service with therapy directed at improving his auditory discrimination and his use of alternative communicative strategies such as gesture and a communication notebook. Close contact has been maintained between the therapists from the local service and the author including a number of joint visits to LT.

The investigations reported in this study began in May 1995, two months after the onset of LT's aphasia. All assessments were administered by the author and were carried out in LT's home. Over the period of investigation various assessments were repeated to monitor for recovery in LT's performance. The following summary of assessment results provides a profile of LT's language performance.

Auditory input processing

LT presents with a severe impairment of auditory comprehension. Assessments indicate difficulties in the early stages of auditory processing. LT makes errors when required to identify a target picture from a field of phonologically related items; Minimal pairs requiring picture selection 11/40 (Subtest 4, from Psycholinguistic Assessment of Language Processing in Aphasia; Kay, Lesser and Coltheart 1992, henceforth abbreviated to Palpa). Further difficulties accessing a full semantic representation from the auditory stimulus are also indicated. LT's selection errors are predominantly semantically based where semantic distracters are available; spoken word to picture matching 20/40 (Palpa subtest 47), 9 close semantic errors, 3 distant.

LT has shown little recovery in this area of language processing over the period of the study. Although his performance on the spoken word to picture matching subtest showed a significant improvement over the first seven months post onset (30/40, McNemar test, Chi square 5.8, $p < 0.02$) no further significant recovery has been noted. Minimal pair performance has remained unchanged. Auditory lexical decision tasks have consistently proved impossible to complete.

The severity and extent of LT's auditory processing deficits are consistent with the conclusion that auditory feedback is unavailable as a mechanism for monitoring the adequacy of his spoken output. This does not, however, preclude the possibility that the impairment of other monitoring procedures may be necessary to create LT's persistent insensitivity to the disordered nature of his speech.

Semantic skills

The presence of semantic errors on the spoken word to picture matching assessment raised the possibility of a central semantic impairment. This seemed to be supported by LT's poor performance on the three picture version of the Pyramids and Palm Trees assessment. LT identified only 23/52 items correctly. This score was consistent with chance and suggested a considerable semantic level impairment. However, the scale of the semantic deficit appeared inconsistent with other aspects of LT's behaviour. For example, he uses everyday objects appropriately and shows no signs of confusion. This led to the proposal that LT's performance on the task might not accurately reflect his semantic abilities. This was supported by the observation that LT had found the assessment task difficult to complete, although he appeared to recognise the individual stimuli. In an attempt to simplify the processing demands, the test was presented in a modified form. The three pictures for each item were presented on separate cards in the same layout as they are presented in the published form of the assessment. LT was asked to place the stimulus picture with the item that it is most associated with. He scored 45/52 on this format of the test. The two administrations of the task were separated by a five month period to avoid the possibility that LT might recall the test items from the previous presentation. LT's superior performance on the later administration of the spoken word to picture matching subtest (see above) suggests that this interval is likely to have incorporated a period when semantic skills underwent some spontaneous recovery. However, it is unlikely that this factor alone is able to account for the dramatic improvement seen in his performance on the modified Pyramids and Palm Trees test. This conclusion is supported by the observation that no further improvement has been noted (even on the modified form of the task) despite the fact that there was potential for some further recovery. LT's performance on the modified Pyramids and Palm Trees test therefore appears to be a more accurate reflection of his semantic level skills. A number of assessments have investigated his semantic skills further. None have demonstrated a significant effect of imageability (e.g. see written word to picture matching task described below).

The impact of the altered format of the Pyramids and Palm Trees assessment indicates that LT's ability to complete tests may be influenced by the form of their presentation. This suggests that other assessments may be giving a somewhat depressed reflection of LT's true language processing abilities. This has led to the use of modified forms of standard assessments where necessary, for example the modified visual lexical decision task described below. The information has also been utilised when designing therapy activities. It has further been noted that LT benefits from the use of practice trials which allow him to acclimatise to the nature of any activity.

Written input processing

LT's comprehension of written stimuli was initially severely impaired. He scored just 15/40 on a written word to picture matching task (Palpa subtest 48) with more than half of the errors being semantic in nature. However, there was evidence that pre-semantic stages of processing were better preserved. LT was able to cross case match letters successfully and scored 93/120 (78% correct) on a visual lexical decision task (Palpa subtest 25). LT's performance on the lexical decision task appeared to be somewhat hampered by the format which requires a yes / no decision. In a modified version of the assessment the stimuli from the Palpa assessment were presented in 80 word - non word pairs where each real word was matched to the most visually similar non word item. LT was asked to indicate which item in the pair was the real word. His performance increased (70/80; 88% correct) although on this occasion the improvement was non significant (McNemar test, Chi square 2.8, not significant).

Despite the presence of semantic errors on the written word to picture matching test, subsequent tasks have failed to identify a significant effect of imageability on LT's ability to access meaning from written stimuli. For example, a written version of the concrete / abstract word to picture matching task described by Marshall et al (1996) was presented. (Since imageability and concreteness correlate highly it has been suggested that the terms can be used interchangeably, Franklin, Howard and Patterson 1994). In the task LT was shown a picture and asked to underline which of two written words was most closely associated with the picture. Each item was presented twice, once with two concrete words and once with two abstract words. For example, a picture of a dentist was presented with the word pairs doctor / dentist and survey / examination. The concrete and abstract words were matched across the group for frequency. LT correctly identified 32/40 target words. There was no difference between his performance on the concrete and abstract stimuli (concrete items 16/20, abstract items 16/20).

Reassessment with the Palpa written word to picture matching subtest has been able to demonstrate a steady improvement in LT's ability to access meaning from written stimuli. On a more recent re-administration of the task (May 1997) LT identified 35/40 target items correctly, representing a significant improvement over his initial performance (McNemar test, Chi square 16.4, $p < 0.001$). This finding supports the observation that the written support of spoken stimuli in conversation often facilitates comprehension.

Written output

LT's written output is severely limited. Early attempts at spontaneous writing resulted in the production of written jargon. Attempts to copy written material were also largely unsuccessful containing letter formation errors, letter omissions and substitutions.

Although LT expressed general dissatisfaction with his writing he found it hard to recognise specific errors even when these were identified for him. This occurred despite his relatively good performance on written lexical decision, again suggesting that error awareness and input processing skills may fail to show a direct relationship (Nickels and Howard 1995).

LT's written output has shown some subtle recovery. He is now able to copy written stimuli with reasonable accuracy and will occasionally identify and correct errors spontaneously. He is able to convert written stimuli from both upper and lower case. His handwriting has become increasingly cursive and is, according to his wife, now recognisable as his former hand. LT has also recently shown improved ability to sort three and four letter anagrams using letter tiles in the presence of a picture stimulus to identify the target word. Delayed copying (where the stimulus is removed before LT is asked to write the item) is poor although there is a significant effect of lexical status suggesting some orthographic mediation. LT was asked to write 20 five letter real words and 20 non words derived by creating plausible anagrams of the real word items. All real word items had frequencies below 50 occurrences per million (Francis and Kucera, 1982). LT produced 6/20 real word items correctly but no non words. The difference in the copying of real and non word items is significant (Chi square 4.9, $p < 0.05$).

Spoken output

LT's speech is fluently produced with apparently little effort. Intonation and prosody are appropriate for a native English speaker. Neologisms outweigh the number of real word items and typically bear little obvious resemblance to possible target items. It is not always possible to identify individual non words in connected speech with any degree of confidence. However, LT is able to produce discrete responses in picture naming tasks. The severity of the disruption to LT's spoken output means that the content of his speech is rarely accessible to even the most familiar listener. Samples of LT's speech were obtained in two conditions to demonstrate the nature and severity of his jargon.

Connected speech

LT's connected speech consists primarily of abstruse neologisms. The sample given in

Figure 4.a illustrates the paucity of real words and their inability to convey his meaning. LT was responding to a question about his son in America.

The sample contains 35 distinguishable items, of which only 10 are real words taken from 6 types. All real word items are function words; 3 pronouns and 3 prepositions with a high frequency of use in the language, range 20,870 - 2,280 occurrences per million words (Francis and Kucera, 1982). This follows previous findings that real word items appearing in neologistic speech tend to be high frequency items and drawn from the closed set of function words in English (Ellis, Miller, and Sin, 1983). The sample contains 19 neologisms. The 6 filler items (ers and erms) may suggest that some process of lexical search is occurring at these points.

The connected speech sample reveals the poverty of LT's spoken output. Neologisms predominate and real word items, particularly content words, occur only rarely. The conversational sample also indicates that neologisms tend to be abstruse items where, in the absence of other identifying information, the identity of the target is indeterminable. The neologistic nature of much of LT's speech therefore frequently conceals his intended message and poses a considerable barrier to communication.

Figure 4.a   Connected Speech Sample

"He /spɪt æl'dʒɒlɪtə/ erm his , erm
/'vɛdɪʃən 'halɪʃ wɪz ʃɜm / er it /raɪʧ/ with
erm /'aɪdrɒɪtɪn 'tɛlɪ tɛl'radədʒɪn 'fʌdʒə /
there with with /'vɜʧɪn hʌdʒ vɪn, raɪ
'datɪŋɪŋ/ in in erm / bə'lʌspə/ in erm
/i'sɜdlən , i'sɔʊleɪ /."

Picture naming assessment

LT's ability to retrieve single words correctly was assessed on five occasions using the picture naming subtest (Subtest 53) from the Palpa. This test uses 40 black and white line drawings to elicit naming attempts. The assessments were carried out in October and November 1995. Repeated assessment with the same stimuli provided an indication of the amount of variability present in LT's performance. This might be present in his ability to name the individual items correctly and in his overall success (total number of correct responses) on each trial.

LT's responses were recorded on digital audio tape and transcribed in broad phonemic transcription. This level of transcription was used for this and for all future samples since the purpose of the analyses was to obtain information about the phonemic (rather than allophonic) content of LT's neologistic output.

LT was given unlimited time to respond to the picture and all his responses were recorded. LT typically made more than one response to each target. In total he produced 493 responses in his attempts to name the 200 items. Only two items over the 5 trials could not be transcribed, less than one percent. It is impossible to determine with any degree of certainty the motivation for LT's multiple responses to items. For example, they may reflect repeated attempts to produce the target item and as such may indicate the operation of some form of monitoring mechanism. Alternatively, LT may simply be attempting to reiterate a response which he believes to be correct.

The results of the five picture naming trials are shown in Table 4.1. The repeated trials show the severe disruption of LT's ability to produce target phonology correctly. Over the 200 naming opportunities he named only 18 pictures correctly, 9% of all items. Across the five trials only one item, dog, is consistently named successfully. Although this item may derive some benefit from its relatively high frequency, (147 per million) other, higher frequency items are never named correctly, for example heart (199 per million). LT's performance on the final trial was somewhat improved. On this occasion he correctly named 8 items; significantly better than his performance on 1.11.95 (McNemar test, Chi square 4.2, $p < 0.05$) but not significantly better than his performance on any other trial. The result raised the possibility that LT was beginning to benefit from the

Table 4.1 Repeated picture naming trials (Palpa subtest 53)

	Date	Number of items named correctly	Correct responses
1.	4.10.95	2/40	mountain, dog
2.	11.10.95	2/40	cow, dog
3.	1.11.95	2/40	belt, dog
4.	15.11.95	4/40	brush, glass, dog, belt
5.	22.11.95	8/40	scissors, star, belt, dog, foot, glass, eye, onion

effects of repeated exposure to the test items or alternatively to show some general recovery of language function. The early assessment with the Palpa naming stimuli provided a baseline against which future improvement might be measured. Unfortunately, as will be seen in the subsequent chapters, LT has shown no convincing evidence of improved naming performance over the period of the study.

LT's performance across the five picture naming trials varies in both the number and identity of items correctly named. This finding provides tentative support for the proposal that lexical representations of output phonology may be preserved in LT's system but are, on the majority of occasions, unavailable to him. This would account for the fact that LT produces neologisms for items he has named correctly on previous trials and consistently names only one item correctly. The hypothesis also accounts for the occasional presence of real words in LT's spontaneous speech.

The real words contained in the connected speech sample showed a particular bias towards high frequency, function words. Ellis et al (1983) have argued that the apparent preservation of such words in neologistic jargon arises not from an effect of grammatical category but rather from the frequency advantage which these items enjoy over open class, content words. This raised the possibility that LT's lexical retrieval may be positively influenced by an effect of word frequency.

Naming stimuli varied for lexical frequency

To investigate the proposal that LT may be more successful at naming higher frequency items he was asked to name the three sets of vocabulary from Palpa subtest 54. These three groups are designed to systematically vary the lexical frequency of the target items. The results are shown in Table 4.2.

Table 4.2 Frequency varied picture naming (Palpa subtest 54)

	High frequency target items n = 20	Mid frequency target items n = 20	Low frequency target items n = 20
Number of items correctly named	4	1	0
Neologism responses	40	47	42
Total number of phonemes in neologisms	182	208	214
Total target related phonemes in neologisms	62	57	66

LT's responses were analysed for the number of items correctly named in each group. As with his performance on the previous naming task, LT named very few items correctly. Although his naming was most successful in the high frequency group this was not significantly better than his naming of the low frequency items (Chi square 2.5, not significant).

The severity of LT's output deficit may mean, however, that correct responses are an insufficiently sensitive measure to detect subtle differences across the three groups of vocabulary. In an attempt to find a less crude measure, the numbers of target related phonemes in neologistic responses to the items were calculated. The analysis counted all target related occurrences of all phonemes in each neologism produced during the task. Although LT often produced more than one response to a target, similar numbers of responses were obtained across the three sets of items (see row 3, Table 4.2). The ability of phonemes to maintain their target position in the response was not considered. There was no significant difference in the number of target related phonemes across responses to the three groups of stimuli (high Vs medium frequency, Chi square 1.5, not significant; high Vs low frequency, Chi square 0.3, not significant). The analysis showed that, at best, only about 34% of the phonemes produced in LT's neologisms are target related.

The assessment therefore failed to reveal any influence of lexical frequency on LT's output using these measures. The absence of a detectable effect of frequency in this task does not exclude the possibility that lexical frequency is able to facilitate LT's output. The content nouns used as stimuli in the assessment are much lower in frequency than the function words used in his spontaneous language sample. The mean frequency of the high frequency group is only 225 occurrences per million. The items used in the Palpa subtest may therefore fall below the point where the advantage of frequency is able to overcome the impediment posed by the output processing deficit.

Discussion

LT presents with aphasic disturbances to all language modalities. While auditory comprehension has remained severely restricted, written input skills have shown some recovery and can be usefully employed in functional contexts. The extent of the auditory input deficits are consistent with LT's failure to detect his speech errors via a mechanism of auditory feedback. In contrast, the greater preservation of written input skills may contribute to LT's general dissatisfaction with his attempts at writing although this seldom permits the detection and correction of specific errors.

The severity of the spoken output disorder revealed by the preliminary investigations suggests that the majority of LT's non word responses can be classified as abstruse neologisms. Target words cannot be identified for neologisms produced in connected speech, and in picture naming tasks, where the identity of the target is known, relatively few phonemes are target related. Despite difficulties determining 'lexical' boundaries in connected speech samples, LT typically produces clearly discrete neologisms in picture naming tasks. The following investigations therefore involve the analysis of LT's spoken responses in single word tasks such as picture naming and reading aloud. This permits the investigation of his neologistic output for the presence of phonological characteristics which may help to identify the mechanisms underlying its production. The suspicion that the spoken output obtained from such structured tasks may differ qualitatively from connected speech (Kohn and Smith 1994a) may limit the extent to which findings from these analyses can be generalised to all neologism production. However, the results should provide the basis for the future investigation of neologism generation in LT's connected output.

5. Classification of Palpa picture naming responses

LT produced 493 responses during the five picture naming assessments with the Palpa stimuli (Subtest 53). These were classified according to the criteria outlined in Chapter 3. The results of the classification are shown in Table 5.1.

The classification shows that neologisms are the most prevalent response. Relatively few items are identified as semantic errors or as phonological distortions of a semantic error. The larger number of semantic + phonological errors in the final assessment arise from a small number of items where LT produced lengthy sequences of responses.

Table 5.1 Classification of responses produced during the 5 Palpa naming trials

	4.10.95	11.10.95	1.11.95	15.11.95	22.11.95	Total
Correct responses*	3	2	4	5	9	23
Neologisms	95	94	64	70	84	407
Semantic errors	4	5	2	1	3	15
Sem + phon error	3	5	10	3	26	47
Don't know	1	0	0	0	0	1
Total number of responses	106	106	80	79	122	493

*The number of correct responses here is greater than the 'number of items correctly named' given in Chapter 4 because on five occasions LT repeated a correct response to an item.

Jargon homophones

As discussed in Chapter 3 the categorisation system classed as non word responses those items which were considered to be real words only by chance. A subsequent analysis confirmed the validity of regarding these items as jargon homophones.

The group of 407 neologisms was reviewed for the number of items conforming to the phonology of a real word item. 57 responses were identified. Jargon homophones thus form a relatively small proportion of the non word data (14%).

The length of jargon homophones and neologisms was measured by the number of phonemes they contained. The number of jargon homophones and neologisms at each length is indicated in Table 5.2. This identifies that the distributions for the number of phonemes in the two response types are different, jargon homophones showing a strong tendency to contain fewer phonemes. Chi square confirms that this difference is significant (Chi square (8) = 116.512, $p < 0.0001$).

Table 5.2 Number of neologisms and jargon homophones at each phoneme length in the Palpa picture naming data

Number of phonemes:	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10+**
Neologisms	7	21	72	121	53	37	24	6	9
Jargon homophones	12	22	16	5	2	0	0	0	0

Discussion

The analysis indicates that jargon homophones are typically shorter responses than the other items in the neologism category. This follows previous findings that jargon homophones tend to be more prevalent among shorter responses (Green 1969, Nickels and Howard 1995). It is also consistent with the proposal that these responses conform to the phonology of real words only by chance (Ellis, Miller and Sin 1983, Nickels and Howard 1995). In line with this finding, responses produced by LT which appeared to be jargon homophones were retained in the category of neologisms.

6. The phonemic content of neologisms

The different accounts of neologism production create differing expectations for the phonemic content of non word output. Accounts which base neologism production on lexical representations predict that neologisms will show a normal distribution of English phonemes. In contrast, accounts which attribute neologistic phonology to non lexical sources predict that phonemes may deviate from the normal English frequency distribution.

The preservation of aspects of English phonology in LT's non words such as the phonemic inventory and the frequency distribution of phonemes was investigated.

<u>Analysis of the phoneme content of neologisms</u>

The current analysis considered the phonemic content only of neologisms. Correct responses, semantic and semantic + phonological errors were excluded from the investigation. When a picture naming attempt involved more than one neologistic attempt at the target, all responses were admitted to the analysis.

The 407 neologisms generated by LT's naming attempts during the five picture naming assessments were analysed for the phonemes they contained. Table 6.1 shows the number of neologisms produced in each trial and the total number of phonemes they contained.

Table 6.1 Neologisms and their phonemes in the Palpa picture naming data

	Date	Number of neologisms	Total number of phonemes
1.	4.10.95	95	507
2.	11.10.95	94	552
3.	1.11.95	64	287
4.	15.11.95	70	318
5.	22.11.95	84	415

The number of occurrences of each of the 44 English phonemes was calculated. The consonants and vowels were then ranked in order of their frequency of occurrence. The frequency distributions for consonants and vowels are shown in the first two columns of Tables 6.2 and 6.3 respectively. These tables clearly show that phonemes do not occur equally in the neologisms. While some consonants and vowels predominate others occur more rarely. Three phonemes fail to appear in the sample at all.

Normative data for the frequency rankings of consonants and vowels in English were obtained from Denes (1963). These are shown in the third column of each table. Spearman rank correlations were used to compare the rankings obtained from the analysis of LT's neologisms with the normative data. Both the correlations were significant; for consonants rho (24) = 0.529, $p < 0.01$, and for vowels rho (20) = 0.687, $p < 0.001$.

A subsequent analysis investigated the identity of the initial phonemes in neologistic responses. Only 22 neologisms presented with an initial vowel. The remaining 385 non word items commenced with a consonant. This follows the normal distribution of English word initial phonemes where consonants are more likely to occupy this position than vowels (Denes 1963). The group of initial vowels was too small to permit further analysis. The 385 neologism initial consonants are shown ranked for their frequency of occurrence in Table 6.4. This table also presents normative data for the identity of word initial consonants taken from Denes (1963). A correlation performed between the two rankings gave a non significant result; rho (24) = 0.393, $p \leq 0.058$. The failure of the correlation to reach significance is likely to arise from the rather different distribution of the consonant /ð/ in the two rankings. When this consonant is removed the two rankings show a significant correlation; rho (23) = 0.532, $p < 0.01$.

Discussion

The current analyses indicate that the use of phonemes in LT's neologisms is biased, there being significant differences in the frequency with which different phonemes occur. The frequency weightings for overall phoneme use in the neologisms correspond closely to the frequency weighting seen in English real words. Consonants and vowels which are popular in the normal language also appear frequently in LT's non words. However, this is a general trend and there are some exceptions to the correlation. These may arise from the nature of the normative data. Frequency rankings for phoneme use in spoken English tend to be based on American dialects (e.g. Hultzen, Allen and Miron 1964, Mines,

Table 6.2 Frequency of occurrence of consonants in LT's neologisms in the Palpa naming data and the normal frequency distribution for English

Ranking for frequency of use in LT's neologisms	No. of occurrences of the consonant	Ranking for frequency of occurrence in English
r	219	t
n	141	n
d	139	s
t	110	d
l	88	l
k	87	m
b	76	ð
p	53	k
g	49	r
s	40	w
ŋ	32	z
j	27	b
ʃ	27	v
w	22	p
m	20	f
dʒ	20	h
tʃ	16	j
z	14	ŋ
f	14	g
h	12	ʃ
ʒ	9	θ
θ	6	dʒ
v	5	tʃ
ð	0	ʒ

Table 6.3 Frequency of occurrence of vowels in LT's neologisms in the Palpa naming data and the normal frequency distribution for English

Ranking for frequency of use in LT's neologisms	No. of occurrences of the vowel	Ranking for frequency of occurrence in English
ə	220	ə
ʌ	132	ɪ
ɪ	89	aɪ
æ	63	ɛ
a	61	i
ɒ	60	əʊ
ɛ	56	ʌ
əʊ	35	ɒ
aɪ	33	æ
aʊ	27	eɪ
ɔ	25	u
eɪ	14	ɔ
u	11	a
ʊ	10	aʊ
ɜ	8	ʊ
ɛə	5	ɜ
ɒɪ	3	ɛə
ɪə	1	ɪə
ʊə	0	ʊə
i	0	ɒɪ

Table 6.4 Frequency rankings for word initial consonants in neologisms and real words

Ranking of frequency of occurrence of neologism-initial consonants	Number of occurrences of the consonant in neologism initial position	English word initial consonants ranked in order of occurrence
r	73	ð
d	71	w
l	43	s
k	30	h
t	28	t
s	22	m
j	22	b
w	17	j
b	15	d
h	11	k
ʃ	10	f
p	8	n
θ	6	l
dʒ	6	g
f	5	p
tʃ	5	r
n	5	ʃ
g	4	θ
z	3	v
v	1	dʒ
ð	0	z
ʒ	0	tʃ
m	0	ʒ
ŋ	0	ŋ

Hanson and Shoup 1978). This can influence the frequency with which different phonemes appear. For instance, normative data collected on spoken American English will exaggerate the use of the phoneme / r / due to the rhotic nature of these dialects. The normative data provided by Denes (1963) avoids this difficulty by basing the analysis on a Southern English accent, i.e. the native accent of LT. However, these data were not collected from spoken transcripts but were extrapolated from the predicted pronunciation of written passages of connected English. The nature of the sample collected from LT differs by being a transcript of spoken language. More significantly, it differs by being repeated attempts at the production of single content words rather than a passage of connected speech or dialogue. These discrepancies may influence the results since the distribution of some phonemes is biased away from content words. For example, the consonant / ð / is particularly associated with closed class function words in English and occurs much more rarely in content words. These differences may therefore account for the number of inconsistencies seen between the rankings for overall frequency of consonant use in LT's neologisms and the normative data. Given these differences it is perhaps even more striking that the overall frequency distribution of phonemes in LT's neologisms matches so closely that seen in English real words.

The discrepancies in the nature of the samples for the normative data and LT's neologisms appeared to have a more significant influence on the rankings for initial phoneme use. The distribution of consonant / ð / is not only biased towards English function words but is predominantly situated in word initial position in these items. In contrast, its rare occurrences in content words are biased away from word initial positions. This is likely to account for the considerable difference between LT's use of the phoneme in initial position in his attempts to produce content nouns and the occurrence of the consonant in word initial position in the normative data. When the consonant was removed from the analysis, the distribution of initial consonants in LT's neologisms was found to be strongly correlated with the normal distribution of initial consonants in English.

In maintaining the normal overall frequency distribution of phonemes the current data conform to the results of previous studies which have found this aspect of English phonology to be preserved in neologistic output (e.g. Green 1969, Hanlon and Edmondson, 1996). The data for initial phoneme use appear to differ from those offered by Butterworth (1979) which suggested a random distribution of neologism initial phonemes. In contrast, LT's use of word initial phonemes corresponded to real English words both in the ratio of initial consonants to vowels and in the frequency distribution of initial consonants once /ð/ was removed from the analysis.

The range of phonemes present in LT's neologisms was restricted to the inventory of English phonemes, no non native sounds being identified in the non word responses. Three phonemes failed to appear in the sample at all. This may occur because, for two of the phonemes, the stimuli fail to target these sounds. The other missing phoneme, / i /, is targeted only once in the picture names. There were no instances where a neologism violated the phonotactic rules of English, suggesting that LT's non word production is also constrained by this parameter of normal English phonology. Again, this is in concordance with the findings of several previous studies (e.g. Green 1969, Buckingham and Kertesz 1976, Duchan et al 1980, Hanlon and Edmondson 1996).

7. Levels of target relatedness in the neologisms

Two accounts of the mechanisms responsible for generating neologisms predict that non word items will show a significant relationship to the phonology of the target word. Partial activation accounts view neologisms as arising from a failure to fully retrieve the target representation from the phonological lexicon or level. These accounts predict that some target phonology will therefore be available and will be realised in the non word. Phonemic paraphasia accounts propose the distortion of target lexical representation following its successful retrieval. These accounts also allow for the preservation of some target information in the non word response.

Alternative accounts of neologism production do not base the non word on the target phonological representation. Dual impairment accounts identify a whole word substitution as occurring prior to the phonological processing stage. Hence, the phonological representation undergoing corruption is no longer that of the intended target word but that of the substitution. Consequently, no relationship is predicted between the phonology of the neologism and that of the original target. Other accounts view neologistic phonology as derived from non lexical sources, therefore again predicting that no phonological relationship should exist between the target and the non word.

Previous studies have investigated the target relatedness of neologisms by looking at the number of target phonemes they contain (e.g. Miller and Ellis 1987). When constructing neologisms LT's system appears to be restricted to the phonemic inventory of English (see Chapter 6). Thus, each model of neologism production expects a certain proportion of phonemes to be shared between the target and neologism purely by chance. Evidence that the number of phonemes common to the target and the neologism is greater than can be accounted for by this factor of chance would indicate that neologisms are drawing more particularly on the phonological representation of the target word.

Miller and Ellis (1987) propose a method for establishing whether the amount of phonology shared between the target and the neologism exceeds the level which can be expected to occur by chance. LT's neologistic responses to the targets in the five Palpa picture naming trials were analysed with this method.

Analysis of the degree of target relatedness in LT's neologisms

Neologistic responses produced in the Palpa naming trials were analysed for their phonological relationship to the target. Correct responses and responses judged to be semantic errors or combinations of semantic + phonological errors were excluded from the analysis. On some occasions this meant that all LT's responses to a particular target were ineligible for inclusion. In such circumstances the item was removed from the investigation. On many other occasions LT produced more than one neologism in his attempt to name the picture. In these instances a neologism was selected at random from the sequence of responses. This was achieved by numbering the neologisms according to their position in the sequence of non word responses. A random number was then generated using the 'random' function from a scientific calculator and the appropriate neologism selected. The use of this procedure removed the need for the subjective selection of neologisms which could have influenced the results.

The analysis compared the selected neologism with its target picture name. The number of phonemes from the target word occurring in the neologism were counted. The neologisms were then separated from their original targets and randomly reassigned back to these items. The number of phonemes from the target word occurring in the pseudo neologism was then counted.

Identical regimes were applied to the genuine and pseudo neologisms when counting the number of target related phonemes. Position information was ignored. Thus an occurrence of a target phoneme anywhere in the response was counted as target related. This is in line with the approach used by other authors when evaluating the target relatedness of non words (e.g. Ellis et al 1983). However, if the neologism contained more than the target number of instances of an individual phoneme only the number required by the target were counted as target related. For example, /ˈkəʊkə / produced for the target word cow was counted as containing only one target related phoneme. This scoring regime prevents LT from gaining credit for the perseveration of previously successful phonology.

The 5 picture naming trials were examined separately. The results of the analyses are shown in Table 7.1. The number of items included in each analysis is given with the results for each trial. On four occasions across the five trials the reallocation process resulted in a neologism being reassigned to its original target. These items were left in the analysis. No trial contained more than one instance of this.

The number of target related phonemes in the pool of genuine neologisms and the number of target related phonemes in the pool of pseudo neologisms were compared for each trial. Phonemes that are target related in the pseudo neologisms can be considered to occur by chance. This allows investigation of whether the level of target related phonemes in the sample of genuine neologisms significantly exceeds the number that could be expected to occur by chance.

Table 7.1 Results of the randomisation exercise with randomly selected neologisms from the five Palpa picture naming trials.

Date of Palpa picture naming trial	Number of neologisms analysed	Total number of phonemes in the randomly selected neologisms	Number of target related phonemes in the randomly selected neologisms	Number of target related phonemes in the pseudo neologisms	Result of comparison with Chi square analysis
4.10.95	37	199	50	23	11.3, $p < .001$
11.10.95	38	228	57	21	18.9, $p < .001$
1.11.95	36	168	41	20	8.0, $p < .01$
15.11.95	37	174	54	17	22.9, $p < .001$
22.11.95	31	147	39	18	8.7, $p < .01$

The five trials correspond well in terms of the number of phonemes that are genuinely and pseudo target related on each occasion. Target related phonemes in the genuine data form approximately 25 - 30% of the response phonology. Thus a relatively small proportion of LT's phonemic output appears to be derived from target phonological representations. The consistency of this figure across the five trials reinforces the claim that LT's naming performance is relatively stable. However, the number of target related phonemes in the genuine responses significantly exceeds the number of target related phonemes found in the pseudo neologisms in each trial. This indicates that despite the low level of target relatedness seen in the genuine data, LT's responses are significantly more related to the target phonologies than can be accounted for by chance.

A potential criticism of these data arises from the concern that the results may be influenced by a small number of highly target related responses in the genuine neologisms. These might mask the fact that while a few responses are strongly target related, the remaining neologisms show no relationship to the target phonology. The random selection of neologisms from sequences of non word responses was designed to counteract this criticism. A subsequent analysis excluded the possibility that the levels of target relatedness seen in the genuine data arise from a small number of highly target related responses.

The distribution of target related phonemes in neologism responses

The randomly selected neologisms used in the previous analysis were inspected for the number of target related phonemes they contained. The presence of a significant proportion of highly target related neologisms would predict a bimodal distribution in the number of target phonemes occurring in responses. In other words, neologisms would be expected to contain either very few or very many target related phonemes. This would be consistent with the assertion made by Buckingham and Kertesz (1976) that non word responses polarise to two groups in their levels of target relatedness. The distribution of target related phonemes across LT's non word responses is shown in Table 7.2.

Table 7.2 Distribution of target related phonemes across neologisms

No. of target related phonemes:	**0**	**1**	**2**	**3**	**4**	**5**	**6**
Genuine neologisms	51	60	35	26	3	3	1
Pseudo neologisms	101	61	13	4	0	0	0

Table 7.2 shows that about 72% of LT's neologisms contain at least one target related phoneme. However, the distribution of target related phonemes is biased towards the lower end of the range. Very few responses contain more than three target related phonemes. The few exceptions to this pattern, e.g. the response /'ræərəbʌnjən / to the target onion, are rare and would be insufficient to bias the data significantly. The

distribution of target related phonemes in LT's neologisms therefore identifies that the bulk of the target related effect arises from the many non words which contain one, two or three target phonemes.

The presence of a large number of responses containing even two or three target phonemes might however be surprising given the previous description of LT's output as typically unintelligible with neologisms not readily identifiable as approximations of target phonologies. Table 7.3 shows that LT's neologisms are relatively lengthy responses (mean length 5 phonemes, range 2 - 11 phonemes). Moreover, as Table 7.1 demonstrated, across all five trials the target related phonemes constitute only 26% of LT's total phonemic output.

Table 7.3 Length of neologism responses measured by number of phonemes

Number of phonemes	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Neologisms of that length	9	18	35	58	25	18	10	3	2	1

Discussion

The analyses reveal that LT's neologisms show significant levels of target relatedness. This effect is created by a large number of neologisms in the genuine data which contain one, two or three target related phonemes. Very few non word responses are highly target related. The overall proportion of target related phonemes in the data indicates that the bulk of non word phonology is not derived from the target lexical representation. Nevertheless the number of target related phonemes which are present in the non word responses is greater than can be accounted for by the effects of chance alone.

The finding that very few of LT's non word responses are highly target related also serves to dismiss a potential criticism of the analyses for phonemic content undertaken in Chapter 6. These analyses found that the use of phonemes in LT's neologisms corresponded closely to the normal frequency distribution of phonemes in English. It might have been argued, however, that this effect was created by a large number of highly target related responses in the data. The presence of these responses might have concealed the fact that the remaining abstruse neologisms showed a phoneme distribution significantly different from the normal English pattern. A number of authors have argued that while neologistic phonology deviates from the normal frequency distribution, phonological paraphasias retain the normal distribution of English phonemes (e.g. Butterworth 1979, Christman and Buckingham 1989). The current finding dismisses this criticism by demonstrating that very few of LT's neologisms are highly target related and that the majority of his responses contain many phonemes which are not derived from the target phonology.

The greater than chance levels of target relatedness found in the non word data suggest that LT's production of neologisms is in some way mediated by the phonology of the target word. Thus it seems that even when the system fails to produce the target phonological representation in full, this information is nevertheless able to exert a significant influence over the phonemic content of the response. The results argue in favour of an account of neologism production which maintains a direct link between the phonological representations of the target word and the phonology produced in the non word. Theories which separate neologisms from target phonologies, either through a process of whole word substitution or by suggesting a non lexical source of phonology, will have more difficulty explaining how a measurable relationship continues to exist between phonology of the neologism and that of its original target.

Finally, the results identify that LT's apparently abstruse neologistic output shows a significant relationship to target phonologies. The term 'abstruse' will continue to be used to describe those neologisms where the relationship with the target word is less striking than in the case of highly target related neologisms. However, the use of the term does not imply that a significant relationship with the target phonology will not be present. In other words, the terms 'target related' and 'abstruse' will continue to be used descriptively and should not be taken as indicative of discrete groups of neologisms or to denote specified levels of target relatedness.

