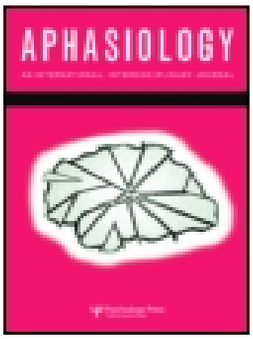

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Phonological therapy for word-finding difficulties: A re-evaluation

Julie Hickin

De Montfort University, Leicester, UK

Wendy Best and Ruth Herbert

University College, London, UK

David Howard

University of Newcastle-upon-Tyne, UK

Felicity Osborne

Birkbeck College, University of London, UK

Background: Treatments for word-finding difficulties in aphasia using semantic techniques have been shown to be effective (e.g., Marshall, Pound, White-Thomson, & Pring, 1990). The evidence with regard to phonological treatment is more equivocal, however, with some studies reporting only short-term improvement in word retrieval (e.g., Howard, Patterson, Franklin, Orchard-Lisle, & Morton, 1985a) and other studies reporting lasting effects (e.g., Miceli, Amitrano, Capasso, & Caramazza, 1996). There is also little in the literature on the use of orthographic cues in treatment (Howard & Harding, 1998). Additionally, whereas several studies have reported the results of using cues in facilitation of word-finding difficulties (e.g., Patterson, Purrell, & Morton, 1983), none so far has attempted to relate response to facilitation and response to treatment using similar techniques in the same individuals.

Aims: This study set out to investigate whether the use of phonological and orthographic cues in the treatment of word-finding difficulties could produce lasting improvements in word retrieval. The response of the participants to phonological and orthographic cues in a facilitation study was also related to their response to treatment using similar cues.

Methods & Procedures: The study used a case series design. The participants were eight people with acquired aphasia who were all at least 1 year post-onset, had a single left CVA, and had word-finding difficulties as a significant aspect of their aphasia. Detailed assessment of each participant was carried out to identify the nature of their word-finding difficulties and this was related to response to treatment.

Outcomes & Results: Results are given for the eight participants, seven of whom benefited overall from treatment. Both phonological and orthographic cues were effective in improving word retrieval. For the group as a whole there was a significant correlation between the overall outcome of facilitation and response to treatment.

Address correspondence to: Julie Hickin, Division of Psychology and Speech and Language Therapy, De Montfort University, Scraptoft Campus, Leicester LE7 9SU, UK. Email: JHickin@dmu.ac.uk

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Conclusions: The theoretical and clinical implications of the relationship between the individual's level of language impairment and their response to therapy are discussed. It is also suggested that the results from facilitation appear to have potential in predicting the outcome of phonological/orthographic therapy with aphasic participants. Finally, it is concluded that phonological and orthographic treatments for word-finding difficulties can be highly effective and that they represent an under-utilised and under-researched tool in the clinician's armoury.

Word-finding difficulties are probably the commonest symptom of aphasia. There is anecdotal evidence (see Parr, Byng, Gilpin, & Ireland, 1997) and evidence from the field of conversational analysis (e.g., Lesser & Algar, 1995) of the significant impact that problems with word finding have on everyday communication. It seems imperative therefore that we develop effective means of treatment.

Treatments for word-finding difficulties using semantic techniques have been shown to be effective (e.g., Howard et al., 1985a,b; Marshall et al., 1990). The evidence with regard to phonological treatment is more equivocal. In 1985 Howard et al. published two seminal papers comparing the effectiveness of semantic and phonological techniques in both facilitation and treatment of word-finding difficulties. (*Facilitation* studies investigate the effectiveness of using a cue on *one* occasion on later word finding, usually a few minutes or days later. *Treatment* refers to the *repeated* use of a therapy task, e.g., a cue, in an attempt to improve word finding in the long term, ideally permanently.) Early reports had suggested that phonological facilitation was less effective than semantic (Patterson et al., 1983) and this seemed to be confirmed by Howard et al.'s 1985 study. The latter concluded that phonological facilitation techniques (e.g., phonemic cues, word repetition) resulted in only short-term improvement in word retrieval, whereas semantic facilitation techniques (e.g., word-to-picture matching, semantic judgements) resulted in relatively long-lasting improvement. When they went on to compare these two tasks in a treatment study, the differences in the effects of the two types of task were minimal (Howard, 2000; Howard et al., 1985b). However, their facilitation findings had a powerful influence on the type of research and therapy carried out for word-finding difficulties, with the emphasis being placed on semantic techniques (e.g., Horton & Byng, 2000).

More recently a number of studies have shown that phonological approaches to both facilitation and treatment of word-finding difficulties *can* be effective. Best, Hickin, Herbert, Howard, and Osborne (2000) report the results of a phonological facilitation study related to the treatment study described here (see also Best, Herbert, Hickin, Osborne, & Howard, 2002). This showed improvement in word-retrieval more than 10 minutes after the use of a phonological cue. These results contradict those of both Patterson et al. (1983) and Howard et al. (1985a, Experiment 4). Regarding treatment studies, there are a number of papers reporting the effective use of phonological techniques. These include Davis and Pring (1991), Raymer, Thompson, Jacobs, and Le Grand (1993), and Miceli et al. (1996). It has indeed been suggested that phonological approaches should be the treatment of choice for those whose word-finding difficulties lie at the post-semantic/lexical level (e.g., Nettleton & Lesser, 1991).

