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Research Report

Therapy for naming difficulties in bilingual aphasia: which language benefits?

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Abstract

Background: The majority of the world's population is bilingual. Yet, therapy studies involving bilingual people with aphasia are rare and have produced conflicting results. One recent study suggested that therapy can assist word retrieval in bilingual aphasia, with effects generalising to related words in the untreated language. However, this cross-linguistic generalisation only occurred into the person's stronger language (L1). While indicative, these findings were derived from just three participants, and only one received therapy in both languages.
Aims: This study addressed the following questions. Do bilingual people with aphasia respond to naming therapy techniques developed for the monolingual population? Do languages respond differently to therapy and, if so, are gains influenced by language dominance? Does cross-linguistic generalisation occur and does this depend on the therapy approach? Is cross-linguistic generalisation more likely following treatment in L2 or L1?
Methods & Procedures: The study involved five aphasic participants who were bilingual in English and Bengali. Testing showed that their severity and dominance patterns varied, so the study adopted a case series rather than a group design. Each person received two phases of naming therapy, one in Bengali and one in English. Each phase treated two groups of words with semantic and phonological tasks, respectively. The effects of therapy were measured with a picture-naming task involving both treated and untreated (control) items. This was administered in both languages on four occasions: two pre-therapy, one immediately post-therapy and one 4 weeks after therapy had ceased. Testing and therapy in Bengali was administered by bilingual co-workers.
Outcomes & Results: Four of the five participants made significant gains from at least one episode of therapy. Benefits arose in both languages and from both semantic and phonological tasks. There were three instances of cross-linguistic generalisation, which occurred when items had been treated in the person's dominant language using semantic tasks.
Conclusions & Implications: This study suggests that 'typical' naming treatments can be effective for some bilingual people with aphasia, with both L1 and L2 benefiting. It offers evidence of cross-linguistic generalisation, and suggests that this is most likely to arise from semantic therapy approaches. In contrast to the results in the academic literature, the direction of generalisation was from L1 to L2. The theoretical implications of these findings are considered. Finally, the results support the use of bilingual co-workers in therapy delivery.

Keywords: aphasia, bilingualism, case series, speech-and-language therapy.

What this paper adds
Most speech-and-language therapists encounter bilingual clients on their aphasic case loads, particularly in diverse world cities such as London. Yet, the research evidence on which they can draw is limited. Very few experimental studies of therapy have been conducted with bilingual aphasic people. This paper reports such a study, and provides evidence that naming impairments in bilingual aphasia can respond to therapy. Encouragingly, some instances of cross-linguistic generalisation were also observed, whereby the treatment of words in one language improved naming of the translation equivalents in the other. This paper also suggests that treatment delivered through bilingual co-workers can be effective.

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Introduction

Bilingualism (or multilingualism) is not exceptional. Rather it is the norm for at least half the world's population (de Groot and Kroll 1997). Definitions of bilingualism are disputed, although most agree that the term need not signal balanced competencies in L1 (first language) and L2 (second language). One view sees bilingualism as a continuum, with variations in proficiency depending upon patterns of acquisition, exposure and use (Wei 2000). Equal proficiencies certainly cannot be assumed for many bilingual speakers in the United Kingdom. The current study involved bilingual speakers of Bengali and English who originated from Bangladesh. Four of the aphasic participants travelled to the UK as adults and reported pre-stroke Bengali dominance. The other was raised and educated in the UK and reported pre-stroke English dominance.

The growing presence of bilingual clients on clinical case loads poses a number of challenges. Even if the therapist is bilingual she/he may not share the client's languages, making it necessary to work through interpreters and co-workers. The speech and language therapy profession lacks well-controlled tests for all the languages represented in the UK and, when materials are available, scores may be difficult to interpret because pre-stroke language competencies are not known. There is also evidence that bilingual speakers perform differently from monolingual speakers on standard language tests, even when their proficiency in the tested language is high (Roberts *et al.* 2002).

A further challenge relates to therapy. Here, as Roberts (2008) argues, many key questions are unresolved. We need to know whether approaches developed in a monolingual context are effective for bilingual speakers and, if so, whether L1 and L2 are equally likely to benefit. We also need to know whether therapy gains are language specific, or subject to cross-linguistic generalisation.

Existing evidence on these questions is sparse. Some clinical reports suggest that 'traditional' language stimulation may be effective for bilingual clients (Sasanuma and Park 1995, Watamori and Sasanuma 1978). However, as the time post-onset was short in these cases, it is difficult to be certain that gains were due to therapy rather than spontaneous recovery. Wiener *et al.* (1995) report equivalent treatment gains for bilingual and monolingual clients. However, this study was retrospective, rather than experimental, and the treatment content was not specified.

Few studies have systematically explored cross-linguistic generalisation from therapy. Those that have been conducted produced conflicting findings, with some finding no generalisation (Galvez and Hinckley 2003) and others suggesting that it is limited to cognates, that is, cross-linguistic word partners that share very similar forms (Kohnert 2004). Galvez and Hinckley (2003) attribute their null result to the nature of their therapy, which involved cued naming, and suggest that generalisation requires a greater emphasis on semantic processing. Indeed, Kohnert (2004), who did achieve some generalisation, used a combination of semantic and phonological activities in treatment.

Edmonds and Kiran (2006) tested semantic therapy with three aphasic clients who were bilingual in Spanish and English. Using established techniques (Drew and Thompson 1999), they administered four programmes of naming therapy, all of which resulted in gains to the treated language. Encouragingly, there was also some cross-linguistic generalisation. In all cases this occurred after therapy was delivered in Spanish (L2), with generalisation to related items in English. Treatment of English (L1) was only attempted in one case and did not result in generalisation. The authors use their results to argue that, unless competencies are balanced, generalisation is most likely to occur from L2 to L1.

The issue of generalisation from therapy is not simply of clinical importance, it may also illuminate the nature of the bilingual language processing system. Many bilingual language models propose a shared semantic system connecting to L1 and L2 lexicons (for example, Green 1986). According to the Revised Hierarchical Model (Kroll and Stewart 1994), the connections are asymmetrical, with stronger connections between L1 and semantics than between L2 and semantics. This model also incorporates a direct (non-semantic) link between the lexicons, which is similarly asymmetrical. Therefore, activation flows more strongly from L2 to L1 than from L1 to L2. The asymmetries of the model are thought to reflect acquisition, with L2 being mediated, at least in part, by the first language.

Other models dispense with separate L1 and L2 lexicons. According to the Bilingual Interactive Activation Model (Dijkstra and van Heuven 2002) there is just one integrated lexicon that stores all the words known to a bilingual individual. Although this is a model of receptive language, Kroll and Dijkstra (2002) argue for a similar architecture in production. Therefore, when naming a word in one language, equivalent and related words in the other are automatically activated. To ensure that only words in the target language are produced, 'language nodes' set the language for production and suppress the other.

Applied to aphasia therapy, the above models both predict cross-linguistic generalisation from semantic approaches, given that one conceptual system feeds activation to lexical entries in both languages. Such gains may also occur from phonological approaches, either because of direct lexical connections (Revised Hierarchical Model) or the integrated nature of the

lexicon (BIA model). The Revised Hierarchical Model also predicts uneven patterns of generalisation, depending on the language of treatment. This arises because of the asymmetrical connections within the model, whereby activation is conveyed more strongly from L2 to L1 than in reverse. Thus, paradoxically, treatment in L2 may be more likely to bring about cross-language gains than treatment in L1. In terms of *within* language effects, both models predict that therapy should benefit target items in the treated language. In the Revised Hierarchical Model semantic to L1 connections are stronger than semantic to L2 connections. This may suggest that therapy in L1 will bring about stronger *within* language gains than therapy in L2, particularly when it adopts a semantic approach.

