PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY B BIOLOGICAL SCIENCES

The Treatment of Acquired Aphasia

David Howard

Phil. Trans. R. Soc. Lond. B 1994 **346**, 113-120
doi: 10.1098/rstb.1994.0135

The treatment of acquired aphasia

DAVID HOWARD

Psychology Department, Birkbeck College, University of London, Malet Street, London WC1E 7HX, U.K.

SUMMARY

A number of large-scale trials have established that language therapy with acquired aphasic patients can result in significant improvement. However, such trials use a variety of different treatments with patients with qualitatively varying disorders. The group results give no information about the treatments that were effective for particular types of problem.

More recent studies of treatment have examined the effects of more closely defined treatments for more closely defined disorders. Treatment based on the facilitation of word retrieval show quite long-lasting effects from limited amounts of treatment, when the treatment gives either semantic or phonological information about the word, but the improvements are mostly limited to the items involved in treatment. The establishment of strategies for word retrieval based on patients' retained abilities results in more generalized improvement. The need for studies that relate analysis of a patient's disorder more closely to the process of treatment is discussed.

1. ON THE EFFECTIVENESS OF APHASIA THERAPY

More attention has been paid to the effectiveness of aphasia therapy than to that of rehabilitation for almost any other kind of acquired disorder. Strong claims have been made on both sides; some authors have concluded that it is clear that aphasia treatment is wholly ineffective, whereas others have argued that it is clear that no aphasic person should be denied treatment. Sadly, much of this debate has been conducted on the basis of prejudice, rather than being tempered by sensible evaluation of the available evidence.

Like other acquired neuropsychological disorders, aphasia shows a variable amount of 'spontaneous' improvement over the first few months after onset; some patients will apparently recover completely from an aphasia within the first few weeks or months. Others, in contrast, can be left with a severe and long-lasting language disorder. Against the background of this variable spontaneous recovery, the effectiveness of aphasia treatment can be hard to establish.

One tack that has been taken is to investigate the results of systematic treatment on patients who are treated after spontaneous recovery is complete. The difficulty for this approach is that, although there is agreement that most spontaneous improvement occurs in the first few weeks or months after onset, improvement may continue, probably at ever-decreasing rates, over much longer periods (see, for example, Butfield and Zangwill 1946; Willmes & Poeck 1984). At a more fundamental level, the reasons for spontaneous recovery and why it varies so much in extent between aphasic patients are not understood. Nevertheless, there are studies in which treatment has started many years after onset, and which have showed substantial improvement as a result of therapy (see, for example, Basso *et al.* 1979; Broida 1977). These case reports seem to establish beyond any reasonable doubt that in at least some cases systematic language therapy can result in substantial improvement for individual subjects. They do not, however, establish that aphasia therapy is effective for the population of people who become aphasic.

For many researchers, the best experimental approach that can be adopted for investigation of treatment effects where, over the population, the condition shows a variable outcome, is the randomized controlled trial. The technique is simple: once patients are identified as candidates for the trial, they are assigned randomly to treatment and control groups. Ideally, both experimenters and subjects are unaware which are the treated patients. As a result, neither experimenter bias nor placebo effects with the subjects can affect the outcome. This approach was developed for the evaluation of drug treatments, where the outcome of patients treated with a pharmacologically inert placebo can be compared with the outcome of treatment with a specific drug. However, as Cochrane (1972) points out, there is no reason why this approach cannot be adopted for the evaluation of any treatment technique.

Randomized controlled trials of aphasia therapy have yielded conflicting results. Where the outcome with patients who are treated by trained therapists is compared with that with control subjects who receive no treatment, the majority of studies find a significantly better outcome for the treated patients (Hagen 1973; Shewan & Kertesz, 1984; Wertz *et al.* 1986; but

Phil. Trans. R. Soc. Lond. B (1994) **346**, 113–120
Printed in Great Britain

see Lincoln *et al.* 1984). There are, in addition, several studies that compare the outcome for treated patients with those for whom treatment was unavailable; in all cases, these studies also show substantial beneficial effects of treatment (Basso *et al.* 1979; Poeck *et al.* 1989).

Other randomized controlled trials have addressed issues of how aphasia therapy should be delivered. The evidence suggests that therapy can be effective whether started soon after onset or whether it is delayed for several months or even longer (Wertz *et al.* 1986; Poeck *et al.* 1989) and that the outcome with individual therapy is marginally better than for group treatment (Wertz *et al.* 1981).

