

Research Report

Investigation of a new intervention for children with word-finding problems

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(Received 10 January 2004; accepted 8 June 2004)

Abstract

Background: Around one-quarter of children attending language support services have difficulty in retrieving words. Therapy studies with such children have shown that both semantic and phonological techniques can improve word finding. A new approach to intervention is described using a computerized aid that converts letters into sound cues.

Aims: (1) To assess the word-finding abilities in a small series of children with word-finding difficulties. (2) To investigate whether intervention with a computerized aid can improve children's ability to find words. (3) To evaluate the effect of therapy on connected speech (using the Test of Word Finding in Discourse) and in relation to children's, parents' and other practitioners' views (using a questionnaire). (4) To understand the outcome in relation to an interactive model of speech production.

Methods & Procedures: Five children (aged 6:10–10:7) were assessed on a variety of background measures. Following baseline assessment, two sets of items were included in therapy: a research set (with matched control items) and a further set selected for their functional relevance for each child. Intervention using the computerized aid took place once a week for half a term (6 weeks).

Outcomes & Results: The children differed from one another in their language development and non-verbal abilities, but all had difficulties in word retrieval. All children showed significant improvement in naming intervention items after therapy. This effect was maintained half a term later. Despite very different profiles, the children benefited similarly from the intervention, suggesting a common processing source for change. After the intervention, two children showed a significant reduction in word-finding behaviours (e.g. use of substitutions, repetitions and empty words) on the Test of Word Finding in Discourse. The views of participants, parents and professionals were varied but generally positive.

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Conclusions: The main effect of therapy can be understood, in relation to an interactive model of speech production, as strengthening links from meaning to form. Use of the aid in therapy improved word finding for targeted items and this occurred within a clinically realistic timeframe. The finding that the gains in word retrieval maintained suggests that the intervention can be functionally useful if target items are chosen appropriately. Measurable change for two children in connected speech suggests wider benefits can also occur. Overall, the aid can be a useful additional tool for therapists/teachers working with children with this difficulty.

Keywords: word-finding, children, intervention, model of speech production, therapy.

Introduction

'I was about to say porcupine, um what is it ..., not apple juice, oh ... the fruit with the funky hairdo', said Marie trying to find the word 'pineapple'.¹ We all experience difficulty in finding words, which are in our vocabulary from time to time. However, for some children with impaired language, this problem is severe. These children may be unable to find words to name things, to express their feelings, to answer questions in class, or to label abstract concepts. Such difficulties occur in conversation, narrative and structured tasks and have implications for the child's overall well being. An inability to find the right words when you know what you wish to say has long term implications for self-esteem, social development and educational attainment. This paper aims to present and understand the outcome of a new therapy for word-finding problems carried out with five children. The Introduction considers the nature of word-finding difficulties and possible causes.

Nature of the difficulty

Clear consideration of what defines a 'word-finding problem' is essential in attempting to understand the source of this difficulty. Word-finding abilities are often assessed using picture naming, where the target is clear and psycholinguistic variables such as word frequency can be manipulated. In a review of the area, Messer and Dockrell (in preparation) note that, since our receptive vocabularies are larger than our expressive vocabularies throughout development and indeed in adulthood, all children may experience word retrieval difficulties to some extent. They emphasize the importance of looking at both lexical comprehension and naming skills relative to age norms and classify two groups of children as having word-finding problems: (1) children whose lexical comprehension skills are age appropriate but whose naming skills are not and (2) children whose lexical comprehension skills are below age norms but whose naming skills are further below these skills. In clinical practice, finding that a child struggles to retrieve words which they appear to understand (e.g. correctly responding to word-to-picture matching using semantically related foils or to forced-choice questions about the items) further suggests genuine word-retrieval problems over and above the wider vocabulary-learning difficulties that often form part of a language impairment.

Thus, the criterion of 'comprehension superior to production with respect to controls' is useful in assessing whether a child has word-finding problems. Once this

is established, the situation for individual lexical items can be assessed. Whilst this is of obvious clinical and educational interest, it may not be easy to determine. Two reasons for this are as follows. (1) Children's naming may vary across occasions, even on the same day (within the field of acquired language disorder variability across occasions can be taken to suggest a problem with access rather than storage (Shallice 1987, see also McGregor and Appel's 2002 discussion of this issue in relation to one child's naming problem)). (2) Comprehension is not 'all or nothing', in particular, recent research (Funnell *et al.* in preparation) demonstrates that normally developing children are often able to produce words for which they have only partial semantic knowledge. In addition, the degree of semantic knowledge is related to ease of retrieval (McGregor *et al.* 2002).

Clinical consensus suggests that difficulty in finding words may occur as part of wider cognitive and language impairments or in relative isolation. A recent survey (Best 2003) of speech and language therapists working with children suggested impairments in phonological awareness, expressive language, phonology, literacy, semantics and auditory short-term memory can co-occur with word-finding problems. Areas of relative strength included verbal comprehension and strengths in visual processing. The problem is not uncommon, Dockrell *et al.* (1998) found that, of children in language support services, 23% were identified as having word-finding problems.

Underlying cause

Leonard *et al.* (1984) discuss two possible underlying causes for word-finding problems in children. The first, the 'storage' hypothesis, proposed that the child has not learned the names for lexical items adequately, and is therefore less accurate and slower at naming (for a single case study investigating a storage hypothesis, see McGregor and Appel 2002). The second hypothesis focuses instead on 'retrieval'. The claim here is that the stored lexical representations are comparable to those of children with normal language development but that the information or names are less accessible.

These possibilities do not fit well with more recent models of speech production where there is a distinction between storage of lexical semantic information and storage of phonological form.² Considering such a model, where conceptual information accesses semantic information which in turn accesses phonological forms for production, one can envisage at least four possible deficits:

- (i) In storing lexical semantic information (used for comprehension and production).
- (ii) In accessing lexical semantic information for production.
- (iii) In accessing the phonological form for production.
- (iv) In storing phonological information for production.

The first of these deficits would be likely to result in difficulties with receptive vocabulary as well as word production and would not therefore be able to explain deficits *restricted to* retrieval. Despite this Messer and Dockrell (in preparation), in their thorough review, claim that the most common view in the literature is that semantic representations in children with word-finding difficulties are less complex and that this makes retrieval inaccurate, slow or unsuccessful. Evidence in support of this comes from the finding that these children tend to name digits and letters as well as controls (German 1985, Dockrell *et al.* 2001), perhaps suggesting intact

retrieval processes and problems with words with more 'complex' semantics. Furthermore, McGregor and Waxman (1998) investigated children's responses to questions designed to elicit different levels of semantic information. The word-finding group were less likely to produce subordinates and more likely to produce 'don't know' responses and to accept the wrong label. The controls were matched for chronological age and it would be interesting to know if the findings held with language age controls. Their final result, the children accepting the name of a semantic co-ordinate in error, leads us back to the original point that whilst a deficit in semantic storage or organization (i) may be the source of word-finding problems in some children, such children are also likely to show problems in word learning and comprehension of these same items when this is stringently assessed. A problem with word-retrieval over and above one in comprehension will reflect difficulties at a later stage of production (ii-iv) above, although some children with a later problem could of course also have different semantic organization from the norm.

Account (ii) refers to difficulties in accessing *lexical* representations for production from conceptual representations. If this pathway can be separated out from that used in comprehension it may turn out to be the source of word-finding problems occurring in the presence of intact comprehension. A difficulty here might account for the finding with respect to letters and numbers, where there is a one-to-one relationship between conceptual and lexical representations, as opposed to nouns and verbs where conceptual relations are likely to link to many lexical representations (e.g. the features 'furry', 'four legged' and 'pet' will activate cat, dog, etc.) and in this way the mapping is more complex.

There are no clear group or single case accounts of deficit (iii), a problem in accessing the phonological form from lexical semantic representations in the developmental literature. This contrasts with a large number of adult cases where the anomia in acquired aphasia is held to arise at this level (for a review, see Nickles 1997). The difference may simply be due to the difference between damage to a once intact system versus a problem in developing a speech production system. Alternatively it could be that this difficulty is usually proposed where other aspects of processing (semantic and phonological) are found to be relatively intact, and that this occurs less often in children where different components interact during development (e.g. Chiat and Hunt 1993).

In the fourth account above (iv), a deficit in phonological representations can be related to a suggestion put forward to explain wider specific language impairment (SLI, i.e. language problems broader than difficulties with word learning and word retrieval). Bishop (1997, also Tallal and Stark 1981) proposed that children with SLI have an auditory input deficit which affects their processing of speech sounds and therefore the development of phonological representations. Such a deficit has also been reported in children with dyslexia. In both cases, an input deficit present in early development may have a lasting impact on a child's language/literacy development even though it may not be detectable in the older child (Bishop 1997). In relation to this, Constable *et al.* (1997) provided a single case account within a psycholinguistic framework. Michael was worse than children matched for lexical comprehension (using the BPVS) at picture name verification. He accepted phonologically related names for pictures. The authors conclude that he had imprecise phonological representations. In a group study investigating naming in a 'tip-of-the-tongue' state, Faust, Dimitrovsky and Davidi (1997) found that children with language disabilities did not differ from a control group in the amount of

semantic information they had about words, but had less valid and more invalid information about the phonological form than the controls. They conclude that their findings support a two-stage model of lexical retrieval.³

Breakdown in stages of speech production beyond (iv) above, e.g. in assembling phonology for production or in motor programming, would be more likely to be classified as speech production deficits as the phonological form has been retrieved. It is useful here to maintain Stackhouse's (1993) distinction between phonological disorders in the cognitive sense (iii and iv above), and in the sense of speech production. The former can be thought of as problems up to and including storage of phonological forms for production. The latter may be considered as 'post-lexical' problems in assembling or producing sounds.

In addition to semantic and phonological explanations for word-finding difficulties, there exists a more general 'processing speed' account. Whilst children with word-finding deficits have been found to be slow to find names, the finding of normal reaction times with letters and numbers appears to rule out an explanation resting on their generally taking longer to respond.

In summary, the jury is still out on the cause of word-finding problems in children. This lack of consensus probably results from studies using different populations varying from 'language disabled' (Faust *et al.* 1997) through children with SLI (Lahey and Edwards 1999) to groups with tightly defined word-finding problems (Dockrell *et al.* 2001). It is important to be aware that word retrieval difficulties are likely to have different causes in different children. The proposed accounts are not therefore mutually exclusive.

Errors

When unable to find a form, children with word-finding difficulties tend to provide responses related to the target in meaning, sound or both. They may also circumlocute, talking around the word or say 'I don't know'. Wiig and Becker-Caplan (1984) provide a detailed overview of different ways of classifying naming errors (Wiig and Becker-Caplan 1984: 12, their table 2). In storytelling, German (1987) found children with word-finding problems produced significantly more of several response types: reformulations, repetitions, fillers (e.g. 'um'), and empty words (e.g. 'thing') than chronological age controls. It is important to note that normally developing children also make 'errors' when trying to find words. For example, 7-year-olds with normally developing language made 10% semantic errors on naming a set of common items, but tended not to make sound (phonological) errors (Dockrell *et al.* 1997). Furthermore, Dockrell *et al.* (2001) found that, in noun naming, their word-finding group made no more errors than the language age controls. Additionally, semantic errors were the most frequent error type across all groups of children. Messer and Dockrell (in preparation) conclude that there are no obvious differences in the types of errors produced by language-matched controls and those with word-finding problems.