Edmonds and Kiran (2006) argue that their results are compatible with the Revised Hierarchical Model. The fact that semantic therapy brought about generalised gains is in line with the proposed centrality of the semantic system. The uneven pattern of generalisation also concurs with the asymmetries of the model. However, as acknowledged by the authors, the evidence provided by this study is preliminary. Only three participants were involved, and of these only one was treated in both languages. Therefore, predictions about the direction of generalisation were not given a strong test. Furthermore, only semantic therapy was attempted. It is therefore unclear whether generalised gains might equally occur from phonological therapy.

The current study explored the effects of semantic and phonological naming therapy with five bilingual aphasic people. Each participant received both types of therapy in Bengali and English with outcomes measured in the treated and untreated languages. The study was therefore able to address the following questions:

- Do bilingual people with aphasia respond to naming therapy techniques developed for the monolingual population?
- Do languages respond differently to therapy and if so are gains influenced by language dominance?
- Does cross-linguistic generalisation occur and does this depend on the therapy approach?
- Is cross-linguistic generalisation more likely following treatment in L2 or L1?

As the treating therapist in this study was not a Bengali language user,[1] Bengali therapy was delivered by bilingual co-workers working alongside and under the supervision of the lead author. These were non-professionally qualified staff who received training about stroke and aphasia and about the procedures adopted in the study. The workers interacted directly with the study participants, that is, they did not perform the role of interpreter.

The use of bilingual co-workers is a recognized feature of speech and language therapy practice (Royal College of Speech and Language Therapists (RCSLT) 2003) and reflects the fact that teams of qualified therapists cannot be skilled in all the languages represented on linguistically diverse caseloads. For example, Mennen and Stansfield (2006) found that 34 different languages (other than English) featured on the paediatric speech and language therapy caseloads of three UK cities, leading to the recommendation that support services, including bilingual co-workers, should be put in place. While the use of bilingual co-workers is often proposed, this mode of delivery has not been systematically evaluated. The study, while very preliminary, suggests that positive outcomes may be achieved through their use.

Method

Participants with aphasia

Five pre-morbidly right-handed participants with aphasia took part in the study (for details, see table 1). All originated from Bangladesh and were bilingual in Bengali (Sylheti dialect) and English. The language histories reported in table 1 were explored via the Language Acquisition Questionnaire from the Bilingual Aphasia Test (Paradis and Libben 1987). Table 2 reports the self-ratings elicited in the questionnaire. This shows that all bar Rasheda[2] rated themselves as Bengali dominant before their stroke.

All participants with aphasia had word-finding difficulties in both their languages. In terms of comprehension, most were able to follow everyday conversations. The exception was Salma, whose husband reported difficulties in both English and Bengali. Non-verbal semantic skills were tested with the all picture version of the Pyramids and Palm Trees test (Howard and Patterson 1992). This was administered by the bilingual co-workers with instructions in Bengali. Stimuli judged to be culturally inappropriate were also removed, leaving 38 items. Table 1 shows that scores for all participants were impaired, particularly for Salma and Saleha. However, conclusions have to be guarded given that control data is not available for this modified version of the test. All participants had a right hemiplegia/hemiparesis.

Control participants

Twenty healthy controls (eight women and 12 men) were recruited to develop the test materials. They were bilingual in Bengali and English and were from the same East London Bangladeshi population as the aphasic participants, so used the same Sylheti dialect. Controls' mean age was 49.11. All were L1 speakers of Bengali but with long term exposure to English (mean number of years in the UK was 23.2 years). Eighteen

Table 1. Details of the participants with aphasia.

Pseudonym	Age (years)	Gender	Neurological information	Time post-onset (months)	Aphasic speech characteristics	Score on Pyramids and Palm Trees (%)	Parental/ home language	Language of education; years in education
Saleha	50	Female	Left hemisphere stroke	18	Severe word-finding difficulties; single-word utterances	59	Bengali	Bengali; 10 years
Salma	41	Female	Haemorrhage in left internal capsule and lentiform nucleus	41	Severe word-finding difficulties; single-word utterances	67	Bengali	Bengali and English; 14 years
Tarik	52	Male	Left thalamic haemorrhage	7	Non fluent with word-finding difficulties; two- to three-word utterances	70	Bengali	Bengali; 12 years
Rasheda	17	Female	Left intra-ventricle subarachnoid haemorrhage	21	Fluent, with word-finding difficulties	75	Bengali	English; 11 years
Azad	50	Male	Left parietal haematoma	16	Fluent, with word-finding difficulties	83	Bengali	Bengali; 17 years

rated their spoken English as 'good' or 'very good', with the remaining two describing it as 'not good'.

The research team

All English language assessment and therapy was conducted by the first author. Bengali assessment and therapy was conducted by three co-workers who were bilingual in Bengali and English and acted under the supervision of the first author. They were undergraduate students from City University, but not studying speech and language therapy.[3] All sessions run by the co-workers were conducted entirely in Bengali. The first author provided initial training for the co-workers and briefed them extensively before each session on task requirements and on how to cue participants. The only speech and language therapist in Britain who is bilingual in Bengali and English acted as language consultant to the project.

Background testing

Background testing aimed to evaluate post-stroke lexical competencies in Bengali and English. Tests were originally developed in both the written and spoken modalities. However, two participants (Tarik and Rasheda) could not carry out written tests in one of their languages, owing to low pre-stroke competencies; and two (Saleha and Salma) scored at floor on all tests with a written element. Therefore only spoken tests are reported here. These were: spoken word to picture matching, repetition, and spoken naming.

A further aim of the background testing was to explore the effects of phonological, semantic and cross-linguistic naming cues across both languages. It was hoped that this would offer further insights into participants' lexical skills and provide a prognosticator for therapy.

Test development

In the absence of lexical values for Bengali, for example, for frequency and familiarity, control naming data were used to identify test stimuli (Croft *et al.* 2006). The controls were asked to name 150 pictured nouns in Bengali and English. All nouns were imageable and judged to be culturally acceptable to the Bengali participants. Half had high English lexical frequencies (greater than 50) and half low (less than 15) (Francis and Kucera 1982). None was cognate in English and Bengali, but all were cognates in Sylheti and standard Bengali. Judgements about cognate status and cultural acceptability were made by the language consultant.

Two naming assessment sessions (one in each language) were conducted with each control participant, separated by at least 7 days. Half the controls were tested first in Bengali and half in English. Pictures were

Table 2. Pre-stroke self-ratings of Bengali and English language competencies.

	Bengali			English		
Pseudonym	Speech	Reading	Writing	Speech	Reading	Writing
Saleha	Very good (from birth)	Very good (5)	Very good (5)	Very good (26)	Not good (26)	Not good (26)
Salma	Very good (from birth)	Good (5)	Good (5)	Good (12)	Good (12)	Good (12)
Tarik	Very good (from birth)	Very good (5)	Very good (5)	Very good (16)	Unable	Unable
Rasheda	Good (from birth)	Not good (6)	Not good (6)	Very good (5)	Good (6)	Good (6)
Azad	Very good (from birth)	Very good (5)	Very good (5)	Good (10)	Good (10)	Good (10)

Note: Values in parentheses are age (years) of first exposure.
Source: Language Acquisition Questionnaire (Paradis and Libben 1987).

presented on a computer in a different random order on each occasion. Controls' responses were scored as correct or incorrect, and latencies were calculated for all correct responses. Latencies were the time lag between the presentation of the image and the onset of the response, and were collected using the Soundbytes computer program.[4] Once a response was given (and recorded by the computer), the tester presented the next picture. New pictures were presented automatically after 10 seconds if the participant failed to respond.

The control naming data were used to derive the 60 items used in the background tests. All items had at least 70% name agreement in both languages and had matched Bengali and English naming latencies. Mean syllable length of the Bengali words was 1.85 (range = 1–4) and of the English words was 1.4 (range = 1–3). The 60 items were divided into two sets (A and B), so that each included equal numbers of high and low frequency items (as determined by English values). Set A formed the stimuli for the naming and repetition tests. Set B formed the stimuli for the word-to-picture matching test. For each test there was a different running order of items, which was also changed for testing in Bengali and English. The order of testing (that is, whether or not Bengali was tested first) was counterbalanced across tests and participants.

