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The effects of decreasing and increasing cue therapy on improving naming speed and accuracy for verbs and nouns in aphasia

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Background: Verb impairments in aphasia have generated considerable theoretical interest in the literature (Druks, 2002; Druks & Masterson, 2003; Marshall, 2003) but this is not reflected in the number of studies investigating therapies for verb impairments (Conroy, Sage, & Lambon Ralph, 2006). Recent anomia therapy studies have compared errorless and errorful techniques (Abel, Schultz, Radermacher, Willmes, & Huber, 2005; Fillingham, Hodgson, Sage, & Lambon Ralph, 2003; Fillingham, Sage, & Lambon Ralph, 2005a, 2005b, 2006). Decreasing cues have been proposed as the optimal interaction of low error and sustained effort in therapy in the amnesia literature (Komatsu, Mimura, Kato, Wakamatsu, & Kashima, 2000). Following on from Conroy, Sage, and Lambon Ralph (2008), we predicted that decreasing cue therapy would result in greater effects in terms of both naming accuracy and speed relative to increasing cues.
Aims: The present study aimed to answer the following questions: (1) Would naming therapy consisting of decreasing cues result in greater naming accuracy for verb and noun targets than therapy consisting of increasing cues? (2) Would decreasing cues result in speedier naming responses to verb and noun targets than increasing cues?
Methods & Procedures: A case-series study that utilised decreasing versus increasing cues as naming therapy for verbs and nouns was implemented with seven participants with aphasia of various sub-types and degrees of severity. A total of 120 target words were collated for each participant, divided into three sets, each consisting of 20 verbs and 20 nouns. Set A was used in decreasing cues therapy, set B in increasing cues therapy, and set C served as control items. Ten sessions of therapy were delivered to each therapy set concurrently. The speed of post-therapy naming responses as well as accuracy was recorded.
Outcomes & Results: All participants showed significant therapy gains after both decreasing and increasing cue therapies, with little or no change in naming of control sets. The two therapies were equivalent in the degree to which participants improved in naming accuracy and yielded almost identical overall speed of naming responses. Naming speeds for successfully named items, post-therapy, were faster for nouns than verbs (perhaps reflecting their shorter length), and faster at immediate than follow-up assessment.
Conclusions: Decreasing cues are as effective in naming therapy as increasing cues, in terms of both accuracy and speed of naming for verbs and nouns.

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Keywords: Anomia; Cueing; Verbs; Nouns; Therapy.

The theoretical literature on verb impairments has provided a rich set of findings about the nature of verbs, which could directly inform therapy studies (Conroy, Sage, & Lambon Ralph, 2006). Yet there have been relatively few published verb, as opposed to noun, naming therapy studies in the aphasiological literature. This may reflect the fact that verb processing is more dependent on morphological and syntactic levels of linguistic processing, as well as phonology and semantics even at the level of single-word action naming. Nouns, therefore, serve as a more clear-cut focus of attention for naming therapies. Aside from morphology, verb and noun differences are often ascribed to either syntactic or semantic sources. However, Black and Chiat (2003) argued that the distinction between nouns and verbs cannot be reduced to either syntax or semantics alone. Rather they described the distinction as "a continuum or convergence of properties at the conceptual-semantic and phonological levels" (p. 231). Typically, these distinctions reflect relatively higher linguistic and cognitive demands in verb as opposed to noun processing. These factors suggest that verbs may be inherently more difficult as therapy targets for many people with aphasia.

The limited number of verb-related studies have either compared verb against noun therapies (Pashek, 1998; Raymer et al., 2008; Wambaugh, Doyle, Martinez, & Kalinyak-Fliszar, 2002; Wambaugh et al., 2001) or examined the effects of verb therapy on related skills such as sentence production (Edwards, Tucker, & McCann, 2004; Marshall, Pring, & Chiat, 1998; Mitchum & Berndt, 1994; Raymer & Ellsworth, 2002). All of these studies found little or no generalisation from treated to untreated verbs. Three studies concluded that verb therapy was beneficial for their participants with regard to sentence production (Edwards et al., 2004; Marshall et al., 1998; Raymer & Ellsworth, 2002), while one did not (Mitchum & Berndt, 1994). A further distinct group of studies focused on verb and argument structure therapies (Fink, Martin, Schwartz, Saffran, & Myers, 1992; Murray & Karcher, 2000; Schneider & Thompson, 2003; Webster, Morris, & Franklin, 2005). These differed from verb-naming studies in that they trained production of verbs and key nouns in sentences; in other words, the verb and its argument structure. A recent study examined the effects of verb training through sentence production therapy including direct treatment of specific verb forms to ensure correct grammatical expression of tense and person agreement (Bastiaanse, Hurksmans, & Links, 2006). The study reported positive therapy gains on the sentence construction subtest of the Aachen Aphasia Test (Weniger, Willmes, Huber, & Poeck, 1981) and on measures of functional verbal communication. Finally, the effects of gesture facilitation as a treatment method for verb naming have also been investigated. This intervention was based on the link between semantic knowledge for verbs and actions (Druks, 2002). Positive treatment effects were found, with gesture-plus-verbal facilitation proving more effective than verbal facilitation for only one participant (Pashek, 1998), and as effective as semantic-phonologic treatment in four participants (Rodriguez, Raymer, & Gondalez Rothi, 2006).

Potential treatment implications have emerged from theoretical accounts of verb impairments. A full review of cueing-based therapies (the method used in this study) is beyond the scope and focus of this paper but excellent reviews can be found

elsewhere (Nickels, 2002). More specifically, however, the notion of minimising errors in the therapy process has been investigated recently in noun-naming studies (Fillingham et al., 2005a, 2005b, 2006). Given the relatively high cognitive and language demands of verb processing (see above), minimising errors during therapy could be particularly helpful. In recent years, there have been a growing number of studies investigating the efficacy of errorless learning for aphasia therapy, particularly for aphasic word-finding difficulties. A series of studies by Fillingham and colleagues found that errorless therapy was as effective as increasing, hierarchical cueing (errorful) therapy (Fillingham et al., 2005a, 2005b, 2006). Other contemporaneous studies found that errorful therapy may be more effective in some cases (Abel et al., 2005).

Direct comparison between these studies reveals that there were differences in the therapy methods and that these might be the root of the variation in results. Fillingham et al. used a relatively "pure" form of errorless learning by presenting participants with object pictures together with both their phonological and orthographic word forms, and requesting immediate repetition (with the participants selected to have minimal repetition impairment). Even this technique was not completely pure, as a few errors inevitably occurred. In contrast, Abel et al. compared increasing cues in therapy (hierarchical cueing, starting with the more minimal cue first) against decreasing cues (starting with whole word repetition but reducing the quantity of cues through therapy, thereby allowing more errors to emerge). Abel et al. predicted that decreasing cues might have been more beneficial for participants with severe naming disorders in that it prevented them from producing such frequent errors. However, their results showed no participant improving only in the decreasing cues condition, some who showed positive effects with both increasing and decreasing cues, and several participants who showed positive effects with increasing cues only. This led Abel et al. to conclude that "patients with aphasia do not seem to be hampered by their own errors" (2005, p. 845).