Single cases, groups and case series

Single case studies with adults with acquired aphasia have shown that anomia can occur due to breakdown at different levels in speech production (for a review, see

Nickels 1997). Such detailed investigations of individual patterns of performance have been used to inform the development of new models of speech production (e.g. Goldrick and Rapp 2002).

In contrast to the single case approach, much of the work with children has taken the form of group studies. Here the search has been for a single cause for the deficit in all the children. This mirrors the wider research in child language impairment where Bishop (1997) talks in terms of the 'primary process' that is implicated in SLI, which has been understood variously in terms of a grammatical deficit (e.g. Van der Lely 1998), difficulties in perceiving acoustic information (e.g. Tallal and Stark 1981) and more recently in relation to a phonological account (Chiat 2001).

In discussing SLI, Bishop (1997) notes the need for converging evidence from different approaches, including intervention. In intervention research a 'case series' approach is recommended as this can bring together the strengths of detailed analysis possible with single cases and the possibility of generalizing findings from groups (Howard 2003).

Intervention studies with children with word-finding problems

There are few well-controlled research studies investigating therapy for word-finding problems. Studies have focused on comparisons between intervention techniques (e.g. semantic versus phonological approaches, Wing 1990, Hyde Wright *et al.* 1993; and elaboration versus retrieval, McGregor and Leonard 1989). Whilst there are some methodological concerns in each case, the results of such studies combine to suggest that therapy can improve word-finding abilities in children. In addition, the improvement may be found in children of a wide age range (e.g. Wing 1990, 6–7 years; Hyde Wright *et al.* 1993, 8–14 years), can generalize to untreated words (Hyde Wright 1993) and can last (McGregor 1994). However, the studies conflict as to the most effective approach. For example, both Hyde Wright *et al.* (1983) and Wing (1990) contrasted semantic and phonological approaches. In the former study, in which 8–14-year-olds participated, the semantic techniques appeared to bring about improvements in word finding whilst the phonological techniques did not. In the latter study with younger children (6–7 years), the reverse was found. One reason for this discrepancy may be that different children, for example of different ages, or with different strengths and weaknesses in their language, respond best to different interventions.

Whilst approaches emphasizing the initial sounds (phonemes) have been used as part of therapy (e.g. Hyde Wright 1993, Easton *et al.* 1997) no study has investigated using the link between letters and sounds in therapy with children with word-finding problems. Indeed, there is little mention of using letters in the literature. One reason for this omission is likely to be the common association between language impairments and problems with literacy development. However, all that is required for use of the computerized aid used in the present study is knowledge of single initial letters, a skill present in many older children with word-finding difficulties.

Introducing the 'aid'

A computerized aid was used which translates from letters into sounds (e.g. on pressing b the aid produces 'buh'). The aid has been shown to be successful in

treating word-finding difficulties in adults with acquired aphasia. Bruce and Howard (1988) showed that adults with aphasia who had some initial letter knowledge for words they could not find and whose naming benefited from initial sound cues, benefited from the aid which provides the missing link (letter to sound conversion) between these two skills. The processes involved in self-cueing picture naming using the aid are shown below:

- Access semantic representation from picture.
- Search for word form.

If unable to retrieve word form (i.e. name picture):

- Find initial letter from the set of buttons on the aid.
- Press button, aid produces phoneme associated with letter.
- Use phonological cue to aid word retrieval.
- Produce target name.

A follow-up study demonstrated that a very high proportion of adults involved in therapy with the aid showed some benefit (Best *et al.* 1997). Various hypotheses put forward to explain the success of the aid included the adults having control over the therapy process and the fact that naming in this way involved semantics (from the picture), orthography and phonology, and as such was likely to help people with deficits in any of these processes.

Methods

The study took the form of a case series design with each child acting as its own control. There were four main assessments of word finding (Assessments 1–4, i.e. A1–A4), each half a term (6 weeks) apart. Between the first two (A1 and A2), a series of informal and formal background assessments were carried out to look at the children's word finding in detail. This phase also acted as a baseline to compare with intervention; if the children's word finding was improving due to maturation, on going therapy or regular sessions with the research SLT then this would be clear from the difference between A1 and A2. Therapy then took place between A2 and A3. There was then a 'no intervention' follow-up phase, which was followed by the final assessment, A4. The phases of the study are illustrated as follows:

A1 ← background → A2 ← intervention → A3 ← follow – up → A4.

The background assessments carried out between A1 and A2 included the following:⁴

- Ravens Progressive Matrices (Raven *et al.* 1998) to tap non-verbal ability.
- Squirrel Nut test (Pitchford and Eames 1994), in which one of two pictures (e.g. squirrel and rabbit) goes best with a third associate (e.g. nut). This taps a child's knowledge of conceptual relationships without using words.
- Phonological Assessment Battery (PhAB; Frederickson *et al.* 1997) to assess children's phonological abilities. All subtests apart from spoonerisms were administered.
- Repetition: used to investigate the children's ability to retain and produce the names of the pictures and non-words devised from these.

- Picture–word verification: they were also given a picture word verification task (/lexical decision in Stackhouse and Well's (1997) terms) in which pictures were paired with either the correct form or a form one phoneme different from the name (e.g. is it tissors? for a picture of scissors).
- Detailed Test of Naming: children were also given a detailed test of naming (using items taken from Druks and Masterson 2000) that involved investigation of (1) the effects of length and familiarity (using subsets of 25 items each matched for the other variable and for age of acquisition, imageability and visual complexity), (2) the effect of phonological cues (providing the initial phoneme of the target plus schwa for items they were unable to name), (3) initial letter knowledge (children were asked to point to the initial letter from a choice of 13 letters) and (4) written naming (scored for whole word and initial letter correct) of a subset of the same items. Tasks investigating (1–3) were administered in a Latin square design such that each item was given in only one of the tasks on each occasion. Written naming (4) was given on a further separate occasion.

Repeated assessments

The set of assessments listed below were administered at A1 and again at A4 to look at change over the whole study for each child:⁵

- British Picture Vocabulary Scale: used to provide a measure of children's lexical comprehension to compare with their score on a test of word retrieval. It was also included as a control task to look at change that might be happening due to ongoing education/ therapy. This measure should not be influenced by the intervention used in this study.
- Clinical Evaluation of Language Fundamentals (Semel *et al.* 2000): selected subtests were used to investigate aspects of language comprehension and production. Subtests where children's standard score was neither at floor nor appropriate for their age were repeated at A4 as further control tasks.
- Word Finding Vocabulary Test (Renfrew 1995): allowed investigation of children's naming on a set of items unrelated to the intervention or control sets.⁶
- Test of Word Finding in Discourse (German 1991): included to look at the children's word retrieval in connected speech. It includes composite picture description and asking children about related situations (e.g. for a picture of a fairground, part of the instruction given is 'tell me what you did when you went to a place like the one in the picture ...').
- British Ability Scales—Word Reading: part way through the study, feedback suggested that the intervention might be having an influence on children's reading. Therefore, for the three children where it was still possible, reading words aloud was assessed before and after intervention.
- 'Views': views of the child, parent, teacher and therapist were collected at the start of the study and again after intervention (at either A3 or A4 depending on availability). The questionnaires made use of a visual scale and an example is shown in appendix A.

Criteria for inclusion

Inclusion in the project was based on the child's recent clinical records and from discussion with the therapist, the criteria for inclusion were as follows:

- Performance on a test of word finding is poor and reveals problems finding words which are in the child's vocabulary as evidenced by correct comprehension of those words.
- Performance on other tests of language and cognition is above that on tests of word finding.
- Child shows familiarity with letters.

Children were not included in the project at a time when they were having individual therapy specifically focused on word finding. However, many children were involved in ongoing language work. For some, this involved group work, which included tasks aimed at improving vocabulary. The five children in the study did not all have 'pure' word-finding problems with no other associated difficulties. Rather they had varied patterns of strength and weakness and were in this way representative of the population therapists may meet routinely in clinics/schools/language units.

Ethical considerations and liaison

An information sheet was compiled for children, parents, teachers and therapists involved in the project. This explained that children would be involved in order to forward the course of research and that they would not receive intervention tailored to benefit them individually; involvement in the research might have no effect on a child's ability to find words. It was made clear that the child could withdraw from the research at any time. Throughout the study, Health Service therapy took priority over the research project. The names used in reporting the study are not the children's real names.

Assessment and intervention were carried out in collaboration with the child's speech and language therapist with the aim of strengthening links between clinical practice and research. The exact nature of the contact with other professionals varied. At a minimum, this involved the research therapist feeding back the findings for a particular child to their speech and language therapist, teacher and learning support assistant (LSA) where applicable, on a regular basis. The maximum involvement was with a LSA able to attend several of the therapy sessions.

Background assessment findings

The findings from the assessments are summarized in table 1.

A profile of each child's educational environment and language development follows.

Rod

Rod was 10;7 at the start of the study. He had a severe language impairment and literacy difficulties. Rod attended a speech and language unit spending some sessions integrated in mainstream school. In conversation, Rod tended to produce single

Table 1. Assessment results

	Rod		Shaun		Sas		Becca		Marie		
Age at start (years; months)	10:7		6:10		9:6		9:5		8:10		
Renfrew raw score ($n=50$)	39		19		35		32		36		
Age equivalent BPVS	7;1–2		3;7		6;3		5;5		6;4–7		
standard score age equivalent	73		87		91		82		99		
Raven's progressive matrices percentile	6;10		5;2		8;4		6;0		8;9		
Squirrel Nut test wnl (within normal range) for age-matched controls	90th		42nd		5th		51st		80th		
	0.91 wnl		0.68 ^a outside controls		0.86 wnl		0.96 wnl		0.95 wnl		
Phonological Assessment Battery (standard scores)											
Alliteration	88		82 ^{&}		70		82		100		
Rhyme	96		n.t.		76		89		83		
Non-word reading	0		n.t.		82		82		105		
Pictures (speed)	91		<52		108		102		69		
Digits (speed)	69		n.t.		110		102		112		
Alliteration fluency	69		0		87		69		124		
Rhyme fluency	94		0		90		82		89		
Semantic fluency	72		109		102		79		92		
Detailed test of naming											
Proportion correct ($n=64$)	0.72		0.45		0.67		0.80		0.92		
Hi Fam Low Fam mean RT (s)	15	21 ^b	13	8	17	15	19	21	23	21	
($n=25$ in each set)	1.47	1.44	2.44	2.71	1.54	1.82	2.05	1.68	1.76	1.56	
Long Short mean RT (s)	16	18	11	12	17	17	16	22 ^{**}	24	22	
($n=25$ in each set)	1.51	1.39	2.45	2.26	1.79	1.61	1.64	1.80	1.79	1.61	
Effect of cues Initial letter knowledge (/64)	4/9		n.t.		8/14		6/12		0/2		
	0.80		0.64 ^c		0.86		0.86		0.86		

Table 1. Continued

	Rod	Shaun	Sas	Becca	Marie
Further assessments					
Written naming (initial letter correct, /22)	0.59	0.60	0.73	0.82	0.82
Picture-word verification (/40)	0.90	0.90	0.95	0.97	1.00
Repetition (/20)	0.85	0.90	0.85	0.95	0.90
Minimal pairs (/18)	1.00	0.89 ^d	0.94	1.00	1.00
Letter-to-sound conversion (/17)	0.94	0.65	0.94	0.88	0.94

^aShaun was significantly worse than age-matched controls on this task ($n=29$, mean age 6;6, control mean 49.83, SD 3.75, $\bar{z}=-2.86$, $p<0.05$, two-tailed); however, the score may reflect his difficulty in focusing on a task containing such a large number of items ($n=57$) rather than a difficulty with processing pictures or in accessing meaning from pictures.

n.t., not tested, where testing was deemed inappropriate for the child's age/stage of development. In Shaun's case, his short span of attention combined with the sheer number of assessments meant that it was not possible to assess him fully on all measures.