The differing outcomes from semantic and phonological techniques raise a number of questions. First, why is it that semantic tasks may produce longer-lasting changes in word retrieval than phonological tasks? One difference between the two is the element of choice. In semantic tasks the aphasic client is generally expected to make a choice (for example choosing one picture from a set to match a word), whereas in phonological tasks

information about the word-form is generally presented without the need to make a choice (e.g., the initial phoneme of a word is presented as a cue in a straightforward manner). Byng and Jones (1993) postulated that the extent to which an individual is required to actively manipulate information/problem solve may be important in determining the effectiveness of therapy. Thus, it could be that the act of making a choice encourages deeper processing of the therapy task, thereby producing long-term changes in word retrieval. This may also relate to the claim by Robertson and Murre (1999) that active attention to the stimuli is necessary for effective rehabilitation. In this study we provide a choice of phonological or orthographic cues as part of therapy.

Second, given that the effects of phonological cues in *facilitation* may be long-lasting (Best et al., 2000), would it be possible to use phonological cues successfully in *treatment*, thus adding weight to those more recent studies showing positive outcomes from such treatment (e.g., Davis & Pring, 1991)? It has indeed been proposed that effective facilitation techniques would also be effective in treatment (e.g., Howard et al., 1985a) but without supporting evidence. In this study, we were able to test this by examining whether two of the cueing techniques used in the facilitation study (word-initial CV spoken and written letter cues) would be effective in treatment.

Third, we were interested to see if there was a relationship between a participant's response to cues in facilitation and in treatment—a relationship that has never been explored. In particular, would an individual's response to facilitation (which could be given as part of background assessment) enable us to predict response to treatment using the same cues? Investigating this link pertains to the issue of developing a theory of therapy. Crucial to the latter is the ability to predict response to treatment for an individual from the results of background assessment (Byng & Black, 1995; Caramazza & Hillis, 1993; Howard & Hatfield, 1987). This is investigated further in our study by considering how the person's handling of phonological and orthographic information in lexical and sublexical tasks in assessment relates to their response to treatment using phonological and orthographic cues.

The inclusion of orthographic cues in the study warrants discussion. There are only a few studies of the use of written cues to improve word finding, e.g., Nickels (1992), Howard and Harding (1998) and Basso, Marangolo, Piras, and Galluzzi (2001). This may partly reflect the findings from a study by Bruce and Howard in 1988. They investigated 20 people with Broca's aphasia and found that none of the people studied had all three of the abilities deemed necessary to generate their own phonemic cues from written letters (i.e., that they showed ability to indicate the initial letter of a word they were unable to say, to convert letters to sounds, and to benefit from phonemic cues). However, Bruce and Howard (1987) successfully treated five people with word-finding difficulties by using a cueing aid which provided the missing link of converting letters to sounds. This was replicated by Best, Howard, Bruce, and Gatehouse (1997) in a single case study. They found that it was only necessary to show *some* ability to benefit from phonemic cues and *some* awareness of orthography in order to benefit from treatment using the cueing aid. In the latter study treatment took place once a week for 5 weeks and resulted in improved word finding for treated words. This improvement also generalised to untreated words beginning with the treated letter/sound, and to words beginning with other sounds. Improvement was not dependent on the presence of the aid. Best et al. suggest that treatment enabled their client to make use of his existing knowledge of orthography and link this with phonology but not as a conscious strategy. Rather, ''It appears that the treatment affected a fundamental change in (his) word-finding, altering automatic and not strategic processes in his linguistic system'' (p. 134). Thus the use of

orthographic cues in the treatment of word-finding difficulties merits further investigation.

Finally, we will consider the issue of generalisation of treatment for word-finding difficulties. Ideally, treatment of a limited set of items would result not only in improved ability to retrieve that set, but also improved ability to retrieve words in general (although this is not to underestimate the benefits of improved ability to retrieve a functionally useful set of items only—e.g., Hickin, 1997, who worked on a small vocabulary of colour and flower names with an aphasic woman who was a keen gardener and artist). One might predict that semantic treatment—which often involves thinking about the relationships between words—would result in generalisation of treatment at least to untreated items that are semantically related to the treatment set. This may be mediated by activation of shared semantic features in a connectionist model such as that proposed by Dell (1986). There is some evidence that this can occur, e.g., FW in Marshall et al.'s 1990 study, and AER and TRC in Nickels and Best (1996). Phonological treatments that focus on the output form of the individual word might, on the other hand, be predicted to result in item-specific improvement (e.g., both participants in Miceli et al.'s study and DF in Nettleton & Lesser, 1991). However, there are contradictory examples of clients given semantic therapy showing improvement only on treated items (e.g., RS, Marshall et al., 1990) and of people treated using phonological techniques showing generalisation (e.g., MF, Nettleton & Lesser, 1991). It has been suggested that a factor influencing whether generalisation occurs or not is the nature of the deficit, i.e., that clients with post-semantic deficits may show item-specific improvement whereas those with semantic deficits may show generalisation. For example, Miceli et al. (1996) argue that if output representations are selectively impaired and are addressed by fully intact semantics then what is required by treatment is the precise restoration of these damaged/inaccessible lexical entries, and that on this basis generalisation would not be expected. Nickels and Best (1996) discuss the possibility that the lexical therapy they carried out with PA (which resulted in item-specific improvement) may be working by strengthening the links between the semantic system and the phonological output lexicon. It also seems possible that the distinction may be between treatment that involves simply producing the item (e.g., by repetition/reading aloud) relatively automatically and others where deeper processing is required. In this latter case generalisation may occur if the processing involves making a new link or developing a new strategy that may be applied across items (see Best et al., 1997).

METHOD

Design

In considering the effectiveness of aphasia therapy, there has been much debate over recent years concerning the appropriate research methodology (e.g., Howard, 1986; Robey, 1998; Robey, Schulz, Crawford, & Skinner, 1999). Nickels and Best (1996) advocate the use of a case series design. This ''allows the results of therapy to be related to individual deficits and strengths'' (p. 110) which informs us as to how therapy might be working, while at the same time demonstrating the efficacy of therapy with a number of different individuals. Thus, we have used a case series design in our study and will present both the group results and also comment on the response of individual participants within the group where this informs us as to the mechanisms by which therapy may be working.