8. Conclusions from the Palpa data

The investigations of the five Palpa naming assessments revealed the severity of LT's spoken jargon. He was very unlikely to produce a correct response in his attempts to name the pictures. Moreover, his performance was relatively stable. There was little indication that increased familiarity with the stimuli improved his ability to name the items correctly.

The investigations identified a number of phonological characteristics of LT's neologisms. His non word output contains only English phonemes and these are produced in phonotactically legal combinations. Moreover, neologisms use phonemes in the same proportions as real English words. This is indicated by the fact that the frequency ranking of phonemes in the neologisms and the normal frequency distribution of phonemes in the language correlate strongly. Furthermore, LT's neologisms appear to be sensitive to the normal distribution of word initial phonemes. Finally, neologisms bear a significant phonological resemblance to the target they replace. The number of phonemes shared by the targets and genuine neologisms is consistently and significantly greater than the number shared by targets and randomly reassigned neologisms. The relationship between target and non word phonology exists when neologisms are selected at random from the sequence of non word responses. Additionally, nearly three quarters of all the neologisms analysed were found to contain at least one target related phoneme. The greater than chance level of target relatedness thus appears to be a genuine feature of the data rather than an artefact of the preferential selection of highly target related responses.

The results of the analyses indicate that LT's neologisms maintain features of both normal word phonology and, more specifically, features of individual target word phonology. Tentatively, these conclusions might be taken to support the view that neologisms are derived from failed attempts to produce the phonological representation of the target word, i.e. supportive of partial retrieval and phonemic paraphasia accounts of neologism production. There are, however, a number of limitations to the investigations carried out with the current stimuli.

The 40 items in the Palpa picture naming subtest are not controlled for their phonemic content, thus they should naturally reflect the normal frequency bias in the distribution of English phonemes. This makes it difficult to determine the source of the frequency bias in LT's use of phonemes. This may arise from the sensitivity of neologisms to the target phonological representations or may represent a generalised feature of LT's non word production.

The frequency bias in the Palpa stimuli also makes it difficult to investigate LT's use of individual phonemes. For instance, the absence of three items from the phonemic inventory of the non word responses may occur simply because these items are seldom (or never) required by the target phonologies. The use of phonemically uncontrolled stimuli also make it impossible to assess whether LT shows differential levels of success in realising individual target phonemes.

It was therefore important to investigate these factors in stimuli controlled for their phonemic content, a variable which has not been controlled in previous studies of neologistic jargon. A vocabulary was developed where the stimuli were controlled for the phonemes they contained. Analyses of LT's picture naming attempts with these items are given in the following chapters. These will be followed by discussion of the implications for the theories of neologism production.

9. Consonant controlled stimuli

A new set of picture stimuli was developed. This was designed to control the number of occasions each phoneme occurred in the target words. It proved impossible to control the incidences of all consonants and vowels within the same set. The current vocabulary therefore controlled only the occurrences of consonants.

The vocabulary consists of 47 picturable nouns which are restricted to the frequency range 0 - 100 per million (Francis and Kucera 1982). There are two outliers, measure (107) and mother (280). These items were required owing to the rather restricted distributions of the consonants /ʒ/ and /ð/ in English content nouns. As far as possible the consonant vowel structure of the items was restricted to either a CVC or a CVCV structure. There are three exceptions to this pattern; treasure, zebra, and wigwam.

The set of stimuli targets 94 consonants. All consonants in each word are scored for their occurrence, apart from the instances of the consonants / t, r, b, / in the items treasure and zebra. These items were necessary in order to target the consonants /ʒ / and / z / the required number of times. In fact, it was only possible to include two items containing the consonant /ʒ /, (treasure and measure). The consonants / t, r, b, / in the items treasure and zebra are not scored and LT gains no credit for realising them correctly in his responses. Similarly, occurrences of the three consonants in these words were not included when the total numbers of consonants were calculated. All other consonants are targeted on four occasions within the stimuli. Where possible, consonants are targeted twice in word initial position and twice in word final position. When the distribution of a consonant prevents this, for example with the consonant / h /, the phoneme is targeted only in its normal position. The 47 stimuli are given in Appendix One.

Controlling the stimuli in this way removed the normal bias in the distribution of English consonants. Analysis of the phonemic content of LT's responses to these targets would allow investigation of the differential use of consonants in his neologisms. To acquire a sufficiently large sample for such an analysis the stimuli were presented on several occasions.

Picture naming with the stimuli controlled for consonant content

LT's ability to name the controlled vocabulary was assessed over 10 trials between March and May 1996. The stimuli were presented using 40 black and white line drawings, 1 black and white photograph and 6 coloured pictures. LT was given unlimited time to respond. Where errors were apparently based on semantic or visual confusions a spoken description was presented in an attempt to identify the correct target. When this failed to modify LT's response, the target was supplied in both written and spoken forms. This procedure was adopted since it was possible that LT was unsure of the intended target for the stimulus. Confusion as to the identity of the target might arise from the need to supply contextual information in a number of the picture stimuli. For instance the stimulus for the target mother consisted of a woman holding a child. Several of LT's responses suggested that he was attempting to produce the incorrect target 'child'. Since such responses would have to be excluded from the analyses it was hoped that by supplying the correct target the number of such errors in future trials would be reduced. Given the apparently intractable nature of LT's output deficit at this point (he was currently 12 months post onset and showed almost no evidence of recovery) it was unlikely that supplying the target would provide a significant advantage for these items. Responses produced after a spoken description were admitted to the analysis. Responses subsequent to the presentation of the correct target were not scored. LT's responses were recorded on digital audio tape and transcribed in broad phonemic transcription. As before, LT tended to produce many responses to each stimulus. These were classified into the categories used previously: correct responses, neologisms, semantic errors and semantic + phonological errors. These responses occurred in similar proportions to those seen in the Palpa naming data, neologisms being the most prevalent response type. As with the Palpa data there were very few untranscribable responses, 35 over the ten trials. The results of the classification are shown in Table 9.1.

The high numbers of semantic + phonological errors might initially suggest that these error types are becoming more widespread amongst LT's responses. However, these errors typically occur as multiple responses to a few items in each trial. For instance, LT's response to the picture stimulus for the target word hive in the initial naming trial contained 25 attempts to name the bees shown in the same picture. A number of others consisted of occasions where it was difficult to cue LT to produce a single word response to the stimulus. For instance, the response, "washing your hands" to the target picture for soap. These phrases were produced fluently and did not appear to be operating as circumlocutions for LT.

Table 9.1 Responses to the ten naming trials with the controlled stimuli

Date of naming trial	Correct responses	Neologisms	Semantic error	Semantic + phonol. error	Total responses
18.3.96	9	205	28	76	318
20.3.96	6	193	17	30	246
10.4.96	9	209	8	35	261
19.4.96	11	194	9	43	257
24.4.96	12	190	6	50	258
1.5.96	13	164	9	5	191
3.5.96	14	180	11	10	215
8.5.96	10	117	8	22	157
10.5.96	7	115	4	4	130
17.5.96	4	121	7	6	138
Total	95	1,688	107	281	2,171

Table 9.2 shows the number of items named correctly in each naming trial. The numbers are slightly lower than the number of correct responses shown in Table 9.1 since on occasions LT repeated a correct response. LT's naming was consistently poor over the ten naming trials and in total he named just 69 items correctly (mean 6.9, standard deviation 1.85). There was no improvement in his ability to name the pictures over the ten trials despite the repeated attempts at the same stimuli, Mann Test S = 3, not significant.

Discussion

As with the Palpa stimuli, LT showed very poor naming performance on the picture naming task. There was no evidence that familiarity with the stimuli or the presence of repeated naming opportunities facilitated his performance. Correct responses continue to be a small group within the total set of responses. Neologisms predominate.

The naming trials provided a corpus of responses for the phonological analyses undertaken in the subsequent chapters.

Table 9.2 Number of items named correctly in the ten naming trials with the controlled stimuli

Date of naming trial	Number of items named correctly
18.3.96	6
20.3.96	4
10.4.96	8
19.4.96	8
24.4.96	9
1.5.96	9
3.5.96	7
8.5.96	8
10.5.96	6
17.5.96	4

10. Consonant distribution in naming responses to the controlled stimuli

The consonant vocabulary controls the number of occasions that each consonant is targeted in the stimulus words, thereby flattening the normal frequency distribution of English consonants. This allows comparisons to be made with the number of occasions each consonant is used in LT's responses and thus permits investigation of how far the consonant weighting in his neologisms is influenced by the phonology of the target words.

Each English consonant appears as a scored item on four occasions in the set of target stimuli. The ten administrations of the naming assessment mean that each scored consonant is targeted on 40 occasions in the data. The exception, /ʒ/, appears in only two of the stimulus words and is targeted on only 20 occasions. This gives a total of 940 scored consonants across the ten naming trials. LT's strategy of producing more than one attempt at each picture potentially disrupts the controlled nature this design, biasing the number of times some consonants are targeted. To maintain the controlled status of the sample it was necessary to select just one response for each item. The selection of responses was carried out using the following protocol.

1. Semantic and semantic + phonological errors were excluded on the basis that these responses are uninformative regarding LT's ability to produce the phonology of the target item.

2. Correct responses were selected as the response of first choice where they occurred.

3. Where a response consisted of a single neologism this was selected for the analysis.

4. Where the response to the picture stimulus consisted of a sequence of neologisms a single item was selected using the following criteria. The neologistic response which correctly targeted the greatest number of scored consonants was identified and selected. Where two or more neologisms correctly targeted the same number of consonants, the item which contained the most target related phonemes (consonants and vowels) was selected. No credit was given for reduplicated target phonology where this was not required by the stimulus word. When this procedure failed to identify a single item, the

shortest neologism containing the most target phonology was selected. Where two or more neologisms were equal on all these measures the item occurring earlier in the sequence of responses was selected.

The use of the above criteria results in the most successful response to each item being selected for analysis (correct response or earliest, shortest and most target related neologism). This provides a view of the optimal use of consonants in LT's neologisms. It should be remembered that LT produces many responses which are far less successful approximations of the target phonology. The analyses carried out with the Palpa naming data showed that neologism responses selected at random nevertheless display greater than chance levels of target relatedness, indicating that the result was not influenced by a preferential selection of LT's most successful responses. Thus a general ability to retain significant amounts of the target phonological representation in the non word has already been demonstrated. The current analyses were designed to reveal LT's ability to realise different consonants from the target representations. It was decided that investigating LT's optimal performance would be the most informative, providing the greatest opportunity for discerning patterns of accurate consonant use in his neologisms.

<u>Distribution of consonants in the selected responses</u>

The results of the response selection procedure are shown in Table 10.1. A total of 69 correct responses and 375 neologisms were selected from the corpus of responses for further analysis. 26 items were rejected because LT produced only semantic or semantic + phonological errors to the target (6% of all selected responses). These items are indicated in Columns Four and Five. The removal of these targets from the analysis again disrupts the controlled nature of the stimuli, eliminating a total of 52 opportunities to produce a scored consonant. However, this represents a relatively small proportion of the total set of scored consonants (6%). The eliminated items were distributed over 18 different consonant types and only one consonant, /ʤ/ was eliminated on more than 5 occasions. This was the result of a relatively strict scoring regime which considered the response / ' mʌg / for the target <u>jug</u> to be a semantic error rather than a jargon homophone. This response occurred five times in the data. Since all other consonants were affected to a similar extent by the removal of the selected semantic and semantic + phonological errors, the analyses continued to assume that each consonant was targeted

Table 10.1 Analysis of selected responses from the ten naming trials with the controlled stimuli

Date of trial	Correct responses	Neologisms	Semantic error	Semantic + phonological error
18.3.96	6	33	7	1
20.3.96	4	39	4	0
10.4.96	8	38	1	0
19.4.96	8	36	1	2
24.4.96	9	35	1	2
1.5.96	9	37	1	0
3.5.96	7	40	0	0
8.5.96	8	36	3	0
10.5.96	6	40	1	0
17.5.96	4	41	2	0
Total	69	375	21	5

on the full 40 occasions. The fact that this was no longer strictly true may introduce an element of noise into the data. However this should serve to underline the validity of any patterns detected.

The selected responses (correct responses and neologisms) contained a total of 983 consonants. Each of the 24 English consonants appears in the sample. Table 10.2 shows the consonants ranked in order of their frequency of use (Column One) and gives the total number of occurrences of each consonant (Column Two)[1]. The ranking shows a significant difference in the rate of use across the range of consonants. The third column of Table 10.2 shows the normal frequency distribution of consonants in English taken from Denes (1963). The overall frequency distribution was used for these and all subsequent analyses since the investigation was not restricted to response initial phonemes. The relationship between the ranking for rate of consonant use in the selected responses and the normal frequency distribution in English was examined using a Spearman Rank Order Correlation. This gave a significant positive correlation; rho (24) = 0.601, $p < 0.01$.

Table 10.2 Frequency of occurrence of consonants in LT's selected naming responses to the controlled stimuli and the normal frequency distribution for English

Consonant	Total number of occurrences in the selected responses	Frequency of occurrence in English
s	90	t
l	78	n
t	65	s
g	64	d
n	62	l
r	61	m
k	59	ð
b	55	k
p	54	r
z	53	w
d	52	z
ŋ	49	b
m	45	v
w	34	p
ʃ	32	f
tʃ	26	h
f	19	j
θ	18	ŋ
dʒ	16	g
j	15	ʃ
h	14	θ
ð	8	dʒ
ʒ	7	tʃ
v	7	ʒ
	Total = 983	

Reliability

A particular concern surrounding the analysis of neologistic data is the reliability of the phonemic transcription. This was particularly relevant for the current investigations which would involve analysing LT's responses for subtle patterns of phoneme use. Previous studies have resolved this issue by having more than one listener transcribe all data samples. Differences between the two transcriptions are then resolved by discussion (e.g. Kohn and Smith 1994a, 1994b). This was not an option in the current study, given the large amounts of data to be analysed. In an attempt to determine the reliability of the transcription therefore a picture naming trial was selected at random and re-transcribed approximately 18 months after the original transcription had been completed. LT's optimal response to each target was again identified and compared, on a phoneme by phoneme basis, with the selected response from the original analysis. Reliability between the transcriptions was at the level of 87%. This is consistent with the level of interrater reliability obtained and considered to be acceptable by previous studies (Christman 1992, 1994). Moreover, discrepancies between the two samples seldom affected whether or not a target consonant was correctly realised in the selected response, a particular focus of the current study. When the two sets of selected responses were compared on this measure 97% agreement was achieved. The investigation therefore suggested that the transcribed samples were an accurate account of LT's picture naming responses.

Discussion

The full inventory of English consonants is represented in LT's responses to the stimuli. This supports the suggestion that the absence of phonemes in the Palpa responses may have arisen, in part, from the failure of the stimuli to target all phonemes.

Although the full range of English consonants is represented in the sample there are significant differences in the frequencies with which they occur. Thus, LT's responses do not preserve the even distribution of consonants seen in the target words. The positive correlation of the Spearman rank order analysis shows that the rate of consonant use in LT's neologisms remains strongly related to the typical English distribution. Consonants which are used frequently in English real words also occur frequently in LT's responses. Items which occur less often in the normal language appear only rarely. The preservation of the normal English frequency distribution occurs despite the fact that the controlled stimuli have removed this feature from the target words. Thus it appears that the ranking reflects a genuine bias in the use of consonants by LT's system. When composing output the system appears to be sensitive to the distribution of consonants which would be expected were the responses to be genuine English words. The ability of LT's jargon output to retain this feature of English real word phonology may go some way to explaining why the output gives the impression of being English jargon. However, in the current sample it also represents a certain insensitivity to the target phonological representations. This may jeopardise the possibility of the neologisms displaying greater than chance levels of target relatedness. The relationship between the phonology of the individual neologisms and their target words was therefore examined.

Footnote One

The controlled stimuli are designed to target each consonant an equal number of times, thus requiring LT to produce each consonant equally often. There are four exceptions to this; /ʒ/, which is targeted only twice and / t, r, b, / which occur as unscored consonants in the items treasure and zebra. Since these instances of the phonemes exist as unscored or untargeted consonants their presence in LT's responses to these items is ignored. This means that despite being target related, use of these consonants in responses treasure and zebra are excluded from the total number of occurrences of the consonants. This was important for the accuracy of later calculations which used the number of occurrences of consonants to indicate the level of accurate / inaccurate use (etc.) of consonants.

11. Levels of target relatedness in selected responses to the controlled stimuli

The finding that neologisms produced to the controlled stimuli nevertheless maintain a normal frequency bias in their consonant distribution suggests that non words may no longer show a significant relationship to target phonologies. The selected neologisms were therefore analysed for their level of target relatedness.

Investigation of levels of target relatedness in the selected neologisms

The genuine and chance levels of target relatedness of the selected neologism responses were calculated. The analysis considered only the selected neologisms to the controlled stimuli. Correct responses were excluded from the analysis. Thus the investigation considers only LT's ability to produce target phonology in the context of an error response. Each picture naming trial was analysed separately. The number of target related phonemes (consonants and vowels) in each of the selected neologisms was counted before the responses were randomly reassigned to the targets. The reassignment generated a pool of pseudo neologisms which were analysed for the number of pseudo target related phonemes they contained. This allows the level of target relatedness in the genuine neologisms to be compared with the level which might be expected to occur by chance.

When counting the number of target related phonemes in a genuine or pseudo response to a target the following protocol was followed;

i. each phoneme in a response can be counted as target related only once, independent of how many times it is required by the target

ii. no credit is given for reduplicated phonemes in a response where the target requires only one instance of the phoneme

iii. genuine or pseudo neologism responses to the items treasure and zebra were only given credit when they correctly targeted /ʒ/ or / z / respectively, and where they correctly targeted the relevant vowels.

The reallocation process resulted in 6 neologisms being reassigned to the original target.

These items were left in the analysis. In no trial did this occur on more than two occasions.

The results of the analysis are shown in Table 11.1. In each picture naming trial the number of target related and pseudo target related phonemes was compared with a Chi square test. On each occasion the difference was shown to be significant.

Table 11.1 Results of the randomisation exercise with the selected neologisms from the ten naming trials with the controlled stimuli.

Date of naming trial	Number of neologisms analysed	Total number of phonemes in the selected neologisms	Number of target related phonemes in the selected neologisms	Number of target related phonemes in the pseudo neologisms	Result of comparison with Chi square analysis $p < 0.001$
18.3.96	33	131	45	18	14.1
20.3.96	39	149	54	25	13.5
10.4.96	38	148	50	16	21.2
19.4.96	36	139	44	12	21.5
24.4.96	35	132	49	13	25.8
1.5.96	37	136	57	9	44.2
3.5.96	40	158	61	17	31.5
8.5.96	36	141	52	10	34.8
10.5.96	40	154	55	10	37.8
17.5.96	41	154	50	10	31.5

Discussion

For each picture naming trial the number of target related phonemes in the genuine responses significantly exceeds the number found in the pseudo neologisms. Thus, the level of target relatedness in the selected neologistic responses is significantly greater than can be accounted for by the effects of chance alone.

The current analysis replicates the finding from the Palpa data that neologisms show a significant relationship to the target phonology. However, the two investigations are not completely comparable. In the analysis of the Palpa data, neologisms were selected at random from the sequence when more than one non word was produced to the target. Thus no subjective decision was involved in the selection of the items to be analysed. In contrast, the selected neologisms to the consonant stimuli are chosen precisely because they are considered to be LT's closest attempt at the target (see selection criteria in Chapter 10). The analysis of the Palpa data therefore shows that LT's neologisms are significantly more related to the phonology of the target than can be expected by chance. The current analysis demonstrates that LT's most successful neologisms continue to show a greater than chance level of target relatedness despite their failure to match the controlled stimuli with an even frequency distribution for consonant use. However, the selected nature of the responses prevents this conclusion from being generalised to all LT's neologistic responses in the consonant controlled naming data.

In an attempt to gain an insight into the level of target relatedness present in the other neologisms a further investigation was carried out. This employed the criteria used in the Palpa data to select non word responses for the analysis. Specifically, where more than one non word response was produced to the same target, a single item was selected at random from the sequence of responses (see Chapter 7 for a full explanation of the criteria used). The investigation was restricted to the data from the first naming assessment with the consonant controlled vocabulary. The number of target related phonemes in the genuine neologisms was established using the scoring procedure described earlier. The neologisms were then randomly reassigned to the targets and the level of target relatedness in the pseudo neologisms examined. The genuine neologisms contained a significantly higher number of target related phonemes than the pseudo errors; target related phonemes in the genuine neologisms = 34/157, target related phonemes in the pseudo neologisms = 15/157 (Chi square 7.8, $p < 0.01$). Thus the data suggest that randomly selected neologisms produced in response to the consonant controlled stimuli continue to show a greater than chance level of target relatedness. It therefore appears that the failure of LT's neologisms to replicate the target distribution of consonants has not caused the overall level of similarity with the target to be reduced to the level of chance.

12. Position effects in the realisation of target phonology

Phonemic paraphasia accounts of neologism production have suggested that the phonemic distortion may arise from a failure to maintain the target phonological representation during phonemic encoding. This predicts that the ability to realise target phonemes may be influenced by their position in the target word. In particular, if encoding is assumed to proceed from right to left the frequency of segmental errors may increase across each response (Kohn and Smith 1995). In contrast, partial activation accounts predict that the ability to realise target phonemes will be equal across responses (Kohn and Smith 1994b). Accounts of neologism production which dissociate non words from the phonology of the target specifically predict that the production of target phonemes will be random and thus expect no influence of target position.

The following analysis was carried out to determine whether LT's ability to realise target phonemes differed across the response. The investigation compared his ability to realise word initial and word final target phonemes in neologisms.

Realisation of target initial and final consonants

The analysis considered the 375 selected neologisms produced in response to the controlled stimuli. These target words control not only the frequency with which consonants appear but also the position in which they occur. Thus artificial differences caused by the distribution of consonants in the target words should be eliminated.

The selected neologisms were reviewed and occurrences of the initial and final phonemes of the target word scored. The position in which the phoneme appeared in the response was not considered, except where this was needed to determine whether the phoneme was a realisation of the target initial / final phoneme. This situation only arose for the three items where the stimuli target the same phoneme more than once.

For instance, the response / ˈbɪgwʌm / for the target wigwam was scored as correctly realising only the target final phoneme. As in previous analyses, no credit was given for additional occurrences of target initial or final phonemes in responses.

The selected neologisms contained a total of 332 target initial or final phonemes. These were evenly distributed between target initial and target final phonemes; initial 167/332, final 165/332. The analysis therefore failed to demonstrate any significant difference in the ability to realise phonemes from the beginning and end of target lexical representations.

Discussion

The results of the current analysis are consistent with the findings of Miller and Ellis (1987). These authors found that serial position failed to influence the realisation of target phonemes in RD's neologisms. No advantage was found for the realisation of word initial phonemes and there was no decline in the presence of target phonemes across responses. This result was replicated in RD's written output. The distribution of target graphemes across written responses was consistent with chance. Miller and Ellis (1987) therefore concluded that there was no evidence to support a decay explanation of RD's output.

Kohn and Smith (1995) investigated the spoken responses of six fluent speakers for an influence of position information on the production of target related phonemes. These authors argued that the presence of position effects differed for subjects with deficits of lexical activation and those with disruptions to phonemic planning. Subjects identified as presenting with phonemic planning deficits showed a significant increase in errors from left to right across responses. In contrast, the consonant errors of speakers identified with activation deficits were distributed evenly across responses.

The finding that LT shows an equal ability to realise word initial and word final phonemes suggests that the decay of phonological representations during phonemic planning may be unable to explain his neologism production. As discussed, the absence of position effects in non word output have been used by other authors to argue that neologisms arise from lexical activation deficits. However, it is unlikely that the absence of position effects alone is sufficient evidence for the phonemic paraphasia account of neologism production to be rejected. Errors in phonemic planning may occur for a number of other reasons. For instance, the system may inaccurately translate the abstract phonological code, may misapply redundancy rules or may misselect phonemes. Since none of these errors involves the decay of the phonological representation, no effect of phoneme position is predicted. The current data are therefore unable to exclude the possibility that LT's neologisms arise from deficits occurring at the level of phonemic planning.

13. Introduction to further investigations with the controlled naming data

Three conclusions can be drawn from the initial investigations of LT's responses to the consonant controlled stimuli. Firstly, it appears that the full consonant inventory is available to the system when composing non word responses. Given sufficient opportunities, all English consonants can be realised in the neologistic output. Secondly, the use of consonants in neologistic responses is reliably influenced by two factors; the normal frequency distribution of consonants in English and the phonological representation of the target word. Moreover, these factors are independent. Neologisms continue to show a bias in their use of consonants despite this feature being absent in the target stimuli, however they continue to be significantly related to the target phonologies despite differing in this respect. Any potential theory for the mechanisms underlying neologism production in LT's system must be able to account for the fact that the frequency biased distribution of consonants and the greater than chance levels of target relatedness are reliable and independent features of his output. Finally, position information does not appear to be influential in the ability to realise target consonants in neologistic responses.

The controlled nature of the stimuli permits further and more detailed levels of analysis to be carried out. In particular, it becomes possible to investigate the behaviour of individual consonants both as target related and as error phonology. Three specific questions will be pursued in the subsequent chapters.

1. Do individual target consonants show differential levels of success in their ability to be correctly realised in neologisms? If so, what factors influence the ability to realise a target consonant? Do all consonants show levels of target related use greater than is predicted by chance?

2. Does the system make differential use of individual consonants as error phonology? What factors influence this use?

3. Is there a discernible relationship between target and response phonology at the level of individual consonant substitutions?

These investigations represent an extension of previous studies of neologistic output. They should supply further valuable information regarding the composition of LT's neologisms. Although the individual data may not be able to discriminate between the differing models of non word production, when combined with other analyses, they should support the evaluation of the differing accounts of neologism production.

14. Investigation of the differential use of consonants as target related and error phonology

The controlled stimuli require that each of the English consonants be produced an equal number of times. This allows differences in the ability to realise individual target consonants to be investigated. This form of analysis is not possible where stimuli have not been controlled for their phonemic content. In such data the normal frequency bias of English consonants provides only limited opportunities for the realisation of some consonants in target related contexts. This prevents comparisons from being made across the inventory.

Controlling the number of times each consonant is required by the target words also allows the nature of error phonology to be investigated. Since the stimuli restrict the number of times that each consonant is required, additional incidences can be considered to be error occurrences. Without controlling the phonemic content of the target representations it is impossible to tell whether biases are present in the frequency with which individual consonants occur as error phonemes.

If intrinsic differences are demonstrated in the use of individual consonants as target related and error phonology it is also important to establish what factors underpin this. Given that the normal frequency distribution for consonants has already been found to have a strong influence on the phonemic content of LT's responses, the production of consonants both as target related phonemes and as error phonology was investigated in relation to this.

Investigation of patterns of consonant use in the selected responses

The production of target consonants in the selected naming responses was investigated. The analysis was designed to reveal individual differences in the frequency with which consonants are correctly realised in LT's responses.

Each selected response was inspected for the number of scored, target consonants it contained. The analysis considered any occurrence of the targeted consonant in the response to be correct. In other words, the ability to preserve the target position of the consonant in the response was not considered. The presence or absence of each scored consonant in the selected response was marked in the following way:

✓C	the target consonant appears in a correct response
✓N	the target consonant appears in any position in the selected neologism
XN	the target consonant fails to appear in the selected neologism
XSE	the selected response to the item is a semantic error, therefore it is eliminated
XSE+PE	the selected response to the item is a semantic + phonological error, therefore the response is eliminated

Items which elicited only semantic or semantic + phonological errors as the selected response are unable to inform the investigation of target phonology in LT's non word responses. These items were therefore eliminated from the investigation and will not be considered further. As discussed in Chapter 10, this represents a disruption to the controlled number of occasions that each consonant is targeted by the data. However, for the reasons given before, the analyses will proceed by assuming that each consonant is targeted on the full 40 occasions. /ʒ / is only targeted by the stimuli on 20 occasions. All calculations allow for the fact that this consonant has half the number of potential occurrences.

During the analysis some neologisms were found to contain more than one occurrence of a targeted consonant,

e.g. <u>bus</u> > / 'bʌbə/

Where this occurred LT received credit for only the number of instances of the targeted consonant required by the target. Consequently, only one occurrence of / b / is scored as target related in the above example (✓N). The other occurrence was scored as a non target related or error occurrence of the consonant. This approach was adopted on the grounds that the stimulus does not demand the extra instance of / b /, and on this occasion the consonant is not therefore related to the target phonology. This scoring regime prevents LT from being credited for the perseverative use of target phonology in his responses.

Two stimuli (wigwam and judge) target the same consonant more than once. Responses to these items were required to produce the target consonants twice. So, responses containing only one instance of the target consonant were scored as successfully realising the phoneme only once.

e.g. judge > /dʒʌb /

This response is scored as targeting /dʒ/ correctly once (✓N) and failing to target it on the other occasion (XN). This prevents LT from benefitting from the fact that the stimulus targets the same consonant twice.

The results of the analysis are shown in Table 14.1.

Column Two shows the number of occasions that each consonant is correctly realised in a correct response (✓C). Column Three identifies the number of occasions when a target consonant is correctly realised in a neologism (✓N). The fourth column is a summation of the previous two columns (✓C+✓N). This figure represents the total number of times each individual consonant appeared correctly in the selected responses from the ten naming trials. The fifth column identifies the number of occasions that a target consonant failed to be realised in the selected non word (XN). The final two columns show occasions when the consonant was not targeted because the selected response to an item was either a semantic error (XSE) or a semantic + phonological error (XSE+PE).

The results in Table 14.1 show that LT's ability to correctly realise target consonants is not equal across the inventory. Consonants differ significantly from each other in terms of the total number of occasions that they occur correctly in selected responses (✓C+✓N). For example, the consonant / v / is correctly realised on only 4/40 occasions. In contrast the consonant / p / is correctly produced on 30 out of the possible 40 occasions when it is targeted. This difference is highly significant (Chi square 32.0, $p < 0.001$). The results demonstrate that just as consonants differ significantly in their frequency of overall use, so their rate of target related use also varies. The number of target related occurrences differs significantly across the consonant inventory. This may indicate the presence of a relationship between the two patterns, i.e. that the ability to correctly realise target consonants is related to their overall frequency of use. This was investigated in the

Table 14.1 Ability to correctly target consonants in the selected responses from the naming trials with the controlled stimuli

Consonant	✓C	✓N	✓C+✓N	✗N	✗SE	✗SE+PE
p	9	21	30	9	1	0
b	6	18	24	13	2	1
t	11	17	28	12	0	0
d	10	14	24	12	2	2
k	5	21	26	12	1	1
g	4	23	27	8	5	0
f	1	6	7	33	0	0
v	0	4	4	34	0	2
θ	9	4	13	25	2	0
ð	7	1	8	29	3	0
s	7	22	29	10	1	0
z	7	20	27	12	1	0
ʃ	9	4	13	24	2	1
ʒ	0	4	4	16	0	0
h	4	4	8	29	2	1
ʧ	3	11	14	25	1	0
ʤ	2	8	10	21	9	0
m	14	6	20	15	5	0
n	1	19	20	17	2	1
ŋ	15	13	28	12	0	0
r	4	22	26	14	0	0
w	6	18	24	16	0	0
l	2	23	25	13	1	1
j	1	8	9	29	2	0
Total	137	311	448	440	42	10

next analysis.

The relationship between frequency of use and the ability to realise consonants correctly

This analysis investigated the presence of a possible relationship between overall frequency of use and the ability to realise target consonants. A Pearson product moment correlation coefficient was calculated to compare the total number of times each consonant occurred in the selected responses (target related and non target related occurrences, see Table 10.2) with the total number of occasions that the consonant was correctly realised (column 4, Table 14.1). The correlation gave a significant result, $r = 0.903$, $p < 0.001$.

The analysis indicates that the number of target related uses of a consonant increases with its number of uses in the sample as a whole. Popular consonants in LT's responses are often successfully realised in responses to the stimuli. Consonants which appear less frequently in the responses are also less likely to occur when they are demanded by the target word. The result suggests that the frequent use of popular consonants benefits their ability to appear as target consonants. These phonemes occur more frequently and therefore have more opportunities to be target related than consonants which occur more rarely. The infrequent use of other consonants potentially limits their number of appearances in target related contexts.

The high rate of use of the popular consonants, given the constrained number of occasions when they are required by the stimuli, suggests that these consonants must also frequently appear in contexts incorrectly. This may serve to reduce their overall accuracy of use. Attempts to measure differences in the successful use of consonants must therefore also take into account the frequency with which the phonemes are misused. The following analysis aimed to do this by investigating the proportion uses which are target related for each consonant.

Levels of accurate use

To control for the unequal rates of use across the consonant inventory, the pattern of target related and non target related uses was investigated for each consonant individually. For each consonant the number of target related occurrences in the selected responses (✓C+✓N), was compared with the total number of times the consonant appeared in the sample of selected neologisms and correct responses (both target related and non related occurrences). This gives the proportion of the total number of uses that are target related. Secondly, the number of occasions that each consonant occurs in a non target related context was compared to the total number of all unrelated consonants in the selected responses. Since the stimuli restricted the required use of each consonant to the 40 scored occasions, every other occurrence of the consonant can be considered as a non target related use. This allows the contribution that each consonant makes to the overall pool of non target related consonants to be demonstrated.

The results of these analyses are shown in Table 14.2 The columns are calculated as follows:

Column Two	gives the total number of times that each consonant occurs in the selected responses, independent of whether these were target related uses or not
Column Three	represents the number of times in the sample that the consonant is realised correctly in a response, (correct response or neologism). This is ✓C+✓N from Table 14.1
Column Four	shows the proportion of occurrences of the consonant that are target related, i.e. $\frac{\text{column three}}{\text{column two}}$
Column Five	is the number of occasions that the consonant occurs when it is not demanded by the target, that is the total number of non target related occurrences of the consonant i.e. column two - column three
Column Six	gives the percentage of the set of unrelated consonants that each consonant represents,

i.e. $\frac{\text{no. of times consonant is unrelated}}{\text{total number of unrelated consonants}} \times 100$

or, $\frac{\text{column five}}{\text{total for column five}} \times 100$

It is evident from Table 14.2 that consonants show differences in the proportion of their uses that are target related. For instance, the proportion of uses which are target related for the consonant /ɣ/ is 1.0 This item is only ever used in contexts where it is required by the target. In contrast, target related uses of other consonants may form only a relatively small proportion of their total number of appearances, for example it can be as low as 0.3 for the consonants / s, n, l, /. These consonants frequently occur in non target related contexts.

Consequently, some consonants make a greater contribution to the pool of non target related consonants than others. As already noted, / ɣ/ makes no contribution to this pool. In contrast, the individual consonant / s / accounts for 11.4% of all the non target related consonants in the selected responses. Table 14.3 shows the consonants ranked in their order of misuse in the selected responses. There is a significant difference across the ranking.

Clearly consonants differ in their rates of accurate use. While some consonants are used consistently accurately, others are distributed more evenly across both related and non target related contexts. In fact, some consonants occur more frequently in non target related contexts than they do in target related positions. This again raises the possibility that the overall frequency distribution of consonants influences their accuracy of use.