Test content

*Spoken naming (*n = *30)*

In this task the participant was shown a line drawing and asked to produce the spoken name either in Bengali or English. The test was administered twice in each language to explore naming consistency and the effect of different cues. In one administration, participants were provided with a cross-linguistic cue when they failed to name an item. This consisted of the equivalent name in the other language. In the other administration, they were provided with a semantic cue (in the test language). In both administrations, if the first cue failed to elicit a response it was followed by a phonemic cue in the target language, consisting of the first phoneme (or cluster) plus schwa. Test administrations were separated by at least 7 days.

*Repetition (*n = *30)*

No pictures were used in this test. Each target was spoken by the tester for the participant to repeat. The test was administered once in Bengali and once in English.

*Spoken word to picture matching (*n = *30)*

This test mirrored the design of the equivalent task in the Psycholinguistic Assessment of Language Processing in Aphasia (PALPA; Kay *et al.* 1992). The participant heard a spoken name and had to match it to one of five pictures. These comprised the target (for example, 'leaf'), a close semantic distractor (for example, 'flower'), a distant semantic distractor (for example, 'nut'), a visual distractor (for example, 'feather'), and an unrelated distractor, which was semantically related to the visual distractor (for example, 'bird). Distractors were vetted by the consultant for cultural appropriacy. The test was administered once in each language.

Table 3 presents test results in Bengali and English across the five aphasic participants (naming scores are for uncued responses). Participants have been ordered according to Bengali naming success. Comparative data from the 20 healthy controls are also presented for the word-to-picture matching and naming tests. Control repetition data were not collected.

Controls scored at ceiling on both the comprehension and production tests, with no difference between their Bengali and English scores. The collection of naming latencies used during test development aimed to ensure that the stimuli were matched for naming difficulty across the two languages. The equal control scores on the tests suggest that this was achieved.

The aphasic participants demonstrated a wide range of performance. Taking comprehension first, Rasheda and Azad scored at or close to ceiling on the word-to-picture matching test, while Saleha, Salma, and Tarik were clearly impaired. All participants' errors in both languages were predominantly semantic. Rasheda and Azad also scored relatively highly in production. Indeed

Table 3. Results of background testing with the aphasic participants.

Test (in all tests $n = 30$)	Saleha	Salma	Tarik	Rasheda	Azad	Controls, mean (SD; range)
Spoken word to picture matching						
Bengali	22	21	26	29	**30**	29.87 (0.35; 28–30)
English	18	13	22	28	**29**	29.67 (0.62; 29–30)
Repetition						
Bengali	30	28	28	30	28	
English	17	23	24	30	29	
Spoken naming (uncued): test 1						
Bengali	2	7	18	19	24	27.7 (1.75; 24–30)
English	1	1	5	**27**	**26**	27.45 (2.21; 24–30)
Spoken naming (uncued): test 2						
Bengali	1	10	16	23	**25**	
English	0	3	14	**27**	23	

Note: Scores shown in bold are within 2 standard deviations (SD) of control mean.

their English spoken naming was within or close to two standard deviations (2 SDs) of the control mean. Scores were much poorer for Saleha, Salma, and Tarik. For all participants, repetition exceeded naming in both languages. The pattern was most striking for Saleha whose naming was virtually at floor, but who scored 100% in Bengali repetition and 57% in English.

Tables 4 and 5 report the naming errors made by each participant in Bengali and English. For all participants, failure to respond was a common error category and predominantly so for the two with the most impaired naming (Saleha and Salma). In contrast, phonological errors were rare. Proportions of semantic errors seemed to relate to naming success, in that these tended to occur when overall error numbers were low. Relating error categories to levels of impairment is difficult. For example, there is evidence that semantic errors in naming need not signal a semantic deficit (Caramazza and Hillis 1990). Indeed, these errors here may reflect an attempt to generate a response, albeit one that is not quite the target.

All participants made some code switching errors, or responded in the non-target language. In most cases, the direction of these errors was into the language with the strongest naming performance. Therefore, for example, Rasheda only code switched into English (her stronger language), while Tarik and Salma switched more into Bengali.

One aim of the background testing was to identify differential competencies. Only Azad performed similarly in Bengali and English across all tests. Rasheda scored equally highly on most tests, but her naming significantly favoured English (McNemar Chi-square $= 9.94$, degrees of freedom (d.f.) $= 1$, $p < 0.05$). Saleha, Salma, and Tarik scored consistently higher in the Bengali than in the English tests. For Saleha, the difference was significant in repetition (McNemar Chi-square $= 13$, d.f. $= 1$, $p < 0.01$).

Table 4. Errors made by the aphasic participants in Bengali across the two administrations of the naming test.

		Percentage breakdown					
Pseudonym	Total number of errors	No response	Semantic	Code switch	Phonological	Neologism	Perseveration
Saleha	57	87.7	7	1.8	3.5		
Salma	43	76.7	14	2.3	4.7		2.3
Tarik	26	42.3	30.8	23.1	3.8		
Rasheda	18	50	38.9	11.1			
Azad	11	27.25	45.5	27.25			

Table 5. Errors made by the aphasic participants in English across the two administrations of the naming test.

		Percentage breakdown					
Pseudonym	Total number of errors	No response	Semantic	Code switch	Phonological	Neologism	Perseveration
Saleha	59	98.3			1.7		
Salma	56	76.8		14.2	3.6	3.6	1.8
Tarik	41	53.6	9.8	31.7	4.9		
Rasheda	6		100				
Azad	11	36.4	36.4	18.2	10		

Table 6. Percentage of items named following a cue (number cued).

Condition	Saleha	Salma	Tarik	Rasheda	Azad	Total
Naming in Bengali						
Semantic cue	0 (29)	0 (20)	28.6 (14)	0 (7)	40 (5)	8 (75)
Cross linguistic cue	0 (28)	4.3 (23)	9.1 (11)	0 (11)	20 (5)	3.8 (78)
Phonemic cue[a]	15.8 (57)	42.9 (42)	27.3 (22)	22.2 (18)	42.9 (7)	27.4 (146)
Naming in English						
Semantic cue	0 (30)	7.4 (27)	18.7 (16)	33 (3)	14.3 (7)	8.4 (83)
Cross linguistic cue	0 (29)	8 (25)	21.4 (14)	0 (3)	0 (4)	6.6 (75)
Phonemic cue[a]	39 (59)	55.8 (52)	40 (35)	20 (5)	80 (10)	46.6 (161)

Note:[a] Combined data from tests 1 and 2.

For Salma, it was significant in word to picture matching (McNemar Chi-square = 6.4, d.f. = 1, $p < 0.05$) and naming (McNemar Chi-square = 11.27, d.f. = 1, $p < 0.001$), and for Tarik it was significant in naming (McNemar Chi-square = 5.76, d.f. = 1, $p < 0.05$).

Another aim was to explore the effect of cues. Table 6 shows that, across the group, phonemic cues were far more likely to elicit a correct response than cross-linguistic or semantic cues. It is difficult to detect strong patterns in the individual data, given that the number of cued items is often very small. Nevertheless, where there is a preferred cue type, it is nearly always phonemic. In terms of language, only one participant, Saleha, produced differential data, in that naming in English was significantly more responsive to cues than naming in Bengali (Chi square = 6.558, d.f. = 1, $p < 0.01$). This pattern was evident in both administrations of the test.

Finally, we explored naming consistency. This was a concern for one participant, Tarik, who named significantly more English items in the second assessment than in the first (McNemar Chi-square = 4.92, d.f. = 1, $p < 0.05$).

Discussion of background tests

Three novel tests explored the bilingual language skills of the aphasic participants. In developing the tests, we aimed to ensure that Bengali and English items were of comparable difficulty, by matching them on the basis of their control naming latencies (controls had very similar language histories to the aphasic participants). We also only included items that had good name agreement in both languages; that is, at least 70% of the controls used the target English and Bengali word when naming the picture.