[&]Supplementary alliteration test with pictures.

^bRod showed a tendency to be more accurate at naming the low familiarity set, but this did not reach significance.

^{**}Difference in accuracy for long and short items is significant (Fisher exact test, one-tailed, $p=0.047$). Becca made phonological errors on four of the longer items (e.g. hospital \rightarrow /hostəbəl/).

^c $n=24$ items for Shaun as it was not appropriate to administer the whole set.

^dFurther testing revealed problems discriminating changes of place and voice for plosives.

words or short phrases after a long delay. At times, the listener needed to offer alternatives to move the conversation forward. However, Rod produced longer utterances and this was dramatically influenced by his confidence in the situation, e.g. he spoke more with peers. His speech and language therapy report noted 'some problems in understanding spoken language with more marked difficulty in formulating and using language to convey specific information' with a 'marked difficulty in finding the words he needs', and that he 'often uses gesture or description to convey meaning'.

Rod was the only child included in the study not to exhibit a comprehension-production gap on formal testing (compare BPVS and Renfrew Word Finding Vocabulary Test in table 1). He was included for the following reasons: he often made errors associated with word-finding difficulties, he clearly scored as having word-finding problems on the Test of Word Finding in Discourse and he demonstrated good comprehension of items he failed to name in the 60-item test. He had strengths in non-verbal skills as demonstrated by reaching the 90th centile on Raven's Matrices, and by his excellent drawing.

Shaun

Shaun was 6;10 at the start of the study. He attended a language resource with some integration into mainstream school. Shaun was referred with language problems in comprehension and production. His speech was unclear but generally intelligible. There were considerable concerns over his behaviour, attention and listening. Shaun presented as lively, enthusiastic and communicative with noticeable word-finding difficulties 'me got brand new—you know—you guess'. In a one-to-one session, as required by the research, with frequent changes of activity, Shaun was able to sit and complete a task.

There was a gap between his comprehension and production on formal assessment (Renfrew Word Finding Vocabulary Test A.E. 3:7, BPVS A.E. 5:2). Shaun scored as having word-finding problems on the Test of Word Finding in Discourse with, using German's terminology, a high incidence of substitutions ('thingy'), word reformulations, repetitions and 'empty words' (e.g. 'er').

At this stage, Shaun was not reading but he was often able to convert the initial letter of a word to a sound. Of note is his strength in the semantic fluency subtest on the Phonological Assessment Battery (standard score 109, cf. 0 for alliteration and rhyme fluency). His good performance on this test which requires generation of items within a semantic category is likely to reflect speech and language therapy having included work on items in semantic categories. He was slow to name the items that he knew on the Naming Speed subtest. This is also consistent with a lexical retrieval problem.

Sas

Sas was 9;6 at the start of her involvement in the project. She attended mainstream school with 10 h support each week from a learning support assistant and termly programmes provided by a Speech and Language Therapist. Assessment by an educational psychologist suggested Sas had moderate learning difficulties and a diagnosis of ADHD. However, the school suggested that she was not functioning in

the same way as other children with the latter diagnosis. They also emphasized her difficulties with visuo-spatial tasks and numbers. Sas's profile of abilities is perhaps more mixed than the flatter profile associated with moderate learning difficulties. The speech and language therapist noted that Sas did not have specific language problems, her learning difficulties were broader, but that her word-finding difficulties were very noticeable and more marked than her other language difficulties.

Formal testing supported this with a considerable discrepancy between single-word comprehension (BPVS A.E. 8:4) and production (Renfrew A.E. 6:3). The score of 5th percentile on Raven's Matrices appears to reflect Sas's visuo-spatial difficulties. Sas was very keen to be involved in the project. The first intervention session was difficult as Sas did not know what was required and was keen to talk about anything rather than carry out the task! In addition, for some items she asked 'what is this?' Having observed this, the research therapist queried whether the therapy was appropriate for Sas whose behaviour suggested that the problem might be in fully understanding the items. The temptation for the therapist was to give semantic information to inform Sas's knowledge of 'what it was'. This, however, was resisted and the intervention followed the outline above.

Becca

Becca was 9:5 when she became involved in the study. She had in class support for language problems, specialist teaching and thrice-weekly speech and language therapy. Her therapist noted that Becca used restricted language and had difficulties with comprehension. While some difficulties finding words were evident, the therapist noted that this might have been part of a wider difficulty with learning vocabulary.

Becca's comprehension problems were clearly evident in conversation where she benefited from repetition and rewording. Whilst Becca's vocabulary was less than would be expected for her age, the discrepancy with her score on a test of word finding suggests some problems in retrieving words she knows. This is supported by her variable performance in picture naming (she was able to find a word one week and not the next), and her ability to benefit from phonological cues (e.g. trying to name a picture of a cherry, Becca gave no response but when cued with 'ch' she produced the word. This occurred on six of the 12 occasions when an initial sound cue was provided). In addition she showed difficulty in finding words on the Test of Word Finding in Discourse, making word substitutions, e.g. 'light' for candle and making frequent use of 'stuff'. The school and therapist felt that formal testing did not capture the nature of Becca's language difficulties well.

In contrast to her language, Becca scored on the 51st percentile on Raven's Progressive Matrices demonstrating age appropriate ability. She also demonstrated relative strength in the Squirrel Nut test, where she chose the correct picture to go with the associate on 96% (55/57) of occasions scoring the same as the mean for an older group of control children (control group mean age 10:9, mean score 54.23, range 49–57).

Marie

Marie was 8;10 when her involvement in the study began. She attended a Foreign language school and was bilingual in English (mother) and Spanish (father) having

been exposed to both languages since birth. Marie had no extra support in school. Her language skills aside from word finding had been assessed, in English, by a speech and language therapist as within normal limits. Her difficulties in word finding were evident in everyday conversation and the SLT report noted this was the case for nouns and verbs and that naming resulted in errors of meaning and sound. Her mother reported that Marie also had word-finding difficulties in Spanish and that she used strategies to help Marie at home. Marie presented as lively and enthusiastic, talkative and partially aware of her difficulties in finding words.

Her comprehension vocabulary was assessed as age appropriate (as measured by the BPVS A.E. 8:9) and this contrasted greatly with word-finding abilities (e.g. Renfrew A.E. 6:4). She was well above average on Raven's Matrices (80th percentile). Despite Marie's lack of response to the two cues given during assessment, there were several examples of successful phonological cueing during her therapy sessions.

Further comments on background assessment

Detailed testing was initially carried out with the aim of relating different children's psycholinguistic profiles to the outcome of the intervention. However, as the outcome did not differ for the different children, see the section 'outcome of intervention', it is not appropriate to relate individual profiles to the outcome (Howard 2003). Therefore, rather than discussing the detailed results of each assessment for each child, an overview of the background information on the children is provided.

Table 1 indicates that all the children except Shaun were within the range of control scores for their age on the Squirrel Nut test suggesting good processing of pictures and meaning from these. Considering the Phonological Assessment Battery, on the test of rapid naming of pictures, Shaun and Marie stood out as being slower than would be expected for their age, Rod was slow at naming digits.

On the detailed test of naming, Shaun, by far the youngest child, scored least with Marie naming the largest number of items correctly. There were no significant effects of familiarity on the individual children's naming accuracy or speed. Likewise, there were no significant effects of length except for Becca's superior accuracy on short over long items—she tended to make phonological errors on longer items. Finally, there were no effects of familiarity or length on the accuracy or naming reaction times of the children as a group. This may reflect the true pattern as the sets were carefully matched for other psycholinguistic variables, or may be due to the small group size. All the children responded to phonemic cues and all showed good initial letter selection.⁷ Both Rod and Sas appeared to find it easier to select an initial letter than to write it themselves (shown under written naming, initial letter correct).

All the children scored 90% or above on word-picture verification and 85% or more on repetition. Shaun had some difficulty with minimal pairs and, in particular, with discriminating changes of place and voice for plosive sounds (e.g. /p/ versus /t/, or /p/ versus /b/). This had the potential to affect his interpretation of the cues provided by the aid. In addition, children were generally able to convert letters to sounds, the function provided by the aid. However, in the context of this task the children were not also attempting to find a word, search for the initial letter, and make use of the phonological cue. Indeed even slightly subceiling performance on each of these may mean that self-cueing via orthography is not possible whereas the

letter-to-sound conversion provided by the aid, in addition to the visual choice of letters available on the machine, may allow the children's naming to be cued.

Overview of the children

In summary, the five children included in this study were varied in terms of their overall learning abilities, their pattern of language development, their educational placement and the support they were receiving. As such, they are likely to reflect the mixed clinical population referred for intervention. They were not selected for the clarity of their language profiles or the likelihood of a positive outcome. The inclusion of Sas is perhaps particularly noteworthy in this respect as she did not have a difficulty restricted to language. All the children were referred by speech and language therapists as having word-finding problems and in each case, this was supported by the results of assessment.

Selecting intervention items

Three sets of 60 black-and-white line drawings were compiled. All the picture names began with one of the nine initial letters available on the aid. The words varied in mean age of acquisition (early, mid and later acquired⁸). These are a subset of the items used by Howard *et al.* (1995). Screening was carried out to select the most appropriate set for each child. Children were asked to name the first ten items of the easiest (earliest age of acquisition) set. If they were correct on seven or more items, their naming of the next set was screened. Once again, if they were correct on seven or more of the items their naming of the next set was screened. The set for which they named fewer than seven of the initial 10 items was named in full. This was the middle age of acquisition set for the youngest child and the later age of acquisition set for the remaining four children.⁹

A further set of personally relevant functional items useful for home/school was included. These items were different for each child and were chosen by the child, parent and teacher/learning support assistant. The number of items in the personally chosen set varied considerably. Unfortunately, for Shaun only seven items were provided. In contrast, there were 14 items for Rod, 15 for Becca, 16 for Maria and 19 for Sas. Items were very varied, e.g. squash (a cordial), transparent, sausages, Muslim, freckles, scruffy. Items in the functional sets also all began with one of the nine letters on the aid.