The relationship between frequency of use and accuracy of use

The relationship between the overall frequency of use of consonants and their rate of accurate use was investigated. A Pearson product moment correlation coefficient was used to compare the proportion of target related uses for each item (column four, Table 14.2) with the total number of times each consonant occurs. The analysis gave a

Table 14.2 Patterns of consonant use in the selected naming responses to the controlled stimuli

Consonant	Total number of times the consonant occurs	Number of times the consonant is target related	Proportion of occurrences that are target related	Number of non target related occurrences	% of group of unrelated consonants this item represents
p	54	30	.56	24	4.5
b	55	24	.44	31	5.8
t	65	28	.43	37	6.9
d	52	24	.46	28	5.2
k	59	26	.44	33	6.2
g	64	27	.42	37	6.9
f	19	7	.37	12	2.2
v	7	4	.57	3	0.6
θ	18	13	.72	5	0.9
ð	8	8	1.0	0	0
s	90	29	.32	61	11.4
z	53	27	.51	26	4.9
ʃ	32	13	.41	19	3.6
ʒ	7	4	.57	3	0.6
h	14	8	.57	6	1.1
tʃ	26	14	.54	12	2.2
dʒ	16	10	.63	6	1.1
m	45	20	.44	25	4.7
n	62	20	.32	42	7.9
ŋ	49	28	.57	21	3.9
r	61	26	.43	35	6.5
w	34	24	.71	10	1.9
l	78	25	.32	53	9.9
j	15	9	.60	6	1.1
TOTAL	983	448		535	100

Table 14.3 Consonants ranked in order of frequency of misuse in the selected naming responses to the controlled stimuli

Consonant	Number of non target related occurrences
s	61
l	53
n	42
t	37
g	37
r	35
k	33
b	31
d	28
z	26
m	25
p	24
ŋ	21
ʃ	19
f	12
tʃ	12
w	10
h	6
dʒ	6
j	6
θ	5
v	3
ʒ	3
ð	0

significant, negative correlation, $r = -0.684$, $p < .001$. Consonants which are rarely used in the responses have a much higher proportion of accurate use than more frequently used consonants. Popular consonants show a lower proportion of accurate use, despite the fact that they occur more frequently in the sample.

The relationship between target related and error uses of consonants

LT's use of consonants in the selected responses was further investigated using Analysis of Variance. The investigation analysed consonants in terms of their frequency of misuse. This approach provided a view of the relationship between the production of target related and error phonology in LT's responses.

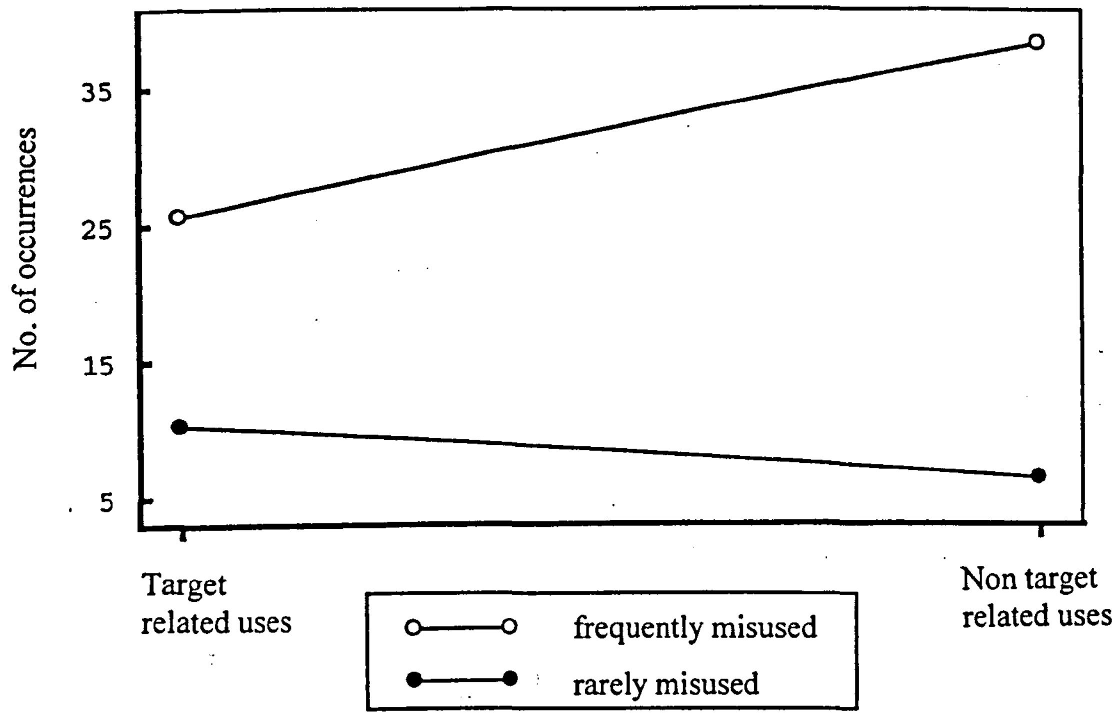
The analysis compared the top and bottom ten consonants from the ranking for frequency of misuse (Table 14.3). Table 14.3 suggests that consonants lie along a continuum for the frequency with which they are misused. Nevertheless, the selection of the ten most frequently misused and the ten least frequently misused consonants provides two groups which represent the two ends of this continuum.

A two factor mixed ANOVA was used with Consonant Type (frequently misused consonants Vs rarely misused consonants) as a between factor and Accuracy (target related Vs non target related uses) as a within factor.

The main effects of Consonant Type ($F(1,18) = 105.58$, $p < 0.0001$) and of Accuracy ($F(1,18) = 5.50$, $p < 0.05$) were significant. The former reflects the expected effect resulting from the selection of the consonants. The latter effect reflects the fact that the number of non target related uses exceeds target related uses. A significant interaction ($F(1,18) = 18.91$, $p < 0.001$) was found between the variables, see Figure 14.a. This indicates that non target related uses predominates for frequently misused consonants and that there are more target related uses for rarely misused consonants. Simple main effects indicates that the former effect is significant ($F(1, 18) = 806.45$, $p < 0.001$) but that the latter is not.

In summary, the ANOVA confirmed that frequently misused consonants occur more commonly in LT's responses. This is consistent with the previous finding that frequency of use is negatively correlated with accuracy of use. Across all phoneme use the number

Figure 14.a Interaction between Consonant Type and Accuracy in the naming data



of non target related occurrences of consonants significantly exceeds the number of target related uses. Since the analysis includes target related consonants occurring in correct responses, the finding is further evidence that LT's neologistic output contains a large proportion of error phonology. The significant interaction between Consonant Type and Accuracy shows that the relationship between target related and non target related uses is dependent on the group of consonants investigated. The ten most frequently misused consonants are used significantly more often in non target related contexts than as target related phonology. In contrast, the ten least frequently misused consonants have more target related uses than non target related uses, although this does not reach significance. Thus the two groups of consonants are distinguished not only by their rate of misuse but also by their rate of target related use.

Discussion

The analyses revealed a number of significant patterns in the way consonants are used in LT's speech. Investigation of the scored consonants showed that the ability to realise consonants in target related contexts differs significantly across the inventory. Some consonants are more likely to be correctly realised in responses than others. Unsurprisingly, this ability is strongly related to the overall frequency of use of the consonant. Popular consonants show high rates of success whereas rare consonants are less able to appear when they are demanded by the target phonology. Closer analysis of the patterns of use for individual consonants showed that they differ in the proportion of their uses which are target related. Some consonants appear to have a rather broad distribution, appearing equally often in target related and non target related contexts. Other consonants appear to be used rather more discerningly. They appear in target related contexts but are unlikely to be used in situations where they are not demanded by the target word. This is demonstrated by the fact that a very high proportion of their uses are target related. In fact some consonants were never used inaccurately. Comparison with the frequency ranking of consonants showed that accurate use is inversely related to popularity. The more frequently a consonant occurs in the selected responses, the lower the proportion of its uses which are target related. Consonants occurring more rarely are used with much higher levels of accuracy. The ANOVA showed that overall, consonants are used in non target related contexts more frequently than in target related contexts. However, this is only true for the most frequently misused consonants. Rarely misused consonants have more target related uses than inaccurate uses.

In summary, the results show that rare phonemes occur accurately. They are used relatively infrequently and are unlikely to be misused in non target related contexts. It seems that the use of these consonants is reserved for target related situations. Popular consonants initially appear to benefit from their high rate of use. They are often target related but their use also appears to be less discriminate, they are very likely to occur in contexts where they are not demanded by the target.

The observed patterns in the selected responses indicate differential patterns of use within the group of consonants. It appears that consonants are not equal. The results also suggest a further influence of phoneme frequency in LT's neologisms. The results indicate that the frequency bias in the use of consonants reflects different patterns of use across the inventory. The fact that some consonants occur more frequently than others reveals more than just the fact that some consonants are more popular than others. It is also informative about the levels of success and the accuracy with which these consonants are used. These observations may help in the development of more detailed understanding of the mechanisms responsible for generating neologistic phonology in LT's system. Their implications in this respect are discussed in Chapter 17. Meanwhile, the discovery that the proportion of target related uses for a consonant varies according to its frequency of use has implications for the investigations of the effects of chance. The previous assessment of the levels of target relatedness of neologisms (Chapter 11) simply counted the numbers of target related phonemes in each neologism and pseudo neologism. However, the current investigations indicate that something more complex may be occurring. The discrepancies in the frequencies and levels of accurate use suggest that each consonant may have its own individual chance level of target relatedness. For instance, the pervasive and indiscriminate use of the popular consonants raises the possibility that these phonemes may only ever be target related by chance. In contrast, the predominantly accurate use of the rare consonants may suggest that chance plays only a limited role in producing target related occurrences of these consonants. Again, these findings would have significant implications for understanding the possible processes of non word production. In view of this it was important to investigate the chance levels of target relatedness for each consonant individually. This is presented in the following chapter.

15. Individual levels of target relatedness

The discovery that consonants differ both in their overall frequency of use and in their rate of accurate use suggests that the levels of success predicted by chance should also differ for individual consonants. For instance, it is possible that some consonants may owe all their target related occurrences to the effects of chance. This is particularly relevant for those consonants which have a high percentage of inaccurate use. These are widely distributed amongst the neologisms and their high level of inaccuracy suggests that they may be used with little or no reference to target phonology. It is therefore possible that a large number, possibly all, of their target related uses may occur by chance. The following investigations were undertaken to establish whether individual consonants were operating above their own particular level of chance. It was anticipated that differences across the group of consonants might be related to differences in their frequency of misuse. These factors would be important when developing a model of neologism production in LT's system.

Chance levels of target relatedness for individual consonants

A procedure of randomly reallocating neologisms to targets was previously used to establish the overall chance level of target relatedness of the selected neologisms. These data can also be used to indicate the chance levels of target relatedness for individual consonants.

The random reallocation procedure was carried out with the selected neologisms to the controlled stimuli in Chapter 11 (see this chapter for details of methodology). The procedure generated a corpus of 140 pseudo target related phonemes (consonants and vowels) in the pseudo neologisms. 75 of these phonemes were consonants (54%) and it is this corpus of pseudo target related consonants which provides the basis for the current investigations.

Inspection of the group of pseudo target related consonants showed a bias in favour of certain consonants. Table 15.1 shows the pseudo target related consonants (✓PN) ranked for their frequency of occurrence in Column One with the number of occurrences in the second column. The difference across the ranking is significant.

Table 15.1 Rankings for number pseudo target related occurrences and rate of use of consonants in the naming data with the controlled stimuli

Ranking for number of pseudo target related occurrences (✓PN)	Number of pseudo target related occurrences in the reallocated responses (✓PN)	Ranking for frequency of consonant use in the naming data
s	12	s
l	7	l
b	7	t
n	6	g
d	6	n
g	6	r
k	5	k
tʃ	4	b
r	3	p
t	3	z
j	3	d
w	3	ŋ
m	2	m
dʒ	2	w
p	2	ʃ
f	1	tʃ
h	1	f
v	1	θ
z	1	dʒ
θ	0	j
ð	0	h
ʃ	0	ð
ʒ	0	ʒ
ŋ	0	v

The ranking for frequency of pseudo target related occurrences is strongly correlated to the overall frequency of consonant use in the naming data. This frequency ranking is shown in the third column of Table 15.1. The correlation is significant; rho (24) = 0.722, $p < 0.001$. The finding that the frequency of pseudo target related occurrences relates to the overall rate of use is not surprising. The more often a consonant appears in the responses to the original stimuli the more available it is to be target related by chance in the reallocation exercise.

The ability of frequently used consonants to exceed chance levels of target relatedness

The number of pseudo target related occurrences obtained for each consonant in the pseudo corpus allows investigation of whether individual consonants exceed chance levels of target relatedness in the selected neologism responses. As discussed above, this is particularly relevant for the frequently used consonants which also show a high level of misuse.

Table 15.2 shows the consonants ranked for their frequency of misuse in the naming data. Column Two gives the total number of occurrences of each consonant in the selected neologism responses. This includes both target related and non target related uses from the neologism data (but excludes target related uses occurring in correct responses). Column Three shows the total number of target related uses of the consonant across the selected neologisms. This is ✓N from previous tables. Column Four shows the number of pseudo target related occurrences in the pseudo error corpus (✓PN).

Table 15.2 shows that the number of target related uses occurring in the selected neologisms exceeds the number predicted by chance for each individual consonant. Of particular interest was whether the popular consonants showed significantly greater than chance levels of target relatedness. To demonstrate this Chi square analyses compared the genuine and pseudo number of target related uses. Table 15.3 shows the results for each of the 10 most frequently misused consonants. This indicates that overwhelmingly the consonants show significantly greater than chance levels of target relatedness. Only two items fail to show a significant effect and for both these consonants the figure approaches significance. Similar analyses were not completed for the less popular consonants. The small numbers of target related and pseudo target related occurrences

Table 15.2 Genuine and chance levels of target related use for individual consonants in the naming data for the controlled stimuli

Consonants ranked for frequency of misuse in the naming data	Total number of occurrences in the selected neologisms	Total number of target related occurrences in the selected neologisms i.e. ✓N	Number of chance target related occurrences in the reallocation of neologisms i.e. ✓PN
s	83	22	12
l	76	23	7
n	61	19	6
t	54	17	3
g	60	23	6
r	57	22	3
k	54	21	5
b	49	18	7
d	42	14	6
z	46	20	1
m	31	6	2
p	45	21	2
ŋ	34	13	0
ʃ	23	4	0
f	18	6	1
ʧ	23	11	4
w	28	18	3
h	10	4	1
ʤ	14	8	2
j	14	8	3
θ	9	4	0
v	7	4	1
ʒ	7	4	0
ð	1	1	0

Table 15.3 Comparison of genuine and chance levels of target relatedness for the ten most frequently misused consonants in the naming data

Consonants ranked for frequency of misuse in the naming data	Total number of occurrences in the selected neologisms	Total number of target related occurrences in the selected neologisms i.e. ✓N	Number of chance target related occurrences in the reallocation of neologisms i.e. ✓PN	Result of comparison with Chi square analysis
s	83	22	12	3.0
l	76	23	7	9.3, $p < .01$
n	61	19	6	7.2, $p < .01$
t	54	17	3	10.4, $p < .01$
g	60	23	6	11.6, $p < .001$
r	57	22	3	16.6, $p < .001$
k	54	21	5	11.4, $p < .001$
b	49	18	7	5.4, $p < .02$
d	42	14	6	3.2
z	46	20	1	20.0, $p < .001$

of these consonants make the analyses invalid. Moreover, the predominantly target related distribution of these consonants indicate that these consonants usually appear in response to their presence in the target phonology.

Discussion

The investigation of the role of chance in the target related uses of consonants allows further conclusions to be drawn about the phonology of LT's neologisms. Consonants are not used equally. Some occur more frequently than others and those which are frequently used also commonly appear in non target related contexts. Despite this, their genuine rate of target related use is typically significantly greater than the level predicted by chance. This indicates that despite their high rate of misuse, the accurate use of these phonemes is frequently motivated by the presence of the phoneme in the target phonology. However, since it is not possible to define the precise level of chance it must be assumed that this may also make some small contribution to the total number of target related uses for popular phonemes.

Other consonants occur much more rarely in the data and thus have fewer target related uses. However, these items are used more selectively. They occur almost exclusively in target related contexts. Their low rate of use would make it difficult to demonstrate individually that these items are target related more often than can be accounted for by chance. However, previous investigations indicate that items are typically realised only when the target phonology requires them. They are much less able to occur in contexts where they are not demanded by the target.

The implications of the current findings for theories of neologism production in LT's system will be discussed in Chapter 17.

16. Consonant substitutions in the naming data

The ranking for the frequency of misuse of individual consonants (Table 14.3) has revealed something of the nature of error phonology in LT's neologisms. This appears to be composed largely from high frequency consonants. A final investigation examined the nature of error phonology at the level of the individual consonant substitutions.

The investigation of individual consonant substitutions should be able to reveal whether a systematic relationship exists between error and target phonology. Such an analysis requires instances where the nature of the substitution can be confidently established. That is to say, neologisms are required where it is clearly apparent which aspect of the non word phonology replaces which aspect of the target representation. Highly target related neologisms are the best example of this. Where a neologism reproduces all but a small part of the target phonology correctly, the nature of the error can be identified with a reasonable degree of certainty. For the purposes of the current analysis, neologisms were collected in categories which enabled the nature of a single consonant substitution to be established. As a function of the stringent criteria needed to identify these substitutions, the neologisms used necessarily show a high degree of similarity with the target word, maybe involving only a single phoneme alteration. This has the advantage of allowing investigation of whether neologisms which are highly target related show the same characteristics as the larger set neologisms. In previous studies target related neologisms may be labelled as phonological paraphasias and are often separated from the general pool of more abstruse neologisms. This is done with the reasoning that highly target related neologisms may arise from the operation of phonological processes different from those which produce abstruse neologisms. However, as Butterworth (1985) points out, such a division involves the application of theoretical preconceptions to the raw data. Up to this point the current study has argued for the merit of considering the whole set of non words uniformly, independent of how related to the target they are. As will be demonstrated in the subsequent analysis, highly target related responses form a very small component of LT's neologistic output. Showing that the phoneme substitutions in these non words operate under the same principles identified in the wider set of abstruse neologisms would legitimise the approach of analysing them together, suggesting that all neologisms lie along a single continuum of target relatedness.

Consonant substitutions in the naming data

Substitution errors were collected from the pool of selected responses which have been used in all the previous analyses. Each neologism contained an identifiable substitution where a target consonant was replaced by another, single error consonant in the neologism. The substitutions were collected in three categories where it was possible to be reasonably certain about which consonant in the non word replaced which target consonant. The three types of substitution are as follows:

Type One

The error consonant is the only error in the response. The neologism maintains all other aspects of target structure and phonology.

e.g. ˈtʃɛri → ˈsɛri

Type Two

An error consonant occurs along with a vowel substitution. The other target consonant is present and in its target location within the neologism. Any other target vowel is also present and maintains its target position and stress.

e.g. ˈtʃiz → ˈtʃɛs

Type Three

A single consonant substitution is present in a neologism which complicates the target CVC structure by the addition of an extra, unstressed syllable. The correct stressed vowel is present and one other target consonant is in its target position either side of the vowel. The additional, unstressed syllable does not contain the missing target consonant.

e.g. ˈjəʊk → ˈkəʊtə

In all of the categories, neologisms which involved the transposition of a target consonant to a non target position within the neologism were discounted.

e.g. 'hæt → 'tædə

Likewise, instances which involved a target consonant being replaced by more than one substitution consonant were also rejected.

e.g. 'hæt → 'kræt

A total of 65 neologisms containing phoneme substitutions of the above types were found in the pool of selected non word responses. The numbers found of each type are shown in Table 16.1.

Table 16.1 Consonant substitutions in the selected naming responses to the controlled stimuli

Substitution type	Number found in the selected neologisms	Percentage of the pool of selected non word responses this group represents (x / 375)
Type One	24	6%
Type Two	33	9%
Type Three	8	2%

Neologisms containing phoneme substitutions of these types form a relatively small section of the data, only 17% of all the selected neologism responses. This reinforces the view that very few of LT's non word responses are highly target related, the majority of his neologisms being more distant from the target.

The three types of consonant substitution were analysed separately. However since no significant differences were found between the groups the results will be presented together.

Patterns of consonant misuse in the substitution data

The substitutions were initially inspected for the identity of the error consonant. Error consonants were identified according to their location in the frequency of misuse ranking in the naming data (Table 14.3). This ranking had shown that some consonants were more likely to be used inaccurately than others.

The results of the analysis are shown Table 16.2. This shows that substitutions utilising consonants from the top end of the frequency of misuse ranking (top 10 misused consonants) form the largest group. This group is significantly larger than the number of substitutions drawing on consonants from the bottom section of the ranking (bottom 10 misused consonants), Chi square 40.8, $p < 0.001$.

Table 16.2 Consonant substitutions in the naming data: the location of error consonants in the frequency of misuse ranking

Location of error consonant	Number of substitutions
Error consonant located in the top 10 in the ranking of misuse	46
Error consonant located in the middle 4 in the ranking of misuse	10
Error consonant located in the bottom 10 in the ranking of misuse	9
Total	65

The current analysis therefore establishes that the pattern of consonant misuse seen in the substitution data reflects the pattern established for the main body of the data. Popular consonants tend also to be used as error phonemes. The finding that the highly target related neologisms match the general set of neologisms on this feature strengthens the argument that they arise from the same processes responsible for generating more abstruse non words in LT's output.

Investigation of the frequency relationship between error and target consonants

The highly target related neologisms reveal not only the identity of the error consonant but also the identity of the target consonant it replaces. This allows the nature of the frequency relationship between the target and error consonants to be examined. For the purpose of these analyses the target and error consonants were compared for their location in the English consonant frequency ranking (Denes 1963). The analyses thus investigate how far error phonology is influenced by this normal language parameter at the level of individual substitutions.

Substitutions were analysed for the frequency relationship between the two consonants. Error consonants were marked as being either higher or lower in the frequency ranking than the target consonant.

51/65 consonant substitutions involve the replacement of the target consonant with a consonant occurring higher in the frequency ranking. Only 14/65 substitutions replaced the target consonant with a consonant from lower in the ranking. The difference is highly significant (Chi square 39.9, $p < 0.001$).

Further analyses indicated that the presence of this frequency relationship was independent of the identity of the error consonant. Error consonants were identified according to their location in the frequency of misuse ranking, i.e. either as popular error consonants (occurring in the top 10 items in the frequency of misuse ranking) or as rarely misused items (occurring in the bottom 10 items in the frequency of misuse ranking).

46 consonant substitutions utilised a popularly misused consonant as the error consonant. Of these, 37 replaced a target consonant from lower in the frequency of misuse ranking. Only 9 error consonants from the top of the frequency of misuse ranking replaced target consonants which were higher in the ranking. The difference is significant, (Chi square 31.7, $p < 0.001$).

Thus, substitutions using consonants from the top 10 in the frequency of misuse ranking uphold the previously found frequency relationship. Error consonants are most likely to replace target consonants which occur lower in the frequency ranking.

Substitutions involving consonants from the bottom 10 in the frequency of misuse ranking were also found to maintain the trend seen in the total set of substitutions. Only 9 substitutions use a rarely misused consonant as the error phoneme. Of these, the error consonant occurs higher in the frequency ranking than the target on 5 occasions. On 4 occasions the error consonant is lower in the frequency ranking than the target. The difference fails to reach significance. This is likely to be the result of the rather small numbers involved. The group of low frequency error consonants did not differ from the set of high frequency error consonants in terms of their ability to preserve the normal frequency relationship between target and error phonology (37/46 Vs 5/9, Chi square 1.7, not significant).

The results therefore indicate that an effect of frequency exists at the level of the individual substitution errors. Consonant substitutions show a pattern whereby high frequency consonants commonly replace target consonants occurring lower in the frequency ranking.

Discussion

The group of highly target related neologisms which involve a single consonant substitution reflect a normal feature of LT's neologism production. Consonants which are used in error are likely to be those which are also commonly misused in the wider set of neologisms. The rarer consonants, which are seldom used inaccurately in the main body of neologisms, are also rarely used as error substitutions in the highly target related neologisms. This indicates that target related and abstruse neologisms share this feature of their phonology, suggesting that the processes which operate to produce abstruse neologisms are also important in the production of non words more closely related to the target. This supports the proposal that the two types of neologism arise from the same processing mechanism. It also serves to confirm the validity of the initial approach which opted to analyse non words as a single group, independent of their levels of target relatedness.

An influence of frequency has previously been found in the neologisms as a whole. Consonants used frequently in the neologisms are consonants which are also common in English real words. Moreover, levels of popularity and misuse within the neologism data correlate well. Consonants which are frequently used are also frequently misused. The current analysis demonstrates that this general influence of frequency extends to specific instances of consonant misuse. There is a strong pattern for error consonants to be of a higher frequency than the consonants which they replace. This pattern appears to apply whatever the frequency of the error consonant. Substitutions involving high frequency error consonants show a strong pattern of replacing less frequent target consonants. Lower frequency error consonants maintain this pattern, although the trend drops to below significance. The pervasive role of frequency, both as a general feature of neologistic phonology and as a factor in individual consonant substitutions must be explained by any potential theory of neologism production in LT's system.

17. Observations and conclusions from the naming data

The analyses of LT's responses to the controlled stimuli revealed significant patterns in his output.

As previously observed, LT produces very few correct responses in his naming attempts. The majority of his responses can be categorised as neologisms. LT's typical response pattern is a sequence of neologistic attempts at the target. No significant improvement has been detected in his ability to name the target stimuli correctly.

LT's output draws on some consonants more frequently than others. The different rates of use across the consonant inventory correspond closely to the normal distribution of consonants in English. This appears to be a reliable feature of LT's neologism production. The pattern persists in the responses to the controlled stimuli where this bias was absent from the target words.

Analysis of the levels of target relatedness in the selected neologisms suggests that they are constructed with reference to the target phonological representation. LT's most successful neologisms are consistently and significantly more related to their targets than can be accounted for by the effects of chance. This occurs despite the fact that the controlled stimuli and LT's responses now differ in the frequency with which they use different consonants. The responses used in the initial analysis were selectively chosen for their proximity to the target phonology. A subsequent analysis showed that when neologisms are selected at random from sequences of non word responses their level of target relatedness continues to exceed the level predicted by chance. This suggests that the ability of non words to bear a significant resemblance to the target phonology is a reliable feature of the data.

No difference was detected in the ability to realise the initial and final phonemes of the target word. Target position did not therefore appear to influence the ability to realise target consonants in neologistic responses.

Analysis of LT's optimal responses to the consonant controlled vocabulary did however reveal other, more subtle patterns of consonant use. Firstly, the level of target related use is seen to vary across the consonant inventory. High frequency consonants are more often target related than lower frequency consonants. As well as being used frequently in target related contexts, popular consonants also commonly appear in situations where they are not demanded by the target word. This lowers the proportion of their uses which are accurate. Rare consonants appear to be used more discerningly. They occur rarely in the responses and therefore have few target related occurrences. However, they are also unlikely to occur in non target related settings and hence have much higher proportions of accurate use. Thus, although these items occur relatively rarely, they are very likely to be target related on the occasions when they do appear. In summary, frequency of consonant use shows a positive correlation with the frequency of target related use but a negative correlation with the proportion of uses which are target related.

This pattern might suggest a rather indiscriminate use of the popular consonants, in fact it might have indicated that popular consonants were only ever target related by chance. Analysis of the chance levels of target relatedness of individual consonants excluded this possibility. Despite their general popularity, frequently used consonants in the genuine data typically operate at significantly higher levels of target relatedness than were found in the pseudo neologism data.

The final observation regarding consonant use in LT's neologisms concerns individual consonant substitutions. Here also phoneme frequency was found to have an effect. Overwhelmingly, consonant substitutions maintain a normal frequency relationship between the error and target consonants whereby high frequency consonants are used to replace consonants which are lower in frequency. This relationship is preserved independently of the frequency of the individual error consonant.

Chapter 2 suggested that the various accounts of neologism production offered in the literature could be assigned to four broad groups, distinguished by the relationship they propose between the phonology of the target word and the phonology of the neologism. The different types of account made differing predictions regarding the phonological characteristics of jargon output. The data obtained from LT's responses to the controlled stimuli will be reviewed for the support they lend to the different accounts of neologism production.

Non lexically derived phonology

Theories which attribute neologistic phonology to non lexical sources are the most seriously challenged by the data from LT's neologisms. These accounts, which argue that neologisms are constructed without reference to the target lexical representation, specifically predict that non words should show no greater than chance levels of similarity with the phonology of the target word. This is in conflict with the finding that LT's neologisms retain significant levels of target relatedness both generally and in the use of individual consonants. The theories are, however, consistent with the finding that the position of phonemes in the target representation fails to influence the realisation of these items in the neologistic response.

Non lexical theories of neologism production predict that no particular patterns should be evident in the way target phonology is preserved or replaced in non word phonology. The accounts are therefore unable to explain the presence of systematic patterns in the target related use and misuse of consonants. Furthermore, these patterns were found to be strongly influenced by the frequency of English consonants. Thus the theories are forced to explain how this normal language parameter influences the construction of non lexical phonology. The random phoneme generator, as proposed by Butterworth (1979), is specifically postulated to select phonemes arbitrarily from the inventory. Although the perseverative use of individual phonemes is accommodated, it is predicted that this may further move the distribution of phonemes in neologisms from the normal English distribution. The ability of the random phoneme generator model to account for the data was already challenged by the finding that the initial phonemes in LT's neologisms show strong similarities with the normal distribution of initial phonemes in English. Evidence suggesting the random selection of initial phonemes was precisely the data which Butterworth used when developing his random generator account. The investigations with the stimuli controlled for consonant content which found an influence of normal frequency both on the general use of consonants and on their patterns of accurate and inaccurate use is also specifically at odds with the predictions made by the theory. In contrast, the use of pre-coded syllable units by a random syllable generator might predict a normal frequency distribution both in the overall use of consonants and even in the distribution of initial phonemes since the syllable units may well preserve these aspects of English phonology. However, this model predicts that a frequency bias should only be present in the overall use of consonants. It is unable to account for the fact that phoneme frequency exerts further specific effects both on the ability to realise target phonology and on the construction of error phonology.

Dual impairment accounts

Theories of non word production which view abstruse neologisms as arising from a process of lexical substitution followed by phonological distortion also predict that there should be no systematic relationship between the phonology of the neologism and that of its original target. Such relationships are precluded by the fact that the phonological representation of the original item does not form the basis of the phonological distortion. Accordingly, these theories are unable to account for the greater than chance levels of target relatedness found in LT's responses to the controlled stimuli.

For the same reason, these accounts of neologism production would not predict systematic patterns in the preservation and replacement of target phonology in the neologisms. Since the accounts do not consider the lexical representation of the target item to be the phonology undergoing distortion, they do not predict that target phonology will be systematically preserved or replaced in the neologism. The theories are therefore unable to account for the patterns found in the use of individual consonants and for the effect of phoneme frequency seen at the level of individual phoneme substitutions. They are however, consistent with the finding that the position of consonants in the original target word fails to influence the ability to realise these phonemes in the non word response.

Although the accounts distance neologisms from the phonology of the original target, they do consider neologisms to arise from the distortion of lexical phonologies. They are therefore unchallenged by the finding that neologisms preserve normal English frequency weighting in their use of consonants. However, they are unable to explain the interactions between frequency of use, levels of target relatedness and proportion of accurate use.

Phonemic distortion of target phonology

A third group of theories consider neologisms to result from the phonemic distortion of the target phonological representation during the stage of phonemic encoding. The direct relationship which these models propose between the target and error phonology predicts that greater than chance levels of target relatedness may be evident in the non word responses. The theories therefore predict this feature of LT's non word data.

Basing neologisms directly on the target representation also allows for the presence of systematic patterns in the way target phonology is preserved or replaced. For instance, it is possible that some components of the target representation may be less vulnerable to errors in phonemic encoding and in particular that phoneme frequency may provide individual consonants with a degree of resistance to the process of substitution. Similarly, the high frequency of these items may predispose their use as error segments. The models are thus able to accommodate the preservation of a normal phoneme frequency distribution and the role which frequency is seen to play in the use and misuse of individual consonants.

Phonemic paraphasias resulting from a failure to maintain the target representation in a short term store while phonemic encoding is completed predict that position effects will be evident in the ability to reproduce target phonemes. However, the failure to detect such an effect in LT's neologisms does not pose a serious threat to phonemic paraphasia accounts. Other mechanisms underlying the distortion are possible, for instance the misselection of segments or the misapplication of redundancy rules. These error mechanisms do not predict the presence of position effects on the ability to realise target information, although they do leave open the possibility that a phonetic relationship will be apparent between the target and substituting phonology. This issue will be pursued in a later chapter.

Partial activation of target phonology

A final group of theories of neologism production suggest that non words arise from the failure to retrieve fully the target representation from the phonological store. The level of target relatedness seen in the neologisms is determined by the amount of target information which is successfully retrieved. These accounts therefore predict that neologisms will show greater than chance levels of similarity with the target. The direct relationship between target representations and non word output also predicts that aspects of normal lexical phonology may be preserved. The accounts therefore respond well to the finding that phonemes show a normal frequency distribution.

The process of partial access to target information can also accommodate systematic patterns in the way target phonology is preserved or replaced in neologistic output. Target information for some phonemes may be more easily retrieved from the phonological store than for others. Given that lexical frequency is known to influence the retrieval of whole word representations, it is possible that phoneme frequency may also exert an effect on the retrieval of the individual components of the phonological representation. The account therefore responds well to the finding that consonant frequency influences the appearance of target related phonology in LT's neologisms. Similarly, a retrieval advantage for high frequency consonants may predispose their use as error phonology. Where low frequency target phonology is inaccessible, higher frequency consonants may be available to operate as error phonology. The accounts can thus explain the strong effects of frequency seen in the production of error consonants both in the main body of the data and at the level of individual consonant substitutions.

Finally, the failure to detect an influence of position on the ability to realise target phonemes is also consistent with the predictions made by this group of theories.

Conclusions

The data obtained from the analyses of LT's naming responses offer the strongest support to those accounts of neologism production which propose a direct link between the phonology of the target word and the phonology of the neologism. Non lexical phonology and dual impairment accounts are not well supported by the data. In contrast, the results of the analyses are consistent with the predictions made by the partial retrieval of target phonology and phonemic paraphasia accounts of neologism production. However, the naming data is less successful at distinguishing between these two competing accounts. This is largely due to the rather similar predictions made by these theories for the phonological characteristics of neologisms. It is not therefore possible to conclusively accept or reject either of these accounts on the strength of the current data.

The data obtained from LT's naming responses indicated that the ability to realise target phonemes varies across the consonant inventory. This differential ability to realise target phonology, coupled with the differential use of consonants as error phonology should further inform the investigation of the mechanisms underlying neologism production in LT's system. Interactive activation networks might be particularly useful when investigating these processes further. These models specify more explicitly the architecture of the phonological store and the processes by which information is retrieved from this store. In particular, they typically propose a segmental level of information where nodes represent individual phonemes. In addition, the models consider that phonological information may also be distributed over a number of layers of representation, for example they may contain levels of representation corresponding to syllable, phoneme and feature information. Consequently, lexical phonological representations no longer comprise a single entry in a phonological lexicon as in serial models of language processing. Rather, they are viewed as consisting of a network of information all of which must be retrieved through the adequate activation of target nodes at differing levels of representation. Moreover, the specific processes by which this information is activated and retrieved are explicitly stated. These models should thus be particularly well suited to explaining the partial realisation of target phonological information seen in LT's neologisms. Finally, the hypothesis that the recovery of target phonological information involves more than the retrieval of a single entry from an output lexicon diminishes the importance of the pre / post lexical retrieval distinction which is a more central concern of serial models of language processing.