One of the participants demonstrated an equal performance in the Bengali and English tests. All others displayed discrepancies that were consistent across tests and significant on at least one. These discrepancies were not all in the same direction (Rasheda favoured English, while Saleha, Salma, and Tarik favoured Bengali), which discounts an intrinsic test bias. Rather they appear to reflect individual differences in language proficiency. The key observation here is that all discrepancies were in line with self reported pre-stroke dominance. It seems that these dominances survived and were possibly inflated by participants' aphasia. The next stage of the study investigated the therapeutic implications of these dominances, both in terms of response to treatment and the direction of generalisation.

All participants responded to cues when attempting word retrieval, which may offer a positive prognosticator for therapy. The effect was most evident when cues were phonological, but arose in both languages. One participant, Saleha, produced paradoxical cueing data, with L2 responding better than L1. This may suggest that, for her, L2 is also more treatable. Cross-linguistic cues did not assist naming for any of the participants; that is, simply providing the word in one language very rarely stimulated production in the other.

Finally, dual administration of the tests, separated by at least 7 days, suggested that naming was stable for all bar one of the participants. The exception, Tarik, had the most recent stroke.

Design of the therapy study

Background testing revealed a wide range of language competencies across the participants, making variable responses to therapy likely. A case series rather than group design was therefore adopted.

The experiment used a repeated measures design, with double baseline, post-therapy and maintenance testing. Further experimental control was provided by a group of items that remained untreated. This design has been widely used to explore the effects of naming therapy in aphasia (for example, Hickin *et al.* 2002). It was selected in preference to a time series design, using repeated test probes during treatment (for example, Edmonds and Kiran 2006). We decided that the participants would be intolerant of such frequent testing, especially as it would have to be administered in both languages.

Each participant selected a personal vocabulary of 150 imageable nouns which acted as assessment and therapy stimuli. Personal selection aimed to promote the functional relevance of treatment. It also ensured that the vocabulary included a high proportion of items that the person could not name at baseline. Each item was represented by a colour photograph or drawing. Naming of these 150 items was assessed five times during the therapy study (T1–5), with each assessment being conducted in both languages. No cues were provided during these naming tests.

T1 and T2 occurred before therapy began. These baselines were separated by 4 weeks, and testing in each language by 5 days. The order in which languages were tested was counterbalanced across test occasions and participants. For example, at T1, three participants named their targets in Bengali first and English second. The remaining two participants named their targets in English first.

After the second baseline (T2) the items were allocated to five groups of 30 items, matched, as far as possible, for naming success. Therefore, each group contained an equal number of items that were named at T2 in each language. Groups 1 and 2 were treated in Bengali using semantic and phonological tasks, respectively. Groups 3 and 4 were treated in English, again with semantic or phonological tasks, respectively. Group 5 remained untreated, so acted as a control. Note that each group of 30 items effectively represents 60 words, that is, 30 Bengali words and their translation equivalents in English.

Participants elected the first language of treatment and all bar Rasheda opted to work on Bengali first. Thus, in phase one four participants received Bengali therapy for groups 1 and 2, while Rasheda received English therapy for groups 3 and 4 (the content of therapy is described below). After this, the 150 item naming assessment was administered again in both languages (T3). This was followed by phase two, during which participants received therapy in the previously untreated language. Therefore, four received English therapy for groups 3 and 4 and Rasheda received Bengali therapy for groups 1 and 2. Naming was then tested again in both languages (T4). The final assessment (T5) was conducted 4 weeks later, during which there was no therapy.

Content of therapy

Each therapy phase consisted of 10 one-hour sessions delivered twice weekly over 5 weeks. Half of each session was used for semantic therapy and the other half for phonological therapy, with the order of therapy alternating between sessions. Each treated item was presented once per session, to ensure equal exposure across the therapies. Therapy in English was delivered by the first author and therapy in Bengali by the bilingual co-workers. They worked under the supervision of the first author, who was also present during the sessions.

The tasks used in therapy were drawn from aphasia naming treatment studies that report positive outcomes. Established semantic and phonological procedures were replicated, in order to test whether these are effective with bilingual speakers. Four semantic therapy tasks were used:

- Semantic associate matching (Nickels and Best 1996): the target picture was presented to the participant together with two other object pictures, one of which was semantically related to the target. The participant was asked to identify the related picture, for example, 'which one goes with the knife?' from a choice of fork and chimney. Distractor pictures did not include any of the participant's 150 tested items.
- Functional questions (Nickels and Best 1996): the target picture was presented to the participant together with two standard-format closed questions: for example, 'Can you *verb* a *target*?'; for example, 'Can you kick a football?'; and 'Can you eat a football?'
- Naming to definition (Drew and Thompson 1999): the participant was presented with a target picture together with a definition. For example, the English definition for carrot was: 'this is a type of root vegetable. It's long and thin and orange and rabbits like to eat them'. The participant was asked to name the picture. If she/he was unable the name was provided by the therapist.
- Semantic feature analysis (Lowell *et al.* 1995): the target picture was presented to the participant and she/he was asked to describe its semantic features. Appropriate cue questions were provided by the therapist, such as 'Where would you find it?' and 'What would you do with it?' The therapist also suggested features for the participant to accept or reject. A new target picture was presented after four features had been correctly provided, or judged, by the participant.

Five phonological therapy tasks were used:

- Repetition of the target in the presence of the picture (Hickin *et al.* 2002): the target picture was presented together with the spoken name for the participant to repeat.
- Phonological cueing (Howard *et al.* 1985): a target picture was presented together with a phonological cue, consisting of the first phoneme or cluster, and the participant was asked to produce the word. If she/he was unable a longer cue was given, consisting of the first syllable. If this was still unsuccessful the whole word was provided for repetition.
- Rhyme judgement (Raymer *et al.* 1993): the target picture was presented together with a rhyme question, for example, 'Does this word rhyme with parrot?' (for the target 'carrot'). An equal number of questions requiring 'yes' and 'no' responses were asked; for example, on another occasion a participant might be

asked: 'Does this word rhyme with hammer?' (for the target 'carrot').

- Syllable counting (Rose *et al.* 2002): the target picture was presented to the participant. If they could name it they did, otherwise the therapist provided the name. The participant was then asked to indicate the number of syllables in the word. If unable, she/he was invited to tap out the number of syllables with the support of the therapist.
- Initial phoneme judgement (Hickin *et al.* 2002): the target picture was presented to the participant together with the spoken name. S/he was asked to say the first sound of the word, for example, 'this word is potato. What is the first sound of potato?' In the event of difficulties the therapist provided the first sound, for example, 'the word begins with /p/. /p/ for potato'.

All the semantic and phonological therapy tasks were presented in the above order to each participant. Once the full round of tasks had been completed any that had proved too difficult for individual participants were abandoned. The successful tasks were then repeated.

Results

Tables 7a–e present Bengali and English naming scores on the 150 items for all participants across the five test occasions. The following sections analyse these results in order to address the study questions.

Naming of control items

Figures 1 and 2 show naming scores on the control items at T1 and T5. They indicate that naming of untreated items was stable for all participants except Tarik. His naming in Bengali was significantly better at T5 than T1 (McNemar Chi-square = 5.82; d.f. = 1, $p < 0.05$). His small gain in English control naming was not significant.

Table 7a. Saleha's naming scores in Bengali and English across the five assessment points; treatment in Bengali occurred between T2 and T3; and treatment in English occurred between T3 and T4.