Children's comprehension of their research set was assessed by asking them to select one of three semantically related words (often co-ordinates) to go with a spoken definition for the target. In Shaun's case, he was unable to hold in memory the three choices (which were provided in written and spoken form). In his case, the target and just one alternative were provided on each occasion and testing was restricted to 20 items per session to ensure he was able to attend to the task. To make the task as stringent as possible, in each case part of the definition was appropriate to each of the words but it was only the target which satisfied all aspects of the definition (e.g. diver, swimmer, astronaut; 'wears a special suit, goes in the water'; buttons, bracelet, cuff; 'part of a shirt, worn round the wrist'). Thus, if a child was able to select the target this demonstrated s/he had an understanding of at least some aspects of the word's meaning. If s/he was unable to select the target this

could be for a number of reasons, including not understanding the words used in the definition.

Intervention

The 60-item naming test used for each child was subdivided into two sets matched for naming during baseline assessment.¹⁰ The sets were randomly assigned to intervention and control conditions.

Intervention, with the computerized aid, took place once a week for 6 weeks. Initially children were introduced to the machine and shown how pressing the letters produced the corresponding sound. During intervention, the children were presented with the therapy pictures (the research and the functional sets) to name with the aid present. In the first three sessions, the children were asked to use the aid regardless of whether they could find the word. This ensured familiarity with the letters and sounds and using the aid. In subsequent sessions, children used the aid only when they were unable to find the word spontaneously. The procedure for using the aid follows:

- (i) Press the initial letter of the word (if failed, go to step (iv) or (v) if (iv) did not result in target name).
- (ii) Repeat the sound cue given by the aid.
- (iii) Name the item (if incorrect go to step (iv), (v) or (vi); move on to next item).
- (iv) Therapist restricts choice to three letters; go to step (i).
- (v) Therapist points to correct letter; go to step (i).
- (vi) Therapist says name for child to repeat (then move to next item).

Results and discussion

The results are integrated with discussion as they are reported and a general discussion is provided at the end of the paper.

Naming responses

The children's responses to naming the research intervention set are given in table 2.¹¹ The left-hand column for each child shows their performance pre-therapy. The first response provided within 10 s was coded. 'Semantic' refers to a single-word response that bears a clear relationship to the meaning of the target (e.g. 'horse' for camel, 'water melon' for pineapple). Responses coded as semantic may not necessarily be a semantic 'error' but may reflect the child's attempt to produce some single-word response to the picture (e.g. 'tree' for leaf, 'address' for label), which, for children with better expressive language, might have resulted in a circumlocution. Before therapy, between 15 and 30% of children's responses fell into this category.¹² The 'no response' category was used for items where the child did not respond or said 'don't know'. Becca gave the highest proportion of 'no responses' (31%) among the children. This may reflect her awareness of the assessment situation and lack of willingness to make an error. The 'other' category included visual errors,

Table 2. Naming responses for research intervention set

Response	Rod		Shaun		Sas		Becca		Marie	
	Pre-	Post-	Pre-	Post-	Pre-	Post-	Pre-	Post-	Pre-	Post-
Correct	0.56	0.85	0.47	0.80	0.42	0.77	0.34	0.93	0.65	0.95
Semantic	0.22	0.00	0.30	0.12	0.30	0.03	0.29	0.02	0.15	0.02
No response	0.11	0.11	0.18	0.05	0.05	0.03	0.31	0.00	0.08	0.02
Other	0.11	0.04	0.05	0.03	0.23	0.17	0.05	0.05	0.12	0.02
Total	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Pre- refers to the mean of baseline assessments A1 and A2.

Post- refers to the mean of the assessments carried out after intervention A3 and A4.

Functional set is excluded as it was not assessed at A1.

n=30 intervention items for Shaun, Sas and Marie; 29 items for Becca; and 27 items for Rod (see note 16).

circumlocutions, morphological and phonological errors and comments (e.g. 'what does it start with?').

The children's phonological errors from the two assessments (A1 and A2) before intervention were investigated in detail. There were surprisingly few of these. Sas and Marie each made one on a multisyllabic word. Marie's other language, Spanish, may have had some influence on her responses (e.g. 'don't know ... /spjun/' for ladle; /kaefei/ for coffee). Shaun made consistent phonological errors on a couple of words (e.g. /deks/ for desk), which may reflect inaccurate storage of the word or consistent phonological processes influencing his production. Both Becca and Rod made phonological errors in their production of multisyllabic words. In Rod's case, these were phonological substitutions (e.g. /teleskøk/ for telescope), in Becca's case the errors involved minor phonetic deviation from the target. Interestingly, these errors occurred on different words in the different assessments. This inconsistency suggests either imprecise or underspecified phonological representations that may on occasion be realized correctly or, perhaps, difficulties with post-lexical production despite correctly stored forms.

Change during therapy

A record of performance on research and functional sets was kept during therapy. The children's progress during intervention is illustrated in figure 1.¹³ Change was gradual over the six sessions¹⁴ and followed a similar course for all the children.

Responses during intervention

Table 3 illustrates the stage at which the children were able to provide the target for items they did not name immediately. Figures for all six sessions and for the research set and the functional set are combined. The first row of data indicates that, on many occasions, four of the children were able to select from nine letters, and to use this or the resulting phonological cue to produce the target (category A). The exception, as can be seen from the second row of data, is Shaun who often needed the therapist to restrict the choice to three letters (category B) before he was able to choose, hear the cue and produce the target. If the choice was not restricted, he

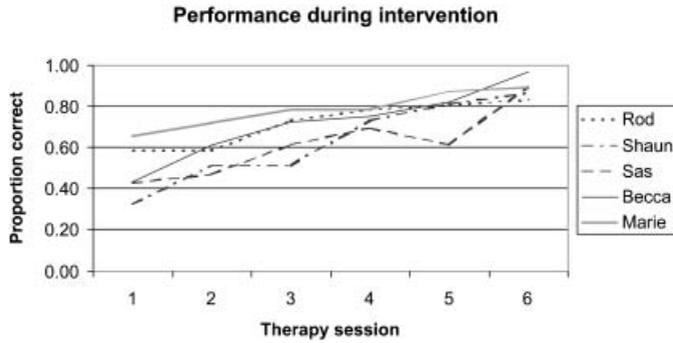


Figure 1. Performance during intervention on the research and functional sets combined.

tended to be over enthusiastic and press all the letters in quick succession. For each of the children, there were a few occasions when they named the item only after the therapist had indicated the correct initial letter (category C). All of the children named a proportion (from 14 to 31% of the items) only after the therapist had given the name for repetition (category D). There were very few 'unable' responses (category E). Thus, in this way, the intervention is virtually 'error free', and likely to be encouraging for the children.

It is important to remember, however, that during the first three sessions the children were encouraged to use the aid even when they could have named the item without (this study design does not allow us to tell whether this was important for the outcome). If the items named with the aid in the first three sessions are discounted, as in the final row of table 3, all the children, except Becca, continued to show use of the aid/cues on over 20% of occasions (categories A–C). Becca made the most responses categorized as 'other' (category F) and these were investigated in more detail. Of the 45 responses in this category, 39 involved her using the aid. Commonly Becca was able to select the correct initial letter, but then produced a response phonologically related to the target and was only able to produce the name when the form was provided for her to repeat (e.g. target 'cuff'; response, pressed C,

Table 3. Responses during therapy

All responses (excluding immediately correct which could not occur in initial sessions as use of aid was required)	Rod	Shaun	Sas	Becca	Marie
A. Named with aid	0.57	0.07	0.44	0.43	0.62
B. Named with choice of three letters	0.03	0.32	0.01	0.01	0.01
C. Named with therapist having pointed to letter on aid	0.03	0.08	0.09	0.02	0.08
D. Repeated target	0.29	0.31	0.29	0.19	0.14
E. Unable to produce name	0.00	0.01	0.00	0.00	0.00
F. Other	0.08	0.21	0.18	0.34	0.15
Data when responses with aid from first three sessions removed					
A, B, C, i.e. Responded using the aid	0.35	0.43	0.37	0.07	0.23

said /kaef/, repeated 'cuff'). This is particularly interesting as Becca made many 'no responses' during assessment of naming which may have reflected a wish not to be 'wrong', which she was perhaps able to 'let go' during therapy, particularly when she was sure of the start of the word form. This finding also reinforces the claim that, for some items, Becca may have partial representations for output. Her difficulty may be with accessing the words from meaning *and* with storage of the forms themselves.

Finally, this section turns to the change in response types with intervention. For each child, there was a session when they stopped using the aid for items they could name without it. For Shaun, Becca and Marie, this was therapy session 4 (i.e. as soon as use of the aid was not required); for Rod and Sas it was session 5; both of them continued to use the aid for almost all items at session 4. The change in response category from the previous session to this session was examined for each child looking at two response types 'A' naming with the aid and 'E' repetition of the target. For all the children items named with the aid in the previous session tended to be named correctly, and items which had been repeated previously tended to continue to fall into this category, with a few being named correctly. Taking Sas as an example, items named with the aid in session 4 tended to be named correctly in session 5 ($n=13$) rather than repeated ($n=0$). In contrast items repeated in session 4 tended to be repeated in the next session ($n=5$) rather than named correctly ($n=1$). This difference between items named with the aid and repeated items reached significance (Fisher exact test, $p<0.05$, two-tailed) for all the children except Shaun for whom the change to correct responses without the aid was more gradual across sessions.

Outcome of intervention: picture naming

Table 4 shows the pre- and post-intervention results on picture naming for the research set (the functional set is excluded as there was no A1 baseline for these items). Immediately after therapy, all children showed significant improvement in naming the intervention items relative to performance immediately before therapy. There was no significant difference in pre- and post-therapy naming performance on the unseen control sets. Pre-intervention baselines A1–A2 showed small improvement but this did not reach significance on the intervention or control set for any child.¹⁵ The scores on therapy sets showed no significant decline at follow-up 6 weeks later,¹⁶ i.e. the improved performance with the intervention sets maintained.

To investigate whether the change on the intervention set differed across children, a test for homogeneity was performed. The lack of a significant effect (χ^2 -test (d.f.=4)=4.53, n.s.) means it is not possible to reject the null hypothesis that the change is the same across the children.¹⁷ For this reason, it would be inappropriate to look at differences in outcome and to link these with background assessments (Howard 2003). This finding is unfortunate in one way, as one of the aims of the study had been to relate the children's psycholinguistic profiles to the outcome of the intervention with the aim of allowing therapists to select children for whom the aid might be most appropriate. The finding that the change on the intervention set did not differ across the children, supported by the fact none generalized to the control set and that the improvement maintained in all cases is suggestive of a similar mechanism for therapy across the children.