For these reasons, the phonological characteristics of LT's output were subsequently investigated against the predictions made by an interactive activation account of lexical retrieval. An initial and rather unspecified account was proposed in an attempt to explain the patterns of the naming data and against which to test the results of subsequent analyses. The account made certain predictions regarding how individual consonants might be influenced by an improvement in the ability to produce target phonology. These are described below.

An initial account of neologism production in LT's system

The account proposes that LT's impaired semantic level processing produces only a weak signal from the semantic system. The reduction in signal strength reduces the amount of input received by nodes at the lexical and segmental levels. The level of input may thus be insufficient for all target phoneme nodes to achieve threshold levels of activation. The account assumes that the activation of phoneme nodes is frequency biased. This provides an advantage for popular consonants in the language. These nodes require less input to reach threshold and therefore fire more quickly and easily than nodes corresponding to lower frequency consonants. These lower frequency consonants require greater amounts of input before they achieve threshold levels of activation. They are therefore only able to occur in responses where they appear in the target phonology. This provides them with stronger activation and allows them to overcome their frequency disadvantage. This would explain their pattern of relatively rare but more accurate use.

The nodes for high frequency consonants fire much more easily. They require very little input before they are able to reach threshold. This makes it is easier for high frequency consonants to occur in positions where they are target related but also in positions where they replace target consonants which are lower in frequency. This leads to the greater number of occurrences of these phonemes, as well as to their pattern of rather indiscriminate use.

The realisation of target phonemes has been discussed in relation to their ability to reach threshold levels of activation. An alternative retrieval mechanism in interactive activation models suggests that at a certain time point the most highly activated node is identified and selected. The current account does not attempt to distinguish between these two selection mechanisms and for the current purposes they will be considered as interchangeable. Later analyses provide evidence which suggest that a 'point of selection' may be a more accurate interpretation of the selection procedure for the current system.

The proposed account suggests that strengthening the input signal to the phonological level should improve LT's output in predictable ways. Firstly, the ability to activate all the component nodes of the target phonology should be facilitated. LT should therefore get more words right. The improved ability to activate target nodes should also result in an increase in the target relatedness of neologisms. Furthermore this should occur by the accuracy of consonant use being improved in a systematic way.

Rarer consonants should benefit from the stronger signal to phonology. Nodes for these consonants should more frequently receive sufficient activation to be realised in the response. However, their frequency disadvantage will continue to prevent their use in contexts other than where they are required by the target. Thus, the number of instances of these consonants will increase while retaining their high levels of accurate use. As this occurs, the number of uses of the popular consonants will decline. These are now receiving stronger competition from the rare consonants. They will be less likely to replace rare consonants in non target related contexts. Thus, a decline in their rate of use is predicted, resulting primarily from a reduction in their levels of inaccurate use. As this occurs, the proportion of uses that are target related will increase.

Four questions therefore motivated the subsequent investigations:

1. Can LT's ability to realise target phonology be influenced by manipulation of the output condition?

2. Does this support the hypothesis that the realisation of target phonology is normally hampered by the presence of a weak semantic signal?

3. How does this influence the patterns of consonant use observed in the naming data?

4. Are these changes consistent with predictions made by the current account of neologism production?

One group of neologisms or two?

It was anticipated that the discovery of an output condition which facilitated LT's ability to realise target phonology might serve to resolve a further issue regarding his non word output. The classification system used for the naming data categorised all non word items as a single group. This approach ignores the possibility that target related and abstruse neologisms may in fact be qualitatively different, arising from separate processing mechanisms. The alternative view considers all non word production to arise from the same processing mechanism, with non words lying along a continuum of target relatedness. Two findings from the naming data lend support to the latter interpretation.

Analysis of both the Palpa naming responses and the initial naming trial with the controlled stimuli showed that neologisms, selected at random from LT's sequences of non word responses, maintained greater than chance levels of similarity with the target phonology. This greater than chance level of target relatedness in arbitrarily selected neologisms suggests that the feature is present throughout the non word data and is not an artefact of the preferential use of LT's most successful output. This being the case, even apparently abstruse responses would appear to be constructed with reference to target phonology. Since this mechanism must be proposed for the production of highly target related neologisms, the result suggests that the two groups of non words may share this method of construction.

Investigation of the consonant substitutions further supported this view. The substitution analyses found that both highly target related neologisms and more abstruse non words show a preferential use of high frequency consonants as error consonants. This agreement between the target related and abstruse responses in the nature of their error phonology suggests that in each case the error consonants may be derived from the same source or mechanism. The target related and abstruse neologisms may therefore represent a single population of non words. If a single mechanism underlies all neologism production then target related and abstruse neologisms can be considered as lying along a continuum of target relatedness.

Further support for this hypothesis would be obtained by showing that the accuracy of non word production can be moved along this continuum. This would require the detection of an output condition which facilitated LT's ability to realise target phonology. Two effects of the task would be needed to support the continuum hypothesis. Firstly, correct responses should become more frequent. This would represent the increased accuracy of target related neologisms, such that they often become completely correct realisations of the target lexical representation. The remaining neologisms, those responses which might be attributed to an alternative processing mechanism, should also show an increase in their level of target relatedness. This would indicate that they have now become more successful approximations of the target phonology. Thus both target related and abstruse neologisms would be demonstrated to move along the continuum of target relatedness. This would support the proposal that both types of non word output arise from the same processing mechanism and therefore represent a single group of responses, distinguished only by quantitative differences in the amount of target phonological information they realise. In contrast, the finding that only LT's more successful responses move nearer to the target phonology would support the claim that two distinct groups exist in the non word data. In this case, responses which are based on target lexical phonologies should become more accurate. This would predict an increase in the number of correct responses. Neologisms arising from a separate processing mechanism should show no increase in their levels of target relatedness in the new condition.

Identifying an output condition which facilitated LT's ability to realise target phonology should thus also serve to resolve this issue.

18. Improving access to stored phonological information

The ability to realise stored phonological representations may be facilitated by the external provision of additional information regarding the target word. This additional information may take a number of forms, for instance phonological cues such as first phoneme information or semantic cues. Alternatively, target phonology may be more successfully realised in response to a written stimulus. The potential for each of these approaches to improve LT's ability to realise the phonology of the target word was investigated.

Semantic Cues

It has long been known that the external provision of semantic information may prompt aphasic naming (Rochford and Williams 1962) although the effect may be less powerful than the provision of phonological information (Rochford and Williams 1962, Myers Pease and Goodglass 1978). Other studies have indicated that tasks which require the subject to access the semantic representation for the target item may significantly prompt immediate naming and facilitate word retrieval for up to 24 hours (Howard, Patterson, Franklin, Orchard-Lisle and Morton 1985a).

A semantic level impairment was indicated by LT's performance on a number of the initial assessments (see Chapter 4). It was therefore possible that the provision of additional semantic information might strengthen the input signal to the phonological level and thus improve his ability to realise the target representation. However, observation of LT's responses to semantic cues suggested that this was not the case. Spoken semantic information supplied by the examiner was occasionally useful for making the identity of the intended target clear, for instance when LT produced a phrase in response to a stimulus picture. However, on the majority of other occasions semantic cues were met with irritation. In these instances LT's comments appeared to communicate that he was aware of the information being supplied. On other occasions semantic information was accepted but did not result in more successful output.

Phonological Cues

The provision of information about the initial phoneme or initial phoneme and first vowel has also been noted to facilitate the immediate production of target phonology in aphasic speakers with impairments at a number of different stages in output processing (Howard and Orchard-Lisle 1984, Kay and Ellis 1987, Bruce and Howard 1987, Best, Howard, Bruce and Gatehouse 1997).

The ability of speakers to utilise such cues relies on their being able to process the auditory information provided. LT shows a considerable impairment in his processing of phonological input, as demonstrated by his poor performance on minimal pair judgement tasks (see Chapter 4). The severity of LT's processing impairment at this level is likely to preclude the use of the phonological information to support spoken naming. This is confirmed by informal observation of his responses to such cues. They appear to be ineffective in improving his ability to realise the target output phonology. The effectiveness of phonological cues is not increased by encouraging LT to attend to the lip reading information accompanying the auditory cue.

Alternative access routes

A number of aphasic speakers show superior reading aloud to naming performance (Marshall, Pound, White-Thomson and Pring 1990, Best et al 1997). This may occur for a number of reasons.

In some speakers reading appears to be achieved by the sublexical construction of output phonology using grapheme to phoneme conversion rules (Kay and Patterson 1985). Other speakers fail to exhibit the regularity effects in reading aloud which this process predicts. In these speakers target phonological representations may be more easily accessed via direct lexical connections from the written input system (Howard and Franklin 1987, Coslett 1991).

The availability of either of these alternative procedures for producing spoken output from written stimuli may allow reading performance to be superior to spoken naming. In addition, Hillis and Caramazza (1995) suggest that where these procedures are themselves impaired, partial information from each may interact to facilitate reading aloud. This proposal raises the possibility that partial information from either route may interact with the weak input from the semantic system to support LT's access to target representations in the phonological output lexicon.

The potential of the written word form to facilitate LT's ability to realise target phonological information was investigated through a series of reading tasks.

19. Investigation of reading skills

A number of tasks investigated LT's ability to read aloud single words. These aimed to identify the processing mechanisms underlying his reading aloud and to investigate the potential for written information to facilitate the realisation of target phonological information.

Reading aloud single words

The 40 items from the Palpa picture naming assessment were presented in written format for LT to read aloud. His performance was compared with the five picture naming trials presented in Chapter 4 (see Table 4.1).

LT read aloud 11/40 items correctly. This performance is significantly better than his picture naming performance ($z = 2.83$, $p < 0.01$).

The result identified that the availability of written stimuli can facilitate the realisation of target phonological information. However, the effect is rather weak and the possibility remained that LT's performance could be further facilitated.

Regularity effects in reading aloud

LT was asked to read aloud the 60 items in Palpa Subtest 35. This task investigates the influence of word regularity on reading aloud. LT scored poorly on the task, producing only 6 correct responses. LT's performance did not reveal a difference between regular and irregular word reading (Chi square 0.18, not significant), although this may arise from the very small numbers involved.

The results are shown in the second row of Table 19.1

Semantic priming and reading aloud

A subsequent task investigated the influence of semantic priming on LT's reading aloud. The 60 regular and irregular words (Palpa subtest 35) were presented in the following

Table 19.1 Performance on reading aloud tasks using stimuli from Palpa subtest 35

Reading Condition	Total number of correct responses	Number of regular items read correctly	Number of irregular items read correctly
Reading aloud	6/60	4/30	2/30
Semantic decision + read aloud	28/60	15/30	13/30

condition. Each written stimulus was presented with a written synonym and antonym. Where this was impossible, for example where no direct synonym or antonym for the target exists, the item was presented with a word which was close in meaning to the target and another which was more distant. Examples of the stimuli used are given below.

	Palpa stimulus	Antonym or word distant in meaning	Synonym or word close in meaning
(i)	TAKE	REPLACE	REMOVE
(ii)	MORTGAGE	GIFT	LOAN

The stimulus word was written at the beginning of the line, followed by the synonym and antonym. The order of presentation of the later two items varied. LT was asked to underline the word closest in meaning to the first word and read the stimulus aloud. The task was completed over two sessions.

As always LT produced many responses during the activity. For instance each of the three written words were read aloud several times while the semantic component of the task was being completed. This made it difficult during the transcription process to establish with certainty the identity of the target word for each production. Since the responses were recorded on digital audio tape, eye pointing information was not available. In order to ensure that only genuine attempts at the 60 target words were included in the analysis only LT's first and last response to each item were considered. LT commenced each test item by reading across the line of three words, since the stimulus word was the first item in each line his first spoken response could therefore be reliably identified as an attempt to produce this target. After selecting and underlining the synonym (or most closely related word) LT was asked to read the stimulus again. This was done because it was anticipated that any priming effect of the task might not be present until after the selection of the synonym.

LT's attempts to read the stimulus words aloud were transcribed and the number of correct responses recorded. The results are shown in the third row of Table 19.1. LT correctly read aloud almost half of the stimuli in the new condition. This performance was significantly better than the unprimed reading aloud condition, see row 2, Table 19.1 (McNemar Chi square 18.1, $p < 0.001$).

The improved level of performance allowed analysis of the effects of word regularity on LT's ability to read aloud. No significant difference was found between the number of regular and irregular items read aloud correctly (Chi square 0.07, not significant).

LT's ability to correctly identify the synonym for the stimulus word and the relationship between this and the correct production of the target is shown in Table 19.2. LT correctly identified the synonym or word closest in meaning to the stimulus for 43/60 items. While this a significantly better performance than is predicted by chance (Chi square 10.4, $p < 0.01$) it is not as successful as might be predicted, given the large increase seen in LT's reading aloud.

Table 19.2 Correct selection of the synonym and correct responses in the semantic decision + read aloud task

	Correct synonym selection	Incorrect synonym selection	Total
Correct production of the stimulus word	21	7	28
Incorrect production of the stimulus word	22	10	32
Total	43	17	60

On first sight there appeared to be a relationship between the correct selection of the synonym and the correct reading of the stimulus. Correct responses are more likely to be associated with a correct selection than an incorrect one. However, it is likely that this result arises from the fact that there are more correct selections in the sample than incorrect ones. When the number of responses which are correct following each selection type are compared, no difference is found between the groups. Correct and incorrect selections are equally likely to prompt a correct reading of the stimulus word (Chi square 0.08, not significant).

This result brought into question the nature of the semantic prime provided by the task. To investigate this further the correct responses were marked as to whether they were produced before or after selection of the synonym. 18 items were read correctly before the selection was made, i.e. at the point of LT's first read across the line of words. 19 items were read correctly after the selection, giving a total of 28 items read aloud correctly on at least one occasion during the task. 9 items were read aloud successfully both before and after the selection. The result indicates that the priming effect of the task is present before the semantic decision is made. LT's first attempt at reading the stimuli is significantly better than his performance in the earlier reading task (6/60 Vs 18/60, McNemar Chi square 7.6, $p < 0.01$). The actual process of selecting the synonym does not enhance reading performance further, performance before and after the selection of the synonym being stable. These results argue against the potential criticism that LT's reading aloud improves because the condition provides him with two opportunities to produce the target word correctly, i.e. before and after the selection is made.

The results show that presenting written stimuli in the context of a semantic decision improves LT's ability to read the items aloud. Both regular and irregular stimuli benefit from being presented in this condition. This argues against the presence of a contribution from sublexical processes and is consistent with the conclusion that the task facilitates the retrieval of lexical phonological information following access via the semantic system. A potential involvement of direct lexical connections is not excluded. However, the fact that the semantic task increases the advantage shown in reading aloud for realising target phonological information identifies that semantic processing must be involved.

LT demonstrates a greater than chance ability to identify correctly the synonyms for the stimuli. This supports the claim that he is able to access some semantic information from written lexical representations. Nevertheless, LT makes many errors on this aspect of the task, suggesting that he frequently fails to process the semantic information accurately. This contrasts with the considerable benefit which the semantic decision appears to offer to phonological output processing. The precise nature of the priming effect offered by the condition is therefore difficult to discern. Correct and incorrect synonym selections are equally likely to result in the correct production of the target word and correct production of the target word is as likely to occur before the synonym is identified as after this selection is made.

These results therefore exclude a number of possible explanations for the nature of the priming effect. It is not possible to argue that a correct selection is necessary to boost the strength of the semantic information reaching the phonological system. This would require correct selections to be better able to prompt correct productions than incorrect selections. The finding that correct productions are no more frequent after the selection than before also argues against the theory that the decision itself primes semantic processing and (independent of whether a correct decision is made or not) improves access to the phonological output lexicon. This account would require performance after the selection to be greater than before, and performance before the selection to be comparable with the level seen in the plain reading aloud task. It seems, rather, that either the context of the semantic decision or the presence of semantic associates serves to improve the production of output phonology. These possibilities suggest that the semantic condition produces some form of increase in the processing undertaken at the semantic level. This results in a stronger semantic signal being supplied to the phonological level and facilitates the realisation of the target phonological representation.

Discussion

The investigations produce a number of conclusions regarding LT's reading performance. Reading aloud shows an advantage over naming. However, the effect is rather weak and performance is so low that it would not be possible to detect effects of regularity. The presentation of written stimuli in the context of a semantic decision produces a further significant improvement in LT's ability to realise target phonological information.

It seems that the semantic task improves reading aloud by strengthening the semantic to phonological signal. This is consistent with the known impairment of verbal and non verbal semantics indicated by auditory and written comprehension tasks and by the Pyramid and Palm Trees assessment. The result supports the suggestion that in the normal course of events, the realisation of target phonological information may be hampered by the presence of a weak semantic signal.

The results of the reading assessments are informative regarding the processing underlying LT's reading aloud. The positive effect of semantic priming suggests that LT is carrying out the reading tasks using the semantic reading route. Use of direct lexical connections alone would preclude the advantage of semantic priming, since this route does not require the retrieval of semantic information prior to accessing the phonological level. Of course, it is possible that LT reads aloud using a combination of input from both the semantic and direct lexical routes. The semantic task may then facilitate LT's reading by improving the strength of the contribution made by the signal from the semantic system while the orthographic information supports direct access to phonological information. Nevertheless, an input signal from the semantic system is identifiably involved in LT's reading aloud.

LT's partial (if not complete) reliance on the semantic route for reading aloud means he is accessing phonology via the same mechanism as when naming. Both tasks utilise an input signal from the semantic system. This allows direct comparisons to be made between production of phonology in semantically primed reading tasks and the production of phonology in naming tasks. Patterns of phonology found in primed reading responses should reflect the patterns seen in LT's naming performance. The improved ability to realise target phonology in the primed reading condition also allows the predictions made for the behaviour of individual consonants to be tested.

20. Select and name task with the consonant controlled vocabulary

A task was required which involved the production of the consonant controlled stimuli in a semantically primed reading condition. The use of the controlled stimuli would allow more detailed investigation of the specific effects of the output condition on LT's ability to realise target phonology. In particular, this would permit the production of individual consonants to be examined for changes in their pattern of use. Thus the predictions made on the basis of the naming data could be tested.

A semantically primed reading task of the type described in the previous chapter could not be employed with the consonant controlled vocabulary since these stimuli consisted largely of concrete nouns where no synonym or antonym existed. A select and name task was therefore devised. Each picture stimulus was presented accompanied by two written words on separate cards. These were the target picture name and a semantically related distracter. For instance the picture stimulus for goose was presented with the correct name and the semantic distracter 'swan'. LT was required to place the target name with the picture before reading or naming the target. The design of the task ensured that the identity of the written word selected by LT was revealed to the presenter.

Select and name task with the Palpa stimuli

The potential of the condition to improve LT's output was examined with a pilot trial using the 40 Palpa picture naming stimuli. The task was presented as described. LT's performance was compared with the five picture naming trials for the same stimuli (see Table 4.1).

LT produced 17/40 target words correctly in the select and name condition. This reflects a dramatic improvement when compared with his picture naming performance ($z = 5.13$, $p < 0.0001$).

Two subsequent investigations confirmed that the semantic decision and the written target combine to create the facilitatory effect of the condition.

The first task investigated the potential of the semantic decision alone to improve output processing. The target picture was presented together with an associated written word and a semantically related written distracter. For example, the picture stimulus lemon was presented with the written stimuli 'gin' and 'wine'. LT was asked to place the correct associated word with the picture and then attempt to name this item. LT named 5/40 pictures correctly. This was significantly worse than his performance in the select and name task (McNemar test Chi square 6.7, $p < 0.1$).

A further task eliminated the decision component of the task while retaining the availability of the written target. Picture stimuli were presented together with their written names and LT was asked to produce the targets. Again his performance was significantly worse than in the select and name condition (8/40, McNemar test Chi square 4.3 $p < 0.05$).

The results indicate that the semantic decision and the availability of the written target combine to produce the significant effect of the select and name task. When either of these elements is removed, LT's ability to produce the target picture names is significantly reduced. In contrast, the select and name task significantly facilitates LT's ability to realise target phonology. This finding is consistent with the previous suggestion that together, the availability of the written stimuli and the increased semantic processing provide a stronger signal to the phonological level. The precise nature of the facilitatory effect offered by the select and name task is discussed in more detail in Chapter 27. In the meantime, the results indicated that the select and name task improved LT's ability to realise target phonology. The task could now be applied to the stimuli controlled for their use of consonants, allowing investigation of the effects on the patterns of individual consonant use.

Select and name task with the consonant controlled vocabulary

The select and name task was carried out with LT using the 47 items controlled for their consonant content on ten occasions between June and July 1996. The repeated presentations of the task might have led to LT becoming familiar with the distracter items used. This could potentially reduce the amount of semantic processing he was required to engage in when selecting the correct written word and so lessen the positive effect of the condition. To prevent this from occurring four different sets of distracter items were used. Each followed the same principle of providing a semantically related distracter to the target picture name. For example, the four distracter items for the stimulus picture goose were swan, duck, flamingo and chicken. The distracter items were controlled only for their semantic relationship to the target. Since the semantically primed reading condition does not rely on sublexical processing neither the target picture names nor the semantic distracters were controlled for word regularity. As before, LT was required to place the correct written name with the picture and then produce the target name. Incorrect selections of the distracter name occurred on only four occasions across the ten trials. On no trial was there more than a single instance of an incorrect selection, and no item was wrongly identified more than once over the ten trials. Incorrect selections were indicated to LT and on each occasion he subsequently associated the correct written name with the picture and attempted to name the item. Approximations of the target after a corrected misselection were admitted to the subsequent analyses. Responses produced prior to the correction were excluded. For all other items, where the correct written name was associated with the picture, all responses to the item were included in the analyses, i.e. those produced both before and after the selection was made. This strategy was adopted following the finding in the previous chapter that priming effects are present both prior to and following the semantic decision. LT's responses during the task were recorded on digital audio tape and transcribed using broad phonemic transcription. LT's typical approach to the task was to remove the card displaying the distracter before placing the written target next to the picture and attempting to produce this item. On other occasions, productions of the distracter as this item was rejected were accompanied by rather scornful intonation or preceded by a real word such as 'not'. This ensured that the transcribed responses could be reliably identified as approximations of the target stimulus. Initially, these responses were analysed only for the number of items which were correctly named. The results are shown in Table 20.1.

LT's naming of the stimuli was consistently higher than in the picture naming condition, although in both conditions the level of performance shows some variability. The two sets of results (picture naming Vs select and name) were compared using an independent t test. This gave a highly significant result ($t = 7.53$, $df = 18$, $p < 0.001$).

LT is therefore significantly better at producing the target names in the select and name condition than when just naming the pictures. The ten trials provide a total of 470 naming

Table 20.1 Correct responses in the select and name task with the consonant controlled stimuli

Date of sample	Distracter set used	Number of items correctly named
10.6.96	1	12
17.6.96	1	12
19.6.96	2	16
24.6.96	2	11
26.6.96	3	13
1.7.96	1	12
10.7.96	3	16
17.7.96	4	16
29.7.96	4	12
31.7.96	2	13

opportunities in each condition. In the naming task LT produced 69 items correctly over the ten trials. In the select and name condition this rises to 133 items produced correctly.

The previous naming opportunities with the consonant controlled vocabulary had shown no improvement with familiarity across the ten naming trials (see Chapter 9). The select and name task, which improved LT's naming performance on a trial by trial basis, might have been more likely to show positive, long term effects of the priming. Analysis with a Mann test showed this not to be the case. There was no significant improvement in naming performance across the ten select and name trials (S = 7, not significant).

Discussion

LT was very successful at selecting the target picture name from the choice of two written words, making only four errors across the 470 items in the ten trials (99% success rate). This performance appears to be better than his selection of the synonyms in the primed reading task presented in the previous chapter. In this task LT correctly selected 43/60 synonyms (72%). The fact that a semantic task which LT performs very easily nevertheless offers a significant benefit to phonological retrieval supports the previous argument for a general increase in the processing undertaken at the semantic level.

LT's superior performance on the semantic task in the select and name condition may arise from the nature of the stimuli used. The stimuli in Palpa Subtest 35 contain a number of rather abstract items, for example 'context', 'sure' and 'effort'. In contrast, the controlled stimuli were originally designed for a picture naming assessment. This resulted in the preferential selection of concrete items. This may have facilitated their processing at the semantic level, giving LT a greater rate of success in the selection component of the select and name task. However, as discussed in Chapter 4, imageability has not been demonstrated to have a significant effect on LT's performance in other tasks. An alternative proposal suggests that the difference arises from the fact that the select and name task requires LT to process only two written stimuli, the target and the semantic distracter. The semantically primed reading condition involved three written stimuli which may have increased the processing demands of this task. Interestingly, the increased semantic processing in the earlier reading task may have offered a greater advantage to the ability to realise target phonology. LT read aloud correctly nearly half of the stimuli (47%). The select and name task appears to be rather less efficient at prompting correct responses. Here 28% of stimuli are produced correctly. This may suggest that reducing the semantic demands of the task diminishes the facilitatory effect on the ability to realise target phonology. This lends further support to the hypothesis that the strength of the signal received from semantics directly influences the ability to realise target phonology. The results also suggest that a modification of the condition which increased the complexity of the semantic task might result in a further improvement in LT's ability to produce correctly the target words. The role of semantic processing in the select and name task is investigated in more detail in Chapter 27.

As predicted, the selection of the written target name facilitates LT's ability to realise the phonology of the target items. This is indicated by a significant improvement in the number of correct responses. Disappointingly from a therapeutic perspective, the effect appears to be short lived. There is no progressive improvement across the select and name trials despite the fact that these occurred in close proximity to each other, the ten trials occurring over a period of eight weeks. The absence of any cumulative effect of the select and name task may indicate that the stimulated increase in semantic processing is subject to rapid decay and therefore has no effect across trials. Alternatively, the processing may be item specific so that increasing the processing for one stimulus has no carryover effect for the subsequent target in the trial. Both of these accounts suggest that the procedure may have only a limited therapeutic application.

The improved ability to realise target phonology in the select and name task is demonstrated by the significant increase in the number of items correctly named. Given the severity of the impairment seen in LT's output, completely correct responses represent an extreme level of success. They are the most successful output possible by the system. Their increased numbers in the new condition suggest that other, more subtle improvements may also be apparent in LT's output. For instance, it might be anticipated that the condition has also increased the degree of target relatedness of non word responses and has encouraged more target focused use of individual consonants. The presence of these more subtle changes in LT's spoken output was investigated through the analysis of his use of individual consonants. These issues are pursued in the following chapters.

21. Levels of target relatedness in the select and name responses

The investigation of consonant production in responses to the controlled stimuli requires the analysis of a single response to each item. As in previous tasks, LT produced several attempts at each target during the select and name assessments, thereby removing the equality in the number of times each consonant is targeted. To remove this imbalance, one response to each stimulus was selected. This was done using the procedure employed for selecting responses in the naming data (see Chapter 10). A correct response was selected as the response of first choice. Where no correct response was produced, the most target related neologism was selected. When two neologisms were equally close to the target, the shorter item, occurring earlier in the sequence of responses was chosen. Semantic errors or semantic + phonological errors were only selected where no neologism was available; semantic errors were chosen in preference to semantic + phonological errors. As discussed before, this procedure provides a view of LT's optimal output but offers the best opportunity for discerning patterns of consonant use in the data. Table 21.1 shows the selected responses for each select and name trial. A total of 133 correct responses and 336 neologisms were selected for analysis. One stimulus elicited only a semantic error. This was excluded from the subsequent analyses although (as in the naming data) the target consonants it contained were still considered to have had the full 40 opportunities to be realised. The decrease in the number of semantically based errors in the selected responses reflects the fact that very few of these type of errors were produced during the task, a total of 7 semantic errors and 6 semantic + phonological errors in response to the 470 items over the ten select and name trials. This provides further evidence for the increased semantic processing occurring during the select and name task.

The corpus of selected correct responses and neologisms was initially examined for the level of target relatedness it showed.

<u>Number of scored consonants realised in select and name responses</u>

Each selected response was analysed for whether it contained the scored consonants of the target word. As in the naming data, each realisation of a target consonant was identified as occurring either in a correct response, ✓C, or in a neologism, ✓N. Target

Table 21.1 Selected responses in the ten select and name trials

Date of trial	Correct responses	Neologisms	Semantic error	Semantic + phonological error
10.6.96	12	35	0	0
17.6.96	12	35	0	0
19.6.96	16	31	0	0
24.6.96	11	36	0	0
26.6.96	13	34	0	0
1.7.96	12	35	0	0
10.7.96	16	31	0	0
17.7.96	16	30	1	0
29.7.96	12	35	0	0
31.7.96	13	34	0	0

consonants which failed to appear in the selected neologism were marked as XN. The two consonants which failed to be realised because the only response to the stimulus was a semantic error were marked as XSE.

The results of the analysis are shown in Table 21.2. The number of occasions that each consonant is realised in a correct response or neologism are shown in the second and third columns. Column Four sums these figures and shows the total number of times each consonant is correctly realised in the ten select and name trials (✓C + ✓N). The fifth column shows the number of occasions a target consonant fails to appear in the selected neologism. The two consonants which fail to be targeted owing to the production of a semantic error are indicated in the sixth column.

Table 21.2 shows that 623 of the 940 scored consonants are realised in LT's selected responses to the stimuli. This compares with a total of 448 consonants correctly produced in the picture naming trials (see Table 13.1). The numbers of correctly realised consonants in each condition were compared with a Chi square test. The improvement in LT's ability to realise target consonants in the ten select and name trials is highly significant (Chi square 65.7, $p < 0.001$). Target consonants are thus more likely to appear in responses in the select and name condition than in the picture naming condition.

Table 21.2 Analysis of the ability to realise consonants in the selected responses in the select and name data

Consonant	✓C	✓N	✓C +✓N	✗N	✗SE
p	15	19	34	6	0
b	17	9	26	13	1
t	8	24	32	8	0
d	12	12	24	16	0
k	9	28	37	3	0
g	18	14	32	8	0
f	6	4	10	30	0
v	7	16	23	17	0
θ	17	8	25	15	0
ð	15	10	25	15	0
s	13	21	34	6	0
z	6	29	35	5	0
ʃ	14	11	25	15	0
ʒ	3	2	5	15	0
h	0	8	8	32	0
tʃ	9	17	26	14	0
dʒ	17	10	27	13	0
m	20	11	31	9	0
n	12	18	30	9	1
ŋ	18	18	36	4	0
r	7	21	28	12	0
w	12	13	25	15	0
l	2	25	27	13	0
j	7	11	18	22	0
Total	264	359	623	315	2

The significant improvement in the ability to realise consonants in the select and name task may arise solely from the fact that more completely correct responses are found in this condition. Thus, although the number of completely correct responses is increased, the accuracy of non word responses may have remained static. The ability of non word responses to realise target consonants was therefore examined separately.

311 consonants were correctly realised in neologisms in the naming data (see Column Four, Table 13.1). In the select and name data this figure rises to 359. Neologisms form a smaller proportion of the selected responses in the select and name data owing to the increase in the number of correct responses. The number of correctly realised consonants was therefore analysed in relation to the number of target consonants in the stimuli which elicited non word responses in each condition.

Table 21.3 shows that 750 consonants were targeted by the stimuli eliciting neologisms in the naming data. Of these, 311 were realised in the non word responses. Stimuli eliciting non word responses in the select and name condition targeted 674 scored consonants. Of these, 359 were realised in the neologisms. The difference is significant (Chi square 19.5, $p < 0.001$).

Table 21.3 The realisation of target consonants in selected neologisms in the naming and select and name conditions

	Naming data	Select and name data
Number of stimuli eliciting a neologism as the selected response	375	336
Number of scored consonants targeted by these stimuli	750	674
Number of scored consonants realised in the selected neologisms	311	359

The result shows a marked increase in the ability to realise target consonants in non word responses. The new condition has therefore facilitated a significant increase in the accuracy of non word output as well as increasing the number of completely correct responses.

Genuine and chance levels of target relatedness of neologisms

Changes in the overall level of target relatedness of neologisms were examined through the random reallocation of responses to targets. This investigates the target related use of all phonemes rather than restricting the analysis to consonants.

The reallocation method used with the naming data and described in Chapter 11 was applied to the corpus of selected neologistic responses from the select and name data. Each select and name trial was analysed separately. Neologisms were first compared to their genuine targets for the number of target related phonemes they contained. The scoring protocol used in Chapter 11 was applied. Neologisms were then randomly reassigned to targets and the number of target related phonemes in the pseudo neologisms counted. The reassignment procedure reallocated neologisms to their original target on only ten occasions, no more than once in each sample. These items were left in the analysis. The numbers of genuine and pseudo target related phonemes in each trial were compared using a Chi square test. The results of the analysis are shown in Table 21.4.

Table 21.4 reveals that in each trial the number of genuinely target related phonemes in the neologistic responses significantly exceeds the number which could be expected to occur by chance. Given the increased accuracy of consonant use already demonstrated, it is unsurprising that this investigation replicates the finding from the naming data that LT's selected neologisms are significantly more related to the target phonologies than chance predicts.

The analysis showed that the selected neologisms contained a total of 1276 phonemes (consonants and vowels). Selected neologisms in the naming data contained a total of 1442 phonemes. However, the naming data contained more selected neologisms than the select and name data; 375 of the 470 selected responses in the naming data were neologisms whereas non words accounted for only 336 of the selected responses in the select and name data. These figures indicate that LT's non word responses in the select and name task have become more target related without becoming longer.

Table 21.4 Results of the randomisation exercise with the selected neologisms from the select and name trials

Date of select and name trial	Number of items analysed	Total number of phonemes in the selected neologisms	Number of target related phonemes in the selected neologisms	Number of target related phonemes in the pseudo neologisms	Result of comparison with Chi square analysis $p < 0.001$
10.6.96	35	132	51	7	40.9
17.6.96	35	140	59	11	42.1
19.6.96	31	119	50	17	21.3
24.6.96	36	132	50	10	32.8
26.6.96	34	139	64	13	44.9
1.7.96	35	134	61	7	55.4
10.7.96	31	106	59	8	54.6
17.7.96	30	105	51	9	39.2
29.7.96	35	141	70	14	51.3
31.7.96	34	128	59	18	29.7

Discussion

The current investigations indicate that the facilitatory effect of the select and name task goes beyond an increase in the production of completely correct responses. Analysis of the selected neologisms showed a significant improvement in the ability to realise the consonants of the target words. The select and name task therefore increases the accuracy of non word output as well as increasing the ability to produce correct real word output.

The classification system used to date has assumed that neologisms form a single population, all non words being assigned to the same category. As discussed in Chapter 17 there were certain concerns with this. It was possible that two groups of non words exist, responses which are based on attempts to realise lexical phonology and other neologisms which may have a different processing source. The finding that both target related and abstruse neologisms benefit from the new output condition argues against this. It seems that neologisms exist as a single population lying along a continuum of target relatedness. In the select and name condition non word responses shift along this continuum. Neologisms which were already highly target related become more so and in a number of cases become completely correct realisations of the target representation. This accounts for the increased number of correct responses produced in the new condition. This is not the only change seen in the select and name data. The remaining non word responses also show an increase in accuracy, becoming more highly target related. This supports the view that abstruse neologisms are also attempts to realise target phonology and can therefore benefit from the facilitation priming offered by the new condition. This identifies a single processing mechanism underlying all non word production and supports the view that non words represent a single group of responses.