More recently, McKissock and Ward (2008) contrasted three treatment conditions (errorless, errorful with feedback, and errorful) and found that the latter treatment, in which participants were encouraged to guess at a picture name but were not given the correct target word, was not significantly different from a no-treatment condition. At the same time, errorless and errorful with feedback treatments (in which guesswork was followed by correct naming being confirmed or the correct name being given) were as effective as one another in improving naming. McKissock and Ward noted that it is important to clarify terms such as "effort" and "feedback" in the context of errorless learning, which can encompass a range of techniques that may differ in subtle but important ways. Effort here refers to both the demands of the task, the degree of engagement, and strategic thinking on the part of the participant in errorless therapy.

Further consideration of the role of effort in errorless learning can be found in the amnesia literature. Komatsu et al. (2000) speculated that there may be a potential trade-off between low error and high effort in memory rehabilitation, in that both were likely to make a contribution to the effectiveness of treatment. In their study, Komatsu et al. compared four treatments for face–name associations in participants with memory deficits—these were: high error and high effort; low error and high effort; low error and low effort; and high error and low effort. High error and high effort corresponded with the increasing cues treatment used by Abel et al. (2005),

which has been the standard method of cueing in aphasia therapy, starting with more minimal cues and progressing to larger cues if necessary. Low error and high effort corresponded to the decreasing cues treatment used by Abel et al., in which therapy commenced with whole word cues, which are reduced incrementally through therapy if the participant continued to name correctly but increased again if they did not. In this way, this therapy was "error reducing" (Fillingham et al., 2003), in that error production was minimised but it also required sustained effort on the part of the participant as help was gradually reduced. Low error and low effort corresponded with "pure" errorless learning techniques as used in Fillingham et al. (2005a, 2005b, 2006), McKissock and Ward (2007) and Conroy, Sage, & Lambon Ralph (2008); i.e., word repetition in the presence of an object or action picture representing the meaning of the target word. High error and low effort in the Komatsu et al. study referred to a therapy condition in which participants were asked to select the potential target from a set of five written options. This constrained guesswork makes it easy for the participant but increases the likelihood of generating errors. Komatsu et al. hypothesised that the decreasing cues therapy, which combined low error and high effort, would be the most effective of the four treatment conditions, in that decreasing cues therapy represented the optimal trade-off between error and effort. Despite this, Komatsu et al. found an advantage for errorless learning that was not affected by the degree of effort involved. In other words, the "pure" errorless condition resulted in most correct recall of names, while decreasing cues proved the next most effective method.

The role of error and effort was also discussed by Conroy et al. (2008) in the context of their participants' feedback on the experience of taking part in errorless and errorful therapy for verb and noun naming. All participants found the errorless therapy initially engaging and satisfying, as they were being given the chance to practise naming of items that were difficult for them. In contrast, all participants initially found the errorful therapy somewhat frustrating, as it required them to name items they could not. As the therapy sessions progressed, differing reactions emerged from the participants according to their baseline naming skills. For participants with severe naming impairments, they continued to find errorless therapy more satisfying, especially as in many cases these participants did not improve in their naming quickly and the errorful therapy gave them implicit reinforcement of this fact. For participants with more moderate and mild naming impairments, the errorless therapy eventually became needlessly prescriptive and intrusive in the face of their improving naming skills. On the other hand, the hierarchical cueing of the errorful therapy provided more graded support and thus maintained a certain level of challenge throughout the therapy.

A further difference reported by Conroy et al. (2008) between errorless and errorful therapy was the relative time taken to administer the therapies. As errorless therapy avoided trial and error naming, with its inevitable delays, hesitations, and attempts at error repairs, errorless therapy proved quicker to administer within therapy sessions. During the initial sessions the time difference was estimated at approximately 50% longer for errorful therapy (this tended to reduce, as participants improved in naming in the errorful therapy as sessions progressed and as fewer cues were needed). This time allocation difference reflected quicker naming responses on the part of participants in the errorless therapy, as well as more direct and briefer "instructions" on the part of the therapist. As this study investigated naming accuracy scores as the outcome measure, it was not established whether the

consistently speedier naming responses during errorless therapy, compared to errorful therapy, resulted in quicker naming responses as a result of errorless therapy. The time taken for people with aphasia to carry out language tasks such as naming has been a relatively neglected and under-researched concept in the aphasiology literature (Crerar, 2004) and it was a topic we were keen to examine in the present study.

The themes that have emerged from this literature review led us to examine the role of error, effort, and speed in noun- and verb-naming therapy. Specifically, we aimed to contrast decreasing (error-reducing with sustained effort) against increasing (errorful with sustained effort) cue therapies. We hypothesised that decreasing cue therapy would provide the optimal interaction of low error rates, sustained effort, and some degree of implicit feedback as to progress in therapy, which for some participants would further motivate and encourage active engagement in therapy. We also aimed to examine speed of naming responses across the two therapies. Following on from Conroy et al. (2008), we hypothesised that decreasing cue therapy would generate quicker correct naming responses as well. Quicker word retrieval of single words might then be helpful when the participant is attempting word retrieval in connected speech (which requires speed as well as accuracy of production).

METHOD

Participants

Seven participants with chronic aphasia including word retrieval impairment took part in the case-series study. These were seven of a group of nine participants who had previously taken part in a case-series study comparing pure errorless naming therapy against errorful therapy (Conroy et al., 2008). Participants varied in their aphasia symptoms, severity, and time since CVA. All were monolingual English speakers. Participants were recruited from NHS Speech and Language Therapy services within Shropshire, England. Inclusion criteria were devised to ensure the errorless therapy would be viable and also to eliminate the likelihood of spontaneous recovery. Participants had to be at least 6 months post CVA, with no other history of significant neurological illness such as, for example, dementia or multiple sclerosis. Normal or corrected hearing and vision were required. With regard to language skills, two factors were considered: degree of (noun and verb) naming impairment; and word repetition skills. For the former, noun and verb picture items were taken from the Object and Action Naming Battery (Druks & Masterson, 2000). These were 20 nouns and 20 verbs, with each set matched for significant variables including frequency, imageability, and visual complexity (see Appendix). Participants were required to achieve a score between a minimum of 10% (4/40) and a maximum of 90% (36/40). On the word repetition task, which consisted of the first 20 items in PALPA 9 (Kay, Lesser, & Coltheart, 1992), participants were required to score at least 75% correct. This was in order to ensure that the decreasing cue therapy, which required reliable word repetition skills, would be viable and relatively error-free for all participants.