Studies that have compared the outcome of treatment by trained therapists with that by volunteers have all shown no significant difference in the outcome (David *et al.* 1982; Shewan & Kertesz 1984; Wertz *et al.* 1986). This finding has sometimes been taken to show that aphasia treatment is ineffective. As Marshall *et al.* (1989) emphasize, however, these studies are irrelevant to this issue. Both the groups involved were treated. Furthermore, in most of these studies the volunteers were supported and trained by therapists, and treatment techniques were devised by the supervising therapists. Indeed, in one case 'the home [volunteer] treatment programs were essentially the same as the treatment administered to the speech-language pathologist-treated patients' (Marshall *et al.* 1989, p. 465). The only conclusion licensed by these studies is that, when the content of treatment given by trained therapists and volunteers is very similar, the outcome is similar.

These large-scale (and expensive) studies of aphasia therapy show that, when given systematic language therapy, there is significant improvement for the population of aphasic subjects, as a whole, over and above that which would be expected on the basis of spontaneous recovery. There are, however, some serious difficulties in using the results of these studies to improve the practice of aphasia rehabilitation (Howard 1986).

First, the outcome for individual subjects is variable. Some show substantial improvement in treatment; others show no significant change (see, for example, Poeck *et al.* 1989). Attempts to relate these to variables such as age, sex, type of aphasia (fluent vs. non-fluent; Broca's vs. Wernicke's, etc.) have been generally disappointing. Although in some studies such variables do show statistically significant effects on the outcome, these effects are small when compared with the overall variability in outcome.

Secondly, in every case what was the *content* of the language therapy is unclear. As Basso (1989) emphasizes, there may be little more in common between the treatments involved in these studies than that the person on one side of the table is called the therapist whereas the other is labelled the patient. In the best cases, it is claimed that all of the therapy was motivated by a single philosophy of how treatment should be designed (see, for example, Basso *et al.* 1979; Poeck *et al.* 1989); in other studies even that is impossible (see, for example, Lincoln *et al.* 1984). In every case, however, it is clear that a variety of different techniques will have been used for different subjects, chosen according to some rationale that relates the nature of the aphasic disorder in individual subjects to a therapy procedure. Behind this is the common assumption that aphasia comprises a set of functionally varied language disorders, each of which will have an appropriate treatment. In the studies that show significant beneficial treatment effects, one can assume that some, at least, of the treated subjects had treatment that was effective for their language disorder. Unfortunately, because both the nature of the treatments involved and the kinds of disorders to which they were applied are unclear, it is impossible to know which were the effective treatments, which can be applied with other patients.

The conclusions that can be drawn from these group studies are therefore rather disappointing. They show that, for some subjects, rehabilitation *can* be effective. Whether this is a particularly impressive conclusion is open to doubt; the improvements shown by patients treated long after onset led to the same conclusion. What these studies do not show is which techniques are effective for which particular types of disorder. This is simply because their results average over a set of qualitatively different types of aphasic language disorders, to which a set of qualitatively heterogeneous treatments were applied.

The era in which studies of this kind were possible is probably over. As Poeck *et al.* (1989) point out, given the current evidence, it is hard to argue that treatment should be denied to a control group in order to carry out such a study. Moreover, it has become clear that the conclusions that can be drawn are surprisingly limited. What is necessary, clearly, is studies of the effects of more closely specified treatments applied to more clearly specified disorders.

Over the past fifteen years, considerable progress has been made in identifying the set of qualitatively different disorders in aphasia. On the basis of this, treatment approaches have been tried out, typically with single subjects or with small groups of subjects with more tightly specified disorders. The advance in cognitive neuropsychology has been primarily in the identification and diagnosis of specific types of disorders. However, an analysis of the level at which performance on a task is breaking down does not specify the way in which the disorder should be treated (Howard & Hatfield 1987; Howard & Paterson 1989; Caramazza 1989) although, as will be discussed, it may place constraints on the set of possible treatment approaches. Significant progress has been made in the study of remediation in a number of domains, including the 'agrammatisms' (see Byng & Lesser 1993), and disorders of spelling and reading (see Kremin 1993). In this paper, I will use as an example the advances in the treatment of disorders of word retrieval.

2. DIFFERENTIATING LEVELS OF BREAKDOWN IN WORD RETRIEVAL

The task of word retrieval requires a patient to use a lexical semantic specification to retrieve the

PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY B BIOLOGICAL SCIENCES

phonological form of the word. This phonological specification must then be used to drive the production of the spoken form of the word (see figure 1). One level at which word retrieval can break down is at the level of lexical semantics. These patients make semantic errors in both word comprehension and word production (Butterworth *et al.* 1984; Nickels & Howard 1994). Semantic errors occur most often with words with lower imageability ratings, but their occurrence is unrelated to both word frequency and word length (Nickels 1994). In some cases at least, these patients' naming can be improved by giving them a phonemic cue (the first sound of a word that cannot be retrieved), and semantic errors can be elicited by a miscue (the first sound of a semantically related word; see, for example, Howard & Orchard-Lisle (1984)). In this case it appears that the semantic information used for retrieval of the phonological forms of the words is underspecified.