The overall study consists of three phases each lasting approximately 8 weeks. First, there is an assessment phase—including a facilitation trial—which is reported in the

related special issue (Best et al., 2002). Next, there is a treatment phase which focuses on improving word finding by using cues in a picture-naming task. The results of this phase will be reported here. Finally, there is a second phase of treatment which aims to enable the use of treated words in real-life conversation. This phase is reported by Herbert et al. (2002). Progress is monitored via five assessments, one at the beginning and end of each phase of the study. This is summarised below. Only the results of baseline assessments (i.e., Assessments 1 and 2) and Assessment 3 are reported in this paper.

Assessment 1
Assessment and facilitation study
Assessment 2
Phase 1 of treatment
Assessment 3
Phase 2 of treatment
Assessment 4
No intervention
Assessment 5 (follow-up)
The assessments are composed of the following on each occasion:

1. A quantified measure of word finding in real-life conversation.
2. A measure of word finding in connected speech using Cinderella (Bird & Franklin, 1996).
3. Naming of 200 items.
4. A questionnaire pertaining to feelings about communication skills.
5. A set of control tasks: written sentence comprehension; reading aloud words (n = 52); reading aloud nonwords (n = 26), short-term memory (STM) (picture pointing).

Participants

The participants in the study were eight people with aphasia (see Table 1). For ease of comparison, participants are listed in the same order as in Best et al., 2002). All were at least 1 year post-onset and had suffered a single left hemisphere CVA. They all presented with word-finding difficulties as a significant aspect of their aphasia, but also presented with a range of severity and types of aphasia ascertained via a battery of comprehensive assessment (see Table 2 and following section). None had severe comprehension problems, hearing loss, oral or verbal dyspraxia.

Procedure

Assessment. Participants were first asked if they wished to be involved in the research via an aphasia-friendly consent form specifically designed for the study. This used simple text and pictures combined with a spoken explanation to try to ensure that truly informed consent was given by the aphasic participants despite their communication difficulties (see Osborne, Hickin, Best, & Howard, 1998).

During the first phase of the study detailed assessment was carried out to identify the nature of the individual word-finding difficulties. Tasks were drawn from a range of assessments and looked at several different stages of language processing. These are summarised in Table 2.

TABLE 1
Background information

Participant	*Years post-onset*	*Age*	*Aphasia type*
HM	6	45	Broca's
PH	3	77	Anomic
SC	5	65	Mixed/Wernicke's
DC	5	70	Anomic
OL	2	65	Anomic
NK	3	52	Anomic
IK	3	68	Broca's
KR	8	38	Broca's

Initials for participants, years post-onset, age at the start of their involvement in the study, and aphasia type as assessed by the Comprehensive Aphasia Test (Swinburn et al., 2002).

Naming was assessed using a set of 200 pictures. These were black and white line drawings taken from a number of naming tests (including Nickels, 1992; European Naming Test, unpublished; our own materials). Naming was tested at the beginning and end of the assessment phase (Assessments 1 and 2) to establish baseline naming performance. Written naming was assessed using a subset of 40 items taken from this set. Comprehension was assessed using a variety of tasks (see Table 2). These included the Pyramids and Palm Trees Test (Howard & Franklin, 1992) and tests of spoken and written word–picture matching from the Comprehensive Aphasia Test (Swinburn, Baker, and Howard, 2002) in order to identify difficulties at the semantic stage of lexical retrieval. The tests of auditory discrimination and STM (using picture pointing, and phoneme, digit, and letter spans) were included as the skills tapped by these tests may have an important influence on retention of cues during treatment. Reading and repetition were assessed using both real words and non-words. This was to allow us to examine whether the ability to respond to cues depended on the ability to convert between input and output lexically or sub-lexically.

Facilitation. Participants' response to the single application of a cue was assessed using a set of pictureable CVC items. Participants were presented with a picture to name and if unable to do so within 5 seconds they were given one of three types of help: (i) they were given extra time (5 seconds) to name the picture (the *control* condition); (ii) they were given a single cue (the *single cue* condition); or (iii) they were given a choice of two cues—the target and a distractor—(the *choice* condition). Four types of cue were investigated in each condition: CV spoken, CV written, rime, and repetition. Only one type of cue was investigated during each facilitation assessment. To give an example of the procedure for the CV written cue, when a participant was unable to name a picture (e.g., cage) it would go into one of the three conditions: if the picture entered the *control condition* the participant would be given 5 extra seconds to name it, in the *single cue condition* they would be shown the letters CA and told ''It begins with this'', and in the *choice condition* they would be shown the letters RO (distractor) and CA (target) and told ''It begins with either this or this''. (The distractor cue was always derived from a semantically and phonologically unrelated word, here ''rock''). The immediate effect of the cue on naming was then recorded (*immediate naming*). Testing continued until the