Buckingham and Kertesz (1976) and Buckingham (1977) argue that neologisms fail to show a continuum of target relatedness, but tend rather to polarise into groups of abstruse neologisms and phonological paraphasias. These authors used this evidence to criticise phonemic paraphasia accounts of neologism production. They argued that the possibility for phonemic distortions to occur with varying degrees of severity would predict that neologisms should show a range of target relatedness. Although this criticism was directed at phonemic paraphasia accounts of neologism production, explanations which rely on the partial activation of target phonology make the same prediction. In fact Buckingham (1990) restated the argument when questioning the ability of interactive activation models to explain neologism production satisfactorily. The current results identify that the investigated neologisms do exist along a continuum of target relatedness. These findings counteract the criticisms offered by Buckingham. Moreover, the finding that the accuracy of non word output can be moved along the continuum counteracts a further criticism offered by Buckingham (1987, 1990). He argues that although phonemic paraphasia and interactive activation accounts expect neologisms to become increasingly target related as output function recovers this is rarely demonstrated by the data. Thus the findings provide additional support for those theories of neologism production which predict a continuum of target relatedness to be evident in non word output.

Specific predictions for changes in the behaviour of individual consonants were made when discussing the naming data (see Chapter 17). The finding that the select and name task improves the accuracy of neologism production allows these predictions to be tested.

The following chapter therefore investigates the influence of the new condition on the behaviour of the individual consonants.

22. Patterns of consonant use in the select and name data

The selected responses (correct responses and neologisms) were analysed for the consonants they contained. This allowed investigation of the effects of the select and name task on the production of individual consonants. Comparison with the results of the analysis of the naming data investigated whether the general improvement in the ability to realise target phonology had influenced the use of consonants in the predicted ways.

The selected responses were initially analysed for their target and non target related uses of consonants. This was done using the approach adopted in the naming data (see Chapter 13), allowing direct comparison between the two conditions. The results of the initial analysis are shown in Table 22.1. The columns are as follows:

Column Two	gives the total number of times each consonant occurs in the selected responses, independent of whether these were target related uses or not
Column Three	represents the number of times in the sample that the consonant is realised correctly in a response (correct response or neologism). This is ✓C + ✓N from Table 21.2
Column Four	shows the proportion of occurrences of the consonant that are target related, i.e. $\frac{\text{column three}}{\text{column two}}$
Column Five	is the number of occasions that the consonant occurs when it is not demanded by the target, that is the total number of non target related occurrences of the consonant, i.e. column two - column three
Column Six	gives the percentage of the set of unrelated consonants that each consonant represents,

$$\text{i.e.} \quad \frac{\text{no. of times consonant is unrelated}}{\text{total number of unrelated consonants}} \times 100$$

$$\text{or,} \quad \frac{\text{column five}}{\text{total for column five}} \times 100$$

Frequency of use across the consonant inventory

The calculation of the second column in Table 22.1 allows the popularity of individual consonants to be investigated. This is the total number of occasions each consonant appears in the selected responses, independent of whether these are target related uses or not. Column One in Table 22.2 shows the consonants ranked in order of their frequency of use.

The frequency ranking shows that consonants continue to be used unequally in the selected responses in the select and name data. To establish that the bias in consonant use continues to be based on the normal phoneme frequency of English real words, the ranking of consonants in the select and name responses was compared to the normal distribution of consonants (Denes 1963). This frequency ranking is shown in Column Two of Table 22.2. The two rankings were compared using a Spearman's correlation. A significant, positive correlation was found, rho (24) = 0.482, $p < 0.05$.

Despite the highly significant correlation, a number of exceptions occur in the correlation between LT's use of consonants in the new condition and the normal distribution of consonants in English. To investigate the consistency in LT's use of consonants the ranking for the frequency of consonant use in the select and name task was compared to the ranking found in the naming data. The frequency ranking for consonant use in the naming data is given in the third column of Table 22.2. The rankings were compared with a Spearman's correlation, revealing a particularly strong correlation; Spearman correlation is rho (24) = 0.769, $p < 0.001$.

The analyses found that LT's responses in the select and name data continue to show a bias in his use of consonants. The positive correlation with the normal ranking of consonants in English indicates that LT's use of consonants continues to be influenced

Table 22.1 Patterns of consonant use in the selected responses in the select and name data

Consonant	Total number of times the consonant occurs	Number of times the consonant is target related	Proportion of occurrences that are target related	Number of non target related occurrences	% of group of unrelated consonants this item represents
p	49	34	.69	15	4.0
b	39	26	.67	13	3.5
t	76	32	.42	44	11.8
d	34	24	.71	10	2.7
k	77	37	.48	40	10.7
g	39	32	.82	7	1.9
f	29	10	.34	19	5.1
v	39	23	.59	16	4.3
θ	28	25	.89	3	0.8
ð	27	25	.93	2	0.5
s	67	34	.51	33	8.8
z	54	35	.65	19	5.1
ʃ	46	25	.54	21	5.6
ʒ	6	5	.83	1	0.3
h	15	8	.53	7	1.9
tʃ	40	26	.65	14	3.7
dʒ	30	27	.90	3	0.8
m	31	31	1.0	0	0
n	56	30	.54	26	7.0
ŋ	40	36	.90	4	1.1
r	45	28	.62	17	4.5
w	33	25	.76	8	2.1
l	55	27	.49	28	7.5
j	42	18	.43	24	6.4
Total	997	623		374	100

Table 22.2 Frequency rankings for consonant use in the select and name responses, normative data (Denes 1963) and naming data

Frequency of occurrence in the selected responses in the select and name data	Frequency of occurrence in English	Frequency of occurrence in selected responses in the naming data
k	t	s
t	n	l
s	s	t
n	d	g
l	l	n
z	m	r
p	ð	k
ʃ	k	b
r	r	p
j	w	z
tʃ	z	d
ŋ	b	ŋ
b	v	m
g	p	w
v	f	ʃ
d	h	tʃ
w	j	f
m	ŋ	θ
dʒ	g	dʒ
f	ʃ	j
θ	θ	h
ð	dʒ	ð
h	tʃ	ʒ
ʒ	ʒ	v

by the normal frequency of consonants in the language. The significant correlation between LT's use of consonants in the two naming conditions is important. It suggests that commonly used consonants in the naming condition continue to be well represented in the select and name responses. Similarly, consonants which were less frequently used in the naming data remain relatively uncommon in the select and name responses. This suggests that the observed patterns of consonant use in the naming data have been maintained in the new output condition although they may show some more subtle changes. These were investigated by the following analyses.

Patterns of consonant use and misuse

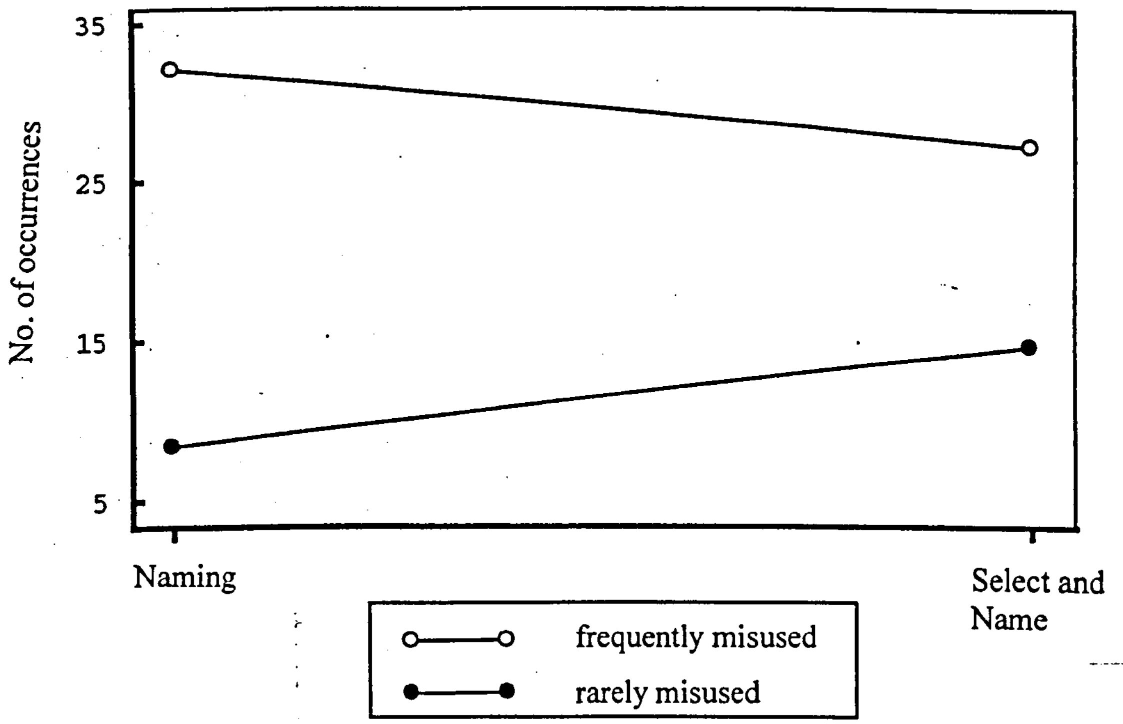
Analysis of the naming data showed that consonants were not only defined by their frequency of use but by the way they were used. Frequently occurring items had a high success rate but also a high rate of inaccurate use within neologisms. In contrast, items which appeared rarely were more likely to be target related when they did occur. To investigate the effects of the select and name task on these patterns of use, the performance of the 10 most commonly used consonants and the 10 least frequently used items were compared across the two conditions.

Although the frequency rankings for LT's use of consonants in the two conditions have been shown to correlate strongly, a few differences exist. This means that the groups of most commonly occurring and least frequently occurring items in the two conditions do not match completely. The purpose of the current analyses is to investigate the effects of the select and name task on the use of groups of consonants identified in the naming condition. Because of this, the frequency ranking from the naming data was used to determine the items. The following analyses therefore examined the behaviour in the select and name task of the ten most commonly misused consonants and the ten least frequently misused items from the naming data (see Table 13.3 for the identity of these items). The use of the consonants in the two tasks was examined by entering them in a three factor mixed Analysis of Variance. In this analysis Consonant Type (frequently misused and rarely misused) was a between factor and Accuracy (target related Vs non target related uses) and Task (Naming Vs Select and name) were within factors.

The analysis revealed one significant main effect and several significant interactions.

Consonant Type $(F(1,18) = 66.72, p < 0.0001)$ unsurprisingly showed a significant result in favour of frequently misused consonants. However, this finding is qualified by an interaction of Consonant Type with Task $(F(1,18) = 13.83, p < 0.01)$, see Figure 22.a.

Figure 22.a Interaction between Consonant Type and Task

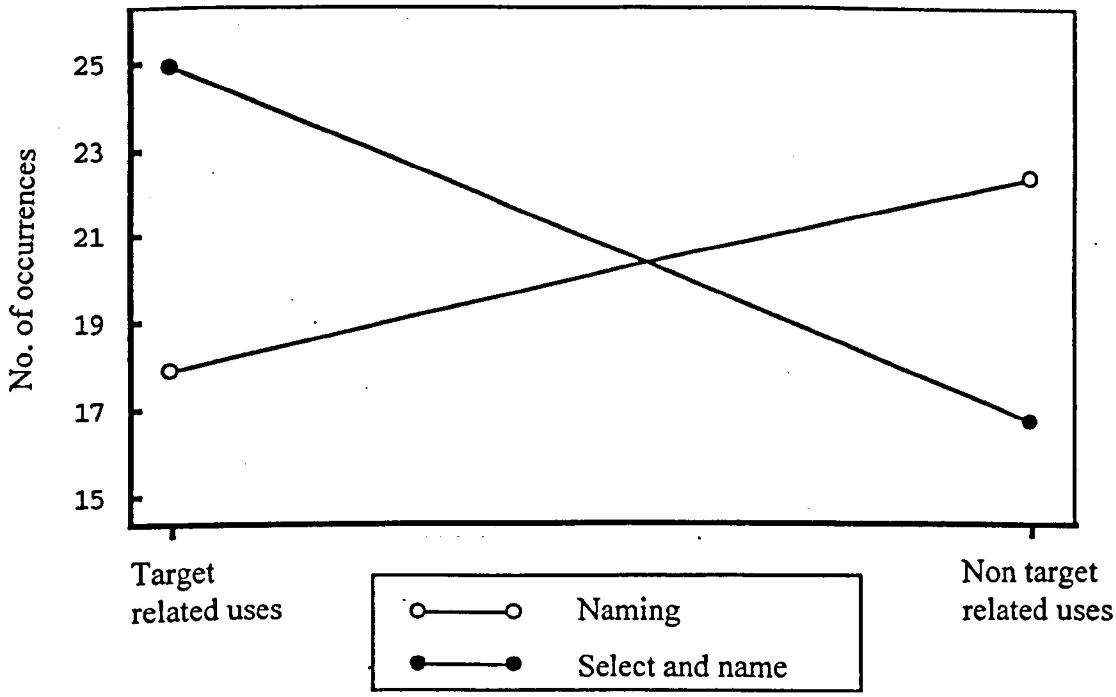


This shows that the difference between the two consonant types decreases in the select and name task. Simple main effects support this interpretation. Frequently misused consonants are used less frequently in Select and name $(F(1,18) = 5.28, p < 0.05)$ and the rarely misused consonants occur more frequently $(F(1,18) = 8.77, p < 0.01)$.

The improvement in accuracy in the select and name task is shown in the significant interaction between Accuracy and Task $(F(1,18) = 28.04, p < 0.0001)$, see Figure 22.b.

As the graph shows, target related uses exceed non target related uses in the select and name responses. In contrast there are more non target related uses of consonants in the naming data. Simple main effects showed the former effect to be significant $(F(1,36) = 13.02, p < 0.001)$. The latter effect falls just short of significance $(p = 0.06)$. Simple main

Figure 22.b Interaction between Task and Accuracy



effects also show that there are more target related uses in Select and name than in Naming (F (1,36) = 13.45, p < 0.001) and more non target related uses in Naming than Select and name (F (1,36) = 8.61 p < 0.01).

The two way interaction Consonant Type and Accuracy is also significant (F (1,18) = 6.25, p = 0.02), see Figure 22.c. This shows that over both tasks, rarely misused consonants have significantly more target related uses than non target related uses, Simple Main Effects (F(1,18) = 5.94, p < 0.05). Frequently misused consonants have more non target related uses than target related uses.

Finally, there is a significant three way interaction (F (1,18) = 8.41, p < 0.01), see Figure 22.d and Table 22.3. This reflects the changing distribution of Consonant Type and Accuracy across tasks. The interaction was investigated using Simple Main Effects. For frequently misused consonants there was a significantly greater number of non target related uses than target related uses in the naming task (F (1,18) = 10.94, p < 0.01). In the select and name task there are non significantly more target related uses than non target related uses. For rarely misused consonants the trend is similar. These already showed greater numbers of target related uses than non target related uses in the naming task; in

Figure 22.c Interaction between Consonant Type and Accuracy

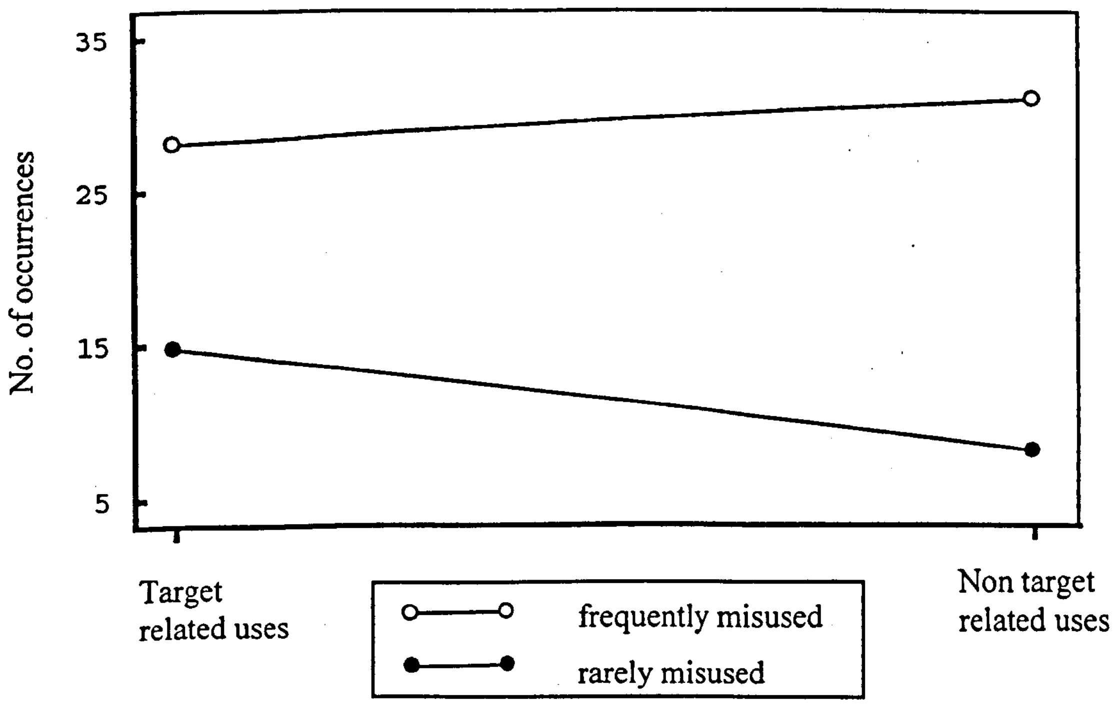


Figure 22.d Three way interaction between Consonant Type, Accuracy and Task

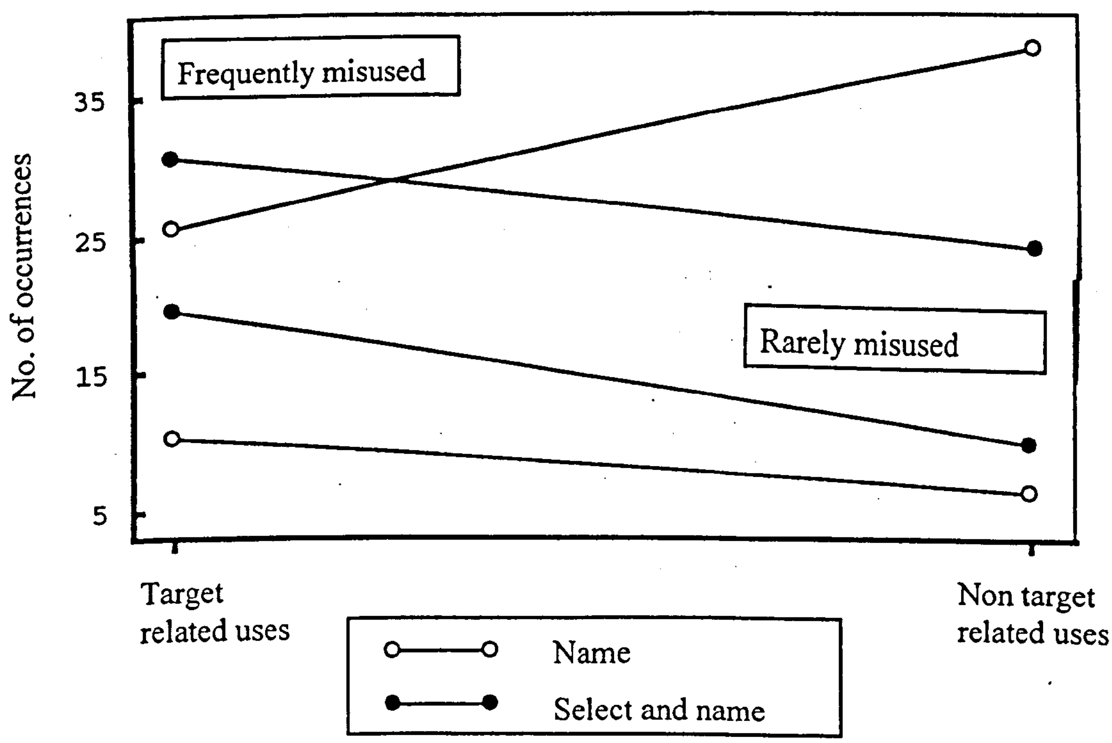


Table 22.3 Table of Means and Standard Deviations

		Name		Select and name	
		Target related uses	*Non target related uses*	*Target related uses*	*Non target related uses*
Frequently misused	*Mean*	25.6	38.3	30.5	23.7
	Standard deviation	2.55	11.04	4.22	12.63
Rarely misused	*Mean*	10.1	6.3	19.2	9.7
	Standard deviation	5.88	3.97	8.40	8.05

the select and name task this effect is significant ($F(1,18) = 6.12$, $p < 0.05$). Among the frequently misused consonants the change in tasks produces significantly fewer non target related uses ($F(1,18) = 23.93$, $p < 0.001$). Among the rarely misused consonants the change in tasks produces significantly more target related uses ($F(1,18) = 9.30$, $p < 0.01$)

Discussion

The analyses revealed some important patterns of consonant use in the select and name data. While there were some significant changes in the way consonants are used there was also a degree of consistency with the patterns observed in the naming data. This suggests that the observed changes represent modifications to already established patterns, rather than the creation of a whole new way of using consonants.

The overall rate of consonant use in the select and name data reflects the frequency of use ranking found in the naming data. Consonants which were popular in the naming task continue to be used frequently in the select and name task. Similarly, consonants which were rarely used in the naming data continue to appear only relatively infrequently in the select and name responses. The groups of ten most commonly and ten least frequently misused consonants continue to differ both in their frequency of use and in their accuracy of use. Popular consonants are likely to be misused by occurring in non target related contexts, rare consonants are seldom used in error.

However, the two groups of consonants make significant shifts towards each other in the new task. This is achieved by a significant reduction in the rate of use of the popularly misused consonants and a significant increase in the frequency of use of the rarely misused items. Thus the two groups of consonants have become closer in their rate of use. Different mechanisms within the two groups of consonants create this movement towards each other. The decreased popularity of the frequently misused consonants arises from a selective reduction in the inaccurate use of these items. While their number of correct uses remains relatively static, they are less likely to be used incorrectly in non target related contexts. This improves their rate of accurate use. In contrast, the increased popularity of the rarely misused consonants is created by a selective increase in the number of their target related uses. While the consonants occur more frequently in the responses, their use remains confined to target related contexts. In other words, these consonants increase their overall frequency of use without impairing their high rate of accurate use.

These changes reflect the increased accuracy of LT's output in the new condition. The number of accurate realisations of target consonants is greater than the number seen in the naming data and now outweighs the number of misused consonants. Moreover, LT's use of the rare and popular consonants now more closely reflects that of the target stimuli where these items are represented equally.

The changes in the patterns of consonant use are consistent with the hypothesis that the select and name task improves the functioning of the same production processes used by LT in the picture naming condition. Facilitating the functioning of these impaired processes would predict the presence of systematic modifications to the patterns of consonant use established in the naming data. This has proved to be the case, with the responses in the new condition preserving the basic features of the naming responses (frequency ranking and patterns of use and misuse) while systematically modifying them so that the non word responses become more accurate approximations of target phonologies. The results of the select and name data are therefore able to inform our understanding of the process of neologism production within LT's system.

The observed effects of the select and name condition are consistent with the account of neologism production offered in Chapter 17. This suggested that LT's ability to realise target phonology is hampered by the presence of a weak signal to the phonological level. The impoverished signal may arise from impaired processing at the semantic level. This results in a reduced ability to activate target phonological nodes to adequate levels. This process disproportionally affects low frequency consonants. These items, which are also low frequency items in the normal language, have lower resting levels of activation. They require more input in order to be selected. This is reflected in their use in LT's output. He is only able to realise these consonants in contexts where they are demanded by the target. This provides them with additional levels of activation and improves their ability to be realised in the response, thus resulting in an infrequent but more highly target related pattern of use. LT's popular consonants are items which are also frequent in the normal language. The nodes for these phonemes have higher resting levels of activation. They need very little input in order to be able to achieve adequate levels of activation. This means that they are less affected by the weak input to the phonological level. They are more often able to appear in responses where they are demanded by the target. However, their high resting levels also predispose the popular consonants to being misused in responses. They frequently achieve adequate levels as a result of spreading activation and thus appear in responses where they are not demanded by the target. In doing this they replace lower frequency consonants which have been unable to reach adequate levels of activation despite the fact that they were required by the target phonological representation.

The select and name task results in a stronger semantic signal to the phonological level. The increased signal strength results in a general improvement in the ability to activate target phonological nodes to adequate levels. This principally facilitates the ability to realise the low frequency consonants in target related contexts. These now receive greater levels of input and are thus more able to overcome their frequency disadvantage in order to achieve adequate levels of activation. This accounts for the increase in their target related occurrences in the select and name responses. The lower resting levels of activation for the nodes corresponding to these consonants continue to preclude their use as error phonology. This allows the highly accurate pattern of use for the low frequency consonants to be preserved.

The popular consonants also receive stronger levels of input activation. These consonants were already quite successful at appearing in target related contexts in the naming data.

Although none of the popular consonants showed ceiling levels of target related use in the naming data, there was a smaller margin for improvement in the accurate use of these phonemes. Consequently, they show only a modest improvement in their number of accurate uses in the select and name task. The principle feature of their behaviour in the naming data was a high rate of misuse. This is selectively reduced in the select and name data in response to the increased success in activating the low frequency consonants. As already stated, the improved input to the low frequency consonants means that the rare items are more likely to be correctly realised in responses. This reduces the number of occasions when they are replaced by the popular consonants, thus accounting for the significant decrease in the misuse of the popular consonants.

The observed changes in the patterns of consonant use are thus exactly what would be predicted by the proposed account of neologism production when the strength of the input signal to the phonological level is increased. There is a general progression towards the target phonologies with groups of popular and rare consonants being differentially affected by the improved ability to realise target phonology.

23. Substitutions in the select and name data

The select and name task resulted in significant changes in LT's output. Correct responses have become more frequent and neologisms more target related. A differential change in the use of consonants across the frequency range was also observed. Popular consonants have become more accurate, reducing the number of occasions when they occur in non target related contexts. Rare consonants have increased their frequency of use while maintaining their high level of accuracy. Despite these changes, a number of similarities with the naming data remain. Popular consonants still significantly outweigh the rare consonants in terms of their frequency of use and continue to show a greater rate of misuse.

The patterns of similarities and differences with the naming data should be reflected in the analysis of consonant substitutions in the select and name responses. The general improvement in the accuracy of non word items might be expected to result in an increased number of highly target related neologisms. Within this group, error consonants should continue to be drawn principally from the set of frequently misused consonants. They should also maintain the normal frequency relationship with the consonants that they substitute, in other words error consonants should continue to replace items which occur lower in the frequency ranking.

Substitutions in the select and name data

Examples of consonant substitutions in the select and name responses were identified using the criteria developed in the naming data. Three types of neologisms containing a single consonant substitution were identified from the pool of selected responses. Type One neologisms deviated from the target by only a single consonant. Type Two neologisms involved both a consonant and vowel substitution. Type Three neologisms complicated the target CV structure by the addition of an extra, unstressed syllable. However, within the stressed syllable of the neologism a single consonant substitution was evident. For a more detailed description of the criteria see Chapter 16. A total of 83 consonant substitutions were found in the select and name data, the numbers of each type of substitution are shown in Table 23.1.

Table 23.1 Consonant substitutions in the selected responses in the select and name data

Substitution type	Number found in the selected neologisms	Percentage of the pool of selected neologisms this group represents (x / 336)
Type One	41	12%
Type Two	31	9%
Type Three	11	3%

The 83 neologisms conforming to the above criteria represented 24% of all non word responses. Highly target related neologisms formed a larger proportion of the total set of non word responses in the select and name data. Only 65 such responses were found in the naming data, 17% of all non word responses. The difference is significant (Chi square 5.3, $p < 0.5$). This finding supports the argument that neologisms are more accurate approximations of target phonologies in the new condition.

The three types of neologisms were initially analysed separately. As with the substitutions in the naming data, no differences were detected between the groups and the results are presented together.

Patterns of consonant misuse in the substitution data

The highly target related neologisms were initially examined for whether they continued to utilise popular error consonants. The analysis used the ranking for consonant misuse in the naming data since this permits the effects of the new condition on groups of consonants identified in the naming responses to be investigated.

56 substitutions utilised a consonant from the group of ten most frequently misused consonants. This compared with only 22 substitutions which misused a consonant from the bottom ten items in the ranking. The difference is significant (Chi square 26.3, $p < 0.001$).

Substitutions in the select and name data therefore continue to reflect the normal pattern of the neologisms by involving error consonants which have a high rate of misuse in the non word data as a whole.

Frequency relationships between error and target consonants

The substitutions were analysed to establish whether the previously found frequency relationship existed between the target and error consonants. The position of the target and error consonants were compared for their position in the ranking for frequency of use in English.

62 consonant substitutions involved an error consonant replacing a target item which occurred lower in the frequency ranking. In 21 substitutions this pattern was reversed and the error consonant replaced a higher frequency target consonant. The difference is significant (Chi square 38.6, $p < 0.001$).

Select and name substitutions therefore continue to show a frequency relationship between the target and error consonants. Error consonants tend to be higher in frequency than the target consonants which they replace.

The groups of substitutions involving error consonants from the top and bottom ends of the misuse ranking were analysed separately to establish whether all substitutions maintain the normal frequency relationship between target and error consonants.

Substitutions involving error consonants from the top of the frequency of misuse ranking preserve the normal frequency relationship. 49/56 substitutions replace the target consonant with a higher frequency error consonant. 7/56 substitutions reverse this pattern. The difference is highly significant (Chi square 60.0, $p < 0.001$).

The frequency relationship is not maintained in substitutions involving low frequency error consonants. In this set the normal frequency relationship is reversed. 9/22 substitutions replace the target consonants with a higher frequency error consonants. 13/22 substitutions consist of a target consonant being replaced by a lower frequency error consonant. Although this reverses the normal frequency relationship, the difference is not significant and the low number of items involved is likely to reduce the reliability of the analysis.

Discussion

Analysis of the consonant substitutions from the select and name data showed that the error consonants involved are typically items which have a high rate of misuse in the non word data as a whole. As with the naming data, this conformity with the general set of non word responses supports the claim that neologisms containing a single consonant substitution represent a target related extreme of the general set of non word items. The significant increase in the proportion of neologisms showing this close relationship with the target is further evidence that the select and name task improves the accuracy of the non word responses.

A strong effect of consonant frequency was found at the level of individual substitutions. Error consonants tend to replace lower frequency target consonants. This was true both across the set of all substitutions and in the set of substitutions involving error consonants from the top end of the frequency of misuse ranking. A small set of substitutions involve an error consonant from the lower end of the frequency of misuse ranking. These substitutions are less likely to show the normal frequency relationship between the error and target items, in fact the error consonant is equally likely to replace a more frequent target as a less frequent consonant. This reversal of the normal frequency relationship however fails to reach significance and the number of these substitutions remains small.

24. Other effects potentially involved in consonant substitutions

Chapters 16 (naming data) and 23 (select and name data) presented neologisms where a single consonant substitution could be identified. In each case the substitutions were seen to retain two important aspects of the general non word data. Firstly, the distribution of error consonants was consistent with the distribution seen in the general data. Error consonants tended to be those phonemes which are popularly misused throughout the non word responses. Secondly, error consonants preserved the expected frequency relationship with the target consonant. High frequency error consonants replaced lower frequency target consonants. These two observations led to the argument that the highly target related neologisms form a subset of the non word data, i.e. that they are produced by the same mechanism that generates the more abstruse neologisms. This suggests that any further pattern of neologism production evident in the highly target related neologisms is likely to be a general principle in the construction of LT's error responses. Such factors cannot be identified in the general set of neologisms where the degree of disruption to target phonology obscures the relationship between target and error phonology.

It was predicted that, in addition to phoneme frequency, shared features between the target and error consonants might affect the nature of consonant substitutions. Within an interactive activation account of lexical processing this would suggest the presence of a level of representation below that of the phoneme nodes. A number of authors have argued for the presence of a level of nodes corresponding to feature information (e.g. Dell and Reich 1980, 1981, Stemberger 1982, Dell 1986). The error consonants in the substitution data were therefore analysed in terms of their ability to maintain the voicing, manner and place information of the target consonants. The number of substitutions identified in the two sets of data is relatively small, 65 in the naming data and 83 from the select and name responses. To enlarge the numbers available for analysis the two groups were considered together. This approach was adopted after comparison of the two groups had failed to find any significant difference between them. The neologisms had originally been classed as one of three types, according to the way they distorted the target CVC structure (i.e. types I, II and III, see previous chapters for descriptions). The two sets of substitutions contained equal proportions of each type of distortion. In addition the two groups showed no significant difference in the identities of the target and error consonants involved in the substitutions. The analyses therefore proceeded by considering the 148 consonant substitutions as a single group.

Analysis of target and error consonant pairs

Each target and error consonant pair in the substitution data was scored for whether the error consonant preserved the voice, manner and place information of the target consonant. The error consonants were then removed from the responses and randomly reassigned to the same slots. Six reallocations produced a phonotactically illegal response, and these items were redrawn. Reallocations which returned an error consonant to its original neologism were left in the analysis.

The pseudo error consonants were then rated for their ability to preserve the voice, manner and place information of the target consonant. Finally, the real and pseudo error data were compared on these measures.

When calculating the ability to preserve manner information the group of approximants were considered as a single group of consonants. In calculating place information the two affricate consonants were considered to share place information with all palatal and alveolar sounds. These assumptions were applied to both the genuine and the pseudo substitutions.

The analyses considered a total of 444 features (voice, manner and place) in each of the sets of genuine and pseudo substitutions. In the genuine substitutions 185 target features are preserved by the error consonant. Only 127 target features are preserved by the error consonant in the pseudo substitutions. The difference is significant (Chi square 16.1, $p < 0.001$).

Further investigation indicated that the ability to preserve target voice, place and manner status was not equal. The preservation of each of these target features by the genuine and pseudo error consonants is shown in Table 24.1.

Table 24.1 shows that the preservation of target voice information by error consonants in the genuine substitution data is no greater than is predicted by chance. In contrast, the

Table 24.1 The preservation of features of the target consonant by genuine and pseudo error consonants

	Genuine consonant substitutions (n = 148)	Pseudo consonant substitutions (n = 148)	Comparison with Chi square
Error consonant preserves target voice information	86	74	1.6, not sig
Error consonant preserves target manner information	51	28	8.4, $p < 0.01$
Error consonant preserves target place information	48	25	8.8 $p < 0.01$

preservation of both target place and manner information in the genuine consonant substitutions significantly exceeds the level found in the pseudo substitutions. This indicates that the ability of the genuine consonant substitutions to preserve these features of target phonology is significantly greater than chance.