Table 1 shows participants' baseline naming score according to results obtained from the Boston Naming Test (Goodglass, Kaplan, & Barresi, 2001). The BNT was administered without its cueing system, purely as a screen of anomia severity. Also shown in Table 1 are participants' age, gender, handedness, years of education, occupation, months since CVA. In addition, Table 1 contains baseline naming

TABLE 1
Participant profiles including naming scores and error types and description of aphasic symptoms

Participant	*KP*	*PM*	*PO*	*JT*	*IH*	*DR*	*WE*
Age	77	43	61	85	62	66	66
Gender	female	female	male	female	female	male	female
Handedness	right	right	right	right	right	right	right
Number of years education	10	13	13	16	12	13	16
Occupation	Administrator	Secretary	Business Manager	Teacher	Housewife	Engineer	Teacher
Months since CVA	59	55	16	19	20	40	65
Baseline naming of matched noun verb sets (20 N, 20 V)	V=3 N=1	V=3 N=2	V=10 N=8	V=12 N=8	V=14 N=14	V=18 N=16	V=16 N=12
Baseline naming score (BNT: max=60)	0	3	24	28	29	35	40
Error type on BNT							
Semantic	0	4	2	12	4	1	8
Phonological	0	6	2	4	0	1	0
No response	60	47	32	16	27	22	10
Unrelated	0	0	0	0	0	1	2
Description of aphasia	Fluent anomic	Non-fluent	Fluent jargon	Non-fluent	Non-fluent	Fluent anomic	Agrammatic

BNT=Boston Naming Test (Goodglass et al., 2001). Error codes: Semantic=semantic relationship to target. Phonological=more than 50% shared phonology with target. Unrelated=no relationship to target.

TABLE 2
Results of language assessments across participants

Participants:		*KP*	*PM*	*PO*	*JT*	*IH*	*DR*	*WE*	
Assessments:	*Max*								*Normal range*
NAMING									
Objects (OANB)	162	15	25	96	96	125	145	125	n/a
Actions (OANB)	100	6	7	29	36	36	62	59	n/a
PHONOLOGY									
Word Reading	80	28	9	63	46	71	74	77	79–80
Nonword Reading	24	1	0	3	0	13	18	22	n/a
Word Repetition	80	55	**79**	**78**	74	76	66	**80**	78–80
Nonword Repetition	80	34	69	58	48	56	41	72	n/a
SEMANTICS									
P & P	52	42	39	47	40	**52**	**52**	46	49–52
K & D	52	44	47	47	37	**51**	**50**	41	48–52
Syn Judgement	96	73	11	67	65	90	82	73	91–96
N V Comp	100	90	72	90	77	**100**	99	95	100
SWPM	40	**39**	26	**40**	**37**	**40**	**40**	**38**	35–40
WWPM	40	**37**	23	**40**	26	**40**	**39**	**40**	35–40

OANB=Object Action Naming Battery; all phonology subtests taken from PALPA; P & P=Pyramids and Palm Trees Test; K & D=Kissing & Dancing Test; Syn Judgement=Synonym Judgement Test; N V Comp=Noun Verb Comprehension Test; SWPM=Spoken Word to Picture Matching; WWPM=Written Word to Picture Matching; n/a=not available; Underlined and Emboldened scores were within the normal range.

scores in a subset of matched nouns and verbs from the Object Action Naming Battery (Druks & Masterson, 2000; see Appendix). There were no significant differences for any participant on their relative noun–verb naming on these matched sets. However, as a group, there was a naming superiority for verbs, which did reach statistical significance (Ws+=21, 2-tailed, p=.03). Finally, Table 1 contains a description of the participants' aphasic symptoms in connected speech.

Background assessment

Participants underwent comprehensive linguistic and cognitive assessment, the results of which are shown in Tables 2 and 3, respectively.

Assessment of participants' language skills focused on single-word processing skills in the domains of naming, phonology, and semantics.

Naming

The full Object Action Naming Battery (Druks & Masterson, 2000) was used as a measure of verb and noun retrieval.

Phonology

Word and non-word reading and repetition tasks from the PALPA (Kay et al., 1992) were used to assess the integrity of participants' phonological representations:

TABLE 3
Results of cognitive assessments across participants

Participants:			*KP*	*PM*	*PO*	*JT*	*IH*	*DR*	*WE*
Assessments:		*Max*							
CMT (pictures)	Score	30	25	28	30	26	28	30	29
	%ile		4.7	13	100	7.1	15.7	100	37.8
CMT (words)	Score	25	13	21	19	17	25	25	20
	%ile		<2.8	1.9	3.1–6.3	2.8–11.1	100	100	6.3
Rey Copy	Score	36	23	26	34	18	35	36	28
	%ile		<1	<1	>16	<1	>16	>16	2–5
Rey Immediate Recall	Score	36	3	5	11	6	22	20	7
	%ile		1	<1	12	24	86	86	4
Rey Delayed Recall	Score	36	6	7	11	4	22	21	7
	%ile		4	<1	10	8	88	92	3
WCST: no of categories	Score	6	2	1	5	0	2	3	3
	%ile		>16	2–5	>16	11–16	6–10	>16	>16
WCST: items to 1st cat	Score	0	21	27	14	94	28	26	20
	%ile		>16	2–5	11–16	>16	6–10	>16	6–10
TEA: elevator counting	Score	7	7	4	5	4	5	7	7
TEA: elevator counting distractions	Score	10	2	0	7	3	1	5	2
	%ile		5	1	10–25	5–10	1	10–23	5
Self-monitoring of naming	%	100	100	90	66	80	100	100	100

CMT=Camden Memory Test; Rey Complex Figure Test – Copy subtest; Rey Complex Figure Test – Immediate Recall subtest; Rey Complex Figure Test – Delayed Recall subtest; WCST=Wisconsin Card Sorting Test; TEA=Test of Everyday Attention.

- Imageability by frequency word reading (PALPA 31).
- Non-word reading (PALPA 36).
- Auditory word repetition: Imageability by frequency (PALPA 9).
- Auditory non-word repetition (PALPA 9).