There is a second class of pre-lexical impairment, characterized by semantic errors in naming, which is less frequently observed. Patients with this type of impairment do not make semantic errors in comprehension; this observation shows that lexical–semantic representations are intact (Patterson 1979; Caramazza & Hills 1990). However, they fail in the process of access to the lexicon, making semantic substitutions when the correct word form cannot be found.

These patients can be distinguished from those whose primary difficulty is in production of a word whose phonological form has been accessed. These patients do not make semantic errors in comprehension, and their naming errors consist primarily of phonological approximations to the target word (see, for example, Kay & Ellis, 1986). These errors occur most frequently in longer words, and words with lower frequency (Nickels 1995). In some cases, these patients show good performance in phonological tasks that do not require overt pronunciation, such as rhyme judgments on pictures that cannot be correctly named (Feinberg *et al.* 1986). Here, the impairment must be in post-lexical processes of speech production, whereas in other subjects it is more likely that the phonological representations themselves are corrupted (see, for example, Hirsh & Ellis 1994).

The picture that is emerging from this research is a set of difficulties in word retrieval with characteristically different patterns of performance that reflect different levels of breakdown. What are the implications of this for treatment? On logical grounds, one should predict that patients should not benefit from treatment aimed at improving levels of representation that are intact, but should benefit from therapy aimed at improving representations (or access to them) at levels that are impaired.

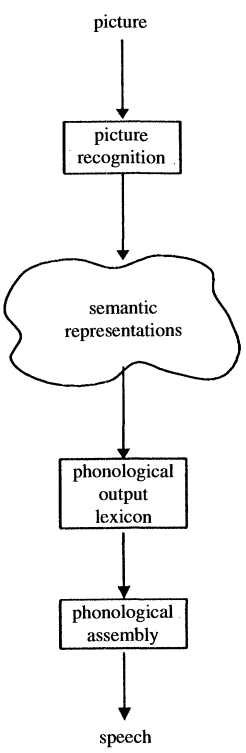

Figure 1. A simple outline of the stages involved in picture naming.

3. THE FACILITATION OF NAMING

When a patient cannot find a word, provision of further information (typically either phonological or semantic) about a word may result in its being correctly produced. Cueing effects have been widely studied; in general across subjects the most effective cues are phonemic (the first phoneme of the sought-for word) (see, for example, Pease & Goodglass 1978). In contrast, additional semantic information results in only marginal improvements in naming.

Patterson *et al.* (1983) investigated the effects of phonemic cues in a facilitation paradigm. That is, they studied the effects of having been phonemically cued to produce a picture name on the patient's ability to retrieve the picture name, when tested 25 min later. They found that phonemic cues were very effective in eliciting correct names, but after the delay patients were no more likely to name the cued pictures than to name untreated control items. In a second experiment they found that repetition of a word improved naming of the corresponding picture, relative to untreated controls, if it was presented immediately afterwards, but this effect disappeared if more than three minutes intervened between word repetition and presentation of the pictures for naming.

Howard *et al.* (1985*a*) contrasted these short-lasting effects of treatments that provide the patient with information about the phonological form of the word, with treatment techniques that required the patient to access the meaning of the word in a comprehension task. These semantic treatments resulted in improved naming of treated items relative to controls. The improvement lasted for at least twenty minutes; in the one experiment where naming was probed twenty-four hours after treatment, stable effects were still found. A series of experiments served to establish that the semantic facilitation effect could be found across a range of tasks, including spoken and written word–picture matching and semantic judgments. Moreover,

PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY B BIOLOGICAL SCIENCES

the facilitation effects were item-specific: there was no effect on the naming of target items when semantic facilitation was applied to a coordinate member of the semantic category. Interestingly, Howard *et al.* (1985*a*) showed that these facilitation effects were significantly smaller with subjects whose characteristic naming errors were phonologically related to the targets; this seems to show that the effect is due to priming of representations at a semantic level or, as Wheeldon & Monsell (1992) suggest for similar results with normal subjects, of representations linking semantic and phonological representations.

Barry & McHattie (1991) showed that semantic facilitation effects were independent of the semantic depth of processing involved: questions requiring only general category knowledge ('Is a duck or a train a living thing?') and more specific attribute questions ('Is a swan or a duck a water bird with webbed feet and which quacks?') were equally effective, resulting in long-lasting improvements of in word retrieval. In replying to these questions, the subjects had to produce the spoken word, so Barry & McHattie included, as a control, repetition of the word. In this paradigm, repetition resulted in significant facilitation of naming although, in contrast to the semantic effects, the size of the repetition effect declined over an interval of 20 minutes. Barry & McHattie's findings strengthen the claim that a variety of tasks involving access to semantic representations cause relatively long-lasting facilitation from a single treatment, but modifies the previous finding of brief effects of phonological information; when word repetition was done in the context of a semantic task (semantic questions and word repetition trials were intermixed) more durable word repetition effects were found.