Table 4. Naming intervention and control items pre-intervention (A1A2) and post-intervention (A3A4)

Name	Set ($n=30$ in each set) [†]	Naming pre-intervention (mean A1A2)	Naming post-intervention (mean A3A4)	Change (as a proportion of scope for change) [‡]
Rod	intervention	0.56	0.85*	0.41
	control	0.56	0.63	
Shaun	intervention	0.47	0.82*	0.32
	control	0.47	0.45	
Sas	intervention	0.42	0.77*	0.38
	control	0.40	0.50	
Becca	intervention	0.34	0.93*	0.47
	control	0.36	0.38	
Marie	intervention	0.65	0.95*	0.53
	control	0.65	0.72	

*Significant change from immediately before (A2) to immediately post-therapy (A3) McNemar test, $p < 0.025$.

[†]Excepting the following: for Rod, the first child to be included in the study, items that he failed on the comprehension task were excluded resulting in intervention and control sets containing 27 and 26 items, respectively; Becca had 29 items in each set, two were excluded so as to match intervention and control sets for number of items failed on the comprehension test.

[‡]This measure was suggested to facilitate comparison across the children given that they had different naming abilities at the start. It was calculated as follows: $(\text{mean score A3A4} - \text{mean score A1A2}) / (1 - \text{mean score A1A2})$.

The figures in table 4 were calculated using the research set only. Including the functional items, results in different amounts of change and the children would then be ranked differently for amount of change.

The data for the group as a whole was also analysed and significant change (mean of A1A2 to mean of A3A4) was shown on the research intervention set (related t -test, $t(4) = 6.85$, $p = 0.0012$, one-tailed) and the control items ($t(4) = 2.25$, $p = 0.044$, one-tailed). The change on the control items that reached significance for the group (but not for the individual children) may reflect the impact of the intervention but it may also result from children developing over time with, in the case of four children, specialized input for their language/learning.

Naming in relation to comprehension

The children's comprehension of the intervention set had been assessed before therapy. Unsurprisingly, as a group, the children were better able to name items that they pointed to correctly in the comprehension task than those that they failed to point to correctly (related t -test $t = 3.73$ (3), $p < 0.05$, two-tailed). For all the children except Rod, a number of items they had not pointed to correctly were included in the intervention (the number of these items was matched across intervention and control sets). Interestingly the change in naming as a proportion of scope available for change ($(\text{mean A3A4} - \text{mean A1A2}) / (1 - \text{mean A1A2})$) was similar for items they pointed to correctly and those that they did not point to correctly on the comprehension task ('comprehended', 'not comprehended': Shaun 0.62, 0.61; Sas 0.61, 0.59; Becca 0.91, 0.88; Marie 0.82, 1.00¹⁸). This finding suggests that the assessment of the children's understanding of the items was incomplete and/or that

the benefits of this approach need not be restricted to items for which a child shows complete comprehension. (This issue warrants further investigation but will need to be approached with care in the light of Funnell *et al.*'s (in preparation) findings concerning unimpaired children's naming without full semantic knowledge and McGregor *et al.*'s (2002) findings regarding a relationship between children's naming and degree of semantic knowledge).

Naming responses after intervention

Looking at table 2, the right-hand column for each child provides a summary of their naming responses to the research intervention set after therapy. After intervention, each error type comprised 5% or less of the children's responses, with three exceptions. Rod still tended not to respond to some items (11%, as before intervention). Sas made (17%) 'other' responses. Many of these involved asking for the initial letter/sound of a picture name, which suggested that she was using first sound cueing as a strategy to help her find words. Some circumlocutions were also still observed (e.g. 'something what you scoop ... a scooper' for ladle). Shaun made (12%) semantic errors (e.g. 'window' for mirror).

Assessments at A1 AND A4

The results of assessments used at the start of the study (A1) and again at follow-up (A4) are reported in table 5.

There was no significant change for any of the children on the language control tasks, BPVS and subtests from the CELF, which were predicted to be unaffected by the intervention. Rod showed a non-significant tendency towards improvement on the BPVS, which may reflect ongoing specialist teaching and speech and language therapy during the project. There was relatively little change overall on the Renfrew, reinforcing the idea that the changes in picture naming were largely limited to the intervention items. Marie did show an improvement of five items, which will be discussed further in the section on the outcome for individual children.

Importantly, both Shaun and Marie showed a significant reduction in the number of word-finding behaviours on the Test of Word Finding in Discourse (TWFD). Specifically, for Shaun, substitutions (thingy), reformulations, repetitions and empty words (um, err) occurred at high rates before intervention. Following therapy, only reformulations remained at a higher rate (>1 SD from the mean) than reported for German's controls. The confidence ranges for the standard score for word-finding behaviours did not overlap on the two occasions of testing. In Marie's case she continued to make substitutions (e.g. semantic errors) and word reformulations at higher rates than German's controls following therapy, but the overall percentage of T-Units¹⁹ with word-finding behaviours had dropped from 55 to 40%, again the two samples did not overlap in confidence range. This suggested that, as for Shaun, the change was genuine and did not simply reflect variation across occasions. Thus, despite the item specific effect when picture naming is assessed, both children show less evidence of word-finding problems in connected speech after therapy. This perhaps suggests a more general change after therapy in that, when the children are given the freedom to formulate their own sentences and select their own lexical items, word retrieval deficits are less evident.

Table 5. Results of assessments at A1 and A4

Name	Rod		Shaun		Sas		Becca		Marie	
	A1	A4	A1	A4	A1	A4	A1	A4	A1	A4
BPVS SS	73 ^a	85 ^a	87	88	91	92	82	79	99	96
CELF Subtest	Word classes		Sentence structure		Word classes		Receptive score		Recalling sentences	
SS	6	7	6	6	4	5	65 ^b		6	7
CELF Subtest			Recalling sentences		Formulated sentences		Expressive score			
SS			4	3	3	3	60 ^b			
CELF Subtest					Concepts and directions					
SS					3	3				
Renfrew Raw score /50	39	42	19	17	35	36	32	36	36	41
TWFD SS										
Productivity words	62	^c	86	83	92	95	^f	90	106	103
Productivity T-units	71	^c	86	92	98	84 ^c	^f	92	102	96
Word-finding behaviours	80	75 ^c	81 ^d	96 ^{d*}	92	88 ^c	^f	80	64 ^g	88 ^{g*}
BAS Single word reading, Raw scores	n.t. ^h		n.t.		22	49 ⁱ	37	38	58	77 ⁱ
Non-word reading ^j	n.t.		n.t.		20/32	27/32	22/32	22/32	89/95 ^k	91/95

SS, standard score; BPVS, British Picture Vocabulary Scale; CELF, Clinical Evaluation of Language Fundamentals; Renfrew, Renfrew Test of Word Finding; TWFD, Test of Word Finding in Discourse; PhAB, Phonological Assessment Battery.

^aChange in Rod's BPVS score approaches statistical significance ($\chi^2=1.51$, $p=0.065$, one-tailed). This may reflect changes occurring as a result of ongoing teaching and speech and language therapy during the course of the project.

^bAssessment was carried out by the therapist. Overall standard scores are given (mean=100). It was not appropriate for subtests to be repeated for the research at A4 as the next CELF scores would form part of the assessment determining Becca's secondary school placement.

^cUnfortunately, this assessment was carried out on a day when Rod had fallen and cut his lip badly. His production of 21 T-units and 176 words was off the scale of standard scores.

^dReduction in Shaun's word-finding behaviours was significant ($\chi^2=1.77$, $p=0.039$, one-tailed).

^eSeveral utterances took the form of lists: you can buy x and buy y and buy z resulting in longer and fewer T-units. This resulted in more T-units with word-finding behaviours even though the total number of words was similar.

^fUnfortunately, the tape-recording from A1 was not audible. However, from the on-line transcription, the standard score for word-finding behaviours is estimated at approximately 85.

^gReduction in Marie's word-finding behaviours was significant ($\chi^2=2.83$, $p=0.0023$, one-tailed).

^hRod and Shaun were included before it was decided to assess word reading.

ⁱDespite Sas and Marie's raw scores for word reading increasing substantially at A4, there was no significant change in their standard scores (Sas 55→59, Marie 66→73).

^jNumber of phonemes correct.

^kOf 95 phonemes, two syllable items were also tested.

It is also of interest that Shaun and Marie both initially showed slow rapid automatic naming. These children, for whom there was an indication of carry-over effects of therapy to connected speech were also two of the three children with the biggest discrepancy between comprehension (BPVS) and production (Renfrew) of words on initial assessment.²⁰ Finally, the intervention may have helped the children, and Shaun and Marie in particular, in more general ways:

- One-to-one focused attention for 1 h a week.
- Improved confidence stemming from being able to retrieve a set of words.
- Focus on listening was part of the task.
- Repeated letter-to-sound conversion may have improved their confidence in reading.

In relation to reading, it was unfortunate that assessments were not carried out with all children, particularly in relation to positive changes suggested by Shaun's teacher and mother (see below). Both Sas and Marie made considerable gains on a formal test of single-word reading during the study, but in neither case was there a significant change in standard score. Future studies should investigate reading in detail before and after intervention. It may be that repetition of letter to sound conversion helps develop early reading skills (Hatcher *et al.* 1994) for a reading remediation study relevant to this point.

Views of children, parents, teachers and therapists

After the intervention all the participants were asked to complete the 'view's questionnaire' (see appendix A) again. The points on the 12-cm scale marked before and after intervention were measured and a mean score across all the raters and all the children was calculated before and after intervention (when both scales were completed). There was no change on numeracy (pre- 6.17, post- 6.08) but a numerical change on word finding (pre- 4.50, post- 5.82) and reading (pre- 6.67, post- 7.50). These changes did not approach statistical significance (word finding, $t(9)=0.58$, n.s.) and the variability in ratings makes it hard to draw firm conclusions. A summary of the comments from children, parents, teachers, learning support assistant and therapists is given in appendix B. It is clear from the overviews and individual summaries in the next section that there were some practical benefits of the project that varied across the children.

Individual children after therapy

During the course of the study a version of the aid called which could be installed on a computer was devised and called 'Key phone'.²¹ This was offered to the therapist/teacher/learning support assistant involved with each child as outlined below.

Rod

The speech and language unit was offered a copy of Key phone but unfortunately problems with the computer's sound card meant it did not work on the classroom computer. There were two ways in which the aid seemed helpful to Rod during the

research project; as an ‘initiator’ and in emphasizing the written form as part of the ‘glue’ of a word representation. The therapist reported increased use of written letter cues in vocabulary groups where the potential target word was constrained by the topic. Both Rod and his mother mentioned use of the letter card at home after the project.