Semantic memory and comprehension of nouns and verbs

- The three-picture version of the Pyramids and Palm Trees Test (Howard & Patterson, 1992). This test required participants to match pictures on the basis of semantic relatedness; e.g., for a *pyramid*, the participant should select a *palm tree* and not a *fir tree*.
- The three-picture version of The Kissing and Dancing Test (Bak & Hodges, 2003). This test resembles the Pyramids and Palm Trees Test in its format but uses action instead of object pictures. The participant is required to match actions on the basis of semantic similarity; e.g., for *kissing*, the participant should select *dancing* and not *running*.
- The Synonym Judgement Test (Jefferies, Patterson, Jones, & Lambon Ralph, 2008) was used to detect milder forms of semantic impairment. This test required participants to match words (presented in written and spoken form) on the basis of semantic relatedness; e.g., for *rogue*, the participant should select *scoundrel*, and not *polka* or *gasket*. Probe, target, and foils within each trial are matched for frequency and imageability, and these factors are varied across trials to produce an orthogonal manipulation of the two variables (high vs low frequency; low, medium, and high imageability).
- The Noun Verb Comprehension Test is an adapted version of a comprehension test supplementary to the Object Action Naming Battery (Druks & Masterson, 2000). This spoken word-to-picture matching test contains 50 noun and 50 verb targets. Target items are presented alongside four semantic-related and one unrelated pictures (e.g., UMBRELLA: *raining*, *roof*, *hat*, *bucket* or *plug*; POURING: *kettle*, *dripping, stirring, dropping* or *yawning*.)
- Spoken word to picture matching (PALPA 47) (Kay et al., 1992). This test consists of five pictured items in an array: one target, one close semantic distractor, one distant semantic distractor, a visually related distractor, and an unrelated distractor. For example, for the target *stamp*, the distractors are *envelope*, *pen*, *picture*, and *paint*, respectively.
- Written word to picture matching (PALPA 48) (Kay et al., 1992). The same test as PALPA 47, except that the probe word is presented in written rather than spoken form.

Assessment of participants' cognitive skills included measures in the domains of memory, executive and attention skills, and self-monitoring of naming.

Memory

- The picture and written word subtests from the Camden Memory Tests (Warrington, 1996). In the picture version, participants looked at a set of composite scenes and decided whether each one had been taken by an amateur or professional photographer. Participants then looked at a set of three photographs

and decided which one they had previously seen. For the written word recognition task, participants read written words appearing on a set of cards, one word per card. Participants then decided which words they had already seen from sets of multiple word lists.

- Copy, immediate and delayed recall parts of the Rey Complex Figure Test (Meyers & Meyers, 1995). This test required participants to copy a complex geometric figure, then to draw this figure from memory 5 minutes later, and then again 30 minutes later.

Executive and attention skills

- The Wisconsin Card Sorting Test (Grant & Berg, 1993) was used to assess aspects of executive functioning such as cognitive flexibility and problem solving. This test examined participants' ability to formulate rules with which to match cards on the basis of shape, colour, or number, and then to shift to different rules as the test progressed. We looked at two measures: number of items to first category, which was the number of guesses a participant made before they had worked out the "rule" for matching cards; and the number of categories, which was the number of times the participant both worked out and maintained the application of a matching rule. This latter measure can be particularly useful in detecting perseveration where a participant has worked out one rule successfully but cannot shift from this as required.
- Two subtests from the Test of Everyday Attention (TEA) (Robertson, Ward, Ridgeway, & Nimmo-Smith, 1994) were used: "elevator counting", which requires sustained attention, and "elevator counting with distraction", which requires divided attention. Elevator counting requires participants to listen to and count a set of tones at random time intervals from 1 to several seconds apart. Elevator counting with distraction requires participants to listen to sets of tones but to count only the low pitch ones while ignoring the high pitch ones. Written numbers were provided in both tasks to avoid problems in verbal number naming.

Skills in self-monitoring of naming

We assessed participants' reliability in judging the accuracy of their own naming by asking them to judge their own response as correct or incorrect. A subset of 50 nouns and 50 verbs from the Object Action Naming Battery (Druks & Masterson, 2000) was used for this task. Participants rated those items for which they made a response (correct or commission error). Table 4 shows the number of items (out of 100) on which each participant made their self-monitoring decisions.

Participant profiles and summary of assessment findings

KP was a 77-year-old widow who lived alone. She did not present with physical disabilities following the CVA she sustained 5 years prior to entering the study. Socially KP would become embarrassed by her difficulties in communication and was very withdrawn, although she attended a monthly stroke support group. Expressively KP was fluent in that she used intact sentence structure with appropriate pronouns and semantically "light" verbs such as "do", "go", "have",

TABLE 4
Self-monitoring of naming: Percentage correct and number of items on which self-monitoring was carried out

Participants:		*KP*	*PM*	*PO*	*JT*	*IH*	*DR*	*WE*
Assessments:	*Max*							
% correct in self-assessment	100	100	90	66	80	100	100	100
Correct		10	13	59	51	39	80	73
Commission errors		34	45	28	33	15	10	18
Trials on which self assessment made		44	58	87	84	54	90	91

but was profoundly anomic, so her utterances were invariably interrupted by failures in word finding. Her attempts to express herself tended to result in frustrated comments on the difficulty of her speech. KP was highly motivated to take part in therapy and showed good sustained attention in therapy tasks. Assessment confirmed that KP was severely naming impaired, with marked deficits in phonological as well as semantic processing. The cognitive assessments indicated some degree of memory impairment, as well as impairments in problem solving and divided attention. KP's self-monitoring of naming was at ceiling, which was consistent with her frequent attempts to self-correct her speech.

PM was a 43-year-old woman who had suffered an embolic CVA following a road traffic accident 4½ years prior to participating in the study. She lived with her partner on whom she was very dependent for practical and physical support, given her dense right-sided hemiplegia. Socially PM saw a small number of long-term friends but mostly spent time with her partner. Her communication skills were severely impaired with regard to verbal expression, comprehension, reading, and writing. She often expressed confusion as to what had been said to her. Expressively PM used a limited range of single words and set phrases effectively but frequently struggled to express herself. She presented with non-fluent speech containing single words without a sentence frame. Motivationally PM was keen to take part in the study but found the assessment and therapy sessions difficult in terms of concentration. Assessment confirmed PM's severe word-finding difficulties alongside mixed deficits in phonological and semantic processing. Cognitive assessment suggested impairment across all domains including self-monitoring of naming.

PO was a 61-year-old retired businessman who lived with his wife. He had suffered a CVA 16 months prior to commencing in the study. PO had some physical disabilities, particularly some right-sided weakness, but walked independently although he required some help with activities of daily living. Socially PO was an outgoing man, who did not allow his communication difficulties to change his relationships. He displayed good everyday comprehension of speech. Expressively, he displayed moderate impairment: fluent output characterised by some intact speech followed by unmonitored use of neologisms and multiple unsuccessful attempts to self-correct phonological errors. He was highly motivated to take part in both the assessment and therapy phases of the study, and was able to sustain concentration in therapy tasks. Assessment indicated that PO had moderate word-finding difficulties. Impairment was evident in phonological processing skills.

Cognitive assessment suggested some memory impairment but with intact attention and executive skills. Self-monitoring of naming was impaired (66% correct).