TABLE 2
Scores on background assessments

		Participants									
Test	*n*	*HM*	*PH*	*SC*	*DC*	*OL*	*IK*	*NK*	*KR*	*mean*	*s.d.*
Picture naming tests 1 and 2: mean	200	0.45	0.36	0.32	0.67	0.52	0.24	0.56	0.40	0.39	0.16
Semantic tests:											
CAT Spoken word to picture matching test	30	1.00	0.93	0.87	1.00	0.97	0.93	0.93	0.93	0.92	0.06
CAT Written word to picture matching test	30	0.87	0.97	0.77	0.97	0.93	0.80	0.97	0.90	0.86	0.17
Pyramids and Palm Trees Test three-picture version	52	0.94	0.90	0.88	0.92	0.96	0.92	0.87	0.77	0.85	0.15
Picture naming: Semantic errors as a proportion of total errors		0.52	0.25	0.28	0.50	0.16	0.18	0.33	0.16	0.29	0.14
Phonological tests:											
ADA Auditory discrimination test	40	0.82	0.68	0.95	0.85	0.70	0.65	0.90	0.65	0.72	0.18
Short-term memory test: phoneme span		1.40	2.50	2.30	2.30	2.90	1.70	2.70	1.70	2.10	0.60
Repetition of words	152	0.73	0.97	0.57	0.95	0.99	0.52	0.99	0.90	0.80	0.23
Repetition of non-words	26	0.31	0.58	0.27	0.50	0.92	0.23	0.81	0.69	0.54	0.29
Repetition of non-words: Initial phoneme correct	26	0.54	0.88	0.50	0.85	1.00	0.38	0.96	0.81	0.78	0.22
Picture naming: Phonological errors as a proportion of total errors		0.20	0.05	0.02	0.11	0.00	0.22	0.00	0.02	0.09	0.10
Reading real words	152	0.70	0.97	0.15	0.97	0.91	0.31	0.92	0.64	0.65	0.32
Reading non-words	26	0.00	0.35	0.00	0.15	0.23	0.00	0.08	0.00	0.11	0.15
Reading non-words: Initial phoneme correct	26	0.38	0.85	0.00	0.92	0.81	0.23	0.92	0.00	0.52	0.34

Participants' performance on the following: CAT—Comprehensive Aphasia Test (Swinburn et al., 2002); Pyramids and Palm Trees (Howard & Patterson, 1992); ADA Auditory Discrimination from Action for Dysphasic Adults Comprehension Battery (Franklin et al., 1992). The remaining assessments are unpublished.

participant had failed to name 36 pictures providing 12 for each of the three conditions. Entry of items into the control, single cue, or choice of cue conditions, was counterbalanced.

After a delay of at least 10 minutes during which therapist and participant had a drink and conversation (i.e., no further language testing occurred) naming of the 36 cued items was retested (*delayed naming*). This whole procedure was then repeated for the remaining cue types (CV spoken, rime, and repetition) each on a different occasion, generally 1 week apart. (Full details of the facilitation study are reported by Best et al., 2002.)

Therapy. During Phase 1, 100 words were treated that were drawn from the set of 200 items named at Assessments 1 and 2. The 200 items were divided into two sets of 100 matched for baseline naming accuracy. These two sets were randomly assigned as treatment and control sets. The treated set was divided into two sets of items matched for baseline naming accuracy: 50 were treated using phonological cues and 50 using orthographic cues. In addition to the 100 treated items, each participant chose 20 words of their own. These were words that they felt would have a useful impact on their everyday lives if treatment resulted in improved ability to retrieve them. These 20 words were assessed at Assessment 2 (i.e., before treatment) and Assessment 3 (i.e., after treatment) only, and were treated following the same procedure used for the 50 orthographic items.

Treatment took place once a week for 8 weeks. All treated items were seen once in each session and each session lasted about one to one and a half hours. Items were presented for naming and, if unsuccessful, participants were presented with a choice of cues. In the phonological condition, the first phoneme (plus schwa) of the target and an unrelated distractor were presented. If still not named successfully, the amount of information given in the cues was increased (i.e., the first syllable was given) and, if still not named, the whole of the target word and the distractor was presented for the participant to choose between. Where the participant still could not name the picture the word form was provided for repetition. So, for example, if someone couldn't name a picture of a penguin they were told ''It begins with either /pɛ/ or /kɛ/''. If still unable to name the picture they were told ''It begins with /pEŋ/ or /koŋ/'', then ''It's penguin or concrete''. Finally, the target word would be modelled for repetition where necessary. Exactly the same procedure was followed in the orthographic condition except that the cues given were written letters.

The number of distractors was increased gradually across the treatment sessions. Thus in the first two sessions one distractor was used, the next two sessions had two distractors, and in the final four sessions, three distractors were used. The order in which the target cue and the distractor cues were presented was randomised for each picture. The order in which the set of items to be treated using phonological cues and the set treated using orthographic cues was also varied (i.e., sometimes the 50 items to be treated using phonological cues were presented first in the session and sometimes second). The order of items within the sets was also randomised across the sessions.

RESULTS

Effects of treatment

As a result of treatment, seven of the eight participants showed a significant improvement in naming the 200 tested items (see Table 3). A statistical comparison of the amount of improvement on the treated and untreated sets shows that five of the seven participants (PH, DC, OL, IK, and NK) who showed overall improvement improved significantly more on the treated items than the untreated items. Only one of these participants showed significant improvement on the untreated items: DC ($z = 1.83$, $p = .033$), indicating for her partial generalisation. The remaining four participants show treatment effects that are item-specific—confined to the treated items.

HM shows no significant difference in the change on the treated and untreated sets. His improvement on the untreated set approached significance ($z = 1.55$, $p = .068$) suggesting that, in his case, there may be generalisation of improvement to the untreated items.

TABLE 3
Improvement in naming the 200 items

Participant	*Assessment 1 Pre-therapy*	*Assessment 2 Pre-therapy*	*Assessment 3 Post-therapy*	*z score*
HM	0.450	0.420	0.550	3.12***
PH	0.325	0.375	0.485	3.57***
DC	0.720	0.735	0.885	4.95***
SC	0.335	0.370	0.370	0.61
OL	0.520	0.505	0.605	2.54***
IK	0.240	0.220	0.335	3.16***
NK	0.555	0.590	0.710	3.96***
KR	0.400	0.370	0.460	2.29***

Figures given are the proportion of items named successfully within 5 seconds, (n = 200).

Treatment took place after Assessment 2. The *z* score is from a Wilcoxon test comparing naming accuracy in the two pre-therapy assessments with accuracy after therapy (*$p < .05$ **$p < .01$ ***$p < .001$, one-tailed).