The analyses suggest a phonological relationship between the target and error consonants in the highly target related neologisms. An alternative explanation suggests that the effect may arise from the identity of the error consonants themselves. The consonant substitutions are already known to rely predominantly on those consonants which LT uses frequently. These phonemes, which are also popular in the language, may be selected from large groups of consonants such as alveolars or fricatives and therefore share feature information with a large number of other consonants. The randomisation exercise should protect against this possibility since it will also serve to increase the level of similarity predicted by chance. A subsequent analysis also excluded this possible account for the observed effects. Each English consonant was compared against each of the other 23 consonants for their similarity in terms of voicing, manner and place of articulation. Consonants were awarded a point for every feature they shared with another consonant. The consonants were then ranked in order of the number of features held in common with other consonants. If the popular consonants are items which share feature level information with large numbers of other consonants then a correlation should exist between the ranking for shared feature information and the ranking for frequency of use. No such correlation was evident between the ranking for shared feature information and the ranking for normal consonant frequency in English, rho (24) = 0.213, not significant. Similarly no correlation was evident when the rankings for shared feature information and frequency of consonant misuse in the naming data were compared rho (24) = 0.209, not significant.

Discussion

Genuine error consonants share significantly more feature information with their target consonants than is shared between pseudo error and target consonant pairs. This indicates that the similarity between the target and error consonants is greater than can be accounted for by chance. The ability to maintain the manner and place information of the target consonant creates this effect. The preservation of target voicing status is no greater than chance. The findings suggest that feature level information, at least for target manner and place of articulation, may influence the choice of error consonants in the highly target related neologisms.

Two potential accounts may explain the failure of target voice information to influence the choice of error consonant. Voicing status is a binary distinction, consonants being either voiced or voiceless. This results in a strong factor of chance and may prevent subtle patterns in the data from being distinguished. An alternative explanation is offered by a number of phonological theories which argue for a qualitative difference between the representation of target voice information and the representation of other feature level information. For instance, it has been suggested that voicing information may be encoded at a different level in non linear models of phonology (e.g. Bernhardt 1992). It may be that these different levels are reflected in speech processing. In this case it is possible that information encoded at the voicing level of representation fails to influence the selection of phonemes.

The findings of the current investigations are in marked contrast to the results of an analysis carried out by Kohn, Melvold and Smith (1995). These authors analysed phonemic paraphasias produced by fluent aphasic speakers during a picture naming task. 143 consonant substitutions involved a single feature change. Kohn et al argue that only target voicing information exerted a significant influence on the choice of the error consonant. However, their analysis was not restricted to comparison of the target and error consonants. Rather, any occurrence of the error feature in the target word was considered to be a potential source of the feature substitution in the response, Kohn et al arguing that this would reflect a process of consonant harmony. This difference in methodology may preclude comparison with the results of the current study. Moreover, the authors neglected to control for the effects of chance. Given that voicing is only a two way distinction, chance is likely to be a fairly large factor, thus calling into question the validity of their findings.

Green (1969) examined literal paraphasias containing a single consonant substitution produced by a neologistic speaker. The majority of error consonants differed from the target by a single distinctive feature when the substitutions were rated for similarity on a four feature system, an oral / nasal distinction being an additional feature to those investigated in the current study. Of the distinctive features investigated, place information was most frequently confused across all consonant substitutions. This led Green to argue that distinctive features may be organised in a hierarchy with place information most vulnerable to disturbance. Interestingly, the features of voicing and nasality (both binary distinctions) were less likely to be confused than manner and place information. However, as with the Kohn et al (1995) study, this analysis failed to control for the effects of chance and it is therefore unclear whether the observed patterns represent significant features in the data.

The results of the current analysis are also in contrast to the findings reported by Miller and Ellis (1987). These authors did control for the effects of chance when evaluating the number of shared phonological features in phoneme substitutions. Pairs of target and error phonemes were rated for similarity on a four feature system, again including an oral / nasal distinction. The number of features shared by each pair of phonemes was calculated. Typically error phonemes differed from the target by only one or two distinctive features. However, this was not significantly different from the number of features shared by target and error consonants in a corpus of pseudo errors. Miller and Ellis therefore concluded that the level of similarity found in the genuine data was no greater than could be accounted for by chance. The discrepancy between the current study and the findings of Miller and Ellis may arise from the fact that these authors included in their analysis two phonological features which offer only a binary distinction; voicing status and the oral Vs nasal contrast. As already discussed, it may be difficult to detect significant levels of similarity with these parameters given the high component of chance. Alternatively, the results may reflect a genuine distinction between the spoken responses of RD and LT.

It is argued that LT's highly target related neologisms represent the target related end of a continuum of non word production. Feature level information in the form of target manner and place information may therefore exert an influence on the selection of error phonology throughout LT's non word output. However, the effects identified by the current investigations are relatively subtle and become evident only when the genuine data is compared with a corpus of pseudo substitutions. This is in contrast with the striking influence observed for consonant frequency which is evident throughout the non word data. It is therefore possible that feature level information only becomes influential when the system is operating with a high degree of success, as in the situation of error responses containing a single consonant substitution. It might therefore be predicted that consonant frequency is the principle influence on the nature of error phonology in responses more distant from the target word. Nevertheless, any account of LT's neologism production will need to accommodate the potential influence of target feature level information on consonant substitutions in highly target related neologisms.

A further point concerns the use of low frequency consonants as error phonology. It is argued that these consonants have lower resting levels of activation and are therefore less able to occur in contexts where they are not demanded by the target phonology. The evidence for an influence of feature level information on the selection of error consonants may explain why the low frequency consonants are occasionally able to appear as error phonology. In these cases it may be that the feature information shared with the target consonant enables the low frequency consonant to reach an adequate level of activation and thus appear as an error phoneme. This might predict that the presence of shared feature level information would be particularly evident in substitutions involving low frequency error consonants. However, the low number of these substitutions in the data (only 31 across both conditions), coupled with the relative subtlety of the effect of feature level information is likely to prevent such analyses from revealing significant patterns.

The investigations revealed that consonant substitutions are mediated by the phonological relationship between the target and error consonants. This requires the inclusion of a level of representation in the lexical network corresponding to feature information. It is suggested that this level of representation exists below the segmental or phoneme level. Activated consonant nodes would supply input to nodes corresponding to the relevant phonological features. Two possible mechanisms may account for the realisation of this information. Activated nodes at the feature level of representation may return activation to the target consonant node as well as to the nodes for all other phonemes sharing that feature information. This would increase their activation levels, thus increasing the possibility that these nodes will be selected. As already discussed, this mechanism may provide low frequency consonants with sufficient input for their occasional use as error phonology. In a lexical network operating without feedback connections, the activated feature nodes may supply input directly to a lower level of representation. This may consist of a pre-motor level of representation or some form of 'clean up' unit where feature level information is collated. Whatever the precise nature of the representation, this level of processing must presumably involve some form of constraint to prevent the production of combinations of phonological features which fail to conform to the specification of an English phoneme. This alternative account is also able to account for the phonological relationship observed between target and error consonants.

The absence of an effect of feature similarity in neologisms investigated by Miller and Ellis (1987) was used by these authors to support their conclusion that the non word responses did not originate from the phonemic distortion of lexical phonologies. The account offered here suggests that phonological feature information may influence error phonology where this is taken to arise from the partial activation of target phonological information. This explanation is possible within interactive activation accounts of output processing where lexical phonologies consist of information distributed over a number of levels of representation.

25. Naming assessments after the select and name trials

A number of changes have been identified in LT's responses in the select and name task. It has been suggested that these are the specific result of the new condition. Alternatively, the changes may represent a general improvement in LT's output processing. This may occur either as part of a pattern of spontaneous recovery or arise as a practice effect owing to LT's increased familiarity with the stimuli.

To investigate these possibilities a further five naming trials were carried out with the consonant controlled stimuli. A generalised recovery of language function would predict that LT's picture naming ability with these items would now be improved. On the other hand, if his select and name responses benefit specifically from the new task then picture naming should return to its previous level.

Picture naming trials after the select and name assessments

LT was asked to name the controlled vocabulary on five occasions in September and October 1996. His responses were recorded on digital audio tape and transcribed in broad phonemic transcription. The results of the five picture naming trials are shown in Table 25.1.

Table 25.1 Correct responses in the five naming trials with the controlled stimuli carried out after the select and name trials

Date of picture naming trial	Number of items correctly named
12.9.96	6
2.10.96	6
9.10.96	8
11.10.96	7
16.10.96	6

LT named 33 items successfully over the five naming trials. His success at naming the stimuli was compared with his performance in the original naming and select and name and name data using Analysis of Variance. ANOVA gave a significant result (F (2,22)

= 34.65, $p < 0.0001$). The mean numbers of correct responses are given in Table 25.2.

Table 25.2 Table of Means

Output condition	Mean number of correct responses
Original ten naming trials	6.9
Ten select and name trials	13.3
Five subsequent naming trials	6.6

The Newman-Keuls test (unplanned comparison) showed the number of correct responses in the select and name task to be significantly greater than the original ten naming trials ($p < 0.01$) and the five subsequent naming trials ($p < 0.01$). The two naming conditions were not significantly different from each other.

The analyses thus indicated that there was no general improvement in LT's picture naming ability as measured by the number of correctly named items. However, it is possible that more subtle changes may be present in his ability to realise target phonology. To exclude this possibility a phonological analysis of LT's most accurate responses to each item was undertaken.

<u>Ability to realise target consonants</u>

LT's most successful attempt to name each target was selected using the criteria previously applied to the naming and select and name data (see Chapters 10 and 21). The selected responses were then investigated for correct realisations of the scored consonants of the target words. As before, target consonants were considered to have been correctly realised if they occurred in any position in the selected real or non word response. This corresponds to the ✓C + ✓N score used in previous chapters. Since the current data involved only half the number of naming trials (5) the total number of scored consonants available to be realised was reduced to 470.

LT's selected responses from the five naming assessments contained 235/470 target consonants. This was compared with his ability to realise target consonants in the two previous groups of data.

(i)	Target consonants realised in the ten original naming trials	448/940
(ii)	Target consonants realised in the ten select and name trials	623/940
(iii)	Target consonants realised in the five subsequent naming trials	235/470

LT realised significantly fewer target consonants in the subsequent five naming trials than he had produced in the selected responses to the select and name data (Chi square 34.2, $p < 0.001$).

In contrast, his ability to realise target consonants was unchanged when compared with the original ten picture naming trials (Chi square 0.5, not significant).

The analyses indicate that LT's ability to realise target phonology in his picture naming responses is unchanged (at least in terms of the ability to realise target consonants) and remains significantly worse than in the select and name condition. These analyses investigated LT's production of target consonants across all his responses. A final analysis excluded the possibility that the subset of non word responses showed an increased level of target relatedness. The number of target consonants correctly realised in the selected neologisms produced in the two sets of picture naming data were compared. This is the ✓N score from previous analyses. As before LT's success at realising target consonants in neologisms was analysed in relation to the number of consonants targeted by those items for which neologisms were the selected response. The results are given in Table 25.3.

Table 25.3 shows that stimuli which elicited neologisms in the original naming trials targeted a total of 750 scored consonants. Of these, 311 were realised in LT's non word responses. Stimuli which elicited non word responses in the five subsequent naming trials targeted a total of 402 scored consonants of which 169 were realised in LT's neologisms. The difference is not significant (Chi square 0.02, not significant).

The analysis therefore reveals no improvement in LT's ability to realise target consonants in his non word responses. There is no evidence that LT's non word errors in the picture naming condition have become more accurate approximations of the target phonologies.

Table 25.3 The realisation of target consonants in selected neologisms in the original ten and subsequent five picture naming assessments with the controlled stimuli

	Original ten picture naming assessments	Subsequent five picture naming assessments
Number of stimuli eliciting a neologism as the selected response	375	201
Number of scored consonants targeted by these stimuli	750	402
Number of scored consonants realised in the selected neologisms	311	169

Discussion

Five picture naming assessments were completed following the ten select and name trials. Analysis of LT's responses provided no evidence for a generalised improvement in his ability to produce target phonology correctly in this output condition. His picture naming performance remained unchanged in terms of the number of correct responses, the number of target consonants correctly realised across all responses and the number of target consonants correctly realised in the selected non word responses.

The results of the analyses are inconsistent with the argument that changes seen in the select and name responses arise from either a spontaneous recovery of language function or from LT's increasing familiarity with the test material. Either of these accounts would have predicted a change in LT's picture naming performance when reassessed with the same stimuli. The improvements detected in LT's output in the select and name data can therefore be attributed to a specific effect of that task. The results also support the conclusion that the effects of the select and name condition are short lived and fail to be maintained between assessments. This is consistent with the finding in Chapter 20 that there is no cumulative effect of the benefits of the task across the ten select and name trials. Rather disappointingly for LT, the results indicate that his output is resistant to long term changes brought about either by the application of priming tasks or through a process of spontaneous recovery.

The implications of the effects of the select and name task for the explanation of neologism production in LT's system will be discussed in the following chapter.

26. Summary and observations from the select and name data

The investigations with the select and name task arose from the proposal that facilitating LT's ability to realise target phonology would influence his spoken output in a number of predictable ways. These predictions were made by the account of neologism production presented in Chapter 17.

Initial investigations explored the potential for facilitating LT's access to stored phonological information. Externally provided semantic and phonological cues were ineffective. Written stimuli demonstrated a significant ability to facilitate the realisation of lexical phonology. However, there was strong evidence that LT's output became even more successful in a semantically primed reading condition. The facilitatory effect of the semantic decision and the absence of a regularity effect indicated that LT's reading aloud in this condition involved him accessing phonological information from the semantic system, as would occur during naming. This allowed direct comparisons to be made between his output in semantic reading tasks and his picture naming performance.

The positive effects of reading in the context of a semantic decision were exploited in a select and name task using the stimuli controlled for consonant content. The assessments replicated the finding that semantically primed reading tasks improve LT's ability to produce target phonology. It appeared that the facilitatory effect of the condition arose from both the availability of the written stimulus and the presence of a semantic task. This suggested a process of summation whereby the task strengthens the input signal to lexical phonological representations by two means. Firstly, the written stimulus provides additional input to the phonological level via direct lexical connections. Secondly, the weak signal from the semantic system is strengthened by the semantic decision.

There was a significant increase in the number of correct responses across the ten select and name trials. Furthermore, neologisms were more accurate approximations of target words. The ability to realise target consonants in non word responses was significantly improved. Highly target related neologisms (non word responses showing a single consonant substitution) also formed a greater proportion of the set of non words.

Significant increases were seen in the number of target consonants realised in both correct and non word responses. This allowed more detailed investigation of the behaviour of individual consonant items in the new task. LT's use of consonants maintained the frequency bias seen in the naming data. The groups of rare and popular consonants continued to be defined by both their frequency and accuracy of use. However, they made significant shifts towards each other in the new condition. This was achieved by a selective reduction in the rate of misuse of the popular items, thereby enhancing their overall accuracy of use. At the same time, rare items increased their popularity by selectively increasing the number of occasions when they appeared in target related contexts. In other words, they became more popular while retaining their highly accurate distribution.

Analysis of the set of highly target related neologisms indicated that consonant frequency continued to play a significant role in individual consonant substitutions. High frequency error consonants replaced lower frequency target items. Further detailed analysis indicated a subtle effect of the phonological relationship between the target and error consonant. Both target manner and target place information were more frequently preserved in the error consonant than was predicted by chance. This suggested that these features of target phonology may also exert an influence over the selection of error phonemes.

Five subsequent picture naming trials excluded the possibility that the changes seen in LT's output were the result of generalised language recovery or increased familiarity with the stimuli. Picture naming showed no improvement in either the number of correct responses or in the accuracy of neologisms. The significant changes observed in the select and name condition can therefore be attributed to a specific effect of the new task.

The discussion in Chapter 17 concluded that the patterns observed in the naming data were best explained by theories which base non word production directly on the phonology of the target words. Alternative accounts, which view neologisms either as non lexical phonology or as the result of dual impairments, were unable to explain a number of features of the naming data. These accounts are further challenged by the results of the select and name investigations.

Non lexically derived phonology

Non lexical accounts of neologism production argue that alternative sources of phonology are appealed to in the context of a complete failure to retrieve target phonological information. When partial information can be accessed from the lexical system a target related non word is produced on the basis of this. Non lexical accounts might therefore argue that the select and name condition has improved the ability to access target phonological information. Lexical searches are therefore successful more often, resulting in target words being realised more frequently. This would account for the increase in the number of correct responses. At the same time the increased ability to retrieve partial target information reduces the number of times that the system needs to appeal to the non lexical source when constructing neologistic phonology. This would predict an increase in the number of target related neologisms.

The theories would therefore argue that the naming and select and name data differ in the number of device generated neologisms they contain. The continuity between the two sets of data in terms of their patterns of consonant use challenges this view. The two sets of data correlate strongly in their use of consonants, sharing the identity of rare and popular consonants in the responses. Furthermore, the changes in consonant use in the select and name data systematically alter the patterns previously established in the naming data. If the increased success in the select and name condition reflected a change in strategy away from device generated neologisms towards lexically based non words then more dramatic changes would be expected in the way consonants are used in the two conditions. The explanation does not predict that patterns of consonant use seen in the randomly generated neologisms would be preserved in non words constructed on the basis of target lexical information.

The random phoneme generator account might be adapted to enable it to explain certain aspects of the data by suggesting that the selection of non lexical phonology is frequency biased. Error phoneme selection would continue to be arbitrary in other respects, i.e. occurring without reference to the target lexical representation. This modified form of the model would thus predict the popular misuse of high frequency consonants and the rare occurrences of lower frequent consonants in non target related contexts. It would also predict a frequency relationship between target and error consonants. However, the model would fail to predict the presence of a phonological relationship between target and error phonology since, as Chapter 24 demonstrated, consonant frequency and shared feature information are not confounded.

Dual impairment theories

A second type of account for neologism production argues that abstruse non words arise from the dual processes of word substitution followed by phonological distortion. These accounts would also be able to explain the greater numbers of correct responses in the select and name condition. The increase in semantic processing created by the semantic decision might reduce the likelihood of a lexical level substitution. At the same time, the stronger signal supplied to the phonological level should facilitate access to output phonology. The combination of these effects would result in more occasions when the target word is produced correctly.

The dual process accounts have greater problems explaining the changes observed within the non word responses. Increasing the semantic processing may reduce the number of occasions when the target word is substituted by another lexical item. In other words, many more neologisms may be constructed on the basis of the phonological representation for the original target word. This shift away from the previous pattern (where neologisms are based on the phonology of a substitution) would predict a very large discrepancy between the target relatedness of neologisms in the naming and the select and name conditions. Although a significant increase in the accuracy of non word responses was detected in the new task this was not as large as might be predicted by the current hypothesis. For instance, the improvement in the ability to realise target consonants was greater for the correct responses than for the non word responses. Correct responses require both aspects of the processing disorder to be eliminated, while more accurate neologisms require only the substitution element to be absent. It might therefore be reasonably expected that non word responses would show greater facilitation in the new condition than correct responses.

Alternatively, the improved processing in the select and name task may fail to exclude the substitution component of the deficit but successfully facilitate access to phonological representations. This predicts that as the output becomes more accurate, the nature of the lexical substitution should become more apparent. In other words as the ability to realise target phonology improves, it should be more obvious that the production is an approximation of a non target item rather than an attempt to produce the stimulus. This in fact argues for a reduction in the target relatedness of the neologisms when compared to the original stimuli. It also predicts that a greater proportion of non word responses should be classified as semantic + phonological errors. Neither of these predictions are supported by the data. Neologisms do show a significant progression towards target phonologies and fewer responses are identified as semantic + phonological errors. The dual impairment theory of neologism production is therefore further challenged by the select and name data.

The select and name findings therefore illustrate further limitations on the ability of the non lexical and dual impairment theories to explain LT's non word data. An alternative account describing how LT's output might be explained within an interactive activation network was presented in Chapter 17. The account predicted that any output condition which facilitated LT's ability to realise target phonology would have very specific effects on the patterns of consonant use observed in the naming data. The ability of the account to accommodate the results of the select and name investigations will therefore be examined.

An interactive activation account of neologism production

It has been argued that the select and name task results in a stronger input signal being supplied to the phonological level. This arises from the increased semantic processing encouraged by the semantic decision and the availability of the written stimulus to activate directly this level of representation. This facilitates the ability to access target phonological representations and increases the production of completely correct responses.

The account is also able to explain the general changes seen in the non word responses. While not always sufficient to produce a correct response, the improved access to phonological representations means that more target information can be realised in the non word responses. Thus, the neologisms would be expected to become closer approximations of target phonologies, as was indicated by the greater numbers of target related consonants. Since the account views the new condition as reducing, rather than altering, the impairment underlying neologism production in the naming data, some similarities would be expected between the two conditions. This therefore easily accommodates the similarities between the two sets of data in their patterns of consonant use.

The initial results of the select and name analyses therefore support the proposed account of neologism generation. The explanation is superior in its simplicity, relying on the presence of a single processing impairment to explain neologism production and avoiding the need to implicate additional, non lexical devices. Furthermore, the account explains the changes in the select and name data as a simple reduction in the severity of the original processing impairment.

The interactive activation account argued that nodes for frequent consonants have higher resting levels of activation and therefore normally require little input in order to be selected. In contrast, lower frequency consonants have lower resting levels of activation and thus require considerable input before they achieve adequate levels of activation. This led to the prediction that the two groups of consonants would be differentially effected by an output condition which enhanced the strength of the input signal to the phonological level. Rare consonants should respond by increasing their rate of use. The strengthened input signal results in them more often receiving sufficient input to be realised in the response. Their frequency disadvantage, however, is likely to continue to restrict their use to target related contexts. The low frequency target consonants now offer stronger competition to popular consonants in these circumstances and are less likely to be replaced by them. This will result in a refined use of the popular consonants. These are less likely to occur as error phonemes but will continue to be often realised in target related contexts. In summary, the rate of use of low frequency consonants will improve while maintaining their highly accurate distribution. Popular consonants will show a selective reduction in their rate of misuse.

The results of the select and name analyses fulfilled these expectations completely. The popular consonants showed a decline in frequency resulting from a selective decrease in their rate of misuse. In contrast, the rare consonants increased in frequency while remaining largely confined to target related contexts.

Conclusions

The support offered to the proposed account of neologism production by the select and name data is encouraging. Each of the predictions made by the account was confirmed by the select and name investigations. However, the account as presented is rather unspecified in a number of respects. For example the precise architecture of the network remains unstated. Likewise, the mechanisms by which activation flows through the network have not been discussed. This issue is important since it must explain specifically how non target phonemes are able to appear in LT's non word responses. Finally, the precise nature of the facilitatory effect of the select and name task might be investigated in more detail. The following chapters therefore aim to develop the interactive activation account of neologism production in relation to these issues.

27. Further investigation of the select and name condition

The select and name task was developed from the finding that LT's ability to realise target phonology was significantly improved in a semantically primed reading condition. Initial investigations in Chapter 20 suggested that the availability of the written stimuli and the semantic decision combine to create the facilitatory effect of the select and name task. The current investigations aimed to examine in more detail the contributions made by the two aspects of the select and name task.

LT completed the selection component of the select and name task very easily, making only four errors in the 470 selections over the ten assessments. This suggests that the task is well within the processing capabilities of his semantic system. It might therefore be argued that this aspect of the task is not able to create a significant increase in the processing undertaken at the semantic level. In contrast, LT's performance on the semantic component of the semantically primed reading task was rather poor (see Chapter 19). In this task LT was required to identify the closest synonym for a written stimulus before reading the stimulus word aloud. Here, LT made several errors, identifying only about half of the synonyms correctly (43/60). This level of performance suggests that this task is rather more taxing of his semantic capabilities. The use of less imageable items, the absence of any picture stimuli and the need to process three written words may all serve to increase the demands of the task. However, despite the fact that LT finds the semantic element of the primed reading task more difficult, the condition results in a dramatic improvement in his ability to produce target phonology. In fact the level of improvement is greater than that found between the naming and select and name trials, see Table 27.1.

Table 27.1 Correct responses in primed and unprimed output conditions

	Correct responses	
Reading aloud	6/60	10%
Primed reading aloud	28/60	47%
Naming controlled stimuli	69/470	15%
Select and name with controlled stimuli	133/470	28%

Two semantic tasks, which LT completes with differing levels of success, therefore both precipitate significant improvements in his ability to realise target phonology. There does not appear to be a simple relationship between the ability to complete the semantic decision and the degree of the improvement seen in the ability to realise target phonology. In fact it is suggested that the more demanding semantic task, which LT completes less successfully, results in a greater improvement in the accuracy of spoken output. This suggests that it may be the degree of semantic processing demanded by the task, rather than LT's success in completing it, which is the important factor in facilitating the retrieval of target phonology. As previously discussed, this supports the argument that semantic decisions may serve to increase the processing undertaken at the semantic level. However, this increase may not be directly reflected by LT's ability to complete the semantic component of the condition. In fact, the results suggest that the effect on phonological processing may be a more accurate indicator of the increased semantic processing. Further investigations examined this proposal in more detail. Two subsequent conditions were developed. These maintained the format of the select and name condition but varied the amount of semantic processing required to complete the selection. Each task was carried out on five occasions using the 47 stimuli controlled for their consonant content. This would allow direct comparisons to be made with LT's picture naming and select and name performance with these items.

Select and name task with unrelated distracters

The amount of semantic processing required to complete the selection was initially reduced by the use of semantically unrelated distracters. It was predicted that this should reduce the facilitatory effect of the condition.

As before, each picture stimulus was presented with a choice of two written words. LT was required to indicate the correct written name for the picture before attempting to produce the target. The written target words were paired with semantically unrelated distracter items. This was accomplished using the same distracter items as had been presented in the original version of the task. Target and semantic distracter pairs were separated and reassigned so that the distracter shared no semantic relationship with the target. To prevent LT from becoming familiar with the stimuli the original select and name trials had utilised four sets of distracter items. Each of these sets was used at least once over the course of five trials in the new condition.

The unrelated select and name task was carried out on five occasions in May 1997. LT made only one error in the selection component of the task over the five trials. The results of his attempts to produce the picture names are shown in Table 27.2.

Table 27.2 Correct responses in the five select and name trials using unrelated distracter items

Date of trial	Distracter set	Number of items correctly named
6.5.97	1	17
16.5.97	1	16
21.5.97	2	17
23.5.97	3	11
30.5.97	4	16

Select initial grapheme and name

A second task attempted to remove all semantic information from the selection as well as significantly reducing the amount of target orthographic information available. Picture stimuli were presented with a choice of two graphemes on separate cards. LT was asked to identify the correct initial letter for the target before naming the picture. In each case the two graphemes consisted of the correct initial letter and the initial letter for one of the semantically related distracters from the ten original select and name trials. Two different sets of distracter letters were used across the five assessments in the new condition.

The select grapheme and name task was carried out on five occasions between November and December 1996. LT was very consistent in his ability to correctly identify the initial letter over the five trials. His success at this aspect of the task is shown in Table 27.3. For each trial the number of correct initial letter selections was compared with the number predicted by chance. Column Three of Table 27.3 shows that in each trial LT's ability to identify the correct grapheme was significantly better than chance.

Table 27.3 Correct letter selections in the five select initial grapheme and name trials

Date of trial	Number of stimuli where initial letter is correctly identified	Comparison with chance $p < 0.001$
22.11.96	40	Chi square 20.5
27.11.96	38	Chi square 15.5
10.12.96	39	Chi square 17.9
16.12.96	41	Chi square 23.2
18.12.96	41	Chi square 23.2

LT's success at producing the target picture names in this condition is shown in Table 27.4.

Table 27.4 Correct responses in the select initial grapheme and name condition

Date of trial	Number of items correctly named
22.11.96	10
27.11.96	14
10.12.96	7
16.12.96	8
18.12.96	13

There was no relationship between the correct selection of the initial letter and the ability to name the target; correct responses occurring after a correct letter selection 44/199, correct responses after incorrect letter selection 8/36. The difference is not significant (Chi square 0.05, not significant).

<u>Investigation of the facilitatory effect of the two new conditions</u>

Analysis of Variance examined the effect of the two new output conditions on LT's ability to correctly name the stimuli. The analysis compared the number of items correctly named in the two new conditions with his performance in the original ten select and name trials. The ANOVA gave a significant result ($F(2,17) = 6.66$, $p < 0.01$). The Table of Means is shown in Table 27.5.

Table 27.5 Table of Means

Output condition	Mean number of correct responses
Original select and name task	13.30
Unrelated select and name task	15.40
Select grapheme and name task	10.40

A Newman-Keuls Test (unplanned comparison) showed that LT's performance in the original select and name task and the unrelated select and name condition did not differ significantly. His performance in the select grapheme and name task was significantly worse than his performance in both the original select and name condition ($p < 0.01$) and in the unrelated select and name condition ($p < 0.05$).

Subsequent picture naming trials

Five further picture naming trials were carried out with the controlled stimuli. This would allow LT's performance in the two new select conditions to be compared relative to his picture naming ability. It would also indicate whether LT's improved performance in the unrelated select and name condition was attributable to spontaneous recovery of output processing.

Five subsequent picture naming trials were therefore completed in June 1997. The results are shown in Table 27.6.

Table 27.6 Correct responses in the five final picture naming trials with the controlled stimuli

Date of trial	Number of items correctly named
6.6.97	5
11.6.97	7
13.6.97	7
18.6.97	6
20.6.97	6

The ability of the unrelated select and name and the select grapheme and name conditions to improve LT's picture naming ability was investigated using Analysis of Variance. Two analyses compared LT's performance in each new select condition with the five picture naming trials completed following the original select and name task (see Chapter 25 and Table 25.1 for results) and the five most recent picture naming trials.

(i) Unrelated select and name condition

Analysis of Variance compared LT's performance in the unrelated select and name task with his naming ability in the two sets of picture naming assessments. The ANOVA gave a significant result ($F(2,12) = 52.00$, $p < 0.001$). The Table of Means is shown in Table 27.7.

Table 27.7 Table of Means

Output condition	Mean number of correct responses
Picture naming trials following the original select and name task	6.60
Unrelated select and name task	15.40
Picture naming trials following the unrelated select and name task	6.20

A Newman-Keuls Test (unplanned comparison) showed that LT's performance in the unrelated select and name task was significantly superior to his picture naming ability both in the five previous naming trials ($p < 0.01$) and in the five subsequent naming trials ($p < 0.01$).

(ii) Select grapheme and name condition

Analysis of Variance compared LT's performance in the select grapheme and name condition with the two periods of picture naming assessments. The ANOVA gave a significant result ($F(2,12) = 7.46$, $p < 0.01$). The means are shown in Table 27.8. A Newman-Keuls Test (unplanned comparison) showed that LT's performance in the select grapheme and name condition was also significantly superior to his picture naming both in the earlier naming assessments ($p < 0.01$) and in the later picture naming trials (p <

0.05).

Table 27.8 Table of Means

Output condition	Mean number of correct responses
Picture naming trials following the original select and name task	6.60
Select grapheme and name task	10.40
Picture naming trials following the unrelated select and name task	6.20

Summary of results

The ability of two new output conditions to facilitate LT's realisation of target phonology (as measured by the number of correct responses) was investigated. In the first task LT was required to select the written picture name where the distracter comprised a semantically unrelated item. In the second task LT was asked to select the correct initial grapheme for the target from a choice of two. In both conditions LT followed the selection by an attempt to produce the target word.

LT's ability to complete the selection component of both tasks was impressive. In the unrelated select and name condition he was almost faultless, making only one error over the five trials. In the select grapheme and name task his success in identifying the correct grapheme was consistently above 80%, a level of performance significantly above chance.

Both output conditions resulted in a significant improvement in the number of correct responses when performance was compared with two picture naming assessments. Moreover, performance in the unrelated select and name task was indistinguishable from performance in the original select and name condition. In contrast, the facilitatory effect of the select grapheme and name condition was significantly less powerful than the original select and name task. The stability of LT's performance in the picture naming assessments precludes the possibility of spontaneous language recovery and identifies the results as arising specifically from the effects of the tasks.

Discussion

The results of the investigations replicate the previous finding that the accuracy of LT's spoken output can be improved by manipulating the naming condition. This was indicated by a significant increase in the number of correct responses. Analysis of neologistic responses in the original select and name task indicated that the increase in the number of correct responses was accompanied by an increase in the target relatedness of neologisms. The current investigations have not included an analysis of error responses. Nevertheless it is anticipated that these would also have benefited from the application of the two new select tasks. Phonological analysis of these responses would confirm whether the changes in the patterns of use for individual consonants replicated those patterns observed in the select and name data.

The results question the previous conclusion that the degree of semantic processing required to complete the selection determines the extent to which the task facilitates output processing. The benefit derived from selecting the target from a semantically unrelated distracter was indistinguishable from the effect seen in the original select and name task. In the original condition the distracter was designed to be closely semantically related to the target. It appears therefore that either the level of similarity between the two words fails to alter the degree of semantic processing involved in the task or that the depth of processing is not critical for the extent of the effect on output processing. The select grapheme and name task was designed to reduce semantic processing to a minimum. The significant facilitation of naming in this task further supports the suggestion that the level of semantic processing involved may not be as crucial as was previously assumed. Given this conclusion it appears that the superior facilitation of the semantic decision for the Palpa reading stimuli (Subtest 35) must arise from some other factor. For example, these stimuli may benefit from containing a number of very high frequency items and from having, as a group, a higher mean frequency than the stimuli controlled for consonant content (mean frequency for the stimuli in Palpa Subtest 35 = 101.87, mean frequency for consonant controlled stimuli = 29.47). Interestingly, this would be the first indication in an assessment task that lexical frequency may have a positive effect on LT's ability to realise target phonology. The fact that this indication does not become evident until stimuli are presented in the semantically primed reading task would support the previous conclusion that effects of lexical frequency on LT's output processing may be relatively subtle (Chapter 4). The suggestion that in this condition the presence of semantic priming and orthographic information may combine with an advantage offered by lexical frequency supports the hypothesis that complex and dynamic relationships exist between processing occurring at different levels within the lexical network.

LT's ability to identify correctly the initial graphemes for picture stimuli suggests some preserved ability to access lexical orthographic information. This was initially surprising given the severity of the impairment seen in written language production (see Chapter 4 for more details). Nevertheless the finding suggests that as with his spoken jargon, LT's attempts to produce written output may also be based on target lexical representations. This would be consistent with the effect of lexical status evident in delayed copying tasks (see Chapter 4). It is also consistent with other reports which have suggested that written jargon may represent the partial retrieval of target lexical orthographic information (Ellis et al 1983). Given LT's superior error awareness and comprehension skills in the written modality, the finding may also indicate that written output processing may be a potentially fruitful avenue for therapy.

A number of points argue against the proposal that LT uses the first letter information to generate a phonemic cue. There was no evidence in his behaviour to suggest that he was completing the task in this way. As in all other tasks, LT's output was fluently produced. No overt attempts to convert the letter into a phoneme were observed. As previously discussed, the severity of LT's auditory processing deficits makes it unlikely that he could exploit auditorily presented phonemic information even if he were able to produce this for himself using letter to sound correspondences.

Alternative explanations for the ability of the graphemic information to facilitate output processing rely on the possibility that LT is able to make internal or direct use of the graphemic information. This might involve the use of visual information to facilitate direct access to phonological information (e.g. Best et al 1997). This process might predict the beneficial effect of the task to be restricted to those items where the initial letter is correctly identified. It has already been demonstrated that no such relationship exists. Correct production of the target picture name was not contingent on the correct selection of the initial grapheme. However, the number of items correctly named despite an incorrect grapheme selection is relatively small, only eight items over the five trials. Given that LT has some baseline picture naming ability, these items may represent his level of performance in the absence of any additional information.