JT was an 85-year-old lady who lived with her husband. She had some physical disability following the CVA she sustained 2 years prior to taking part in the study. JT mobilised with the aid of a walking frame and was dependent on carers for help with activities of daily living. Socially JT saw a limited number of people including family members. Communicatively she presented with reliable comprehension and very obvious difficulty in expressing herself, with marked phonological problems and a non-fluent pattern of single words or sentence fragments. JT was happy to take part in the study and displayed excellent attention and concentration in therapy tasks. Assessment confirmed JT's moderate word-finding difficulties as well as some degree of impairment of phonological and semantic processing. Beyond language, JT had additional deficits in all cognitive domains tested, including self-monitoring of naming.

IH was a 62-year-old lady who lived with her husband. She had sustained a CVA 20 months prior to participating in the study, following which she had had severe physical disability with a right-sided hemiplegia. She used an electric wheelchair independently. Socially IH had become somewhat withdrawn but this was related more to her physical than communication disability. Communicatively IH had good comprehension skills but moderately non-fluent speech marked by occasional word-retrieval delays or failures. She would then initiate a strategy of finger-spelling on her hand in order to self-cue in these instances, which was often successful but very time consuming. IH was highly motivated and able to take part in assessment and therapy sessions. Assessment indicated moderate-to-mild word-finding difficulties, with impairments in phonological processing. Cognitive assessment suggested intact cognitive skills, with the exception of divided attention. Self-monitoring of naming was also reliable.

DR was a 66-year-old retired engineer who lived with his wife. He had retired when he suffered a CVA 3 years prior to commencing in the study. This left no lasting physical disabilities, although DR did still experience marked episodes of fatigue and physical discomfort. Communicatively DR had no verbal comprehension problems and was mildly impaired expressively with occasional word retrieval delays typically caused by phonological errors. DR was highly motivated and able to take part in assessment and therapy sessions. Assessment confirmed DR to have mild impairments in naming and phonological and semantic processing. Cognitive assessment suggested broadly intact skills across domains, with the possible exception of problem solving and flexible thinking.

WE was a 66-year-old woman who lived alone. She suffered a CVA related to cardiac surgery 5 years before taking part in this study. This left WE with severe physical disabilities and she used a walking frame and electric wheelchair to mobilise. Despite this, and marked communication problems, WE continued to run her own business. Communicatively she displayed no problems in verbal comprehension, reading, and writing but was clearly impaired expressively. WE was agrammatic in speech output with non-fluent sentence fragments or single words used typically without morphological endings. Despite this her word retrieval skills were only mildly impaired, although these could get worse as she became frustrated with the effort to communicate. WE was keen to take part in the study and did so successfully, although she frequently found therapy sessions tiring and laborious. Assessment confirmed WE's mild deficits in naming and phonological and semantic processing. Cognitive assessment pointed to some degree of impairment in memory, attention, and executive domains but with intact self-monitoring of naming.

Therapy methods

Following assessment participants received 10 sessions (twice weekly for 5 weeks) of decreasing cue therapy and increasing cue therapy for noun and verb targets in parallel, i.e., both therapies were conducted concurrently in all therapy sessions. The alternative to this parallel-administration design was sequential administration of the separate therapies. We were concerned about the possibility of factors such as reduced motivation as therapy progressed, or any unpredicted events affecting participants at one time point in the study, acting as a potential confounds in the comparison of therapies if one occurred after the other. Also, Fillingham et al. (2006) initially used sequential administration of errorless and errorful methods but found identical results in later studies that used parallel administrations of the therapies (Fillingham et al., 2005a, 2005b). Although, some studies have found that priming effects can have a facilitatory or inhibitory effect on naming of a limited set of phonological or semantically related items (Schnur, Schwartz, Brecher, & Hodgson, 2006), there were two factors that made this unlikely in the present study. First, there was a relatively large set of therapy items undergoing naming practice in therapy sessions: 40 items in decreasing cue therapy, 40 items in increasing cue therapy. Also, these 80 items were not selected to be phonologically or semantically related to each other but instead reflect an unrestricted selection from the items in the Object and Action Naming Battery for each participant (see next section).

Verb and noun therapy targets

The primary outcome measures in the study were naming accuracy and speed. Three sets of target items were selected for each participant. Items that a participant had consistently failed to name three times were selected from the naming tests, particularly the Object and Action Naming Battery (Druks & Masterson, 2000) as this details the psycholinguistic properties of the words in this battery very comprehensively. A total of 120 failed items were collated for each participant. Where a participant had not failed a sufficient number of the items from the Object and Action Naming Battery, items from other naming tests were used: the action naming subtest from the Verb and Sentence Test: VAST (Bastiaanse, Edwards, Maas, & Rispens, 2003) for verbs, and the Boston Naming Test for nouns (Goodglass et al., 2001). These 120 failed items were divided into three sets, each consisting of 40 words: 20 nouns and 20 verbs. Set A were the targets for decreasing cue therapy, set B for increasing cue therapy, and set C was reserved as a control set. The sets were matched for key psycholinguistic variables such as length (number of phonemes), imageability, frequency, and word class. However, it was not feasible to match nouns and verbs within each set on these variables, given the systematically lower imageability scores for verbs. The items contained within the matched sets of nouns and verbs (see Appendix) represent the very limited overlap between nouns and verbs for imageability and thus there were no more available for the therapy sets.

Therapies

Both therapies were conducted in each of the therapy sessions. The order of the therapies was counterbalanced; i.e., session 1 would commence with decreasing cue therapy followed by increasing cue therapy; session 2 would commence with increasing cue therapy followed by decreasing cue therapy. Once all of the treatment

targets had been worked through once, the set was repeated again. Each session, therefore, would consist of two picture presentations amounting to 10 naming attempts per word target.

Decreasing cue therapy

This therapy was designed to make naming highly likely to be successful through providing participants with as much information, initially, as possible and then gradually reducing this external support to ensure sustained effort *and* continued success in naming with as few naming errors as possible. The external support was a five-stage cueing hierarchy, which consisted of the following:

1. Picture plus its written and spoken name given with a request to repeat initially twice, listen again, then three more times.
2. Picture plus a substantial grapheme and phoneme cue (CV in CVC words; a CVC cue was given for bisyllabic words).
3. Picture plus a minimal grapheme and phoneme cue (C in CVC words; CV cue for bisyllabic items).
4. Picture plus a semantic cue in the form of brief definition of action or object.
5. Picture only.

Cue level 3 at the phonemic level was an initial consonant prompt only. We were aware that, with the exception of the nasal consonants /m/ and /n/, it is not feasible to produce other consonants such as /p/ or /t/ without a following vowel. On a practical level this prompt was delivered as the consonant followed by a whispered schwa vowel /ə/.