There is also no significant difference between improvement on the treated and untreated sets for KR. Her improvement was the smallest of those who showed significant improvement (7.5%). Improvement on the untreated items (3%) was not significant, but also not significantly less than the 12% improvement on the treated items. Her performance therefore provides no strong evidence for the generalisation of improvement to untreated items.

None of the participants showed significant change on the control tasks—i.e., written sentence comprehension; read aloud words (n = 52); read aloud nonwords (n = 26); short-term memory (STM: picture pointing).) There was also no significant change between the two baseline assessments for any of the participants. Taken together with the item-specific treatment effects, these findings show that improvement during therapy cannot be attributed to spontaneous recovery or non-specific effects of intervention.

Table 4 reports improvement in naming for the phonologically treated, orthographically treated, and control sets individually. When improvement from the phonological treatment and orthographic treatment is compared (Table 4), there are no significant differences for any participant. KR shows a trend towards greater benefit from phonological than orthographic therapy.

Progress during treatment

Figure 1 shows how naming progressed over the treatment sessions for the group as a whole. This figure shows the mean number of items named spontaneously (i.e., without cueing) during each treatment session (mean of phonologically treated and orthographically treated sets n = 100).[1] It is interesting to note that the effect of treatment appears to be cumulative. In other words, there is not a dramatic immediate improvement in naming as a result of treatment. This was a general pattern shown by all seven of the eight participants who benefited overall from treatment. Finally, in looking at the data from the individuals, it is clear that the starting place for treatment has a strong bearing on

[1] For DC who had seven sessions of treatment the score for session 8 is projected from average performance in sessions 6 and 7.

TABLE 4
Improvement in treated and untreated sets

Participant		*Assessment 1 Pre-therapy*	*Assessment 2 Pre-therapy*	*Assessment 3 Post-therapy*	*Improvement in treated vs untreated*	*Improvement in p treated vs o treated*
HM	Phonological	.46	.40	.56	0.94	−0.20
	Orthographic	.42	.44	.60		
	Untreated	.46	.42	.52		
PH	Phonological	.32	.36	.60	4.26***	−0.93
	Orthographic	.32	.38	.68		
	Untreated	.33	.38	.33		
DC	Phonological	.70	.72	.94	3.01***	−0.24
	Orthographic	.72	.74	.98		
	Untreated	.73	.74	.81		
SC	Phonological	.32	.36	.36	0.39	0.19
	Orthographic	.34	.38	.38		
	Untreated	.34	.37	.37		
OL	Phonological	.52	.50	.70	1.94*	0.72
	Orthographic	.52	.50	.62		
	Untreated	.52	.51	.55		
IK	Phonological	.24	.22	.44	1.86*	0.86
	Orthographic	.24	.20	.36		
	Untreated	.24	.23	.27		
NK	Phonological	.56	.58	.86	4.36***	0.36
	Orthographic	.54	.58	.82		
	Untreated	.56	.60	.58		
KR	Phonological	.40	.36	.56	0.77	1.53
	Orthographic	.40	.36	.44		
	Untreated	.40	.38	.42		

The comparisons of the improvement on treated and untreated and orthographically treated compared to phonologically treated are derived from Wilcoxon two-sample tests for the change between Assessments 1 and 2 and Assessment 3.

Significance levels are one-tailed for the treated vs untreated comparison and two-tailed for the comparison of phonological and orthographic treatment (*$p < .05$ **$p < .01$) (n = 50 for the phonologically and orthographically treated sets and n = 100 for the untreated items).

eventual outcome: ranking of individuals according to naming performance is the same for the first and final therapy sessions.

Improvement in twenty words

Table 5 shows how the 20 words that each participant chose to include in treatment changed. All the participants except IK show at least some improvement with three showing significant improvement.

Relationship between background assessment and response to treatment

Table 2 (see earlier) gave each participant's score on 14 of the tests of language processing carried out during the assessment phase of the study. Performance on each of

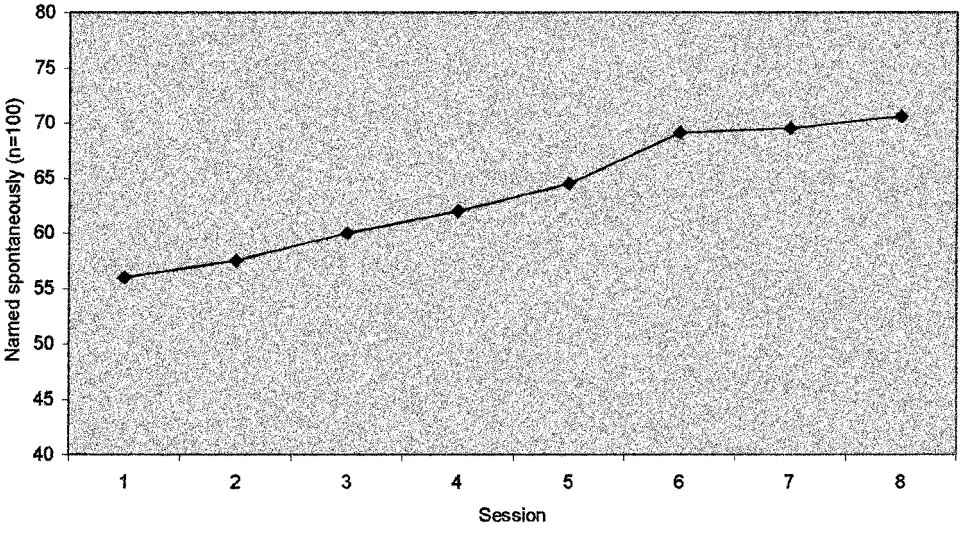

Figure 1. Improvement in naming treated set during therapy: group results. The mean number of items from the treated set (n = 100) named spontaneously (i.e., without cueing) for eight participants across the eight therapy sessions.

these tests[2] was correlated with improvement in naming following treatment. The latter was calculated by subtracting the mean naming score on baseline assessments 1 and 2 from the naming score at assessment 3 (i.e., after Phase 1 of treatment). This was calculated for (i) naming of all 200 items, (ii) items treated using phonological cues, (iii) items treated using orthographic cues, (iv) all treated items, and (v) untreated items.[3]

Table 6 gives the results of the correlations between performance on background assessments and improvement in naming for the group as a whole. Due to the high number of correlations an α level of $p < .01$ was used to determine significance. Note that with a small number of participants, and, with the exception of SC, a limited range of treatment effect sizes (varying from 7.5 to 17%), the power of these correlational analyses is limited. Note also that because SC is an outlier in terms of the size of the treatment effect, his results are particularly influential in determining these correlations.