	Group 1 (/30)		Group 2 (/30)		Group 3 (/30)		Group 4 (/30)		Group 5 (/30)		Total (/150)	
	Bengali	English	Bengali	English	Bengali	English	Bengali	English	Bengali	English	Bengali	English
T1	1	1	1	0	1	1	1	0	0	0	4	2
T2	1	1	1	0	1	1	1	0	0	0	4	2
T3	2	1	9	0	0	0	2	0	0	1	13	2
T4	2	1	5	0	3	1	4	1	0	0	14	3
T5	1	1	5	0	3	2	3	1	0	0	12	4

Note: In Tables 7a–e, Group 1 received semantic therapy in Bengali; Group 2 received phonological therapy in Bengali; Group 3 received semantic therapy in English; Group 4 received phonological therapy in English; and Group 5 was the untreated control group.

Table 7b. Salma's naming scores in Bengali and English across the five assessment points; treatment in Bengali occurred between T2 and T3; and treatment in English occurred between T3 and T4.

	Group 1 (/30)		Group 2 (/30)		Group 3 (/30)		Group 4 (/30)		Group 5 (/30)		Total (/150)	
	Bengali	English	Bengali	English	Bengali	English	Bengali	English	Bengali	English	Bengali	English
T1	5	1	5	4	8	2	6	0	7	3	31	10
T2	7	5	6	5	7	5	6	5	7	5	33	25
T3	7	4	10	7	11	4	6	4	6	4	40	23
T4	4	0	10	0	7	2	5	2	9	0	35	4
T5	6	0	9	0	7	0	6	0	9	0	37	0

Note: See the note to Table 7a.

Table 7c. Tarik's naming scores in Bengali and English across the five assessment points; treatment in Bengali occurred between T2 and T3; and treatment in English occurred between T3 and T4.

	Group 1 (/30)		Group 2 (/30)		Group 3 (/30)		Group 4 (/30)		Group 5 (/30)		Total (/150)	
	Bengali	English	Bengali	English	Bengali	English	Bengali	English	Bengali	English	Bengali	English
T1	12	11	14	12	15	6	13	6	10	8	64	43
T2	17	8	18	7	17	8	17	7	16	8	85	38
T3	22	16	26	12	17	12	13	8	18	9	96	57
T4	20	8	27	13	22	13	20	15	20	9	109	58
T5	21	12	23	13	19	12	20	14	19	13	102	64

Note: See the note to Table 7a.

Table 7d. Rasheda's naming scores in Bengali and English across the five assessment points; treatment in Bengali occurred between T3 and T4; and treatment in English occurred between T2 and T3.

	Group 1 (/30)		Group 2 (/30)		Group 3 (/30)		Group 4 (/30)		Group 5 (/30)		Total (/150)	
	Bengali	English	Bengali	English	Bengali	English	Bengali	English	Bengali	English	Bengali	English
T1	5	9	5	11	7	9	7	9	6	10	30	48
T2	5	10	5	9	6	10	7	9	6	10	29	48
T3	5	15	5	11	12	26	9	20	6	12	37	84
T4	13	18	12	12	11	24	7	17	7	11	51	82
T5	12	15	12	12	11	24	8	17	7	10	50	78

Note: See the note to Table 7a.

Table 7e. Azad's naming scores in Bengali and English across the five assessment points; treatment in Bengali occurred between T2 and T3; and treatment in English occurred between T3 and T4.

	Group 1 (/30)		Group 2 (/30)		Group 3 (/30)		Group 4 (/30)		Group 5 (/30)		Total (/150)	
	Bengali	English	Bengali	English	Bengali	English	Bengali	English	Bengali	English	Bengali	English
T1	9	7	6	8	7	11	4	6	11	11	37	43
T2	8	9	9	9	8	9	9	8	9	10	43	45
T3	22	18	22	9	13	8	11	7	15	11	83	53
T4	20	19	15	4	12	20	10	18	12	12	69	73
T5	21	19	16	5	14	18	11	16	11	13	73	71

Note: See the note to Table 7a.

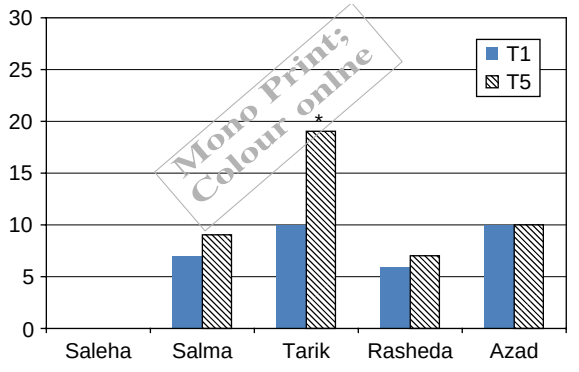

Figure 1. Participants' naming of control items in Bengali at T1 and T5. *Significant difference.

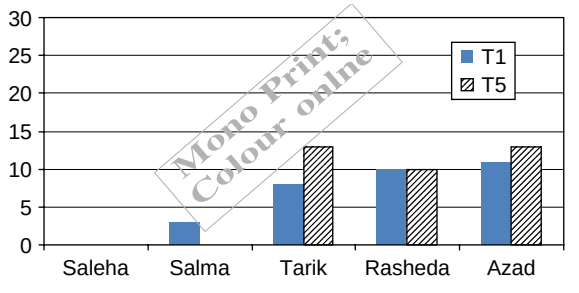

Figure 2. Participants' naming of control items in English at T1 and T5.

Effects of semantic therapy

These analyses compare pre- and post-therapy naming scores for items that received semantic therapy. Therefore, here we compare pre- and post-therapy scores for group 1 (that received semantic therapy in Bengali) and group 3 (that received semantic therapy in English). Maintenance scores are also compared with baseline. Therefore, if Bengali was treated first, group 1 scores are compared across T2 and T3 to determine the effect of therapy, and scores at T2 and T4 are compared to evaluate maintenance. Turning to English, Group 3 scores are compared across T3 and T4 to determine the effect of therapy, and T3 to T5 to evaluate maintenance (assuming that English was treated second). These analyses only consider naming scores in the language of treatment, that is, they do not address cross-linguistic generalisation.

Figure 3 shows the effects of semantic therapy in Bengali, that is, here Bengali naming scores on group 1 are reported. No gains are evident for Saleha, Salma or Tarik. For Rasheda and Azad, naming of treated items improved significantly post-therapy (Rasheda: McNemar Chi-square = 4.08, d.f. = 1, $p < 0.05$; Azad: McNemar Chi-square = 12.07, d.f. = 1, $p < 0.01$) and this gain was maintained (Rasheda: McNemar Chi-square = 4, d.f. = 1, $p < 0.05$; Azad: McNemar Chi-square = 8.64, d.f. = 1, $p < 0.01$).

Figure 4 shows the effects of semantic therapy in English, that is, here English naming scores on group 3 are reported. Two participants demonstrated significant gains (Rasheda: McNemar Chi-square = 12.5, d.f. = 1,

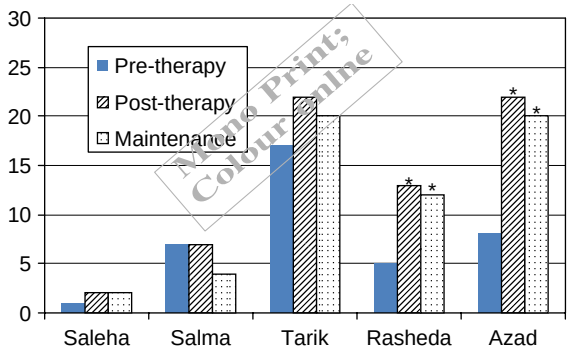

Figure 3. Participants' naming of items that received semantic therapy in Bengali (number correct). *Significant improvement from the baseline.

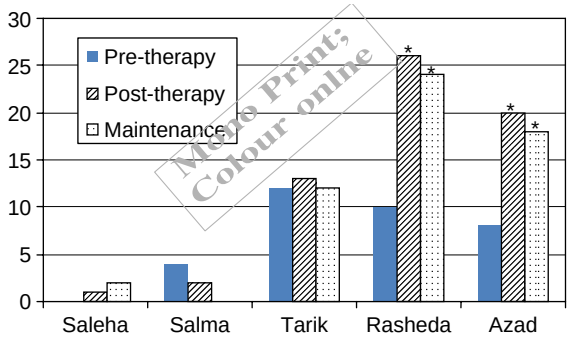

Figure 4. Participants' naming of items that received semantic therapy in English (number correct). *Significant improvement from the baseline.