4. THERAPY FOR ANOMIA USING FACILITATION TECHNIQUES

The results of the facilitation studies suggest that, across groups of patients, more durable improvements in naming are found after semantic treatments than after treatments that give patients information about the phonology of the target word. These effects are found over relatively short periods (up to, say, 24 h). One possible implication of this is that the repeated use of semantic treatments over a longer period of therapy may result in more durable effects than phonological treatments.

Howard *et al.* (1985*b*) compared the results of repeated semantic and phonological treatments on naming. Both kinds of treatments resulted in gradual improvement on the treated items, which was greater than the improvement on control items that were presented for naming as often as the treated pictures but without the facilitations. Improvement after the two kinds of treatment was equivalent. One week after the end of therapy, there was a significant advantage for semantically based treatment, primarily owing to generalization of improvement to the control items that had been presented during the semantic treatments. The items that had been treated by both methods were better than untreated controls, but five weeks later all significant effects of treatment had vanished.

Much more durable effects can be found with semantic treatments. Marshall *et al.* (1990) asked seven aphasic subjects to match a picture to a choice of four written words, at home, twice a day over a period of two weeks. At the end of this period, naming of the target pictures was much better than naming of the untreated control items; this difference was maintained one month later. When six of these patients were re-tested a year later, there was still a significant advantage for trained items (Pring *et al.* 1990).

In this experiment, significant improvement was confined to the treated items and did not show generalization to other untreated items. The implication of this is that semantic treatments are serving to prime access to word-specific representations, rather than in some way developing semantic differentiations within a whole class of semantically related words (Franklin 1994). More recent results from Pring *et al.* (1993), who used a treatment task involving matching written words to a choice of pictures, suggest that partial generalization can be found to untreated items from the same semantic category as those which are treated, but only if the untreated items appear as distractors in the word–picture matching tasks.

The effects of treatments that give the patient information about the phonological form of the word have also been investigated. Davis & Pring (1991) showed that repetition of the picture name, with the picture present, resulted in as much improvement as treatment by spoken word–picture matching, and this improvement was still reliable six months after the end of treatment (see also Raymer *et al.* 1993).

The distinction in these studies between semantic and phonological treatments may have been overstated. In many of the studies that involve semantic treatments, subjects have spoken the word aloud at the time of treatment. Moreover, the assumption that when an aphasic subject repeats a word he or she does not also comprehend it is clearly tenuous: in normal subjects, at least, understanding of spoken words appears unavoidable.

Interestingly, across these studies there is limited evidence for generalization of improvements in spoken naming to untreated items. In contrast, a number of studies of treatment of written naming show generalization to oral production of the picture names, at least with those patients where a common level of impairment underlies the difficulty in spoken and written naming (see, for example, Deloche *et al.* 1993; Hillis 1989).

Taken together, these studies suggest that treatment of aphasic disorders of word retrieval do result in improvement even with patients with long-standing aphasic disorders, either when the treatment provides patients with information about word form or when it requires access to word meaning, although, in practice, both aspects may often be involved. One encouraging feature is that significant therapy effects may be found with quite small numbers of treatments of each of the treated words, and that, nevertheless,

PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY B BIOLOGICAL SCIENCES

improvements can often be sustained for quite long periods. In most cases, however, there is little evidence that treatment gains generalize to untreated items.

5. TREATMENT OF NAMING DISORDERS BY STRATEGIES

The studies of treatment of word retrieval disorders using facilitation techniques show that most of the improvement found is item-specific. The treatments generally provide information about the form or meaning of the words, which are of course specific to individual lexical items. Quite different results emerge from treatments that are aimed to provide patients with a strategy by which intact information can be used to produce words.

For instance, Bachy-Langedock & de Partz (1989) treated a patient who often had (partial or complete) orthographic information about words that he could not produce orally. To improve his spoken naming they taught him a relay strategy where he was encouraged to image the written form of the word, and then to read this written form. In parallel with this strategy for naming, treatment was directed at his reading, to improve his ability to generate the correct phonology for a written word (de Partz 1986). The results were impressive. Before treatment his spoken naming was 52% correct. The words used to assess naming were never used in therapy, but after six months of treatment his spoken naming had improved to 84% correct, and six months later it had improved to 94%.