Two possible explanations for the facilitatory effect of the select grapheme and name condition therefore exist. Both rely on the ability of the graphemic information to increase the strength of the input signal to the phonological level. This may be achieved by one of two means. Correct first letter information may directly activate target phonological information via direct connections between visual and phonological levels of representation. This additional source of input would increase the activation level of the target phonology thus facilitating the ability to realise this information. Alternatively, the additional processing required to complete the orthographic decision may result in increased activation at the semantic level. For instance, activation may reverberate between the semantic and visual levels, thus supplying feedback to the target semantic nodes and resulting in a stronger signal being passed between the semantic and phonological levels. Obviously, this explanation requires the presence of feedback connections within the lexical network.

The select initial grapheme and name condition was initially designed to reduce the amount of semantic processing required in the selection component of the task. However, the condition also reduced the amount of orthographic information available. The robustness of the facilitatory effect of the select grapheme and name condition is therefore somewhat surprising. Given the severity of LT's output disorder it might be expected that the grapheme selection task, which drastically alters the nature of the decision and significantly reduces the quality of the visual information available, might fail to facilitate the retrieval of target phonology. This raises the possibility that the selection process is in itself beneficial, independent of the nature of the processing required to make the decision.

A consistent feature of all three select conditions is the delay they impose prior to the production of output phonology. This delay is introduced by two factors. Firstly, LT is required to suppress his naming attempts until after the two cards displaying the choice (whole word forms or initial letters) are presented. This ensures that his responses represent select and name responses rather than picture naming attempts. Secondly, LT typically then delays his naming attempts until after he has indicated his choice. The presence of this delay may facilitate output processing. For example, it may afford additional time for activation to spread through the lexical network. This may increase the amount of activation able to converge on target nodes at the phonological level, thus increasing the ability to realise these items. This proposal is not inconsistent with predictions made by other models of neologism production.

Schwartz et al (1994) propose that neologisms arise from the presence of weakened inter level connections in the lexical network. Weakened connections transfer activation between levels more slowly thus reducing the time during which energy is able to reverberate between the phonological and lexical levels. This account predicts that reducing the speech rate or increasing the time before the production of output phonology will serve to counteract the effects of the weakened connections, thus resulting in an increase in response accuracy.

Harley and MacAndrew (1992) investigated the proposal that neologisms arise from a reduced flow of activation from the semantic to lexical levels (Miller and Ellis 1987). Harley and MacAndrew simulated the effect of reducing the rate at which activation spreads between the semantic and lexical levels. Their results indicated that at very slow rates lexical targets become distinguishable only after a considerable number of processing cycles. This led these authors also to suggest that if jargon speakers were offered sufficient time they would eventually realise the correct target.

Thus the proposal that a processing delay may facilitate the realisation of target phonology is consistent with the expectations of a number of previously suggested mechanisms for neologism production. As Harley and MacAndrew (1992) point out however, these expectations are confounded by results indicating that successive approximations of target words do not improve over time. Miller and Ellis (1987) found that successive neologisms failed to become more target related across sequences of attempts at the same target. However, it might be counter-argued that successive approximations to a target phonology are qualitatively different from the imposition of a delay prior to speech production. Successive attempts at the same target necessarily require the products of the impaired processing to be realised. Many interactive activation models argue for the resetting of activation levels to zero following production. Thus subsequent attempts at a target may not benefit from the additional processing time. Moreover, since it is possible that only realised nodes are returned to zero after selection, while non realised nodes retain their previous level of activation, noise and the activation of error nodes may actually increase over time. This would predict that responses might in fact move further away from the target phonology, as indeed was found in the sequences of RD's neologisms investigated by Miller and Ellis (1987).

In contrast, a silent delay prior to the production of any output phonology as imposed by the select tasks may have a qualitatively different effect on processing within the system. Here the delay may allow activation to converge on target phonological nodes prior to the first response to the stimulus. Interestingly, this might suggest that the facilitative effect of the select conditions would be more marked in the first attempt at each target i.e. before the mechanism of post selection inhibition returns the realised nodes to zero. However, given that semantic priming and the availability of orthographic information also contribute to the effect offered by the condition the advantage felt by the first response may be relatively subtle. Nevertheless, it seems plausible that part of the facilitation offered by the select conditions arises from the delay imposed on LT prior to the production of response phonology.

The select and name conditions appear to involve three separate components each of which may positively influence the ability to realise target phonological information. These are the presence of a semantic decision, the availability of orthographic information and the imposition of a delay prior to the production of output phonology. The assessments presented in this chapter are unable to disambiguate the relative contribution that each of these components make to the facilitatory effect of the select and name tasks. However, it appears that the mechanisms which can strengthen the input signal to phonology may be more numerous and involve more complicated interactions than previously thought. Further investigations with tasks which varied these factors individually might inform this discussion further, particularly regarding the role of the delay prior to the production of output phonology. An initial task presented in Chapter 20 required LT to associate a semantically related written word with the picture before attempting to name the picture. This failed to produce a significant improvement in naming performance. However, the task was presented only once. In addition, the presence of the two written word forms may have distracted attention away from the target phonological information for the picture name, thus failing to facilitate LT's ability to realise this information. Further tasks might therefore attempt to isolate and investigate in more detail the contribution made by the delay component of the select and name tasks. For example, a further select and name condition might investigate whether LT's ability to realise target phonology is facilitated in a condition where he is required to make a non semantic and non verbal decision regarding the picture stimulus before attempting to name the target.

Two conclusions arise from the results of the current investigations. Firstly, it seems that the input signal to the phonological level can be strengthened via a number of means. Secondly, interactions between these processes may be necessary before significant changes are seen in the quality of LT's output. These conclusions support the previous suggestion that the production of neologisms by LT's system will be best understood within interactive lexical networks which specifically allow the summation of input activation from a number of different sources.

28. Mechanisms for activating error phonology

A principal requirement of any proposed account of neologism production is that it should explain the mechanisms by which non target phoneme nodes become activated during lexical processing.

The strong influence of phoneme frequency throughout the data indicates that high frequency consonants are easily activated erroneously. This may be best explained by an influence of frequency on the resting levels of activation for phoneme nodes. Thus high frequency consonants have higher resting levels of activation and require less input before becoming sufficiently activated to be realised in the response. Nevertheless, the model still needs to identify the original source of activation to non target nodes during processing.

One mechanism by which activation spreads to non target consonant nodes was demonstrated in Chapter 24. Investigation of the substitution data found a significant phonological relationship between target and error consonants. Error consonants were more likely to maintain the manner and place features of the target than was predicted by chance. This suggests that error phonemes may receive activation through their phonological similarity to segments in the target representation. Two further potential mechanisms by which error consonants may receive input during processing were investigated in the following analyses.

<u>Spreading activation from the semantic level</u>

The current model suggests that during naming a weak signal from the semantic system impedes the activation of target nodes at the phonological level. One of the consequences of the impaired semantic processing may be that the feed forward from the semantic level becomes distributed over a number of semantically related competitors at the lexical level. In fact this process may itself contribute to the weakening of the semantic signal, although LT's performance on the three picture version of the Pyramids and Palm Trees suggests that other aspects of semantic processing are also impaired.

The activation of semantically related competitors would allow these items to supply activation to their target phoneme nodes. This may provide a further advantage for high frequency phoneme nodes at the phonological level since these would receive activation from larger numbers of lexical items. However, in order to explain the fact that LT's neologisms are significantly target related, the account must argue that the majority of the input to the phonological level occurs via the target lexical item. Nevertheless it is possible that the activation of error consonants may occur, at least partially, via activation from semantic relatives to the target lexical item.

Error phonology in the select and name task was used to investigate this proposal. The select and name condition presented each written target with a written semantic distracter. This allows the error phonology in LT's responses to be compared with the phonology of a single semantic competitor to the target item. The following analysis investigated whether non target consonants in LT's selected neologisms from the select and name task were derived from the semantic distracter.

The selected non word responses in the select and name data contained a total of 374 error consonants (Column Five, Table 22.1).

Each selected neologism was analysed separately. Neologisms were paired with their semantic distracters and the number of error consonants which also appeared in the phonology of the distracter were counted. Error consonants were only considered to be derived from the semantic distracter when each occurrence of the error consonant had a corresponding occurrence in the distracter. This was in accordance with the previous calculations investigating the target relatedness of neologisms.

The analysis identified 75/374 error consonants as potentially originating from the semantic distracter. In order to control for the effect of chance a randomisation procedure was carried out.

The ten select and name trials continued to be analysed separately. Error consonants in the neologisms were extracted from the non word responses and randomly reassigned to the semantic distracters. The same number of pseudo error consonants were allocated to each distracter as had appeared in the original non word response for that item. The number of pseudo error consonants occurring in the semantic distracters was then counted. The analysis identified that 63/374 pseudo error consonants were also present in the semantic distracter. This number was not significantly different from the number found in the genuine data (Chi square 1.1, not significant).

The analysis thus failed to demonstrate any influence of the semantic distracter on the identity of the error phonology in LT's selected neologisms. This may indicate that during output processing error consonants at the phonological level do not normally receive activation from semantically related lexical competitors to the target. This would be consistent with the findings of Levelt et al (1991) who found no evidence to support the claim that the semantic relatives of the target item become phonologically activated during output processing. However, two limitations require the conclusion from the current analysis to be only tentative.

Firstly, the analysis considered only the influence of a single semantic distracter on the construction of error phonology. During processing, phoneme nodes may receive input from a much larger number of partially activated semantic relatives. Consequently, it may be that no single semantic relative can significantly influence the identity of error phonology. Rather, the activation of non target consonants may arise through the summation of input from several semantically related lexical items. This may preclude the current analysis from detecting the influence of the single semantic distracter on the selection of error consonants.

The written words in the select and name task make the identity of the semantic distracter explicit. Moreover, in order to complete the selection, LT is required to reflect on the semantic properties of this item. It might therefore be anticipated that the particular semantic distracter present in each trial would receive greater activation than it would normally obtain during naming. This in turn would predict that it supplies a greater than normal amount of activation to its component phonology. This would increase the ability of these phonemes to appear in the response. The fact that LT's output becomes more target related in the select and name condition rather than less so suggests that some other process must also be operating. For example, the additional activation supplied to the target lexical node by the written stimulus may enable this item to exert a greater inhibitory effect on competitors during the select and name task. In this case, any potential influence of the distracter on the selection of error phonology would be diminished. This account therefore offers a further explanation for the failure of the current analysis to detect an influence of the semantic distracter on the selection of error phonology.

Residual levels of activation from previous responses

A second potential mechanism facilitating the production of error phonology may be the residual activation of phonemes following their realisation in previous responses. A number of interactive activation models argue for the post selection inhibition of activated nodes (e.g. Dell and Reich 1980, Dell 1988). Nevertheless, the perseverative use of phonemes is frequently noted (e.g. Schwartz et al 1994) and it is assumed that these consonants benefit from their appearance in a previous response. For example, Miller and Ellis (1987) argue that the weakened input from the lexical level diminishes the strength of the inhibition supplied to previously activated phoneme nodes. Thus, the phonemes represented by these nodes are likely to be incorporated in subsequent responses, producing a perseverative pattern of phoneme use.

The corpus of error consonants in LT's highly target related neologisms was used to investigate the potential influence of perseveration on his use of error phonology. The investigation used the two sets of consonant substitutions from the naming and select and name data. These were marked for whether the error consonant had appeared in any response to the previous target in the assessment. Chapter 24 developed a corpus of pseudo consonant substitutions by reassigning the error consonants to the neologisms such that the resulting pseudo error remained phonotactically legal. This corpus of pseudo consonant substitutions was used to control for the effects of chance. This was achieved by examining whether the responses to the previous stimulus in the assessment also contained the pseudo error consonant.

The genuine data indicated the number of error consonants which had appeared in previous responses to be very small; 33 over the 148 items. This was not significantly different from the number found in the pseudo error corpus (26/148; Chi square 0.8, not significant).

Neither the naming or the select and name substitutions differed significantly from chance when the groups were analysed separately. Furthermore, there was no effect of the identity of the error consonant or whether the consonant occurred in the previous response as a target related or error phoneme. The analysis therefore failed to detect any perseverative influence on the use of error consonants in LT's responses. This finding is obtained despite the fact that LT typically overuses the high frequency consonants as error phonology. This suggests that LT's overuse of the popular consonants is predominantly influenced by their frequency rather than by perseverative processes.

Discussion

Two potential mechanisms which might account for the activation of error phonemes in LT's non word output were examined. Neither the phonology of the semantic distracter in the select and name task nor the use of a consonant in a previous response were found to significantly influence the identity of error phonology in his responses. Consonant frequency and phonological similarity with the target phoneme thus remain the only identified factors which determine the selection of non target nodes at the segmental level. However, the possibility remains that other, as yet unidentified factors, also influence the production of error phonology in LT's system.

29. An attempt to explain LT's neologisms within an interactive lexical network

A number of the findings from the current investigations support the conclusion that LT's non word output may be best explained within an interactive activation account of lexical processing.

The significant target relatedness of neologisms suggests that these responses represent the partial realisation of target phonological information. This in turn indicates that phonological representations may not form a single entry within the output processing system but may rather consist of a network of information which can be realised independently. While serial models rely on the presence of a single entry within a phonological lexicon, interactive activation accounts specifically argue that target phonological information is represented by nodes distributed over a number of levels of representation. Thus these models are particularly well suited to explaining how target information may be partially realised in LT's non word output.

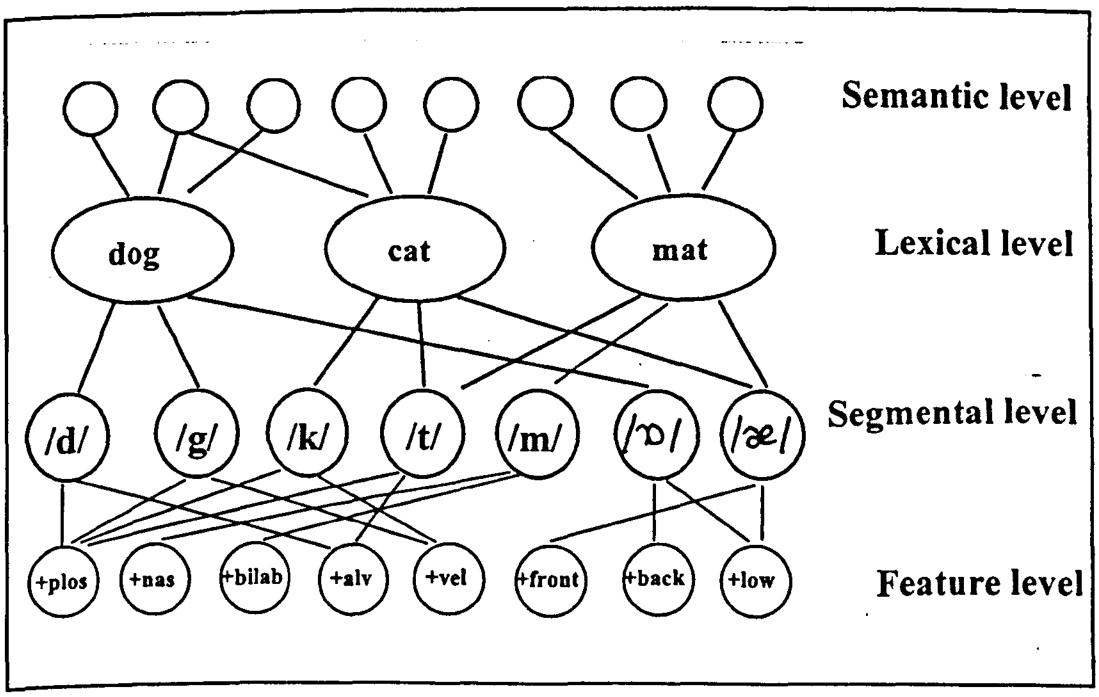
Investigations in Chapter 20 indicated that both the components of the select and name condition were required for the task to facilitate the realisation of target phonology. This suggests that the facilitatory effect offered by the condition arises from the summation of the additional activation offered both by the semantic decision and by the written stimulus. Interactive lexical networks allow input activation arising from different sources to interact and converge on target representations during lexical processing. These accounts are therefore consistent with the suggestion that the summation of two sources of additional input facilitates the realisation of target phonological information in the select and name task. The accounts are also able to explain how further manipulations of the select and name task continue to offer a facilitatory effect to the retrieval of output phonology.

Finally, the influence of target feature level information on the selection of error consonants in the consonant substitution data suggests that the realisation of phonemes may not result from the activation of a single segment node in the lexicon but may rather rely on the activation of a set of features which, when combined, represent the specification of an individual phoneme. Again, this would be most readily accounted for by interactive activation networks which allow the inclusion of a level of representation corresponding to this information.

A number of interactive activation models of lexical processing have been suggested in the literature. These differ in terms of their architecture and in the precise mechanisms by which they allow activation to flow through the system. The following account is not an attempt to suggest a new model of lexical processing. Rather, it explores how the results of the current investigations might best be accommodated within a lexical network which exploits the general principles of such models.

Interactive lexical networks typically comprise three layers of representation. These consist of nodes within semantic, lexical and segmental levels. In addition, a number of authors have argued for the presence of a layer of representation corresponding to feature level information (e.g. Dell and Reich 1980, Stemberger 1985, Dell 1986). A simplified lexical network showing these levels of representation is illustrated in Figure 29.a. The levels of representation are discussed in more detail below.

Figure 29.a A simplified lexical network comprising semantic, lexical, segmental and feature levels of representation



Semantic level

Nodes at this level represent semantic features. The level is conceptual rather than verbal. Groups of nodes corresponding to the semantic representation for a lexical item send activation to the relevant node at the lexical level.

Lexical level

This is the first verbal level. Each lexical item is represented by a single lexical node. Lexical nodes supply input to their target nodes at the segmental level. The resting levels of activation for lexical nodes are frequency influenced. This allows for the effects of lexical frequency which are commonly observed in aphasic word retrieval. The higher resting levels of activation for high frequency lexical nodes may allow for the relative preservation of function words in LT's output, given the frequency advantage that these items enjoy over content words.

Segmental level

This level contains nodes representing individual phonemes. Phoneme nodes connect forward to nodes at the feature level which encode the feature specification for that phoneme. In a departure from some previous models (e.g. Dell 1988, 1989) it is suggested that the resting levels of activation of phoneme nodes are also influenced by their frequency of use in the normal language. Higher frequency phonemes thus have higher resting levels of activation.

Feature level

Nodes at this level represent feature information. Individual nodes correspond to each of the possible values for manner and place of articulation, for example **+ alveolar, + plosive**. It is as yet unresolved whether voicing status is also encoded at this level of representation.

Nodes at each level are connected to their target nodes at the subsequent level of representation by feed-forward connections. The presence of feedback connections within interactive networks has been called into question (e.g. Levelt et al 1991, Nickels and Howard 1995). For this reason inter-level connections in the current explanation will be considered to be unidirectional. The account remains open to the possible presence of within-level inhibitory connections although none of the accounts of lexical processing offered by this account stands or falls on the presence or absence of such inhibitory connections.

A principal assumption of the account is that activation cascades through the network with partially activated nodes able to supply input to lower levels of representation before processing at the previous level is completed.

Processing within the network during naming

LT's semantic errors in comprehension tasks and his poor performance on the non verbal Pyramids and Palm Trees assessment indicate that processing within the semantic system is impaired. The semantic deficit in the lexical network must therefore comprise more than just weakened connections between the semantic and lexical levels. Rather it is suggested that the impaired semantic processing allows semantic nodes to supply only weak activation to the target lexical node. This has a number of implications. Firstly, the weak input to the lexical level diminishes the amount of activation that the target node is able to supply to its target nodes at the segmental level. Secondly, the presence of only weak activation diminishes the advantage of the target lexical node over its competitors at the lexical level. Thus the relative difference between the activation levels of target and error lexical nodes is less than might be expected during normal processing. This in turn may allow the error lexical nodes to supply greater amounts of input to their phonemes at the segmental level than would normally be possible. This would increase the activation of error phonemes. The activation of error phonology would be further advantaged by the fact that the weakly activated target lexical node may offer less inhibition to its competitor nodes at the lexical level. This again would increase the ability of the non target lexical nodes to supply input to error segments at the phonological level.

The processing as described results in target nodes at the phonological level receiving reduced amounts of activation. This reduces the normal distinction between the activation levels of target and non target phoneme nodes. Error segments therefore offer stronger competition to target phonology than would occur in the normal system. The effects of error activation are augmented at the phonological level since activation is distributed to a broad base of error phonemes. Thus the amount of error activation in the system increases at lower levels of representation. This allows an influence of phoneme frequency to become evident. It may also explain discrepancy between the marked and pervasive influence that phoneme frequency exerts on LT's output processing and the more subtle influence of lexical frequency. Miller and Ellis (1987) argued that the weak activation of target nodes at the lexical level predicts an effect of lexical frequency on the ability to realise word phonologies. Nodes for high frequency words benefit from higher resting levels of activation and are thus less affected by the weakened input signal. The current proposal that the higher resting levels of phoneme nodes also offers these items some resistance to the effects of weak activation simply extends this hypothesis. Nevertheless, the proposal may require an adaptation to those models which argue that resting levels of activation vary with frequency only at the lexical level, all phoneme nodes being assumed to rest at zero.

As suggested, high frequency phoneme nodes may also benefit from receiving activation from greater numbers of nodes at the lexical level. It is therefore possible that the phoneme frequency effect arises not from differences in resting levels of activation but from the fact that popular segments receive activation from a greater number of sources. It is thus difficult to determine the exact source of the phoneme frequency effect. Dell (1990) examined various mechanisms used to explain the effects of lexical frequency. These included higher resting levels of activation for frequently used lexical nodes (e.g. Stemberger 1985, Dell 1988) and stronger input connections to nodes representing higher frequency words (e.g. MacKay 1982). Alternatively, higher frequency lexical nodes may benefit by receiving activation from a greater number of sources (e.g. Dell 1986). While the various accounts differ in the mechanisms by which they encode lexical frequency information, Dell (1990) concluded that the functional implications of the accounts are similar. Thus the current explanation will not attempt to differentiate between the potential mechanisms which may contribute to the effect of frequency operating at the phonological level, but will continue to assume that the effect arises predominantly from differences in the resting levels of activation of segment nodes.

The significant level of target relatedness evident in the neologisms indicates that the greater amount of activation to the segmental level must occur via the target lexical node. Thus low frequency phonemes receive greater input when they occur in the phonology of the target word. The rare consonants are therefore only likely to receive sufficient activation to overcome their frequency disadvantage in contexts where they are demanded by the target phonology. This results in the use of these segments being restricted to target related contexts and produces their infrequent but highly accurate pattern of use.

Activated segment nodes supply input to their target nodes at the feature level. Thus even when target segment nodes are unable to overcome the competition from error phonemes, their partial activation may allow them to influence the activation of feature nodes. This accounts for the greater than chance preservation of the target features of manner and place of articulation in the consonant substitutions.

Processing within the network during the select and name task

The activation of the target lexical node is increased in the select and name task by two mechanisms. Firstly, the semantic decision increases the processing within the semantic level. This results in the semantic nodes supplying greater activation to the target node at the lexical level. Secondly, the written stimulus provides additional input directly to the target lexical node via connections from the visual input system. The additional input supplied by these two sources is summated at the lexical level, resulting in the greater activation of the target node. This in turn allows the target lexical node to supply greater activation to its component nodes at the phonological level. The greater activation of the target node at the lexical level may also allow it to exert a greater inhibitory effect on its semantically related lexical competitors. This would reduce the amount of activation these items are able to supply to error nodes at the phonological level. The increased input to target phoneme nodes and a possible reduction in the activation of error phoneme nodes increases the activation distinction between target and error phonology. This facilitates the realisation of target phonology in LT's output, resulting in greater numbers of correct responses and an increased target relatedness of non word responses.

The strengthened signal to the phonological level differentially affects the activation of low and high frequency phoneme nodes. Low frequency target nodes more commonly receive sufficient activation from the target lexical node to be realised and are therefore more frequently present in the responses. At the same time, non target related uses of the high frequency phonemes are reduced by two possible mechanisms. Firstly, the increased availability of the lower frequency phonemes reduces the number of occasions when high frequency phonemes are able to replace target phonemes and appear as error phonology in the response. Secondly, the high frequency phoneme nodes may receive less activation from non target lexical nodes owing to the relative reduction in the activation of these nodes at the lexical level. The number of error uses of high frequency phonemes is therefore reduced, so increasing their overall rate of accurate use.

Finally, the suggestion that the process of making the selection itself may facilitate output processing can also be accommodated by the current account. It is suggested that the decision process imposes a delay prior to the production of output phonology. This lengthens the time during which activation may converge on target nodes at the phonological and feature levels of representation. There are two potential mechanisms for the selection of nodes at each level of representation. The selected node may represent the first node to achieve a threshold level of activation (e.g. Stemberger 1984). Alternatively, at the point of selection, the most highly activated node may be retrieved (e.g. Dell 1986). If the latter process is accepted then the delay provided by the select and name task should provide additional time during which the increased activation from the target node at the lexical level can converge on target nodes at lower levels of representation. This should further facilitate the ability to realise target phonology. In fact, the suggestion that the processing delay may benefit the ability to realise target phonology argues that selection from each level must occur at a 'decision point' rather than with a 'first past the post' mechanism. The widespread misuse of the high frequency consonants indicates that these nodes would very easily achieve threshold levels of activation. In a 'first past the post' mechanism the presence of a processing delay would therefore be unlikely to offer an advantage to lower frequency target phonemes. Higher frequency error phonemes would continue to reach threshold more quickly than target nodes. Thus an increase in response accuracy would not be predicted. The proposal therefore provides tentative support for phonemes being selected at a point of decision. However, even within the context of nodes being selected at a decision point, it is unlikely that the presence of a delay alone would be sufficient to significantly increase the target relatedness of LT's output. Rather it is probable that the delay prior to the production of output phonology serves to augment the beneficial effect of the additional input to the lexical level offered by the semantic decision and orthographic information.

Semantic errors and semantic + phonological errors

The account argues that LT's non word responses arise from weak activation of target lexical nodes. The lexical node is thus unable to ensure that each of its target nodes at lower levels of representation receive sufficient activation to be realised in the response. Thus target phoneme and feature level nodes may be unable to match the activation levels of competitor nodes at each layer.

When a single node at the lexical level does receive sufficient activation to guarantee the full realisation of its constituent phonology a real word response occurs. Where the lexical node corresponds to the target word a correct response is produced. Where the lexical node corresponds to a semantically related competitor, a semantic error is produced. On some occasions a competitor node at the lexical level may be more activated than the target node but still receive insufficient input to ensure that all its phonological components are realised. In these circumstances a semantic + phonological error is produced. The low number of lexical responses in LT's output suggests that in the majority of cases the activation received at the lexical level is insufficient for any single node to ensure the realisation of all its target nodes at the lower levels of representation. However, the low numbers of semantically based errors coupled with the significant target relatedness of LT's neologism responses indicates that while only weakly activated, the target lexical node receives the greater share of the input from the semantic level.

The weakened connections account of non word production

The current account agrees with a number of previous interactive activation accounts of neologism production by identifying the processing deficit as a failure to fully activate target phonological nodes from the lexical level (Miller and Ellis 1987, Harley and MacAndrew 1992). Each of these theories argues for the presence of a relatively specific deficit between the lexical and phonological levels.

In contrast, Schwartz et al (1994) suggest that neologisms would be produced by a global weakening of inter-level connections throughout the interactive lexical network. This impairment would serve to reduce the efficiency with which target phonological nodes are activated, although the global nature of the impairment suggests that further processes would also operate at other levels within the system. Schwartz et al (1994) suggest that the weakened connections are accompanied by an error pattern characterised by a high rate of errors, the production of non lexical forms and the perseverative use of phonology. This 'bad' error pattern may be improved by any factor which allows the system to overcome the deficit posed by the weakening of the connections, for example the strengthening of connections through practice or through recovery. Strengthened connections are indicated by a change in the error pattern whereby error responses are reduced, errors become dominated by the production of lexical forms and phonological errors are increasingly anticipatory in nature. Schwartz et al describe this as a movement from a 'bad' to a 'good' error pattern.

If this account of neologism production is accepted for LT's non word output then his performance in the naming condition should reflect the 'bad' error pattern. Similarly, the recovery in output processing evident in the select and name condition should reflect a shift towards the 'good' pattern.

LT's naming performance conforms to the first two requirements of the bad error pattern. His output shows a high error rate, evident at both the level of whole responses and in the production of individual phonemes. Despite being more target related than chance predicts, LT's neologisms are not typically highly target related. Investigation of his consonant use in the naming condition showed that error uses of consonants are more prevalent than the number of target related occurrences. LT's output is also consistently dominated by the presence of non lexical forms. This supports the conclusion that no lexical bias effect is evident in his output. Possible real words identified as jargon homophones formed only a very small proportion of his neologistic responses. Real words and real word semantic errors were also rare. However, LT fails to show the perseverative use of phonemes required by the bad error pattern. Despite his popular use of the high frequency consonants, analysis of his error consonants in the high frequency substitutions demonstrated that these could rarely be attributed to the preservation of the phonology from a previous response (see Chapter 28). Moreover, the small number of potentially perseverated consonants was found to be no greater than was predicted by chance in a pseudo error corpus.

According to the account of weakened lexical connections, LT's output in the select and name task should represent a shift towards the 'good' error pattern. There is little evidence that this is the case. LT's output does show a reduced error rate in the new condition. This is evident in the increased number of correct responses and in the reduced use of error phonology. However, there is no evidence for an increased lexical bias in his error responses. Jargon homophones in the set of selected neologisms occur at the same rate in the two sets of data (naming data; 133/375, select and name data; 104/336, Chi square 1.4, not significant). Finally, since a perseverative use of phonology was absent from the naming data, this effect cannot be reduced in the select and name responses. Unfortunately, the nature of the sample precludes the investigation for an increased rate of anticipatory errors. Since single word responses are required in a picture naming task and since LT is unaware of the identity of the following item, possible effects of upcoming phonology are eliminated.

The failure of LT's naming responses to conform to the predicted error pattern and his failure to move towards the good error pattern in the select and name task suggest that his non word production would not be well accounted for by the proposal of globally weakened connections.

Explaining input deficits in interactive activation models of language processing

Dell (1985, 1989) has suggested that auditory input processing is achieved by information flowing in the reverse direction through the network of connections responsible for output processing. Information thus flows from lower levels of representation towards the semantic level. Dell argues that the presence of bidirectional inter level connections makes this possible. During output processing these bidirectional connections supply feedback from later to earlier levels of representation. When engaged in input processing the connections act as feed forward links, transferring activation from peripheral to more central levels of processing.

The argument that a single phonological component is responsible for input and output processing has been criticised both in relation to serial processing models of language production (e.g. Miller and Ellis 1987) and interactive activation accounts (e.g. Nickels and Howard 1995). In particular, a single network responsible for the processing of both input and output information is challenged by dissociations between impairments of auditory comprehension and spoken language production. These are well documented in the literature and in particular a number of neologistic speakers are described who present with well preserved auditory comprehension skills (see for example Butterworth 1985, Butterworth and Howard 1987, Robson et al, in press).

Martin and Saffran (1992) use a modified version of Dell's (1986) spreading activation model to account for the symptoms of deep dysphasia observed in an aphasic subject, NC. Martin and Saffran argue that NC's errors in comprehension, repetition and naming can be explained by a pathological increase in the rate at which nodes lose their activation. This processing impairment is global, affecting all levels of representation. Moreover, Martin and Saffran argue that NC's pattern of deficits can be accommodated by a model which uses the same network of nodes to process both input and output information. In support of this claim, Martin and Saffran argue that such a proposal does not require input deficits to mirror output errors. They identify that within spreading activation models the efficiency of processing at earlier levels of representation directly influences the adequacy of processing occurring at later stages. The sequential order of processing stages is reversed during comprehension and production. Thus Martin and Saffran argue that same processing impairment may predict qualitatively different error patterns and quantitatively different error rates for input and output processing.

LT presents with severe disruptions to both auditory processing and spoken language production. Nevertheless, the assumption that input and output processing are achieved by the same processing mechanisms still fails to explain his pattern of deficits. The impairment proposed to account for his production of neologisms consists of a disruption to processing at the semantic level, creating a weak input signal to the lexical level. Later processing is disrupted only by the weak activation of target nodes and the proliferation of error activation, in other respects processing at subsequent stages in the system is assumed to be intact. Errors are therefore created by the disordered input to these levels rather than by deficits such as the loss of representations or the weakening of connections. Reversing the direction of activation flowing through the network would therefore predict that processing would proceed normally at the lower levels of representation (i.e. feature and segmental levels), becoming disrupted only once the impaired semantic level was implicated. The account would therefore predict a pattern of predominantly semantically based errors in comprehension. However, it fails to predict the marked deficits in peripheral auditory processing which are evidenced by LT's poor performance on tasks such as minimal pair discrimination. Thus, in predicting qualitatively different error types for language comprehension and production, Martin and Saffran's proposal is unable to explain the similarities seen in LT's errors in the two modalities. The account of LT's neologism production thus provides further support for the argument that input and output processing must be achieved by lexical networks which are, at least in part, modality specific.

Commonalities with other accounts of neologism production

Chapter 2 identified that theories of neologism production can be categorised into four main groups. The account offered here would be most appropriately placed with other explanations which argue for the partial activation of target phonological information. Nevertheless, the proposed explanation shares some similarities with the other types of account. For example, the account agrees with the 'non lexical' accounts that the initial processing difficulty comprises a difficulty in the retrieval of target lexical information. However, the two types of account differ in important respects regarding the partial availability of this information and the source of the error phonology. The proposed account also agrees with phonemic distortion accounts that the phonological specification of the target lexical item forms the basis for the disordered output. These accounts then differ in whether they regard phonological information to be represented by a single entry or distributed across a number of layers of representation. They also disagree regarding the point at which the information becomes disrupted, i.e. whether this is during or after the retrieval of the information. Finally, the explanation offered for LT's neologisms agrees with dual impairment accounts that other lexical items may be involved in the production of the non word. However, once again there are important differences. Dual impairment accounts argue for a complete lexical substitution to occur prior to the onset of phonological encoding. In contrast, the current account retains the target lexical item as the principle motivator of phonological information but allows the possibility that competitor lexical nodes may contribute to the activation of error phonology.

Modelling neologism production in interactive lexical networks

As discussed, the proposed account represents an attempt to accommodate the findings of the current investigations within an interactive activation account of lexical processing. It is unclear how closely the account describes the genuine mechanisms underlying neologism production in LT's language processing system. It is also uncertain whether the proposed account would be able to replicate the principal features of LT's output during computational modelling. However, future studies might pursue this question and should be informative regarding the validity of the suggestions made here.

Explaining fluent and non fluent output

A final concern regarding the proposed account centres on the production of fluent and non fluent speech errors. In the current explanation the weakened semantic to lexical level signal is seen to precipitate the fluent production of neologistic output. However, similar impairments have been used to account for the qualitatively different spoken errors and aborted naming attempts of non fluent speakers (e.g. Howard and Orchard-Lisle 1984). Moreover, the output of these speakers has also been found to be significantly facilitated by the completion of semantic tasks prior to naming attempts (e.g. Howard et al 1985a, Howard, Patterson, Franklin, Orchard-Lisle and Morton 1985b, Marshall et al 1990). At their current level of development, accounts of aphasic language fail to explain why similar processing impairments give rise to distinctly different error patterns and similar tasks reduce the production of more than one type of error response. The current theory of neologism production also fails to resolve this issue. However, a number of possibilities might be considered.