(i) Improvement in the complete set of 200 items is considered first. This correlates significantly with reading aloud words and the proportion of non-word reading responses where the initial phoneme was correct.

(ii) Improvement in the set of words treated using phonological cues correlates significantly only with written word to picture matching.

(iii) Improvement in items treated using orthographic cues correlates with the accuracy on the initial phoneme in reading aloud nonwords.

(iv) Improvement in the set of treated items correlates significantly with written word to picture matching and accuracy on the initial phoneme in reading aloud non-words.

[2] Except test 5 and 11: proportion of naming errors that were semantic and phonological respectively.

[3] In addition to being correlated with straight change in naming, the background assessments were correlated with change in naming divided by scope for change (i.e., 1 – baseline naming performance). The pattern found was very similar to that for change in naming.

TABLE 5
Improvement in 20 personal items

Patient	*Assessment 2 Pre-therapy*	*Assessment 3 Post-therapy*
HM	0.00	0.20
PH	0.20	0.85*
SC	0.00	0.20
DC	0.50	0.95*
OL	0.25	0.40
IK	0.20	0.00
NK	0.10	0.65*
KR	0.30	0.55

Proportion of items named correctly before and after therapy, n = 20. *$p < .05$ McNemar Test.

(v) None of the background variables correlates significantly with change in untreated items.

These results indicate that ability to retrieve semantic information via the written word and to retrieve output phonology from orthography relate to response to treatment. So, for example, SC does not respond to treatment and has the poorest scores in the group at both written word–picture matching and reading aloud words, and is at floor on retrieval of initial phoneme for nonwords. NK, DC, and PH all perform well on these measures and benefit from treatment.

Relationship between response to facilitation and response to treatment

There is a significant correlation between the effect of facilitation (across the four cueing conditions) and overall therapy outcome for the group as a whole ($r = 0.697$, $df = 6$, $p = .027$).

Figure 2 illustrates the response of each individual to facilitation and to therapy. The response to facilitation was calculated by subtracting the number of items named correctly in the control condition (i.e., after extra time) from the number of items named correctly after a cue, and dividing by the number of trials. Response to therapy was calculated by subtracting the number of pictures named correctly after treatment (at Assessment 3) from the mean number named correctly before therapy, i.e., at Assessments 1 and 2 (the initial naming average).

DISCUSSION

The study outlined here forms part of a larger therapy study in which there was a second phase of treatment and in which carry-over into connected speech and real-life conversation is investigated (see Osborne et al., 1998; Hickin, Herbert, Best, Howard, & Osborne, in press).

TABLE 6
Correlation of improvement in naming with performance on assessment

Test	*All items*	*Phonologically treated items*	*Orthographically treated items*	*All treated items*	*Untreated items*
1. Picture naming tests 1 and 2: mean percentage correct	0.568	0.387	0.385	0.408	0.373
Semantic tests:					
2. CAT Spoken word to picture matching test:	0.689	0.350	0.387	0.392	0.715
3. CAT Written word to picture matching test	0.774	0.790*	0.747	0.809*	−0.138
4. Pyramids and Palm Trees Test three-picture version	0.297	0.013	0.273	0.167	0.313
Phonological tests:					
6. ADA Auditory discrimination test	−0.137	−0.354	−0.025	−0.180	0.118
7. Short-term memory test: phoneme span	0.122	0.322	0.287	0.319	−0.512
8. Repetition of real words	0.558	0.647	0.535	0.618	−0.186
9. Repetition of non-words	−0.252	0.529	0.198	0.363	−0.301
10. Repetition of non-words: initial phoneme correct	0.429	0.592	0.430	0.529	−0.282
12. Reading real words	0.790*	0.743	0.736	0.781	−0.025
13. Reading non-words	0.458	0.508	0.645	0.617	−0.437
14. Reading non-words: initial phoneme correct	0.799*	0.732	0.8178	0.823*	−0.113

Key to tests: as in Table 4.
Df = 6, *$p < .01$, 1-tailed Pearson's $r = .789$ for significance.

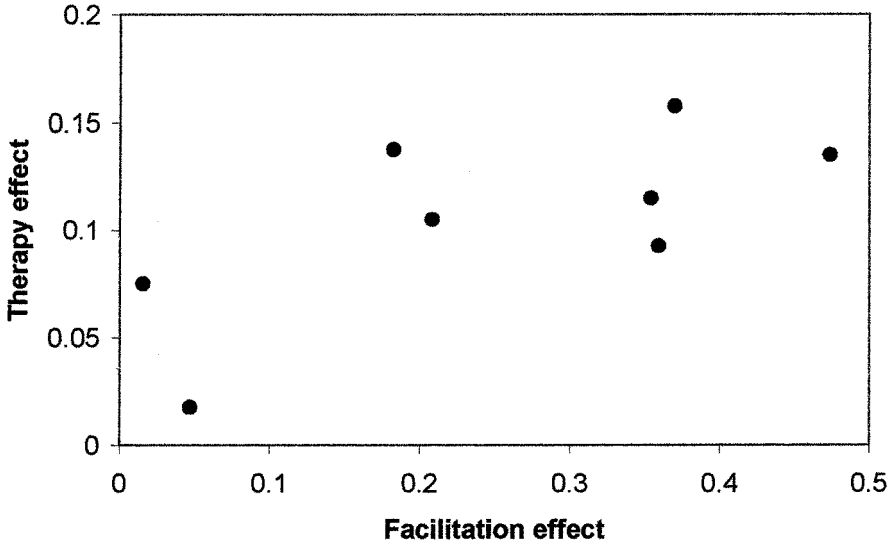

Figure 2. Relationship between response to facilitation and response to therapy.