Shaun

There were no obvious effects of Shaun’s difficulties with auditory discrimination on his performance in the study (he did not, for example, respond as if he had perceived a different cue from the target). After the study, the speech and language therapist who worked with Shaun was given a copy of Key phone to use with him. As in the research study, she needed to restrict the number of letters available. Key phone was used to work on finding the names for pictures within a semantic category and for finding words to definition. It was felt to be useful at helping Shaun find words although the therapist asked for more letters/sounds to be available, and noted Shaun’s own speech production could sometimes unhelpfully influence his choice of letters (e.g. for ‘van’ he selected ‘F’ and said it was fan). Towards the end of the intervention and with his therapist afterwards it was felt that at times Shaun, while benefiting from the choice of letters, no longer needed to hear the sound cue to help him find a word. In the longer term it was agreed that Shaun might benefit from a choice of written letters to help him find a word and would no longer need the letter to sound conversion provided by the aid. Concern over Shaun’s behaviour at home and school continued.

Sas

Towards the end of the intervention Sas, who had begun by sometimes asking ‘what is it?’ now asked ‘what does it start with?’ for some of the items. The positive change in Sas’s word finding was particularly noteworthy as, had it not been for the research project, the therapist would have used a different approach focusing on developing semantic representations. The learning support assistant who worked with Sas contributed greatly by attending some of the sessions and helping compile the functional set of items. She was keen to use Key phone with Sas and another child to carry out tasks suggested by the SLT such as naming to definition and role reversal with this task. In addition to the changes noted in relation to table 5, Sas showed no change on her scores on the judgement tasks in the Phonological Assessment Battery but considerable change in the standard scores for fluency (Alliteration 87 to 111, Rhyme 90 to 98²²). Finally, in a drama exam towards the end of her involvement in the study, Sas was awarded a ‘merit’ by an examiner unaware of her special needs.

Becca

Becca appeared to enjoy the research, she co-operated with all the activities but rarely commented on them. As discussed above, there were times when Becca used the aid and then still needed to hear the form before she produced the target. If the effect of the intervention was due simply to practising saying the set of target

words then one might not expect the benefit to last. In fact, there was no drop off in performance at follow up (e.g. research set A3 27/29, →A4 27/29). This long lasting effect suggests that it may have been the aid combined with production of the target form that was helpful to Becca. At the end of the study, it was agreed that Becca might benefit from a 'carry over' phase of intervention designed to encourage use of the words at home/in class. Her therapist had heard her use some of the intervention items outside therapy but noted that this was inconsistent.

Marie

During intervention Marie demonstrated some confusion between the item pairs that were both phonologically and semantically related (cuff/collar, battery/bulb). One recommendation would be to avoid including such items within the same block of therapy.

After the intervention, Marie was given a small laminated alphabet card. She reported using this in lessons to help her find words. At home she was reported as describing items more, and at times drawing pictures of words she could not find (e.g. plug). Her mother also reported that she appeared to be more confident. Interestingly, she had made progress on the Renfrew test of word finding (A.E. 6:4→7:8–11). This was surprising given the item specific nature of the effect on the research set of items, and should be interpreted with care given the small number of items resulting in a large change in age equivalent score. The result does, however, link with other findings to suggest a more general change had occurred. After intervention Marie was age appropriate on the speeded naming task from the PhAB (standard score A1 69→A4 102). Finally, on the TWFD the number of word-finding behaviours (such as substituting other words) remained high but was significantly lower than before intervention (table 4). The claim is not that Marie's difficulties in finding words had 'disappeared' but that both specific and general changes in word-retrieval had resulted from the intervention.²³

How did the outcome compare with that from other intervention studies?

Table 6 provides a summary of the change in naming resulting from this intervention and related studies. The outcome in terms of improvement on intervention items compares favourably with the most closely related study, that of Easton *et al.* (1997). Both these studies were carried out using an intensity and duration of intervention that is reasonable within most current provision. The more intensive interventions of Hyde Wright *et al.* (1993) and Wing (1990) had significant effects on items that were not included in therapy. Such generalization is obviously preferable to outcomes that are specific to therapy items. Nevertheless, if retrieval of specific items can be improved with a relatively limited amount of intervention and if this effect lasts then such approaches are appropriate as one of the clinicians' tools. The suggestion is *not* that aid is used instead of semantic and phonological approaches but that it is added to the range of techniques available. Clearly further research is necessary to find the optimum approach for different children.

Table 6. Comparison between intervention studies

Reference	Type of intervention	Duration and intensity	Number of children	Change on intervention items ^a	Change on control items ^a
Present paper	cueing aid	six sessions over 6 weeks	5	0.37*	0.05*
Easton <i>et al.</i> (1997)	semantic and phonological	10 sessions over 5 weeks	4	0.24*	0.09 ^b
Hyde-Wright <i>et al.</i> (1993)	phonological	15 sessions over 5 weeks	8	^c	0.04
	semantic		6		0.09* ^d
Wing (1990)	phonological	30 sessions over 10 weeks	5	^c	0.12*
	semantic		5		0.07 ^c

*Significant change for the group.

^aAveraged across the children, e.g. for current study, sourced from table 3, mean score post-therapy on intervention items minus mean score pre-therapy.
 $((0.85+0.82+0.77+0.93+0.95)/5) - ((0.56+0.47+0.42+0.34+0.65)/5) = 0.37$.

^bGain in intervention items was maintained, but the in control set gain, which bordered on significance immediately after therapy, was unfortunately no longer evident at follow-up testing 9 weeks afterwards.

^cThese studies did not investigate change on intervention items as their focus was on developing strategies for word finding.

^dThis change was significant for the group and contrasted with the control group's small deterioration in performance.

^eThis change did not reach significance because one of the children showed a deterioration in performance.

Neither of the latter two studies collected follow-up data.

Summary of main findings

- During therapy, all the children made a gradual improvement in naming.
- All the children used the aid during intervention (on up to 70% of occasions—Marie), even when this was not required (up to 43% of occasions—Shaun). Additionally, all the children repeated some items (up to 30% of the time—Rod, Sas, Shaun and Becca).
- All the children showed significant improvement in naming intervention items. The size of the intervention effect did not differ significantly across the children.
- None of the children individually showed significant gains in naming control items (although the group effect reached significance).
- Improvement on items included in therapy maintained half a term later.
- Two of the children (Shaun and Marie) showed a significant reduction in word-finding behaviours on the TWFD after therapy.
- After intervention, two of the children used a letter card (Rod at home and Marie at school) to help with word finding. Two continued to use Key phone (Shaun with his SLT and Sas with her LSA).
- Views on the intervention were varied. Particularly positive comments were given with respect to reading (Shaun).

General discussion

This section discusses the main findings and relates these to an interactive model of speech production. An overview of therapy studies in the area suggests that therapists can be fairly confident that interventions for word-finding difficulties can be effective. However, there remains little evidence on which techniques might be appropriate for which children. The results of the present study suggest that an approach using an aid that converts letters to sounds is a viable additional technique appropriate for use with children with this, sometimes pervasive, difficulty.

It was hoped that the intervention would provide children with a strategy to improve their word retrieval and that the effects would therefore generalize to control items as had been the case with some adults with aphasia. Unfortunately, such generalization did not occur. The improvement in the intervention set, however, was maintained at 6 weeks post-therapy suggesting the approach can have a lasting effect on targeted items and thus has the potential to be of functional benefit if target items are chosen appropriately. Therapists/teachers commonly select items to match a topic relevant to the school curriculum for that term for vocabulary work and use of the aid for words already in a child's vocabulary might be tied in with this.

The children did not differ significantly in their change in naming, and it would therefore not be methodologically sound to look at psycholinguistic profiles in relation to outcome. Despite the lack of difference between the children, the case series design is appropriate as it allows us to assess the overall effect of the group and to look in detail at the children for whom the intervention was appropriate (Howard 2003). That is not to say it was the *most* appropriate intervention for all the children and further research is necessary to compare the effectiveness of different approaches within series of children.

Additionally, these findings allow an important claim to be made. Despite very different learning and language profiles, the same mechanisms for linguistic change may have been operating for all the children.

Returning to the levels hypothesized in the Introduction, I would like to claim that the children included in this study have difficulties with levels (iii) and (iv):

- (iii) In accessing the phonological form for production.
- (iv) In storing phonological information for production.

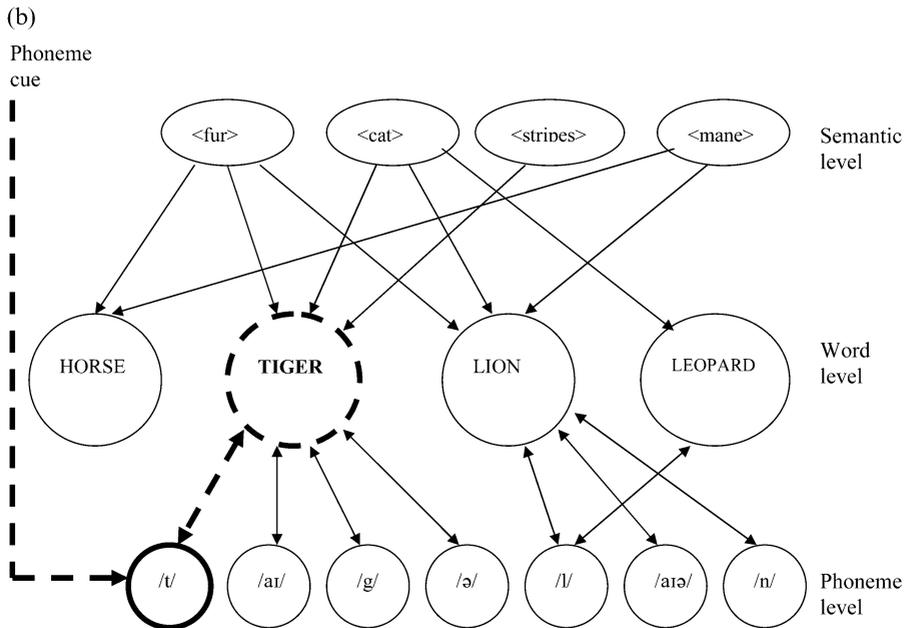
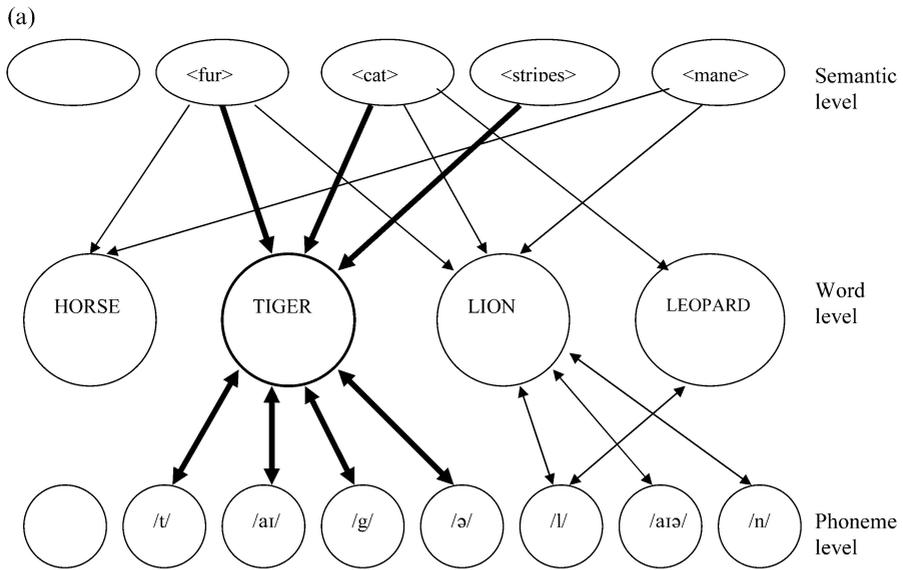
A central semantic cause for the word-finding problems is unlikely because, in general, the children's comprehension of words exceeds word-retrieval abilities, they show significant word-finding behaviours on the Test of Word Finding in Discourse and they perform well on a test of conceptual knowledge using pictures. Additionally, the children's word finding tended to benefit from initial phoneme cues suggesting items are in their lexical system but are difficult to retrieve. The children also demonstrate difficulties with either the fluency or rapid naming tasks or on both of these in the PhAB. Finally, all the children were far better at repeating words than at finding their names suggesting a phonological *speech* problem is not the cause of their difficulties.