Each participant's success in naming was tracked during each session. The second presentation of each picture in each session tended to be more successful than the first in the session, so this was taken as primed naming and did not trigger any decreases in cue. Changes in cue level over the sessions were triggered by success or otherwise in naming in the first presentation in each session using an asymmetric "staircase" method. This means that the cue was reduced when there was considerable evidence of successful naming at the current cue level but was increased again after only one failed naming attempt (in order to balance minimising errors against reducing the cue to maintain effort). The rubric we adopted was as follows: a participant needed to name the item correctly with the current cue throughout the whole session before the cue was reduced in the next session. If an error occurred at any time during a session then the cue was increased for the remainder of that session. For example, if in session 1 an item was named accurately 10 times at cue 1, then in session 2 cue 2 would be used. If cue 2 failed on the first naming attempt, then we returned to cue 1, and if the item was then named it was then repeated a further three times, making the failed naming trial just one in five (thus minimising errors). Following this, in the second picture presentation of session 2, we would continue with cue 1. We would then start at cue 2 again, in the first naming trial of session 3, etc.

Increasing cue therapy

This therapy consisted of the same five-stage cueing hierarchy as in the decreasing cue therapy but in reverse order. This therapy was designed to allow the participant

to attempt naming and providing cues until the participant named the item successfully. Thus the five-stage cueing hierarchy consisted of the following:

1. Picture only.
2. Picture plus a semantic cue in the form of brief definition of action or object.
3. Picture plus a minimal grapheme and phoneme cue (C in CVC words; CV cue for bisyllabic items).
4. Picture plus a substantial grapheme and phoneme cue (CV in CVC words; a CVC cue was given for bisyllabic words).
5. Picture plus its written and spoken name given with a request to repeat initially twice, listen again, then three more times.

In both therapies five naming attempts were made for each picture, thus controlling for overall exposure and naming attempts across the two interventions. The cueing method used in both therapies is a "staircase method" where the participant steps up or down according to their performance for each item during the therapy. In the case of the increasing cue therapy, however, many more of these naming attempts would result in erroneous naming while the reducing cues would keep the rate of errors much lower.

Post-therapy assessments

Post-therapy naming of the verbs and nouns in all three sets was assessed at 1 week post-therapy (immediate results) and then 5 weeks later (follow-up results). Speed as well as accuracy of naming was measured from digital recordings of the participants' naming responses. Goldwave software was used to measure the time from the onset of the picture to the end of the participant's utterance. We opted for the end of the word as opposed to the start so as to include misnamings or false starts. This method gave us precise timings for the items that the participants successfully named.

RESULTS

We first analysed the data at the group level and then tested for the same effects in each individual participant's data. The post-therapy data (immediate and follow-up assessment) were analysed with a three-way ANOVA. This showed one main effect of word class: global mean noun performance=14.2/20 (*SD* 3.9) vs mean verb performance=12.1/20 (*SD* 4.7), $F(1, 8)=9.9$, $p=.02$. There was no significant effect of therapy type—global mean decreasing cue naming score=13.3/20 (*SD* 4.8) vs mean increasing cue naming score=13.0/20 (*SD* 3.6): $F(1, 8)=0.214$, $p=.66$—or of time of testing—global mean immediate post-therapy naming score=13.5/20 (*SD* 4.5) vs follow-up naming score=12.8/20 (*SD* 4.1): $F(1, 8)=1.294$, $p=.299$. There was a trend towards a borderline interaction between therapy and word class $F(1, 8)=3.644$, $p=.105$.

The results are described in five sections:

1. Overall therapy effects for treated and untreated words at both post-therapy assessment points.
2. Results for decreasing and increasing cue therapies.
3. Results for verb versus noun naming.
4. Speed of naming.

5. Factors predicting therapy gains.

Overall therapy effects for treated and untreated words at immediate and follow-up assessments

Figure 1 shows the naming results for the treated words in sets A (decreasing cue therapy), B (increasing cue therapy), and C (control). For all results the participants have been ordered according to baseline naming accuracy, with the most severely impaired on the left and least impaired on the right. The baseline for the verbs and nouns in sets A, B, and C was zero as all of these items had been failed consistently in pre-therapy assessment (and so is not shown in any of the figures in order to simplify them). All participants made statistically significant improvements in their naming of treated items at both assessment points, immediate and follow-up (McNemar 1-tailed, $p \leqslant .002$ for all participants). Four participants showed decreases in naming accuracy between the two assessment points, which were statistically significant for three participants (JT: McNemar 1-tailed, $p = .0002$ IH: McNemar 1-tailed, $p = .003$; and DR: McNemar 1-tailed, $p = .01$). One participant, PO, showed a significant increase in accuracy between immediate and follow-up assessment (McNemar 1-tailed, $p = .01$). Participants' naming of the control items showed no change from the baseline of 0 for three participants, and showed minimal improvement of between two and four items for four participants. None of these changes in accuracy were statistically significant.

Naming results across decreasing and increasing cue therapies

The immediate results for decreasing and increasing cue post-therapy are shown in Figure 2 and the follow-up results in Figure 3. There were no statistically significant differences between the results across the two therapies for any individual participant.

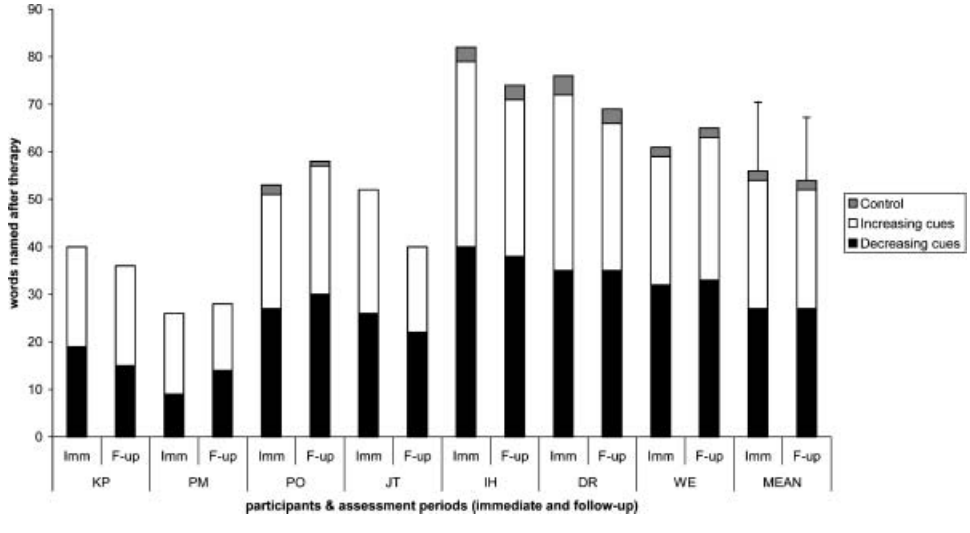

Figure 1. Total therapy effects across sets.