$p < 0.01$; Azad: McNemar Chi-square = 8.64, d.f. = 1, $p < 0.01$) and for both these were maintained (Rasheda: McNemar Chi-square = 10.56, d.f. = 1, $p < 0.01$; Azad: McNemar Chi-square = 6.75, d.f. = 1, $p < 0.01$).

Effects of phonological therapy

These analyses compare pre- and post-therapy naming scores for items that received phonological therapy. Therefore, here we compare pre- and post-therapy scores for group 2 (that received phonological therapy in Bengali) and for group 4 (that received phonological therapy in English). Maintenance scores are also compared with baseline. Therefore, if Bengali was treated first, group 2 scores are compared between T2 and T3 to determine the effects of treatment, and between T2 and T4 to evaluate maintenance. Turning to English, group 4 scores are compared between T3 and T4 to determine the effects of treatment, and between T3 and T5 to evaluate maintenance (assuming that English was treated second). As above, these analyses only consider the language of treatment, that is, here we do not address cross-linguistic generalisation.

Figure 5 shows the effects of phonological therapy in Bengali, that is, here Bengali naming scores on group 2 are reported. Four participants achieved significant gains (Saleha: McNemar Chi-square = 6.16, d.f. = 1, $p < 0.01$; Tarik McNemar Chi-square = 4.9, d.f. = 1, $p < 0.05$; Rasheda: McNemar Chi-square = 5.14, d.f. = 1, $p < 0.05$; Azad: McNemar Chi-square = 9.6, d.f. = 1, $p < 0.01$). These gains were maintained by two of the participants (Tarik: McNemar Chi-square = 5.82, $p < 0.05$; Rasheda: McNemar Chi-square = 5.14, d.f. = 1, $p < 0.05$).

Figure 6 shows the effects of phonological therapy in English, that is, here English naming scores on group 4 are reported. Three participants demonstrated significant improvements (Tarik: McNemar Chi-square = 5.14, d.f. = 1, $p < 0.05$; Rasheda McNemar Chi-square = 7.69, d.f. = 1, $p < 0.01$; Azad McNemar Chi-square = 7.69, d.f. = 1, $p < 0.01$). For two, these gains were maintained (Rasheda: McNemar Chi-square = 6.13, d.f. = 1, $p < 0.05$; Azad: McNemar Chi-square = 5.82, d.f. = 1, $p < 0.05$).

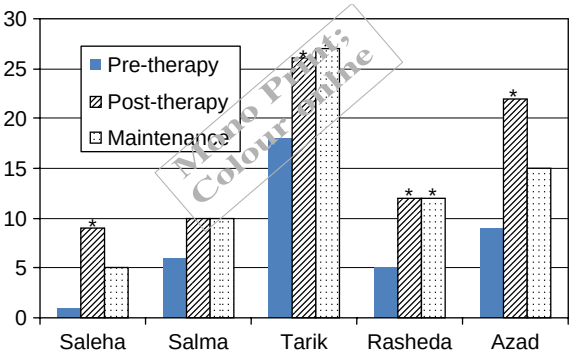

Figure 5. Participants' naming of items that received phonological therapy in Bengali (number correct). *Significant improvement from the baseline.

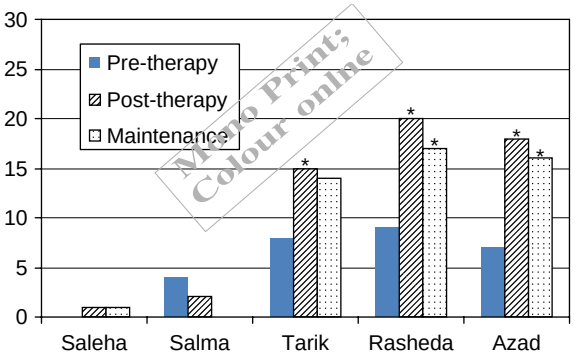

Figure 6. Participants' naming of items that received phonological therapy in English (number correct). *Significant improvement from the baseline.

Cross-linguistic generalisation

These analyses explored naming gains for treated groups of items, but in the untreated language. For example, to find out if semantic therapy in Bengali resulted in cross-linguistic generalisation, English naming scores for group 1 were compared before and after that group received therapy. Maintenance of cross-linguistic gains was also investigated.

The relevant scores are reported in figures 7–10. These show just three instances of cross-linguistic generalisation. Two followed semantic therapy in Bengali (Tarik: McNemar Chi-square = 4.9, d.f. = 1, $p < 0.05$; Azad: McNemar Chi-square = 4.92, d.f. = 1, $p < 0.05$) and for Azad, this gain was maintained (McNemar Chi-square = 8.1, d.f. = 1, $p < 0.01$). The other instance followed semantic therapy in English, in that Rasheda's naming of group 3 in Bengali improved after therapy (McNemar Chi-square = 4.17, d.f. = 1, $p < 0.05$). However, at maintenance, the gain fell just short of significant.

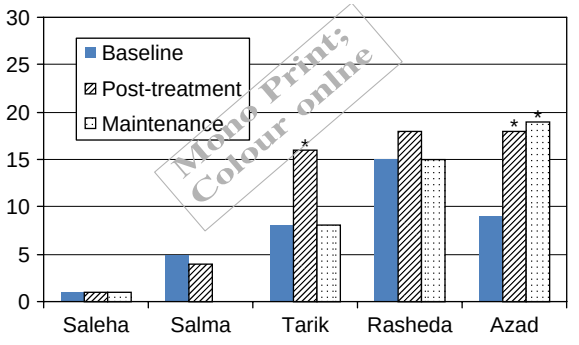

Figure 7. Cross-linguistic generalisation from semantic therapy in Bengali: naming of treated items in English. *Significant improvement from the baseline.

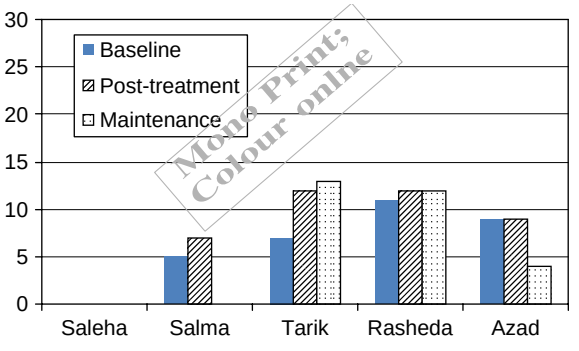

Figure 8. Cross-linguistic generalisation from phonological therapy in Bengali: naming of treated items in English.

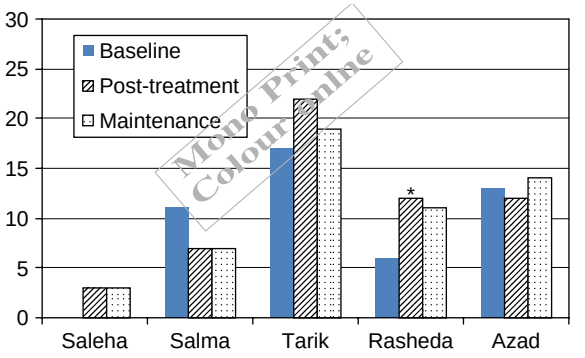

Figure 9. Cross-linguistic generalisation from semantic therapy in English: naming of treated items in Bengali. *Significant improvement from the baseline.