In addition, I would suggest that the therapy works predominantly by strengthening the links between lexical semantic and phonological forms for production (iii) and, some of the time, particularly for Becca,²⁴ it is hypothesized to be helping storage of the correct phonological form for production (iv). The claim is that the majority of words are adequately stored for output. For these words, the initial letter/sound is adequate to cue their production. Other forms are not stored for output, at least not in fully specified and accurate form. In this case repetition is necessary for the child to produce the word and these words tend to need to be repeated on several occasions before the form is stored and can be accessed spontaneously (in response to the picture) or sometimes with a cue.

Interactive model of production

How might these claims be illustrated in relation to a model? Figure 2 is adapted from Goldrick and Rapp (2002), which is a model of adult speech production that has been implemented and lesioned to reflect patterns of performance found in adults with anomia. It is not a developmental model, but an extensive literature search did not reveal an implemented developmental model of speech production. Despite being a model of the adult 'end state' and therefore not ideal for considering developmental disorders, one can envisage development occurring at the different levels within this framework.²⁵

There are two stages of processing in the Goldrick and Rapp (2002) account. First, there is activation of the semantic features associated with a concept. Activation from these is passed on to the word level and the phoneme level units. The phoneme units also feedback to the word-level units. This first stage ends with the selection of the most highly active word level unit, which is given increased activation. A second stage of processing follows which ends with the selection of the most highly activated phoneme units. It is important to note that during normal speech production semantic neighbours of the target word are active.



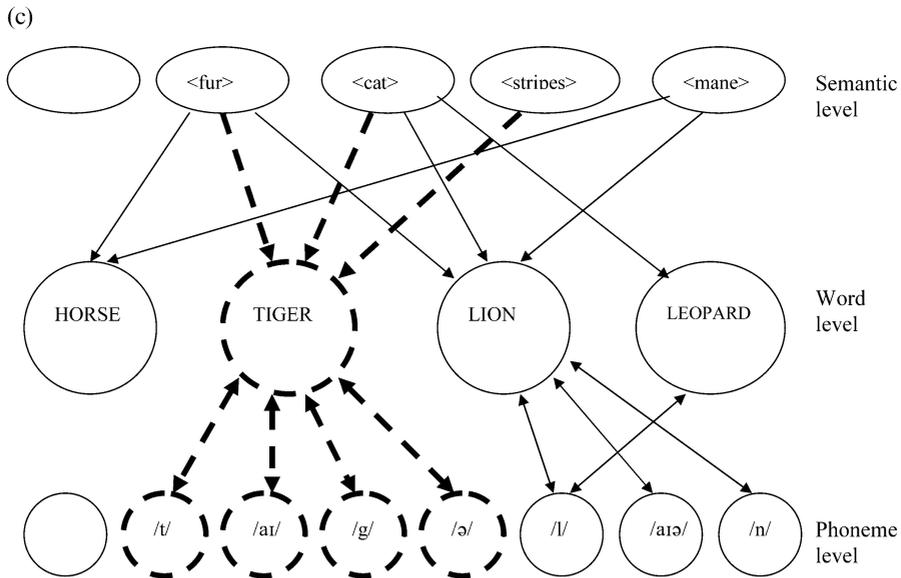


Figure 2. Model of speech production adapted from Goldrick and Rapp (2002) to illustrate the processes involved in production of a single noun and processes that may be occurring during intervention. The example is one of Shaun's errors. The model itself is implemented only for 29 CVC words taken to reflect the characteristics of an 'average' English neighbourhood as suggested by Dell *et al.* (1997). (a) Activation of target. Thick arrows show the flow of activation involving the target. Thin arrows show activation relating to neighbours. (b) Activation from a phonemic cue. Dashed arrows show activation that may result from a phonemic cue. (c) Activation from repeated retrieval of the target form. Dashed lines indicate the units and connections that will be activated repeatedly.

Mechanisms by which the intervention may be working in relation to the interactive model

First, there are the phonemic cues that are provided by pressing the letters on the aid. These might affect the retrieval of the word form by operating in a 'bottom-up' direction, priming the target word over and above semantic neighbours. This possibility is illustrated in figure 2b. In addition, the repeated presentation of the picture and production of the form (whether this is cued or by repetition) will be strengthening the links between meanings and forms. This is illustrated in figure 2c.

Testing predictions stemming from this account of intervention

One way of looking at the change that occurred with intervention is to consider the children's errors. Before therapy, all the children produced single-word errors semantically related to the target (table 2). In relation to the interactive model, this might reflect the neighbour receiving more activation from the semantic level or feedback from the phoneme level than the target and thus becoming the most highly active word unit at the end of the first stage of processing.²⁶ If the intervention can strengthen the links as proposed above, there should be a reduction in semantic errors after intervention. This was investigated by comparing the number

of single-word semantic errors at A2 (immediately before intervention) with the number at A3 (immediately following intervention). There was a significant reduction in semantic errors relative to all other responses for all the children (Fisher exact test, Rob, total $n=27$, pre- 6, post- 0, $p=0.012$; Shaun, $n=30$, pre- 9, post, 2, $p=0.021$; Sas, $n=30$, pre- 9, post- 0, $p=0.001$; Becca, $n=29$, pre- 9, post- 0, $p=0.0009$) except for Marie, where the number of errors was small and the comparison bordered on significance ($n=30$, pre- 4, post- 0, $p=0.056$). Note that this therapy employing letter to sound conversion and the resulting phonemic cues led to a reduction in semantic errors. Without consideration of the study in relation to a model of speech production, this additional investigation of error responses would not have taken place.

This reduction in semantic errors contrasted with no significant change on other error types between A3 and A4 for any of the children (Fisher exact test, Rob, total $n=27$, pre- 5, post- 4, n.s.; Shaun, $n=30$, pre- 7, post- 3, n.s.; Sas, $n=30$, pre- 8, post- 5, n.s.; Marie, $n=30$, pre- 5, post- 1, n.s.) except Becca ($n=29$, pre- 9, post- 2, $p=0.021$). Note that Becca tended to produce part of the target with the cues but sometimes needed to repeat to produce the target correctly (see table 3 and related text), which has already been taken to suggest that in Becca's case the intervention may be strengthening the phonological form (the phoneme level in Goldrick and Rapp's account) as well as strengthening links from semantics to the word form. It may be that the reduction in 'other' error types in her case alone reflects this difference between the children.

Orthographic information

The above discussion has focused on the phonological cues provided by the aid. Having the letters available may also be contributing to the therapy effect. The aid limits the choice of letters to a subset of nine, which remains present so children can look back at them (something not possible with phoneme cues provided by a therapist). Both Rod and Marie used an alphabet card to help word finding after the study. Further therapy studies are necessary to determine whether orthographic information alone benefits word retrieval in children.

Wider picture

It is important to stress that despite the claim that the children may be having similar difficulties with word retrieval and that the intervention may be operating in a similar way, they differ dramatically in terms of their wider learning and language abilities. Sas has learning difficulties and particular problems on visuo-spatial tasks and with numbers. She does not have a diagnosis of specific language impairment. Her word-finding difficulties were more marked than other language difficulties. In contrast, Rod and Becca's word-finding problems formed part of specific language impairments. Shaun's language difficulties occurred in the presence of considerable broader difficulties in behaviour, attention and listening. Finally, Marie was referred for a word-finding problem occurring in isolation from either broader learning or language difficulties. Despite these differences, all the children have shown the ability, with practice, to produce a set of forms that have repeatedly been cued for production. The therapy effect size did not differ for the different children. None

showed generalization to control items and in all cases the improvement in retrieval lasted, i.e. the pattern of change as well as its size was the same across children.

Thus, the intervention appears to have targeted a specific link and the outcomes with respect to picture naming were strikingly similar across the children. In contrast, the wider outcomes of the study, such as word finding in connected speech, are likely to be influenced by the children's abilities and disabilities in other areas along with, of course, much wider issues such as the support available to the child.

Whilst the claim that intervention can generally enhance semantic to phonological links is very appealing, the reality, at least for some children with word-finding problems, may be that the same forms need to be accessed repeatedly (and perhaps in different ways) before spontaneous retrieval becomes easy. Fortunately, all the children were keen to use the aid. Indeed most of them became increasingly enthusiastic as sessions progressed and word retrieval became easier for the targeted set.

It is difficult to know how to interpret the significant reduction in word-finding behaviours in the TWFD for Shaun and Marie. The result is at odds with the improvement in naming being limited to the intervention items. Certainly, it was not the case that the two children used many of the intervention items in their TWFD after therapy. It may be that the study had made them more aware of their difficulties and more likely to produce alternative forms rather than producing classic word-finding behaviours such as 'um' and 'thingy'. It is not clear exactly why this should be the case as this was not targeted in the therapy. Nevertheless, this warrants further investigation as the scores after intervention were outside the confidence intervals from the pre-intervention test indicating a real change on this connected speech task. Finally, these children stood out as being the slowest at finding words they knew (in the rapid naming section of the PhAB), perhaps the strongest indication of a difficulty in retrieving forms for production—the difficulty targeted by this intervention approach.

In the future, it will be important to compare different interventions within the same child or case series of children. The results of such studies will have both clinical and theoretical implications. The inclusion of assessment of connected speech and/or conversation is recommended in order to explore further the interesting findings in this study on the TWFD.

Conclusions

- The study demonstrated that therapy using an aid that converts letters into sounds can improve children's ability to retrieve a set of targeted words.
- Therapy is clinically applicable (in terms of population, intensity and duration of intervention—six sessions over 6 weeks) within many speech and language therapy services.
- Similar pattern of outcome for different children suggests the intervention can be effective in the context of a variety of other language and learning difficulties.
- Intervention can be understood in terms of strengthening links from meaning to form and the phonological form for production in relation to an interactive model of speech production.