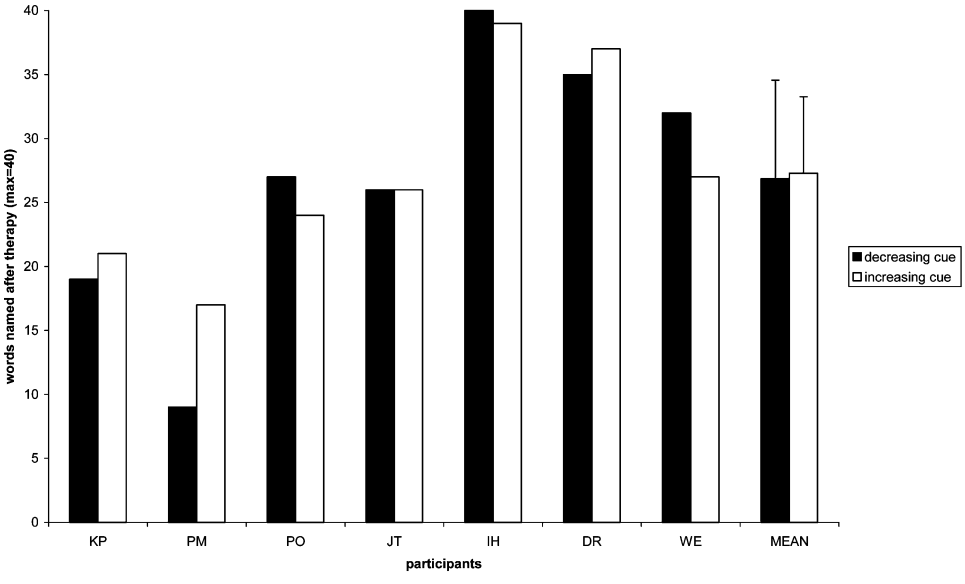

Figure 2. Naming results for decreasing and increasing cue therapies (immediate assessment).

Naming results across verbs and nouns

Figure 4 shows the immediate post-therapy naming results split by word class (nouns versus verb) and collapsed across therapies. As at immediate assessment, the most naming-impaired participant at baseline KP showed a statistically significant difference between noun and verb naming post-therapy in favour of noun naming ($\chi^2=4$, $df=1$, $p=.046$). At the follow-up assessment (Figure 5) two participants showed a similar noun benefit in naming therapy items: these were PM, again one of

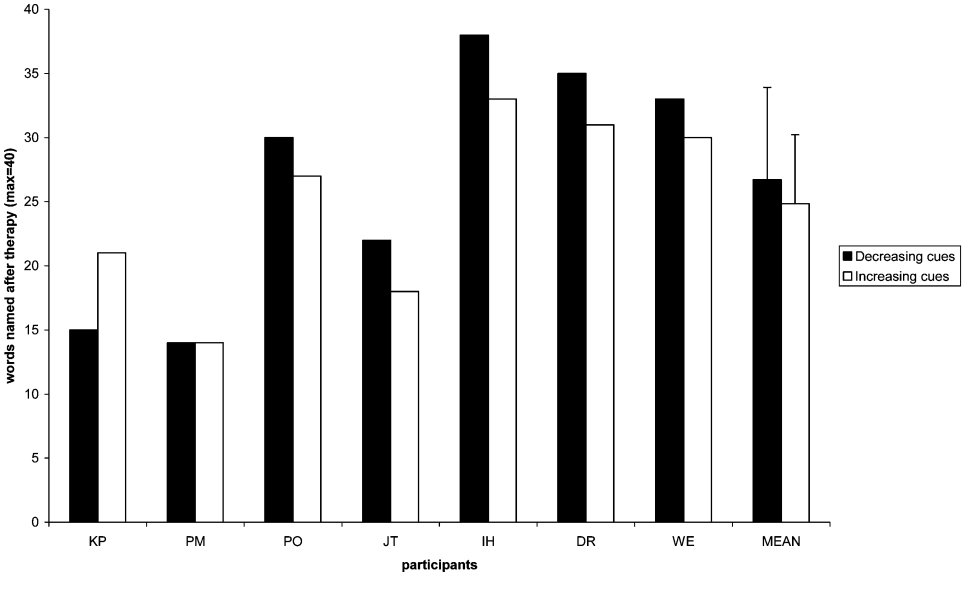

Figure 3. Naming results for decreasing and increasing cue therapies (follow-up assessment).

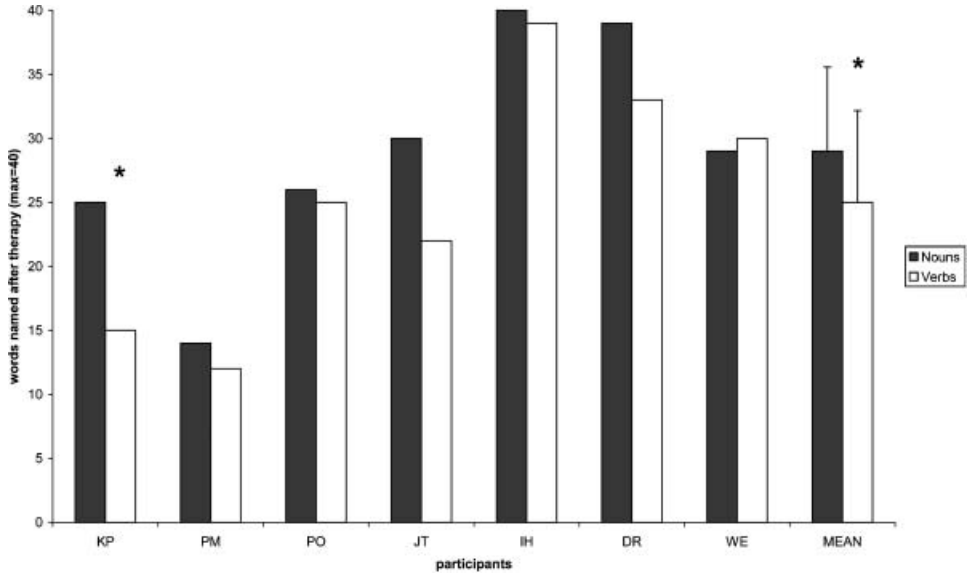

Figure 4. Nouns and verbs named at immediate assessment.

the more severely naming impaired participants ($\chi^2=4.39$, $df=1$, $p=.036$), and DR, one of the least naming impaired participants at baseline ($\chi^2=5.19$, df=1, $p=.023$). In a group analysis, noun naming was significantly better than verb naming across both assessment points (immediate assessment: Ws+=26, 1-tailed, $p=.025$; follow-up assessment: Ws+=19.5, 1-tailed, $p=.037$). Given that it was impossible to match nouns and verbs for imageability and other psycholinguistic factors, these differences could either reflect a true part-of-speech effect or the influence of imageability, etc.