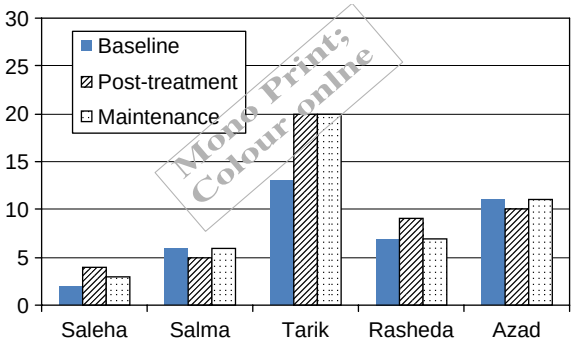

Figure 10. Cross-linguistic generalisation from phonological therapy in English: naming of treated items in Bengali.

Discussion

The first question addressed by this study was do bilingual people with aphasia respond to the naming therapy techniques developed for the monolingual population? When we consider gains in the treated language, the results suggest a qualified 'yes'.

Taking semantic therapy first, this was clearly beneficial for two of the study participants: Rasheda and Azad. Furthermore, their gains occurred in both languages and were well maintained.

Phonological therapy had apparently more widespread benefits. Again Rasheda and Azad benefited in both languages. Tarik and Saleha also improved, although in Saleha's case, benefits were only evident in Bengali. However, when maintenance is considered, the advantage for phonological treatment is less clear. Gains for Rasheda were well maintained in both languages. However, Azad only maintained his improvement in English and Tarik only in Bengali. Saleha's one gain in Bengali was lost at follow-up.

As this summary shows, outcomes varied considerably across individuals, with one (Salma) showing no significant benefits in either language. Similar variations have been observed in treatment studies of the

monolingual population (for example, Fillingham *et al.* 2006), which has stimulated attempts to identify predictors of outcome (for example, Fillingham *et al.* 2005). This could not be analysed in the current study, given the low participant numbers. However, it is clear that the least impaired participants (Rasheda and Azad) showed the greatest gains. These individuals not only had the highest baseline naming scores, but also performed most highly on background tests requiring semantic knowledge, the Pyramids and Palm Trees Test and word to picture matching. Their good response to therapy, therefore, may have been contingent on relatively preserved semantic skills.

Another concern is whether all improvements can be unambiguously attributed to therapy. Most participants displayed unchanged naming of control items, suggesting that their gains on treated items were indeed due to therapy. However, this was not true of Tarik, in that his naming of Bengali controls improved between T1 and T5. This, together with his inconsistent naming during background testing, suggested that he was still experiencing some spontaneous recovery. The fact that experimental control was not achieved for Tarik clearly qualifies his apparent gains from therapy.

The second question was do languages respond differently to therapy and if so are gains in line with language dominance? Before considering the results, we should acknowledge that, although tasks were the same, cross-language conditions were not identical, since therapy in English was delivered by a speech and language therapist, while therapy in Bengali was delivered by co-workers. A further possible confound was order of treatment. Participants were given a choice about which language to target first in therapy, with the expectation that they would chose randomly between Bengali and English. In fact, they all opted to work first on their stronger language. Had we anticipated this, language order would have been counterbalanced.

With these difficulties in mind, the results showed no clear advantage for treatment delivered either in Bengali or English, or for participants' dominant language. Put differently, none of the participants clearly benefited from therapy in one language while not benefiting in the other, despite the fact that all showed patterns of pre- and/or post-stroke language dominance. Therefore, Rasheda and Azad both benefited from treatment in Bengali and English, despite the fact that for Rasheda English was her dominant language, and for Azad it was Bengali. Tarik, who was Bengali dominant, only improved following phonological therapy, but again this was evident in both languages. Saleha's one therapy gain was in Bengali, her dominant language. However, this was not maintained. It was also not in line with her pre-therapy response to cues, where English was found to benefit more than Bengali. Thus, this admittedly small case series suggests that L1 and L2 are equally likely to benefit from naming therapy.

The third question concerned cross-linguistic generalisation, and whether this depends on the therapy approach. The data suggest that the answer is 'yes'. Three of the participants, Tarik, Rasheda, and Azad, showed evidence of cross-linguistic generalisation, that is, where therapy resulted in gains in the untreated language, and in all cases therapy was semantic. None of the participants showed improved naming of items that had received phonological therapy in the other language.

It is reasonable to assume that cross-linguistic generalisation is most likely to occur if the treatment has been effective in the target language. Therefore, unequal patterns of generalisation may be due to unequal within-language effects. Yet in the current study, this was clearly not the case. We found that semantic and phonological treatments were equally likely benefit the target language. Indeed, in terms of immediate gains, phonological therapy was marginally more successful. Yet, only semantic treatment brought about cross-linguistic improvements.

The final question concerned the direction of cross-linguistic generalisation and whether this was influenced by patterns of dominance. Although instances of generalisation were few, they all followed treatment in the person's stronger language. For Azad and Tarik, this was clearly Bengali, in that this was the familial language and was given higher pre-stroke ratings than English. Tarik's post-stroke naming also significantly favoured Bengali. For Rasheda, it was English, despite the fact that Bengali was her parental/home language. She rated her pre-stroke English competencies more highly than Bengali, and significantly favoured English in her post-stroke naming. So, for Azad and Tarik, semantic therapy in Bengali improved naming of equivalent items in English, while for Rasheda the pattern was reversed, with semantic therapy in English benefiting Bengali.

Are these findings consistent with models of bilingual language processing? Taking the therapy approach first, there is a broad consensus that the different languages spoken by a bilingual individual are underpinned by a common and unitary semantic system. Indeed, this is a feature of both the Revised Hierarchical Model (Kroll and Stewart 1994) and the BIA (Dijkstra and van Heuven 2002) models considered in the introduction. There is also considerable evidence that, in normal speech production, activation is relayed from the semantic system to all lexical entries, regardless of the target language (Hermans *et al.* 1998). It is therefore reasonable to assume that therapy pitched at a semantic level will increase activation not only to the treated word forms, but also potentially to the equivalent items in the other

language, an assumption that was confirmed in three of the cases.

The observed pattern of asymmetry is more difficult to explain. The Revised Hierarchical Model suggests that semantic to lexical connections are weighted for proficiency, with stronger links for L1 than L2 (Kroll and Stewart 1994). This would suggest that semantic therapy is more likely to generalise into L1, since here the speaker can capitalize on the intrinsically stronger links. This was indeed the case in Edmonds and Kiran (2006). However, in the current study the reverse was true. In all instances the weaker language benefited from therapy in the stronger.

Whether generalisation can be equally anticipated from phonological therapy is a moot point. The Revised Hierarchical Model proposes direct connections between bilingual lexicons, which bypass the semantic system. These connections allow word forms in one language to relay activation directly to their translation equivalents in the other (Kroll and Stewart 1994). As with the semantic/lexical connections, there is a further proposal of asymmetry, whereby connections from L2 to L1 are stronger than those from L1 to L2. This model suggests that therapy focusing on word forms may bring about cross-linguistic generalisation, particularly when treatment is in L2. However, this pattern was not observed in the current study. It was also striking that in the background assessments none of the participants responded very positively to cross-linguistic cues in naming.

A further modelling issue should be considered. If lexical access in bilingualism is non-language specific, as proposed by the BIA model, some form of control mechanism is required to ensure that the response is generated in the target language. This may take the form of an inhibitory device or may fall out of the competitive nature of the system, whereby the most activated word has the power to suppress all other candidates. This gives rise to an unsettling possibility. It could be that far from promoting generalisation, repetitive exposure to words in therapy has the effect of suppressing corresponding items in the other language. Happily, there was no evidence of this in four of the participants. But the proposal invites a reappraisal of Salma's results, given that her English naming dropped to floor at the final assessment (see table 7b). However, the fall happened after the English rather than Bengali therapy phase, making it difficult to attribute to cross-language suppression.

To summarize, this study suggests that bilingual people with aphasia can benefit from 'typical' naming therapies, with both semantic and phonological treatments proving effective for at least some of the participants. It also offers evidence that both languages can benefit, with no clear advantage for L1 or L2. Although instances of cross-linguistic generalisation were few, they all followed treatments that engaged semantic rather than phonological processing, and occurred after therapy in L1. While the former finding is consistent with many bilingual language processing models the latter is more difficult to accommodate.