The efficacy of treatment

For seven of the eight participants the treatment was successful, adding another tried and tested approach to the range of effective treatments for word-finding problems (for a review see Howard, 2000; Nickels & Best, 1996). In addition, treatment took place once a week for 8 weeks only. This provides an example of an effective treatment regime that is eminently practicable even within the constraints of short-term contracts of treatment. Another point with clinical significance is that progress during treatment is cumulative (see Figure 1). It would therefore seem important to persist with treatment even if it does not appear to have an immediate effect, something that can be difficult to do in the context of limited clinical resources.

The findings of this study are in line with previous results from, for example, Miceli et al. (1996), Davis and Pring (1991), and Howard et al. (1985b), showing significant benefits from phonological treatment lasting for at least a week after the end of therapy, and in most cases much longer.

One difference between this study and previous investigations of phonological treatments is that our participants were required to choose actively between different possible cues. As outlined in the introduction, this may have caused reflection upon the required form of the word, resulting in long-term changes in word retrieval (see Byng & Jones, 1993). Comments from some of the participants add weight to this argument, e.g., SC ''Choice good—makes me use my head'' and KR ''I like it but it no easy''. Basso et al. (2001) also speculate that the reason for the greater effectiveness of orthographic cueing in their study is that ''the search for the correct response ... seems to be under more intentional control in the case of the orthographic cueing method than in reading or repetition'' (p56). In our facilitation study, however, there was no advantage for the choice of cues over providing a single cue, so this suggestion must be tentative. Also, the design of the therapy study does not allow us to exclude the possibility that improvement of treated items was due to repeated exposure to the pictures/repeated attempts at naming. However, this seems unlikely as all of the aphasic participants in the study were noted to

actively use, or attempt to use, the cues for items they could not name immediately. This is also borne out by their comments (see earlier). Howard et al.'s (1985b) finding of significantly greater improvement in phonologically treated items than in controls that were presented for naming as often as the treated items, demonstrates that the effects of similar treatments to that used here result from more than repeated exposure to hard-to-name items.

Improvement in phonologically and orthographically treated sets

All seven of the participants whose naming improved showed no significant advantage for one cue type over the other. In contrast, Basso et al. (2001) report that orthographic cueing was superior to both repetition and reading aloud with 30 normal participants learning ''new'' words (i.e., legal nonwords) and in treating the word-finding difficulties of two aphasic participants. Orthographic therapy may also be preferable for people with severe auditory processing problems or hearing loss (none of whom was included in this study) and is more suited to independent home practice.

Finally, the orthographic and the phonological treatments were carried out within the same sessions and therefore from the design of the present study it is not possible to be unequivocal about their independent effects. However, as the majority of the participants show item-specific effects in treatment, we wish to claim that each intervention is effective.

It is noteworthy that KR was the only person to show a trend towards benefiting more from phonological than orthographic therapy. She was also the only person who was completely unable to read non-words including the initial phoneme (with the exception of SC who showed no treatment effects). This difficulty probably severely impaired her ability to benefit from written cues.

In considering the 20 words that participants chose to include in treatment, three people improved significantly, and a further three showed a trend towards improvement. It is interesting to note that the former were the three who benefited most from treatment as a whole. Of relevance is the fact that most participants chose words that were very closely semantically related (e.g., juice and squash, brother and son, London Eye, Millennium Dome). For some participants this factor caused difficulties during therapy—for example, a semantically related target may be produced in place of the correct target.

Generalisation to untreated items

With regard to generalisation, five of the seven participants who showed significant gains from treatment demonstrated item-specific effects (DC showed significant improvement on untreated items and HM showed a tendency to improve on this set). The item-specific results are in line with the prediction (e.g., Howard, 2000) that phonological therapy will result in item-specific effects because it activates individual mappings from semantics to phonological representations. The assessment profile of the three individuals who benefited most from therapy (NK, DC, and PH) indicates that they all appear to have difficulty with mapping between semantics and phonology; i.e., they perform well on semantic tasks, are able to read and repeat words, and yet show a naming impairment that is considerably helped by cues (for a similar case see Lambon Ralph, Cipolotti, & Patterson, 1999). This adds further weight to the argument that the primary mechanism of lasting phonological cue effects may be strengthening the mapping from semantics to phonology (Howard, 2000; Nickels & Best, 1996). From a clinical perspective,

generalisation of therapy to untreated items is of course the preferable outcome, representing ''maximum gain for minimum effort''. If, however, as Howard (2000) emphasises, the improvement is in the mapping from semantics to phonology, we should expect no generalisation, precisely because this mapping is word-specific and idiosyncratic. If we predict that therapy will not generalise, then it is even more important for aphasic clients to select which words would most usefully be targeted in treatment. (Hickin, 1997).