Nickels (1992) used a similar strategy in treating the naming disorder of a single subject who showed two critical features. First, his written naming was better than his spoken naming, and often, even when he could not retrieve the whole of a written word he was able to give one or more of the initial letters. Secondly, his spoken naming improved when he was given a spoken phonemic cue. Initially, however, he was unable to sound any letters (or non-words) aloud and his reading of real words was characteristically deeply dyslexic. Nickels taught him to sound individual letters by using a treatment strategy devised by de Partz (1986). He was encouraged to use the first letter as a phonemic cue for word retrieval. This strategy resulted in significant improvement in both oral reading of real words and spoken naming of pictures.

Nickel's treatment used learned correspondences between letters and sounds as a basis for a naming strategy with a patient with relatively well-preserved knowledge of initial letters and the ability to benefit from a phonemic cue. Bruce & Howard (1987) used a rather different approach to a similar problem. Instead of teaching patients letter–sound correspondences (a process that can be very time-consuming (see, for example, de Partz, 1986)), they taught patients to use as an aid a computer which, when a letter key was pressed, produced the appropriate phoneme. Five patients, all of whom were better at naming when given a phonemic cue by the experimenter and could sometimes indicate the initial letter of a picture they could not name, were trained to use the aid over five weekly sessions. At the end of the treatment period, all the patients were significantly better at naming when using the aid than without, with the exception of one patient whose unaided naming performance had improved to a level close to ceiling. Moreover, the improvement with the use of the aid generalized to a set of untreated pictures.

Our prediction was that an aid of this kind would be useful only for patients who both benefitted from initial phoneme cues (given by the therapist) and had some remaining knowledge of the initial letters of the names of pictures, when the spoken names were unavailable. More recently, we have been exploring whether this prediction is true. We now have complete data from five subjects. Pre-therapy testing revealed that all of these subjects showed a significant advantage for naming given a phonemic cue, with the exception of JG, although for both JWO and LM the size of the effect was small (see table 1). Three of the patients were significantly better than chance at indicating on a letter board the initial letter of a picture name which they did not on that trial then name correctly; LM achieves a high rate of accuracy, whereas RD and JG, although better than chance, are fairly unreliable. All of the patients are significantly worse at written naming than spoken naming, with the exception of RD, whose oral naming is extremely poor. We should therefore predict that, apart from RD and LM, these patients should not benefit from using an aid that generates a phonemic cue in response to pressing the correct initial letter.

All of these subjects have aphasia of at least two years' duration. Their performance on naming a set of 190 items was tested in three occasions before treatment, with at least one month separating the tests, to ensure that spontaneous improvement was not occurring. On the basis of performance on these three pre-tests, for each subject we selected the 100 pictures that were named least accurately. These were then randomly assigned to two equal sets, one for treatment and one as untreated controls, with the constraint that pre-test performance was equal for the two sets. A further set of fifty items – those named most successfully in the pre-tests – were also presented during treatment, to maintain the patients' morale.

Treatment occurred over five weekly sessions. In

Table 1. *Treated patients: background data*

(Data are percentages of correct naming; n.s., not significant.)

	Patients				
	RD	JWO	JG	JGR	LM
Phonemic cue effects	20	9	5 n.s.	19	11
First letter of unnamed items	20	16 n.s.	51	8 n.s.	81
Written naming	20[a]	10	24	0	2

[a] RD's written naming is significantly better than spoken naming of the same items. All other patients are significantly worse at written naming.

PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY B BIOLOGICAL SCIENCES

Table 2. *Percentage accuracy in naming a set of 190 items before and after treatment*

patient	pre-therapy	post-test with no aid	post-test with aid	follow-up test
RD	16	34	44	38
JWO	34	48	55	53
JG	67	77	76	76
JGR	55	64	56	58
LM	64	71	72	72

each session the 100 pictures were presented in random order. In the first three sessions the patient was required to find the initial letter if they could on the aid's keyboard, press it, repeat the cue, and then name the picture. If necessary the therapist helped them to find the right key. Once the correct key had been pressed, if the patient did not name the picture with the aid's cue, the therapist gave the same cue. If the correct name was still not elicited, the patient was asked to repeat the name. The last two therapy sessions were essentially the same except the patient was only required to use the aid when he was unable to name the picture unaided. One week after the last treatment session, the patients were tested over two sessions a week apart, with the whole set of 190 pictures. In the first session half of the items were tested with the cueing aid available, and half unaided; this was reversed in the second session. The stability of treatment gains was assessed in a further unaided post-test five weeks later.

The results of re-assessment with the complete set of 190 items are shown in table 2. All five patients show highly significant overall improvement, although only one subject, RD, shows any benefit from using the aid (McNemar, $p < 0.01$). RD is of course one of the only two subjects who showed any orthographic knowledge of items that he could not name orally, and who also benefitted from phonemic cues.

Although, as we had predicted, none of the other subjects benefitted from the aid, all of them show significant improvement during the course of treatment (Wilcoxon, $p < 0.001$). In all cases but one, these benefits are maintained at follow-up, five weeks later. The exception, JGR, has a follow-up score which, although it is not significantly different from the first unaided post-test, is also not significantly different from his pre-test naming.