Firstly, the proposed models may currently offer insufficiently detailed descriptions of the processing impairments underlying aphasic output. For instance, impaired processing between the semantic and lexical levels may comprise a number of qualitatively different deficits, e.g. a weakened input signal to the lexical level, raised thresholds of activation for lexical level nodes, the loss of within level inhibitory connections or impairment of the mechanism used to select the most highly activated lexical node. Given the complex interactions involved in interactive lexical networks, it is more than likely that the differences between these processing deficits would result in significantly different error patterns. It may therefore prove vital to specify the precise nature of the aphasic impairment. If this is the case, then the failure of the models to distinguish fluent and non fluent output may simply arise from the level of description which they currently offer.

A second possibility is that the realisation of neologistic errors results from an interaction between the proposed semantic to lexical level deficit and an additional impairment of output processing. It has previously been suggested that the failure to eliminate non lexical errors in jargon aphasia may originate from a deficit occurring within the output processing system itself (e.g. Laver 1980, Schwartz et al 1994). The proposal that within interactive activation models the loss of feedback connections can explain the proliferation of non word errors has recently been challenged (Nickels and Howard 1995). Nevertheless, it remains possible that another, as yet unspecified, processing deficit within the lexical network is responsible for the loss of monitoring ability. In this case, the generation of non word errors during output processing and their subsequent realisation in spoken output may be dependent on the dual occurrence of both processing impairments within the system. In contrast, non fluent speakers may present with a single impairment of lexical processing. Thus, neologistic errors may be 'edited out' by the normal monitoring mechanism prior to their production, so resulting in a non fluent presentation. Obviously, this account would still need to explain how neologistic speakers with good auditory processing skills nevertheless remain insensitive to the disordered nature of their speech.

Interactive activation models are obviously well placed to capture the complexity of the processes and interactions involved in normal lexical processing. As suggested here, their complexity may also allow them to offer more detailed explanations of the processing impairments underlying aphasic speech. However, there is a risk that attempts to explain aphasic output within these models will simply rely on an increasing number of different processing impairments and the potential interactions between these deficits. In this respect, computational modelling may offer a useful means for investigating the validity of the proposals, for example by examining the ability of lesioned networks to simulate aphasic data.

30. Future directions

The current study investigated several aspects of LT's spoken output. A number of other lines of investigation remain and might be pursued in future studies.

Vowel production

Investigations of LT's attempts to name the Palpa stimuli indicated that his use of vowels matched the normal English frequency distribution for these phonemes. Vowels therefore appear to follow consonants in maintaining the normal ranking for overall frequency of use. As discussed in Chapter 8, the Palpa naming data is unable to determine patterns in the target related use and misuse of phonemes. This led to the development of the stimuli controlled for consonant content. A vocabulary controlling the use of the 20 English vowels was developed at the same time. Analysis of LT's responses to these stimuli might therefore reveal whether systematic patterns are also present in LT's accurate and inaccurate use of vowels and whether these patterns, like those discerned in the use of consonants, are largely determined by phoneme frequency. Similarly, the ability of select and name output conditions to increase the accurate use of vowels might also be investigated. Agreement between the two groups of phonemes on these features would lend support to the current interpretation of the consonant data.

Neologism structure

The ability of neologisms to maintain features of the target word such as syllable length, CV structure and stress pattern were not examined by the current study. Observation and preliminary investigations suggested that LT's responses typically complicate target length and syllable structure. They also appear predominantly to follow the typical English pattern of a stressed initial syllable. Difficulties encountered during pilot analyses indicated that more detailed investigations would require the development of stimuli systematically controlling these features of target phonology. Future investigations might therefore examine the ability of LT's neologisms to maintain structural features of the target phonological representation. This should determine whether target structural information exerts a significant effect over the construction of non words or whether neologism production relies on default patterns for structural information. Additionally, the ability to facilitate this aspect of response accuracy through altering the output condition might be examined. It has been suggested that interactive lexical networks should incorporate levels of representation corresponding to structural information such as the consonant vowel structure (e.g. Dell 1988, 1989). The results of these future analyses might therefore be informative regarding the presence of structural levels of representation in interactive lexical networks. Currently, the model remains open to the possibility that levels of representation corresponding to this information may be present in the network. In fact, the presence of such levels might provide a convenient mechanism by which to explain the overwhelming ability of LT's non word responses to conform to the phonotactic constraints of English.

Changes in the patterns of consonant use

The study has monitored LT's progress over a period of two and a half years following the onset of his aphasia. Only very limited recovery of language function has been evident. Unlike the results of other studies which have followed the progress of neologistic speakers (e.g. Kohn and Smith 1994a), LT's spoken output has shown no discernible change. This suggests that his speech is now unlikely to show spontaneous recovery. However, other changes in the nature of his spoken output remain possible. These arise from the strong influence of phoneme frequency on the content of neologisms and from the way in which this information may be encoded in the lexical network. A number of mechanisms have been suggested by which frequency information may be represented in interactive activation models of language processing. Stemberger (1985) and Dell (1988) have suggested that the repeated access of high frequency lexical items raises the resting levels of activation of the nodes representing these items. It would not be unreasonable to suggest that frequency information is encoded at the phonological level by the same process. However, it is unclear whether resting levels are continually being updated in response to fluctuations in the frequency with which nodes are activated. If this were the case, then LT's predominant use of high frequency phonemes might predict that these items would benefit from progressively higher resting levels of activation. As a result, lower frequency phonemes might become increasingly inaccessible to the system, their frequency disadvantage eventually precluding them from appearing even in target related contexts. Ongoing investigation of the phonemic content of LT's neologisms might therefore monitor for the progressive collapse of LT's phonemic inventory to the stereotypic use of a restricted set of high frequency phonemes. Such an evolutionary pattern would not be dissimilar from the stereotypic use of a restricted vocabulary of high frequency lexical items which has been observed in neologistic speakers who resolve to a presentation of Empty English Jargon (Panzeri et al 1987). This evolutionary pattern for the use of phonemes would also suggest that therapeutic intervention might usefully involve the repeated targeting of low frequency phonemes through stimuli biased for these consonants. This might serve to maintain the availability of lower frequency phonemes. It also suggests that while therapy studies have commonly reported difficulties in improving the accuracy of the spoken responses of jargon speakers, intervention might prevent a deterioration in performance. Communicatively, the presence of low frequency phonemes in LT's output is important given their significant contribution to the target relatedness of his neologistic responses. This feature is occasionally able to support the identification of the intended target.

Investigation of connected speech

Apart from an initial sample of connected speech, the current study was restricted to analysis of LT's spoken responses in structured tasks such as picture naming and reading aloud. However, previous studies have shown that jargon speech may show qualitative differences across output conditions (Kohn and Smith 1994a). Future investigations might therefore be directed at establishing whether the patterns of consonant use observed in the current data are replicated in LT's connected speech. Obviously, such analyses would be hampered by the fact that in this condition the targets for LT's neologisms are typically obscure to the listener. This would prevent investigation of the target related use of consonants. However, analyses might aim to establish the overall distribution of consonants, so allowing comparison with the phoneme distributions both for real English words and LT's single word output. Agreement in the frequency distribution of phonemes across the two output conditions would provide a useful replication of the results of the current analyses. Alternatively, significant differences might be anticipated. For example, it might be predicted that the preferential ability to realise high frequency consonants would be exaggerated in connected speech. This might occur for a number of reasons. For instance, the increased rate of processing required for the production of connected output might reduce the amount of time during which activation can converge on low frequency target phonemes. This would further restrict their ability to appear in LT's spoken output and would exaggerate the bias towards the use of high frequency segments.

Further output conditions

The investigations in the current study successfully identified a number of output tasks which significantly facilitated the production of target phonological information. Rather disappointingly none of these conditions precipitated significant changes in response accuracy once the output task reverted to picture naming. This finding was consistent with the observation that LT's spontaneous output has shown little recovery over the course of the study. In addition to the failure of the select and name tasks to create lasting changes in the accuracy of LT's output, no task has been identified which is able to improve response accuracy beyond the level achieved by the original select and name task.

Future investigations might therefore aim to develop a condition that offers a significantly greater benefit to LT's ability to realise target phonological representations. Other work might usefully investigate whether the benefits of the select and name tasks can be applied therapeutically. Although repeated assessment with the tasks has so far failed to generalise to picture naming, it is possible that more intensive use of the task might be beneficial. Additionally, it is suggested that an effect of lexical frequency becomes evident in the select conditions (see Chapter 27). This raises the possibility that therapeutic effects of the task might be more easily achieved with higher frequency lexical items. Given this possibility, a future therapy study might combine the repeated administration of the select and name task with a vocabulary of higher frequency target words.

Alternatively, it may be possible to utilise the implications of the task therapeutically. Results suggested that three components of the select and name task (the semantic decision, orthographic information and processing delay) may combine to facilitate the production of target phonology. It might therefore be possible to encourage LT to precede spoken attempts at individual targets with a pause during which he completed some decision regarding the item he was targeting. This strategy might be implemented by asking LT to identify the target initial grapheme from an alphabet chart. Obviously, the use of the strategy would be hampered by both the laborious nature of such a task and by

LT's poor error awareness for his spoken output. Consequently, the potential value of the strategy might be restricted to situations where the successful realisation of a single lexical item would significantly facilitate the communicative interaction. Nevertheless, given the extreme nature of the communication impairment such an approach may be of some value to both LT and his wife.

Other directions for therapy

If spoken output continues to be resistant to lasting change, therapy may be more usefully directed at establishing alternative communication strategies. Some therapy time has already been invested in encouraging LT to supplement his spoken output with the production of simple, iconic gestures and the use of a communicative notebook. Nevertheless, LT continues to rely predominantly on spoken output for communication. There have been recent suggestions that his ability to manipulate orthographic information may be showing some recovery. He is increasingly able to sort three and four letter anagrams using letter tiles (with a picture stimulus present) and can often then complete delayed copying of the item successfully. Error awareness for written output is limited but superior to monitoring for spoken output. Furthermore, LT will sometimes attempt to produce written output in situations of communication breakdown. This strategy has been communicatively successful on a number of recent occasions and indicates a willingness to utilise the written modality as a supplementary form of communication. These factors may therefore suggest that therapy could enable LT to acquire a small, written vocabulary which he could use to facilitate communication. A recent therapy study with an undifferentiated jargon speaker found that writing therapy was able to establish the reliable production of a small vocabulary, despite similarly impaired written performance at the outset of treatment (Robson et al, in press).

Such writing therapy may offer an additional benefit in the case of LT. Investigations of the select and name tasks found that reflecting on the semantic or orthographic features of the target coupled with the availability of even partial orthographic information significantly facilitates the realisation of target phonological information. Thus, attempts to supplement spoken communication with written output may precipitate the production of more accurate spoken approximations of the target word. Thus the strategy, if established, might offer dual benefits to the communicative situation.

Appendix One Stimuli controlled for consonant content

heather	measure
feather	lorry
mother	diver
judge	pub
hedge	nib
jug	goose
hive	gate
van	bus
wing	soap
watch	zip
wigwam	razor
yo-yo	cheese
yellow	zebra
yoke	veil
path	knife
bath	tongue
thumb	ring
thorn	king
shark	card
shed	safe
fish	hat
dash	lathe
cherry	treasure
torch	

References

Alajouanine, T. (1956). Verbal realisation in aphasia. *Brain*, 79, 1 - 28.

Baars, B.J., Motley, M.T., and MacKay, D.G. (1975). Output editing for lexical status from artificially elicited slips of the tongue. *Journal of Verbal Learning and Verbal Behaviour*, 14, 382 - 391.

Bay, E. (1964). Principles of classification and their influence on our concepts of aphasia. In De Reuch, A.V.S. and O'Connor, C. (eds) Disorders of Language. Boston: Little, Brown and Company. Cited from Kertesz, A. and Benson, D.F. (1970). Neologistic jargon: A clinicopathological study. *Cortex*, 6, 362 - 386.

Bernhardt, B. (1992). Developmental implications of non linear phonological theory. *Clinical Linguistics and Phonetics*, 6, 259 - 281.

Best, W., Howard, D., Bruce, C and Gatehouse, C. (1997). A treatment for anomia combining semantics, phonology and orthography. In Chiat, S., Law, J. and Marshall, J. (eds) Language disorders in children and adults. London: Whurr.

Blanken, G. (1991). The functional basis of speech automatisms (recurring utterances). *Aphasiology*, 5, 103 - 127.

Blanken, G. (1993). The production of stereotyped neologisms in aphasia: a case study. *Aphasiology*, 7, 551 - 568.

Blanken, G., de Langen, E.G., Dittmann, J. and Wallesch, C.W. (1989). Implications of preserved written language abilities for the functional basis of speech automatisms (recurring utterances): A single case study. *Cognitive Neuropsychology*, 6, 211 - 249.

Blanken, G., Dittmann, J., Haas, J.C. and Wallesch, C.W. (1988). Producing speech automatisms (recurring utterances): looking for what is left. *Aphasiology*, 2, 545 - 556.

Blanken, G., Wallesch, C.W. and Papagno, C. (1990). Dissociations of language functions in aphasics with speech automatisms (recurring utterances). *Cortex*, 26, 41 - 63.

Brain, W.R. (1965). Speech disorders. London: Butterworths. Cited from Kertesz, A. and Benson, D.F. (1970). Neologistic jargon: A clinicopathological study. *Cortex*, 6, 362 - 386.

Brown, J.W. (1972). Aphasia, apraxia and agnosia: Clinical and theoretical aspects. Springfield: Thomas.

Brown, J.W. (1977). Mind, brain and consciousness: The neuropsychology of cognition. London: Academic Press.

Brown, J.W. (1981). Jargonaphasia. New York: Academic Press.

Bruce, C. and Howard, D. (1987). Computer-generated phonemic cues: an effective aid for naming in aphasia. *British Journal of Disorders of Communication*, 22, 191 - 201.

Buckingham, H.W. (1977). The conduction theory and neologistic jargon. *Language and Speech*, 20, 174 - 184.

Buckingham, H.W. (1981). Where do neologisms some from? In Brown, J.W. (ed.) Jargonaphasia. New York: Academic Press.

Buckingham, H.W. (1987). Phonemic paraphasias and psycholinguistic production models for neologistic jargon. *Aphasiology*, 1, 381 - 400.

Buckingham, H.W. (1990). Abstruse neologisms, retrieval deficits and the random generator. *Journal of Neurolinguistics*, 5, 215 - 235.

Buckingham, H.W., Avakian-Whitaker, H. and Whitaker, H.A. (1978). Alliteration and assonance in neologistic jargon aphasia. *Cortex*, 14, 365 - 380.

Buckingham, H.W. and Kertesz, A. (1974). A linguistic analysis of fluent aphasia. *Brain and Language*, 1, 43 - 62.

Buckingham, H.W. and Kertesz, A. (1976). Neologistic jargon aphasia. Amsterdam: Swets and Zeitlinger B.V.

Butterworth, B. (1979). Hesitation and the production of verbal paraphasias and neologisms in jargon aphasia. *Brain and Language*, 8, 133 - 161.

Butterworth, B. (1980). Some constraints on models of language production. In Butterworth, B. (ed.) Language Production Volume 1: Speech and Talk. London: Academic Press.

Butterworth, B. (1981). Speech errors: Old data in search of new theories. In Cutler, A. (ed.) Slips of the tongue and language production. *Linguistics*, 19, 627 - 661.

Butterworth, B. (1985). Jargon aphasia: Processes and strategies. In Newman, S. and Epstein, R. (eds.) Current perspectives in dysphasia. Edinburgh: Churchill Livingstone.

Butterworth, B. (1989). Lexical access in speech production. In Marslen-Wilson, W. (ed.) Lexical representation and process. Cambridge, M.A.: MIT Press.

Butterworth, B. (1992). Disorders of phonological encoding. *Cognition*, 42, 261 - 286.

Butterworth, B. and Beattie, G.W. (1978). Gesture and silence as indicators of planning in speech. In Campbell, R. and Smith, P.T. (eds) Recent advances in the psychology of language: Formal and experimental approaches. New York: Plenum.

Butterworth, B. and Howard, D. (1987). Paragrammatisms. *Cognition*, 26, 1 - 37.

Butterworth, B., Swallow, J. and Grimston, M. (1981). Gestures and lexical processes in jargonaphasia. In Brown, J.W. (ed.) Jargonaphasia. New York: Academic Press.

Cappa, S.F., Miozzo, A. and Frugoni, M. (1994). Glossolalic jargon after a right hemispheric stroke in a patient with Wernicke's aphasia. *Aphasiology*, 8, 83 - 87.

Christman, S.S. (1992). Uncovering phonological regularity in neologisms: contributions of sonority theory. *Clinical Linguistics and Phonetics*, 6, 219 - 247.

Christman, S.S. (1994). Target-related neologism formation in jargonaphasia. *Brain and Language*, 46, 109 - 128.

Christman, S.S. and Buckingham, H.W. (1989). Jargonaphasia. In Code, C. (ed.) The Characteristics of Aphasia. London: Taylor and Francis.

Code, C. (1982). Neurolinguistic analysis of recurrent utterance in aphasia. *Cortex*, 18, 141 - 152.

Code, C. (1994). Speech automatism production in aphasia. *Journal of Neurolinguistics*, 8, 135 - 148.

Coppens, P. (1991). Why are Wernicke's aphasia patients older than Broca's? A critical view of the hypotheses. *Aphasiology*, 5, 279 - 290.

Coslett, H.B. (1991). Read but not write "idea": Evidence for a third reading mechanism. *Brain and Language*, 40, 425 - 443.

Dell, G.S. (1985). Positive feedback in hierarchical connectionist models: Applications to language production. *Cognitive Science*, 9, 3 - 23.

Dell, G.S. (1986). A spreading-activation theory of retrieval in sentence production. *Psychological Review*, 93, 283 - 321.

Dell, G.S. (1988). The retrieval of phonological forms in production: Tests of predictions from a connectionist model. *Journal of Memory and Language*, 27, 124 - 142.

Dell, G.S. (1989). The retrieval of phonological forms in production: Tests of predictions from a connectionist model. In Marslen-Wilson, W. (ed.) Lexical representation and process. Cambridge, M.A.: MIT Press.

Dell, G.S. (1990). Effects of frequency and vocabulary type on phonological speech errors. *Language and Cognitive Processes*, 5, 313 - 349.

Dell, G.S. and O'Seaghdha, P.G. (1991). Mediated and convergent lexical priming in language production: A comment on Levelt et al (1991). *Psychological Review*, 98, 604 - 614.

Dell, G.S. and Reich, P.A. (1980). Toward a unified model of slips of the tongue. In Fromkin, V. A. (ed.) Errors in linguistic performance: Slips of the tongue, ear, pen and hand. New York: Academic Press.

Dell, G.S. and Reich, P.A. (1981). Stages in sentence production: An analysis of speech error data. *Journal of Verbal Learning and Verbal Behaviour*, 20, 611 - 629.

De Bleser, R. and Poeck, K. (1985). Analysis of prosody in the spontaneous speech of patients with CV - recurring utterances. *Cortex*, 21, 405 - 416.

Denes, P.B. (1963). On the statistics of spoken English. *The Journal of the Acoustical Society of America*, 35, 892 - 904.

Duchan, J.F., Stengel, M.L. and Oliva, J. (1980). A dynamic phonological model derived from the intonational analysis of a jargon aphasic patient. *Brain and Language*, 289 - 297.

Ellis, A.W. (1985). The production of spoken words: A cognitive neuropsychological perspective. In Ellis, A.W. (ed.) Progress in the psychology of language, Volume 2. Hove: Lawrence Erlbaum Associates.

Ellis, A.W., Miller, D. and Sin, G. (1983). Wernicke's aphasia and normal language processing: A case study in cognitive neuropsychology. *Cognition*, 111 - 144.

Ellis, A.W. and Young, A.W. (1988). Human Cognitive Neuropsychology. Hove: Lawrence Erlbaum Associates.

Francis, W.N. and Kucera, H. (1982). Frequency analysis of English usage: Lexicon and grammar. Boston: Houghton Mifflin.

Franklin, S., Howard, D., and Patterson, K. (1994). Abstract word meaning deafness. *Cognitive Neuropsychology*, 11, 1 - 34.

Grayson, E., Franklin, S. and Hilton, R. (1997). Early intervention in a case of jargon aphasia: efficacy of language comprehension therapy. *European Journal of Disorders of Communication*, 32, 257 - 276.

Green, E. (1969). Phonological and grammatical aspects of jargon in an aphasic patient: A case study. *Language and Speech*, 12, 103 - 108.

Hanlon, R.E. and Edmondson, J.E. (1996). Disconnected phonology: A linguistic analysis of phonemic jargon aphasia. *Brain and Language*, 55, 199 - 212.

Harley, T.A. (1984). A critique of top-down independent levels models of speech production: Evidence from non-plan-internal speech errors. *Cognitive Science*, 8, 191 - 219.

Harley, T.A. (1990). Paragrammatims: Syntactic disturbance or breakdown of control? *Cognition*, 34, 85 - 91.

Harley, T.A. (1993). Connectionist approaches to language disorders. *Aphasiology*, 7, 221 - 249.

Harley, T.A. and MacAndrew, S.B.G. (1992). Modelling paraphasias in normal and aphasic speech. In *Proceedings of the 14th Annual Conference of the Cognitive Science Society*, 378 - 383.

Hillis, A.E. and Caramazza, A. (1995). Converging evidence for the interaction of semantic and sublexical phonological information in accessing lexical representations for spoken output. *Cognitive Neuropsychology*, 12, 187 - 227.

Howard, D. and Franklin, S. (1988). Missing the meaning? A cognitive neuropsychological study of the processing of words by an aphasic patient. London: MIT Press.

Howard, D. and Orchard-Lisle, V. (1984). On the origin of semantic errors in naming: Evidence from the case of a global aphasic. *Cognitive Neuropsychology*, 1, 163 - 190.

Howard, D. and Patterson, K. (1992). Pyramids and Palm Trees. Bury St. Edmunds: Thames Valley Test Company.

Howard, D., Patterson, K., Franklin, S., Orchard-Lisle, V. and Morton, J. (1985a). The facilitation of picture naming in aphasia. *Cognitive Neuropsychology*, 2, 49 - 80.

Howard, D., Patterson, K., Franklin, S., Orchard-Lisle, V. and Morton, J. (1985b). The treatment of word retrieval deficits in aphasia: a comparison of two therapy methods. *Brain*, 108, 817 - 829.

Hultzen, L.S., Allen, J.H.D. and Miron, M.S. (1964). Tables of transitional frequencies of English phonemes. Urbana: University of Illinois Press.

Ihori, N., Kashiwagi, T., Kashiwagi, A. and Tenabe, H. (1994). Jargon agraphia in Kanji and Kana in a Japanese crossed Wernicke's aphasic. *Brain and Language*, 47, 197 - 213.

Jones, E.V. (1989). A year in the life of EVJ and PC. In *Proceedings of the summer conference of the British Aphasiology Society*. University of London Printing Services.

Kay, J. and Ellis, A. (1987). A cognitive neuropsychological case study of anomia. *Brain*, 110, 613 - 629.

Kay, J., Lesser, R. and Coltheart, M. (1992). Psycholinguistic Assessments of Language Processing in Aphasia. Hove: Lawrence Erlbaum Associates.

Kay, J. and Patterson, K.E. (1985). Routes to meaning in surface dyslexia. In Patterson, K.E., Marshall, J.C., and Coltheart, M. (eds.) Surface dyslexia: Neuropsychological and cognitive analyses of phonological reading. Hove: Lawrence Erlbaum Associates.

Kertesz, A. (1981). The anatomy of jargon. In Brown, J.W. (ed.) Jargonaphasia. New York: Academic Press.

Kertesz, A. and Benson, D.F. (1970). Neologistic jargon: A clinicopathological study. *Cortex*, 6, 362 - 386.

Kinsbourne, M. and Warrington, E. (1963). Jargon aphasia. *Neuropsychologia*, 1, 27 - 37.

Kohn, S.E., Melvold, J. and Smith, K.L. (1995). Consonant harmony as a compensatory mechanism in fluent aphasic speech. *Cortex*, 31, 747 - 756.

Kohn, S.E. and Smith, K.L. (1994a). Evolution of impaired access to the phonological lexicon. *Journal of Neurolinguistics*, 8, 267 - 288.

Kohn, S.E. and Smith, K.L. (1994b). Distinctions between two phonological output deficits. *Applied Psycholinguistics*, 15, 75 - 95.

Kohn, S.E. and Smith, K.L. (1995). Serial effects of phonemic planning during word production. *Aphasiology*, 9, 209 - 222.

Kohn, S.E., Smith, K.L. and Alexander, M.P. (1996). Differential recovery from impairment to the phonological lexicon. *Brain and Language*, 52, 129 - 149.

Kotten, A. (1982). Therapy of neologistic jargon aphasia: A case report. *British Journal of Disorders of Communication*, 17, 61 - 73.

Laver, J. (1980). Monitoring systems in the neurolinguistic control of speech production. In Fromkin, V. A. (ed.) Errors in linguistic performance: Slips of the tongue, ear, pen and hand. New York: Academic Press.

Lebrun, Y. (1987). Anosognosia in aphasics. *Cortex*, 23, 251 - 263.

Lecours, A.R. (1982). On neologisms. In Mehler, J., Walker, E. and Garrett, M. (eds.) Perspectives on Mental Representation. Hillsdale, New Jersey: Lawrence Erlbaum Associates.

Lecours, A.R., Deloche, G. and Lhermitte, F. (1973). Paraphasies phonemiques; description et simulation sur ordinateur. In *Colloques IRIA - Informatique Medicale.* Rocquencourt: Institut de Recherche d'Infomatique et d'Automatique. Cited from Lecours, A.R. and Rouillon, F. (1976). Neurolinguistic analysis of jargonaphasia and jargonagraphia. In Whitaker, H. and Whitaker, H.A. (eds.) Studies in neurolinguistics, Volume 2. London: Academic Press.

Lecours, A.R. and Joanette, Y. (1980). Linguistic and other psychological aspects of paroxysmal aphasia. *Brain and Language*, 10, 1 - 23.

Lecours, A.R., Lhermitte, F. (1969). Phonemic paraphasias: Linguistic structures and tentative hypotheses. *Cortex*, 5, 193 - 228.

Lecours, A.R., Osborn, E., Travis, L., Rouillon, F., and Lavallee-Huynh, G. (1981). Jargons. In Brown, J.W. (ed.) Jargonaphasia. New York: Academic Press.

Lecours, A.R. and Rouillon, F. (1976). Neurolinguistic analysis of jargonaphasia and jargonagraphia. In Whitaker, H. and Whitaker, H.A. (eds.) Studies in neurolinguistics, Volume 2. London: Academic Press.

Levelt, W.J.M. (1983). Monitoring and self repair in speech. *Cognition*, 14, 41 - 104.

Levelt, W.J.M. (1989). Speaking: From intention to articulation. Cambridge M.A.:MIT Press.

Levelt, W.J.M., Schriefers, H., Vorberg, D., Meyer, A.S., Pechmann, T. and Havinga, J. (1991). The time course of lexical access in speech production: A study of picture naming. *Psychological Review*, 98, 122 - 142.

Lhermitte, F., Lecours, A.R., Ducarne, B., Escourolle, R. (1973). Unexpected anatomical findings in a case of fluent jargon aphasia. *Cortex*, 9, 436 - 449.

MacKay, D.G. (1982). The problems of flexibility, fluency, and speed-accuracy trade-off in skilled behaviour. *Psychological Review*, 89, 483 - 506.

Maher, L., Rothi, L. and Heilman, K. (1994). Lack of error awareness in an aphasic patient with relatively preserved auditory comprehension. *Brain and Language*, 46, 402 - 418.

Marshall, J., Chiat, S., Robson, J. and Pring, T. (1996). Calling a salad a federation: An investigation of semantic jargon. Part Two - Verbs. *Journal of Neurolinguistics*, 9, 251 - 260.

Marshall, J., Pound, C., White-Thomson, M. and Pring, T. (1990). The use of picture / word matching tasks to assist word retrieval in aphasic patients. *Aphasiology*, 4, 167 - 184.

Marshall, J., Pring, T., Chiat, S. and Robson, J. (1996). Calling a salad a federation: An investigation of semantic jargon. Part One - Nouns. *Journal of Neurolinguistics*, 9, 237 - 250.

Marshall, J., Robson, J., Pring, T., and Chiat, S. Why does monitoring fail in jargon aphasia? Comprehension, judgement and therapy evidence. Submitted to *Brain and Language.*

Marshall, R.C. (1994). Management of fluent aphasic clients. In Chapey, R. (ed.) Language intervention strategies in adult aphasia. 3rd edition. Baltimore: Williams and Wilkins.

Marshall, R.C., Rappaport, B.Z. and Garcia-Bunuel, L. (1985). Self monitoring behaviour in a case of severe auditory agnosia with aphasia. *Brain and Language*, 24, 297 - 313.

Martin, A.D. (1981). Therapy with the jargonaphasic. In Brown, J.W. (ed.) Jargonaphasia. New York: Academic Press.

Martin, N. and Saffran, E.M. (1992). A computational account of deep dysphasia: Evidence from a single case study. *Brain and Language*, 43, 240 - 274.

Martin, N., Dell, G.S., Saffran, E.M. and Schwartz, M.F. (1994). Origins of paraphasias in deep dysphasia: Testing the consequences of a decay impairment to an interactive spreading activation model of lexical retrieval. *Brain and Language*, 47, 609 - 660.

McClelland, J.L. (1979). On the time relations of mental processes: An examination of systems of processes in cascade. *Psychological Review*, 86, 287 - 330.

McGlynn, S. and Schacter, D. (1989). Unawareness of deficits in neuropsychological syndromes. *Journal of Clinical and Experimental Neuropsychology*, 11, 143 - 205.

Miller, D. and Ellis, A.W. (1987). Speech and writing errors in "neologistic jargonaphasia": A lexical activation hypothesis. In Coltheart, M., Sartori, G. and Job, R. (eds.) The cognitive neuropsychology of language. Hove: Lawrence Erlbaum Associates.

Mines, M.A., Hanson, B.F. and Shoup, J.E. (1978). Frequency of occurrence of phonemes in conversational English. *Language and Speech*, 21, 221 - 241.

Motley, M,. Baars, B. and Camden, C. (1982). Covert formulation and editing of anomalies in speech production: Evidence from experimentally elicited slips of the tongue. *Journal of Verbal Learning and Verbal Behaviour*, 21, 578 - 594.

Myers-Pease, D. and Goodglass, H. (1978). The effects of cueing on picture naming in aphasia. *Cortex*, 14, 178 - 189.

Nickels, L. and Howard, D. (1995). Phonological errors in aphasic naming: Comprehension, monitoring and lexicality. *Cortex*, 31, 209 - 237.

O'Connell, P. (1981). Neologistic jargon aphasia: A case report. *Brain and Language*, 12, 292 - 302.

Osborne, J. (1833). On the loss of faculty of speech depending on forgetfulness of the art of using the vocal organs. *Dublin Journal of Medical and Chemical Science*, 4, 157 - 171. Cited from Perecman, E. and Brown, J.W. (1981). Phonemic jargon: A case report. In Brown, J.W. (ed.) Jargonaphasia. New York: Academic Press.

Panzeri, M., Semenza, C. and Butterworth, B. (1987). Compensatory processes in the evolution of severe jargon aphasia. *Neuropsychologia*, 25, 919 - 933.

Perecman, E. and Brown, J.W. (1981). Phonemic jargon: A case report. In Brown, J.W. (ed.) Jargonaphasia. New York: Academic Press.

Perecman, E. and Brown, J.W. (1985). Ukeleles, Condessors and Fosetch: Varieties of aphasic jargon. *Language Sciences*, 7, 177 - 215.

Peuser, G. and Temp, K. (1981). The evolution of jargonaphasia. In Brown, J.W. (ed.) Jargonaphasia. New York: Academic Press.

Pick, A. (1931). In Bethe, A. (ed) Handbuch der normalen und pathologischen Physiologie, 15 (Part 2). Berlin: Springer. Translated by Brown, J.W. (1973) as "Aphasia" Springfield: Thomas. Cited from Butterworth, B. (1979). Hesitation and the production of verbal paraphasias and neologisms in jargon aphasia. *Brain and Language*, 8, 133 - 161.

Robson, J., Marshall, J., Pring, T., and Chiat, S. Phonological naming therapy in jargon aphasia: Positive but paradoxical effects. Submitted to *Journal of the International Neuropsychological Society.*

Robson, J., Pring, T., Marshall, J., Morrison, S., and Chiat, S. Written communication in undifferentiated jargon aphasia: A therapy study. *European Journal of Disorders of Communication*; in press.

Rochford, G. (1974). Are jargon dysphasics dysphasic? *British Journal of Disorders of Communication*, 9, 5 - 44.

Rochford, G. and Williams, M. (1962). Studies in the development and breakdown of the use of names. *Journal of Neurolinguistics, Neurosurgery and Psychiatry*, 25, 222 - 233.

Saffran, E.M. (1982). Neuropsychological approaches to the study of language. *British Journal of Psychology*, 73, 317 - 337.

Schwartz, M.F., Saffran, E.M., Bloch, D.E. and Dell, G.S. (1994). Disordered speech production in aphasic and normal speakers. *Brain and Language*, 47, 52 - 88.

Shattuck-Hufnagel, S. (1979). Speech errors as evidence for a serial order mechanism in sentence production. In Cooper, W.E. and Walker, E.C.T. (eds) Sentence Processing: Psycholinguistic studies presented to Merrill Garrett. Hillsdale N.J.: Erlbaum.

Shuren, J.E., Smith Hammond, C., Maher, L.M., Rothi, L.J.G. and Heilman, K.M. (1995). Attention and anosognosia: The case of a jargonaphasic patient with unawareness of language deficit. *Neurology*, 45, 376 - 378.

Simmons, N.N. and Buckingham, H.W. (1992). Recovery in jargonaphasia. *Aphasiology*, 6, 403 - 414.

Stemberger, J.P. (1982). The nature of segments in the lexicon: Evidence from speech errors. *Lingua*, 56, 235 - 259.

Stemberger, J.P. (1984). Structural errors in normal and agrammatic speech. *Cognitive Neuropsychology*, 1, 281 - 313.

Stemberger, J.P. (1985). An interactive activation model of language production. In Ellis, A.W. (ed.) Progress in the Psychology of Language, Volume 1. Hove: Lawrence Erlbaum Associates.

Weinstein, E.A. (1981). Behavioural aspects of jargonaphasia. In Brown, J.W. (ed.) Jargonaphasia. New York: Academic Press.

Weinstein, E.A. and Lyerly, O.G. (1976). Personality factors in jargon aphasia. *Cortex*, 12, 122 - 133.

Weinstein, E.A., Lyerly, O.G., Cole, M. and Ozer, M.N. (1966). Meaning in jargon aphasia. *Cortex*, 2, 165 - 187.

Weinstein, E.A. and Puig-Antich, J. (1974). Jargon and its analogues. *Cortex*, 10, 75 - 83.

Wernicke, C. (1874). Der aphasische Symptomencomplex. Breslau: Cohn and Weigart. Cited from Kertesz, A. and Benson, D.F. (1970). Neologistic jargon: A clinicopathological study. *Cortex*, 6, 362 - 386.