Acknowledgement

The author thanks all the children who took part in the study with such enthusiasm, the families, teachers and schools of the children, and particularly the speech and language therapists who referred children to the project. The study was funded by a mid-career award from The Health Foundation (previously The PPP Foundation) to the author, with additional support from University College London. The author also thanks Shula Chiat, Jackie Masterson and Liz Relf for help and support throughout the project. Finally, the paper benefited from suggestions for change from Karla McGregor, Ruth Herbert, Lyndsey Nickels, and two anonymous reviewers.

Notes

1. Here Marie's attempt includes all the target's phonology (porcupine not apple juice) in parts, a beautifully apt circumlocution and even perhaps a 'mixed' (phonological and semantic) error in the form of porcupine sharing phonology and perhaps distant meaning to the target (features such as 'from abroad', 'living', 'with spikes').
2. Models of speech production constructed with reference to data from adults with unimpaired language (e.g. Levelt *et al.* 1999), which also take account of data from adults with aphasia (e.g. Dell *et al.* 1999, Goldrick and Rapp 2002), all make this distinction between semantic and phonological representations, although the flow of information differs between the models. All the models are of the adult system and while they can be lesioned to simulate the effects of brain damage and patterns of acquired word-finding problems, they are not developmental and do not deal with possible interactions between levels that may be part of language development (Chiat and Hunt 1993). Stackhouse and Wells (1997) provide a psycholinguistic framework designed for considering language acquisition, but the model does not have a 'phonological output lexicon' or lexemes for speech production. Instead, the semantic representations directly address motor programmes. This is somewhat unfortunate as any model of development will need to entail representations and processes agreed as necessary for skilled speech production as an end stage.
3. See note 2.
4. Where possible, the findings from assessments already administered by teachers or therapists were used.
5. These assessments were at least 6 months apart.
6. This assessment rather than the more comprehensive Test of Word Finding was selected because the latter is widely used in language units and resources and the timing of its use could not be dictated by the present study for which it was important to have a measure before and after intervention (at A1 and A4).
7. It is inappropriate to compare these scores with naming as even though the same items were involved, letter knowledge involves an element of chance (nine letters were presented), so even on items a child does not know 1/9 could be correct by chance.
8. The mean ages of acquisition ratings for the sets were: low 2.27, mid 2.69 and high 4.01, where items were rated on a scale of 1–7. For further details, see Howard *et al.* (1995).

9. One child named only five of the initial 10 items of the middle set, but was correct on 45/60 when the set was named in full. She was therefore reassessed on the late age of acquisition set.
10. Following A1 and A2 assessment of naming and assessment of comprehension, the 60 items were sorted by comprehension, by naming accuracy and, for items not named correctly, by error type. Items were then allocated two alternating letters (ababa ..., etc.) and the sets were sorted by these. Some items were swapped to fine tune this procedure so the intervention and control sets were balanced as evenly as possible for comprehension, naming and error type.
11. The 'functional' intervention set included adjectives and abstract nouns. The error data reported here exclude the 'functional' set and are restricted to the research intervention set of black-and-white pictures of noun targets in order to allow sensible comparisons with related research.
12. Dockrell *et al.* (1997) found younger children (mean age 7:1) with word-finding difficulties made a high percentage of semantic errors. However, a direct comparison is not appropriate as the children were younger than four of those included in the present study. In their study, multiple responses were coded in more than one category.
13. During the first three sessions, children were encouraged to use the aid even if they could name the picture. Thus, 'correct' included correct without the aid and correct with the aid without any further assistance.
14. Unfortunately, the intervention sessions were interrupted for Sas by the school summer holidays. This resulted in the drop off in performance in session 5, which occurred after a 6-week break.
15. Proportion correct on intervention set at A1 and A2: Rod, 0.52, 0.59; Shaun, 0.47, 0.47; Sas, 0.40, 0.43; Becca, 0.31, 0.38; Marie, 0.60, 0.70. Proportion correct on control set at A1 and A2: Rod, 0.50, 0.65; Shaun, 0.43, 0.50; Sas, 0.40, 0.40; Becca, 0.31, 0.41; Rach 0.60, 0.70.
16. Proportion correct on intervention set at A3 and A4: Rod, 0.85, 0.85; Shaun, 0.83, 0.80; Sas, 0.83, 0.70; Becca, 0.93, 0.93; Marie, 0.97, 0.93. The same was true for the personal set of items, with no significant decline from the final therapy session to follow-up at A4: Rod, 0.71, 0.79; Shaun, 0.86, 0.86; Sas, 0.71, 0.86; Becca, 0.87, 0.80; Marie, 1.00, 0.88.
17. The lack of a significant difference may have occurred either because the intervention effects were homogenous or because the study was not powerful enough to detect differences in the size of intervention effect with different children.
18. This figure needs to be interpreted with care as it comes from performance on only five 'non-comprehended' items.
19. A T-Unit is a main clause plus any subordinate clauses that may be attached to a main clause, e.g. noun phrase plus verb phrase. It can also be thought of as an utterance that can stand alone to represent a complete thought.
20. The test for homogeneity indicated the children did not differ with respect to outcome on naming and it is not therefore appropriate to attempt to link this outcome to background assessment. However, as both Shaun and Marie showed, a significant reduction in word-finding behaviours in TWFD and the other children did not, it is appropriate to consider this difference in terms of the broader issue of carryover in relation to their language profiles.

21. Thanks for this are due to Dr Mike Coleman, Department of Human Communication Science, UCL.
22. Her semantic fluency was not retested as the initial standard score was 102.
23. In the last session with Marie, after the final assessment, we discussed using, perhaps picturing, single-syllable cues for multisyllabic items (e.g. cat for catapult, ref. for refugee) where a single sound cue may not be enough to help find the whole form.
24. Evidence for this comes from her need for repetition of the target even when she had correctly indicated the correct initial letter and heard the phonological cue.
25. With development, children's knowledge of semantic features will expand (e.g. they may be able to name a penguin at 2 years but only know penguins live in cold climates when they are older). The links between semantic features and form will develop as will the phonological forms themselves. This is an inadequate description and such models need to be implemented developmentally. In the meantime, frameworks from adult models may still prove useful.
26. In fact, the model predicts that mixed errors, i.e. those related to the target in both meaning and sound (e.g. pen for pencil), will be particularly likely to occur when such neighbours exist. During therapy, Marie made several errors of this type, but there were not enough of these across the children to show any particular pattern.

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Appendix A: Parent's form

The parent's form is provided as an example. Those for the child, teacher and therapist differed slightly.

Parent's views

Name:

Date:

I would be very grateful if you could complete this form and return it to me next week. For questions 2, 3 and 4 put a mark on the line and add a comment if you have one. Please ask if the form is not clear.

1. How does your child's problem in finding words influence communication at home?

2. Has your child's ability to find words changed over the last half-term?

The same Some improvement Much improvement

Comment:

3. Has your child's reading ability has changed over the last half term?

The same Some improvement Much improvement

Comment:

4. Has your child's number work/maths changed over the last half term?
 The same Some improvement Much improvement

Comment:

Please add any other comments you wish to make.

Many thanks for your help.

Appendix B: Views on intervention at A3/A4

Summary results from the marks on the scale as well as written and spoken comments.

Rod

Rod said he was using the letter card at home.

Rod's mother wrote: 'we do think we have been asked to give words less than usual i.e. if he doesn't know he gives us clues'.

His teacher wrote: 'we are trying to cue XXX in by giving him the initial sound/letter—too early to say if this is working'. This was included in Rod's Educational Plan for the next year.

The therapist noted that when he (the therapist) was aware of the target, he could prompt Rod with the first letter and that this enabled Rod to participate more confidently in a science vocabulary group.

Overview: responses were generally positive but the teacher marked 'the same' for Rod's word-finding abilities over the half-term when the intervention took place. Neither the teacher nor the therapist had predicted rapid change. Use of the letter card mentioned by both Rod and his mother is encouraging.

Shaun

On finding words, Shaun said it was 'a bit easier'. He also said: 'reading is very good' and 'my maths not good'.

His mother wrote: 'XXX has made more progress this term than ever before. I believe this project has been very beneficial to XXX as his improvement shows'.

His teacher, in the language resource, stated: 'the project definitely seems to be helping XXX'.

The speech and language therapist wrote: 'his involvement in the project has made me more aware of his word-finding difficulties, so subjectively it seems more of a problem'. She also appreciated the ongoing contact with the research therapist (results of tests, observations of communication, therapy advice).

Overview: feedback from Shaun's mother and teacher was very positive. Both noted a particular change in reading on the scale. It is possible that the emphasis on letter-to-sound conversion in therapy fed into Shaun's early reading development.

Sas

Sas viewed her reading, word finding and numeracy as all showing ‘much improvement’ over the half-term when the intervention took place. When asked to order these for change, she selected reading followed by word finding followed by maths.

Her parents did not respond to requests for feedback after the intervention.

Her learning support assistant wrote: ‘the merit that XXX gained in her drama exam shows an improvement in this area. Sas has moved up two reading stages in the past year and is now keen to read’. This change in reading was echoed by comments from the school Special Educational Needs Co-ordinator.

On word finding, her therapist wrote: ‘it is very hard to assess this objectively. It is noticeable that she is using many less word searching behaviours (filled pauses/revisions) in her conversations and story retell tasks’.

Overview: Sas made a great deal of progress during the time of this project. What is impossible to disentangle is whether this would have happened anyway, particularly with the involvement of a very committed learning support assistant, or whether some of the wider changes in reading and confidence resulted, in part, from this intervention study.

Becca

Becca’s ratings were similarly positive before and after intervention. The only change was a less positive view of reading (she rated ‘some improvement’ after intervention versus ‘much improvement’ pre-intervention).

Her mother wrote: ‘XXX has difficulty finding the correct words and sometimes difficulty expressing what she means. XXX has more vocabulary but sometimes forgets certain words. I am pleased with the improvement XXX has made—she tries to pronounce words rather than just dismissing them’.

The teacher reported not noticing any change in word finding. She said that Becca answered more questions in class over the last half term and would attempt answers but got embarrassed when asked to answer and could not reply in time.

The therapist noted a change in word finding limited to the intervention items.

Overview: Becca’s mother was positive in her comments about change but was also positive before the intervention, perhaps due to Becca having started at the language resource in the past year. In addition, although Becca was noted to use some of the intervention items in class/therapy, the comments from school suggest a very limited wider impact.

Marie

Marie reported that her difficulty in finding words was annoying at home before and after the intervention. After intervention, she said that the letter card was useful at school, especially in English lessons.

Her mother wrote: ‘she still communicates as much as she wants to but when she gets stuck on a word finds it difficult but has now found techniques for dealing with it. She now seems more able to find the initial letters of words she can’t remember. Her general confidence has improved a lot due to varying factors’.

Her teacher did not respond to the request for views after intervention and Marie does not have a speech and language therapist.

Overview: Marie and her mother were both positive about the changes. In particular, use of the letter card at school and improved ability to find initial letters when stuck on a word at home are encouraging.