Whether these gains are due to improvement confined to the items that occur in treatment, or whether there is generalization, can be assessed by comparing the performance on treated items with the untreated controls. The results of this (table 3) show that, with the exception of RD, all the patients show perfect generalization of improvement from the items occurring in treatment to the untreated controls. RD is rather different: he is only better when using the aid with the treated items, and at follow-up there is a significant advantage for treated items over the controls. Thus for RD, unlike the patients reported by Bruce & Howard (1987), there is no generalization of the aid effects.

Thus the intriguing result of this experiment is that training in using the aid can result in highly significant improvement in naming even for subjects who (i) do not have the abilities to use the aid, and (ii) do not use it effectively. Moreover, this improvement generalizes to items never seen in therapy, and the effects are stable for at least five weeks. The improvements seen, although statistically reliable, are, in all cases, small. However, the amount of treatment involved is also small; each item is treated only once in each of five weekly sessions.

For those patients who do not benefit from using the aid, the contents of the treatment are, essentially, naming of the picture in response to a phonemic cue (from either the aid or the therapist) or, where this fails, repetition in the presence of the picture. These are what have generally been described as 'phonological treatments'; typically, such treatments have shown little generalization and the effects disappear in a short time. Why there is a different outcome here is less clear. The treatment involved both reflection on the orthography of the word and generating a response on this basis; it is conceivable that these more active aspects of the treatment may have encouraged generalization. There is some

Table 3. *Percentage accuracy in naming for 50 treated items, and 50 untreated control items, before and after treatment*

Symbols: * indicates that there is a significant difference between treated items and controls; § indicates a significant advantage for naming with the aid for these items.

patient	item set	pre-therapy	post-test with no aid	post-test with aid	follow-up test
RD	treated	0	32	56*§	38*
	controls	0	22	22	20
JWO	treated	8	38	40	34
	controls	8	30	40	34
JG	treated	39	64	64	66
	controls	40	52	60	70
JGR	treated	27	50	46	42
	controls	27	46	30	50
LM	treated	39	60	66	60
	controls	38	64	72	64

PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY B BIOLOGICAL SCIENCES

resemblance between the outcome here and the results of treatment of written naming. Both Hillis (1989) and Deloche *et al.* (1993) found evidence of substantial generalization to untreated stimuli.

7. CONCLUSION

In the 1970s and the first half of the 1980s, considerable effort was put into the question of whether aphasia therapy worked. Although the group studies indicated that in some cases at least there were significant improvements in treatment, it was wholly unclear which treatments were truly effective.

Investigations of treatments in the past decade have increasingly adopted a very different approach. Typically, these studies use relatively clearly defined treatments applied to patients with relatively clearly defined disorders. This has the considerable advantage that it is then possible to apply qualitatively similar treatments to subjects with similar disorders: treatment effects are open to replication. The methodological problem caused by spontaneous recovery is usually dealt with by one or more of three methods. First, most of these studies involve only patients with long-standing aphasia. Secondly, a sequence of pre-therapy baseline scores can show that performance is stable. Thirdly, performance is often measured in a task unrelated to the focus of treatment, on the grounds that spontaneous recovery should generalize across tasks. Systematic investigations along these lines show that specific treatments can have significant effects even with quite small amounts of treatment, even in patients who have already had extensive therapy over long periods, and that these treatment gains can be quite long-lasting.

What has been less encouraging up to now is that the advances made in identifying levels of breakdown have not been reflected in the treatment studies (but see Nettleton & Lesser 1991). In particular there is, as yet, no conclusive evidence that any one particular type of treatment is more effective than another for a patient with any specific level of breakdown. Part of the reason is that knowledge of the level of breakdown in a process does not wholly determine the form that treatment should take (Howard & Hatfield 1987; Caramazza 1989; Howard & Patterson 1989). Moreover, it is often not clearly understood why particular treatments have their effects. However, accurate knowledge of the intact and impaired processes can put important constraints on the possible set of treatment strategies that can be rationally related to the patient's disorder; this is particularly marked in treatments that depend on the use of strategies (see Beauvois & Derouesné 1982). The future of therapy studies must lie in discovering the treatment approaches that work for particular levels of breakdown, and in developing our understanding of how and why treatments have their effects.

The preparation of this paper was supported by grants from the Medical Research Council and the Stroke Association. I am grateful to W. Best, C. Bruce and C. Gatehouse for allowing me to include preliminary results from our joint work.

REFERENCES

Bachy-Langedock, N. & de Partz, M.-P. 1989 Coordination of two reorganization therapies in a deep dyslexic patient with an oral naming disorder. In *Cognitive approaches in neuropsychological rehabilitation* (ed. X. Seron & G. Deloche), pp. 211–247. Hillsdale, New Jersey: Lawrence Erlbaum.