The finding that therapy in L1 is more likely to produce generalised results is potentially problematic for clinicians, given that a client's first language may not be shared with the therapist. However, for most participants in the current study L1 therapy was administered by bilingual co-workers, suggesting that this can be an effective mode of delivery.

This study only involved five participants, so it clearly needs replicating with a larger group. That is, we need more extensive tests of different therapy approaches, with carefully designed measures that can explore effects across both the treated and untreated languages. We also need dedicated tests of alternative modes of therapy delivery, for example, where treatment is delegated to assistants and/or co-workers. Although the findings were encouraging, we only tested delegated therapy in one of the treated languages, and this was L1 for most participants. This mode of delivery needs to be tested for treatments in both L1 and L2 before we can be confident that outcomes are not compromised.

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Notes

1. At the time of the study, there was only one speech and language therapist in the UK who spoke Bengali. This therapist acted as language consultant to the project.
2. All participant names are pseudonyms.
3. When the study was conducted, there were no students of speech and language therapy in London who were bilingual in English and the Sylheti dialect of Bengali.
4. Made available by Michael Coleman at University College London.

References

CARAMAZZA, A. and HILLIS, A., 1990, Where do semantic errors come from? *Cortex*, **26**, 95–122.

CROFT, S., MARSHALL, J. and PRING, T., 2006, Assessing noun naming impairments in bilingual aphasia. *Brain and Language*, **99**, 13–14.

DE GROOT, A. M. B. and KROLL, J. F., 1997, Introduction and overview. In A. M. B. de Groot and J. F. Kroll (eds), *Tutorials in Bilingualism: Psycholinguistic Perspectives* (Mahwah, NJ: Lawrence Erlbaum Associates), pp. 1–16.

DIJKSTRA, T. and VAN HEUVEN, W. J. B., 2002, The architecture of the bilingual word recognition system: from identification to decision. *Bilingualism: Language and Cognition*, **5**, 175–197.

DREW, R. L. and THOMPSON, C. K., 1999, Model-based semantic treatment for naming deficits in aphasia. *Journal of Speech Language and Hearing Research*, **42**, 972–989.

EDMONDS, L. and KIRAN, S., 2006, Effects of semantic naming treatment on crosslinguistic generalisation in bilingual aphasia. *Journal of Speech, Language and Hearing Research*, **49**, 729–748.

FILLINGHAM, J., SAGE, K. and LAMBON RALPH, M., 2005, Further explorations and an overview of errorless and errorful therapy for aphasic word-finding difficulties: the number of naming attempts during therapy affects outcome. *Aphasiology*, **19**, 597–614.

FILLINGHAM, J., SAGE, K. and LAMBON RALPH, M., 2006, The treatment of anomia using errorless learning. *Neuropsychological Rehabilitation*, **16**, 129–154.

FRANCIS, W. and KUCERA, H., 1982, *Frequency Analysis of English Usage: Lexicon and Grammar* (Boston, MA: Houghton Mifflin).

GALVEZ, A. and HINCKLEY, J., 2003, Transfer patterns of naming treatment in a case of bilingual aphasia. *Brain and Language*, **87**, 173–174.

GREEN, D., 1986, Control, activation and resource: a framework and a model for the control of speech in bilinguals. *Brain and Language*, **27**, 210–223.

HERMANS, D., BONTGAERTS, K., DE BOT, K. and SCHRUDER, R., 1998, Producing words in a foreign language: can speakers prevent interference from their first language? *Bilingualism: Language and Cognition*, **1**, 213–229.

HICKIN, J., BEST, W., HERBERT, R., HOWARD, D. and OSBORNE, F., 2002, Phonological therapy for word finding difficulties: a re-evaluation. *Aphasiology*, **16**, 981–999.

HOWARD, D., PATTERSON, K., FRANKLIN, S., ORCHARD-LISLE, V. and MORTON, J., 1985, The treatment of word retrieval deficits in aphasia: a comparison of two therapy methods. *Brain*, **108**, 817–829.

HOWARD, D. and PATTERSON, K. E., 1992, *Pyramids and Palm Trees* (Bury St. Edmunds: Thames Valley Test Company).

KAY, J., LESSER, R. and COLTHEART, M., 1992, *The Psycholinguistic Assessment of Language Processing in Aphasia* (London: Lawrence Erlbaum Associates).

KOHNERT, K., 2004, Cognitive and cognate based treatments for bilingual aphasia: a case study. *Brain and Language*, **91**, 294–302.

KROLL, J. F. and DIJKSTRA, T., 2002, The bilingual lexicon. In R. Kaplan (ed.), *The Oxford Handbook of Applied Linguistics* (Oxford: Oxford University Press), pp. 301–321.

KROLL, J. F. and STEWART, E., 1994, Category interference in translation and picture naming: evidence for asymmetric connections between bilingual memory representations. *Journal of Memory and Language*, **33**, 149–174.

LOWELL, S., BEESON, P. and HOLLAND, A., 1995, The efficacy of semantic cueing procedures on naming performance on adults with aphasia. *American Journal of Speech–Language Pathology*, **4**, 109–114.

MENNEN, I. and STANSFIELD, J., 2006, Speech-and-language therapy service delivery for bilingual children: a survey of three cities in Great Britain. *International Journal of Language and Communication Disorders*, **41**, 635–652.

NICKELS, L. and BEST, W., 1996, Therapy for naming disorders (part 2): specifics, surprises and suggestions. *Aphasiology*, **10**, 109–136.

PARADIS, M. and LIBBEN, G., 1987, *The Assessment of Bilingual Aphasia* (Hillsdale, NJ: Lawrence Erlbaum Associates).

RAYMER, A., THOMSON, C., JACOBS, B. and LE GRAND, H., 1993, Phonological treatment of naming deficits in aphasia: model based generalisation. *Aphasiology*, **7** [Special issue: 'Cognitive Neuropsychology and Aphasia Treatment: An Opportunity for Applied Research'], 27–53.

ROBERTS, P. M., 2008, Issues in assessment and treatment for bilingual and culturally diverse patients. In R. Chapey (ed.), *Language Intervention Strategies in Aphasia and Related Neurogenic Communication Disorders*, Fifth Edition (Baltimore, MD: Lippincott Williams & Wilkins), pp. 245–275.

ROBERTS, P. M., GARCIA, L. J., DESROCHERS, A. and HERNANDEZ, D., 2002, English performance of proficient bilinguals adults on the Boston Naming Test. *Aphasiology*, **16**, 635–645.

ROSE, M., DOUGLAS, J. and MATYAS, T., 2002, The comparative effectiveness of gesture and verbal treatments for a specific phonologic naming impairment. *Aphasiology*, **16**, 1001–1030.

ROYAL COLLEGE OF SPEECH AND LANGUAGE THERAPISTS (RCSLT), 2003, *Standards for Working with Speech-and-Language Therapy Support Practitioners* (London: RCSLT).

SASANUMA, S. and PARK, H. S., 1995, Patterns of language deficit in two Korean–Japanese bilingual aphasic patients: a clinical report. In M. Paradis (ed.), *Aspects of Bilingual Aphasia* (Oxford: Pergamon), pp. 111–122.

WATAMORI, T. and SASANUMA, S., 1978, The recovery process of two English–Japanese bilingual aphasics. *Brain and Language*, **6**, 127–140.

WEI, L., 2000, Dimensions of bilingualism. In L. Wei (ed.), *The Bilingualism Reader* (London: Routledge), pp. 3–25.

WIENER, D., OBLER, L. K. and TAYLOR-SARNO, M., 1995, Speech/language management of the bilingual aphasic in a U.S. urban rehabilitation hospital. In M. Paradis (ed.), *Aspects of Bilingual Aphasia* (Oxford: Pergamon), pp. 37–56.