Relationship between assessment and therapy

As noted in the introduction, a crucial step in developing a theory of therapy will be the ability to predict response to treatment from performance on background assessment. In relation to this, examination of Table 6 reveals that there was no significant correlation between naming ability at assessment and response to treatment. This contrasts with the findings of Barry and McHattie (1991) and Bruce and Howard (1988) who both found a relationship between severity of naming impairment and ability to respond to semantic facilitation and phonemic cues respectively. However, ability to retrieve the initial phoneme on reading non-words correlates significantly with overall naming improvement and with improvement on orthographically treated items and treated items. This indicates that it is important to have at least some ability to retrieve output phonology from orthography in order to benefit from treatment. In addition, reading of words correlates significantly with overall naming improvement, while careful examination of Tables 2 and 6 reveals that word repetition and reading ability for words and non-words also tend to relate to the outcome of treatment. The shared level of processing for these tasks is phonological output processing. This relates to the finding of Raymer et al. (1993) that oral reading performance was predictive of the potential for naming improvement in three of four participants in their study. They postulate that this is because ''oral reading performance may represent the potential for phonological processing available if lexical-semantics were able to access phonological output consistently in naming'' (p. 50). Thus, in successful cued word retrieval, the partial activation of a representation in the phonological output lexicon appears to combine with additional activation from the cue. In relation to sublexical cueing, this explanation is compatible with interactive activation models of word production where there is feedback from the phoneme level to the word level (e.g., Dell, 1986), but is less easy to explain in terms of feedforward models of production (e.g., Levelt, Roelofs, & Meyer, 1999) without additional assumptions (see Best et al., 2002).

It is perhaps important at this point to consider SC, who did not respond to either form of treatment. SC has difficulties with semantic processing and output phonology, and severe difficulties with reading. This combination is the most likely explanation of his lack of response to therapy. This result reinforces the suggestion made earlier that this type of treatment may be most useful for those individuals who have relatively intact semantic representations and phonological representations but whose difficulty is mapping between semantics and phonology.

Relationship between facilitation and treatment

Comparison of the results of the facilitation study and the therapy study suggests that people whose word finding shows short-term gains from phonological/orthographic cues may be those who benefit from therapy involving the same kinds of cues used repeatedly:

for the group as a whole there is a significant correlation between the overall outcome of facilitation and response to therapy.

Five of the seven people who benefited from treatment also showed some benefit from facilitation (HM, PH, DC, OL, and NK: see Best et al., 2002, for details). The one person (SC) who did not respond to treatment did not respond to facilitation. The link between the outcome of facilitation and treatment suggests it may be possible to assess the appropriateness of such treatment within a single session where the effect of phonological and orthographic cues is simply compared with giving extra time for picture naming. People with anomia whose naming benefits from phonological or orthographic cues, over and above extra time, may well be those that would benefit from this treatment approach. However, these results are not conclusive because IK and KR did not show significant cue effects in facilitation but did respond to treatment. This warrants further discussion. KR showed a tendency to benefit more from phonological than orthographic treatment. A retest of her response to facilitation post-treatment showed that although she still did not benefit from orthographic facilitation, she did now benefit significantly from phonological facilitation. In other words, therapy appears to have taught her to use phonological cues. In addition, there is evidence from her progress in therapy that KR is also learning to use letters to self-cue, although this did not produce a significant improvement in naming of the orthographically treated set at Assessment 3. IK presents more of a conundrum, as he responded to both forms of treatment but did not benefit from cues in the facilitation task. This may reflect the severity of his impairment: he is poor at naming, repeating words, and repeating non-words, but has reasonably intact semantic processing and is above floor on most output tasks (see Table 2). It may be that for people with more severe aphasia, one session to measure response to cues is not sufficient as their performance may be affected more by other factors, e.g., fatigue (which is true for IK). It may be necessary to extend assessment by monitoring performance over two to three sessions.

Finally, we would like to discuss inclusion of DC and IK in the project. DC's conversation was lively and fluent and she hid her word-finding problems well, although she was aware of and frustrated by not being able to find the words she wanted in conversation. On a picture-naming task, performance was 73% correct prior to treatment and we nearly excluded her on the grounds that there was relatively little room for improvement. In fact after eight sessions of treatment she reached 96% on treated and 81% on untreated items. Pre-therapy we knew that she did benefit considerably from cues. In a clinical setting this finding could be used as a pointer suggesting this type of therapy might result in change, even for someone with relatively good naming and conversational skills. Most importantly DC also showed significant change on the items she selected as relevant to her and she viewed the outcome of the treatment very positively. For someone with a milder anomia, the experience of improving on certain words can be stimulating: during treatment DC began to write down from the dictionary other words that she wanted to practise and that she could read aloud, thereby providing herself with further ''self-administered treatment''.

IK, on the other hand, has severe word-finding difficulties and is only able to use the occasional word during conversation, relying significantly on gesture, pointing, sometimes drawing, and on his wife's skill at interpreting his message. We debated whether to include him in the study on the basis of the severity of his difficulties, but decided to go ahead as we wanted to assess if treatment *would* work with someone with more severe difficulties. IK was also very highly motivated with the full support of his wife. IK's response to therapy vindicates his inclusion and leads us to urge

caution in immediately excluding someone on the grounds of the severity of their aphasia. Finally both IK and KR are eager to continue this approach to improve their word finding.

As noted in the introduction, this study forms part of a larger project which includes a second phase of treatment aimed at improving retrieval of treated words in tasks approximating more closely to real life. The results of the treatment on word finding in connected speech and real-life conversation are reported in Herbert et al. (2002).

In conclusion, a treatment based on providing a choice of spoken or written cues improved word retrieval in seven of the eight people included in the study. The results from facilitation appear to have potential in predicting the outcome of phonological/orthographic therapy. The possible link between the short-term and much longer-term effects of cues provides a building block in developing a theory of therapy (Byng & Black, 1995; Howard & Hatfield, 1987), and it seems possible that many techniques effective in the short term could be successfully developed into strategies to include as part of treatment for anomia. Previous research has tended to focus on short- or long-term effects and not to investigate both in the same people. Further treatment studies that attempt to make links between short- and long-term outcomes are to be welcomed, as this study has demonstrated the potential of such an approach.

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