Barry, C. & McHattie, J. 1991 Depth of semantic processing in picture naming facilitation in aphasic patients. (Paper presented at the British Aphasiology Society Conference, Sheffield, September 1991.)

Basso, A. 1989 Spontaneous recovery and language rehabilitation. In *Cognitive approaches in neuropsychological rehabilitation* (ed. X. Seron & G. Deloche), pp. 17–37. Hillsdale, New Jersey: Lawrence Erlbaum.

Basso, A., Capitani, E. & Vignolo, L.A. 1979 Influence of rehabilitation skills in aphasic patients: a controlled study. *Arch. Neurol.* **36**, 190–196.

Beauvois, M.F. & Derouesné, J. 1982 Recherche en neuropsychologie et rééducation: quels rapports? In *Rééduquer le cerveau* (ed. X. Seron & C. Laterre), pp. 163–189. Brussels: Mardaga.

Broida, H. 1977 Language therapy effects in long-term aphasia. *Arch. phys. Med. Rehabil.* **58**, 248–253.

Bruce, C. & Howard, D. 1987 Computer-generated phonemic cues: an effective aid for naming in aphasia. *Br. J. Dis. Comm.* **22**, 191–201.

Butfield, E. & Zangwill, O.L. 1946 Re-education in aphasia: a review of seventy cases. *J. Neurol. Neurosurg. Psychiat.* **9**, 75–79.

Butterworth, B.L., Howard, D. & McLoughlin, P.J. 1984 The semantic deficit in aphasia: the relationship between semantic errors in auditory comprehension and picture naming. *Neuropsychologia* **22**, 409–426.

Byng, S. & Lesser, R. 1993 A review of therapy at the level of the sentence in aphasia. In *Foundations of aphasia rehabilitation* (ed. M. Paradis), pp. 319–362. Oxford: Pergamon.

Caramazza, A. 1989 Cognitive neuropsychology and rehabilitation: an unfulfilled promise? In *Cognitive approaches in neuropsychological rehabilitation* (ed. X. Seron & G. Deloche), pp. 383–398. Hillsdale, New Jersey: Lawrence Erlbaum.

Caramazza, A. & Hillis, A.E. 1990 Where do semantic errors come from? *Cortex* **26**, 95–122.

Cochrane, A.L. 1972 *Effectiveness and efficiency: random reflections on health services*. London: Nuffield Provincial Hospitals Trust.

David, R., Enderby, P. & Bainton, D. 1982 Treatment of acquired aphasia: speech therapists and volunteers compared. *J. Neurol. Neurosurg. Psychiat.* **45**, 957–961.

Davis, A. & Pring, T. 1991 Therapy for word finding deficits: more on the effects of semantic and phonological approaches to treatment with dysphasic patients. *Neuropsych. Rehabil.* **1**, 135–145.

de Partz, M.P. 1986 Reeducation of a deep dyslexic patient: rationale of the method and results. *Cogn. Neuropsychol.* **3**, 149–177.

Deloche, G., Dordain, M. & Kremin, H. 1993 Rehabilitation of confrontation naming in aphasia: relations between oral and written modalities. *Aphasiology* **7**, 201–216.

Feinberg, T., Rothi, L. & Heilman, K. 1986 Inner speech in conduction aphasia. *Arch. Neurol.* **43**, 591–593.

PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY B BIOLOGICAL SCIENCES

Franklin, S. 1994 Researching the treatment of anomia: the case for single cases. In *Developments in the assessment and rehabilitation of brain-damaged patients* (ed. F.-J. Stachowiak), pp. 273–275. Tübingen: Gunter Narr.

Hagen, C. 1973 Communication abilities in hemiplegia: effect of speech therapy. *Arch. phys. Med. Rehabil.* **54**, 454–463.

Hillis, A. 1989 Efficacy and generalization of treatment for aphasic naming errors. *Arch. phys. Med. Rehabil.* **70**, 632–636.

Hirsh, C. & Ellis, A.W. 1994 Age of acquisition and lexical processing in aphasia; a case study. *Cogn. Neuropsychol.* **11**, 435–458.

Howard, D. 1986 Beyond randomised controlled trials: the case for effective case studies of the effects of treatment in aphasia. *Br. J. Dis. Comm.* **21**, 89–102.

Howard, D. & Hatfield, F.M. 1987 *Aphasia therapy; historical and contemporary issues*. London: Lawrence Erlbaum.

Howard, D. & Orchard-Lisle, V.M. 1984 On the origin of semantic errors in naming: evidence from the case of a global aphasic. *Cogn. Neuropsychol.* **1**, 163–190.

Howard, D. & Patterson, K.E. 1989 Models for therapy. In *Cognitive approaches in neuropsychological rehabilitation* (ed. X. Seron & G. Deloche), pp. 39–64. Hillsdale, New Jersey: Lawrence Erlbaum.

Howard, D., Patterson, K.E., Franklin, S., Orchard-Lisle, V.M. & Morton, J. 1985*a* The facilitation of picture naming in aphasia. *Cogn. Neuropsychol.* **2**, 41–80.

Howard, D., Patterson, K.E., Franklin, S., Orchard-Lisle, V.M. & Morton, J. 1985*b* The treatment of word retrieval deficits in aphasia: a comparison of two therapy methods. *Brain* **108**, 817–829.

Kay, J. & Ellis, A.W. 1987 A cognitive neuropsychological case study of anomia: Implications for psychological models of word retrieval. *Brain* **110**, 613–629.

Kremin, H. 1993 Reading and writing: cognitive therapies of written language. In *Foundations of aphasia rehabilitation* (ed. M. Paradis), pp. 293–318. Oxford: Pergamon.

Lincoln, N.B., McGuirk, E., Mulley, G.P., Lendrem, W., Jones, A.C. & Mitchell, J.R.A. 1984 Effectiveness of speech therapy for aphasic stroke patients: a randomized controlled trial. *Lancet* **i**, 1197–1200.

Marshall, J., Pound, C., White-Thomson, M. & Pring, T. 1990 The use of picture/word matching tasks to assist word retrieval in aphasic patients. *Aphasiology* **4**, 167–184.

Marshall, R.C., Wertz, R.T., Weiss, D.G. *et al.* 1989 Home treatment for aphasic patients by trained non-professionals. *J. Sp. Hear. Dis.* **54**, 462–470.

Nettleton, J. & Lesser, R. 1991 Therapy for naming difficulties in aphasia: Application of a cognitive neuropsychological model. *J. Neuroling.* **6**, 139–157.

Nickels, L.A. 1992 The autocue? Self-generated phonemic cues in the treatment of a disorder of reading and naming. *Cogn. Neuropsychol.* **9**, 155–182.

Nickels, L.A. 1995 Getting it right? Using aphasic naming errors to evaluate theoretical models of spoken word production. *Lang. cog. Proc.* (In the press.)

Nickels, L.A. & Howard, D. 1994 A frequent occurrence? Factors affecting the production of semantic errors in aphasic naming. *Cogn. Neuropsychol.* **11**, 289–320.

Patterson, K.E. 1979 What is right with 'deep' dyslexic patients. *Brain Lang.* **8**, 111–129.

Patterson, K.E., Purell, C. & Morton, J. 1983 The facilitation of naming in aphasia. In *Aphasia therapy* (ed. C. Code and D. J. Muller), pp. 76–87. London: Arnold.

Pease, D.M. & Goodglass, H. 1978 The effects of cuing on picture naming in aphasia. *Cortex* **14**, 178–189.

Poeck, K., Huber, W. & Willmes, K. 1989 Outcome of intensive language treatment in aphasia. *J. Sp. Hear. Dis.* **54**, 471–479.

Pring, T., Hamilton, A., Harwood, A. & Macbride, L. 1993 Generalization of naming after picture/word matching tasks: only items appearing in therapy benefit. *Aphasiology* **7**, 383–394.

Pring, T., White-Thomson, M., Pound, C., Marshall, J. & Davis, A. 1990 Picture/word matching tasks and word retrieval; some follow-up data and second thoughts. *Aphasiology* **4**, 479–483.

Raymer, A.M., Thompson, C.K., Jacobs, B. & Le Grand, H.R. 1993 Phonological treatments of naming deficits in aphasia: model-based generalization analysis. *Aphasiology* **7**, 27–53.

Shewan, C.M. & Kertesz, A. 1984 Effects of speech and language treatment on recovery from aphasia. *Brain Lang.* **23**, 272–299.

Wertz, R.T., Collins, M.J., Weiss, D.G. *et al.* 1981 Veterans administration cooperative study on aphasia: a comparison of individual and group treatment. *J. Sp. Hear. Res.* **24**, 580–594.

Wertz, R.T., Weiss, D.G., Aten, J.L. *et al.* 1986 Comparison of clinic, home and deferred language treatment for aphasia. *Arch. Neurol.* **43**, 653–658.

Wheeldon, L.R. & Monsell, S. 1992 The locus of repetition priming of spoken word production. *Q. J. exp. Psychol.* **44**A, 723–761.

Willmes, K. & Poeck, K. 1984 Ergebnisse einer multizentrischen Untersuchung über die Spontanprognose von Aphasien vaskulärer Ätiologie. *Nervenartzt* **56**, 62–71.

PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY B BIOLOGICAL SCIENCES