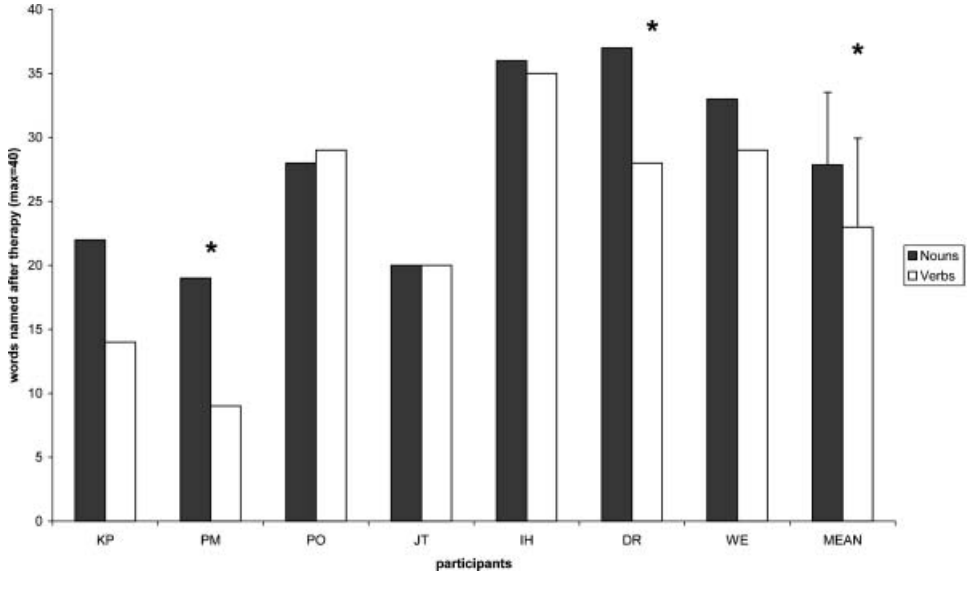

Figure 5. Nouns and verbs named at follow-up assessment.

Speed of naming

The speed of correct naming responses was analysed with a three-way, by-participants ANOVA (factors: therapy type, time of testing, word class). In line with the accuracy measures (see above), there was no effect of therapy type (increasing or decreasing cues) on naming times, nor any interactions with the other factors. There was a main effect of time of testing: global mean response time at immediate assessment=4.3 seconds (*SD* 2.0) vs mean response time at follow-up assessment=5.5 seconds (*SD* 2.2): $F(1, 6)=6.08$, $p=.05$. There was a main effect of word class: global mean response time for nouns=4.3 seconds (*SD* 2.1) vs mean response times for verbs=5.5 seconds (*SD* 2.1): $F(1, 6)=6.58$, $p=.04$. There was also a trend towards an interaction between time and word class, $F(1, 6)=3.94$, $p=.09$. Latencies were analysed for correct responses only, thus potentially altering the balance of phoneme length that had been established across the full set of verbs and nouns. At immediate and follow-up assessments there was a significant difference in the length of the named nouns (mean phoneme length: items named immediately=4.48, $SD=0.60$; items named at follow-up=4.47, $SD=0.52$) and verbs: items named immediately=5.72, $SD=0.30$; items named at follow-up=5.55, $SD=5.55$: $F(1, 6)=49.4$, $p<.001$. There was no significant difference in the length of the items named at immediate or follow-up assessments, $F(1, 6)=4.04$, $p=.09$, nor an interaction, $F(1, 6)=2.34$, $p=.18$. This suggests that the slower overall verb-naming times might have reflected their greater length rather than a word class effect per se. The slowing of successful naming times from immediate to follow-up assessment was not due to any change in length, however.

Factors predicting therapy gains

As noted above, all participants made some gains in noun and verb naming post-therapy. One benefit of a case-series design is that it licenses comparisons of background language and cognitive measures against the therapy outcomes (Fillingham et al., 2005a, 2005b, 2006). Although there are only seven cases available for such analysis, and therefore the power is limited, an exploratory correlation was carried out where the data were collapsed across both therapy types. Comparisons (using Spearman's ρ correlations) looked at possible relationships between the background language and cognitive measures and overall therapy effects for both immediate and follow-up assessment points. Statistically significant correlations are shown in Table 5. These results suggested that the baseline language status (including measures of naming, comprehension, and phonology) was likely to predict the therapy outcome. In addition, performance on the Rey figure (copy and immediate delayed copy) predicted therapy outcome.

DISCUSSION

The present study built on previous findings that had compared errorless and errorful therapy for verb and noun naming in aphasia (Conroy et al., 2008). Here, however, we aimed to retain the benefits of errorless learning while building in some degree of challenge in order to sustain effort and concentration as the therapy progressed. Hence we devised a form of decreasing cue therapy, which commenced as errorless therapy and then attempted to reduce naming cues in a controlled and

TABLE 5
Significant correlations between therapy gains, language and cognitive scores (n=7)

	Total gain immediately post-therapy		*Total gain at follow-up*	
Test	*Spearman's* ρ	*Significance (2-tailed)*	*Spearman's* ρ	*Significance (2-tailed)*
Boston Naming Test	0.786	0.036*	0.821	0.023*
Word reading (PALPA)	0.857	0.014*	0.821	0.023*
Nonword reading (PALPA)	0.793	0.033*		
Pyramids and Palm Trees (3 picture)	0.919	0.003**	0.811	0.027*
Synonym judgements	0.847	0.016*	0.811	0.027*
Noun and verb comprehension	0.937	0.002**	0.883	0.008**
Written word to picture match (PALPA)	0.778	0.039*		
Rey Figure copy	0.786	0.036*		
Rey Figure immediate delay	0.929	0.003**	0.857	0.014*

gradual manner. This was contrasted with a therapy consisting of increasing cues, which represents a more commonly used form of hierarchical cueing. With respect to naming accuracy there were two main findings in this study. First, decreasing cue therapy was as effective as increasing cues in improving naming accuracy for treated items, across our case-series of participants with aphasia. There was no generalisation to untreated items. Post-therapy naming speeds (for successfully treated items) indicated that naming speeds were equivalent for items treated with increasing or decreasing cues. Second, participants made greater numerical gains in noun as opposed to verb naming overall, with statistically significant differences for three participants. This relative noun advantage in naming therapy was also reflected in significantly shorter response times for noun naming at both assessment points.

First, it is worth noting that both therapies provided a positive benefit (all participants' naming improved significantly after both therapies). The number of words they learned was the same irrespective of which therapy was used, matching previous findings from Conroy et al. (2008) and Fillingham et al. (2005a, 2005b, 2006). In those studies, therapy gains were equivalent whether "pure" errorless or errorful therapy techniques were used. In the present study we found similar results for decreasing and increasing cue therapy (the former being an example of an error-reducing rather than purely errorless approach). The primary aim of this study was to produce a decreasing cue therapy in which few errors were made but effort was still sustained. In this way, participants would continue to engage actively in a therapy process that was individually adapted to allow an incremental increase in challenge. All participants who took part in the present therapy study preferred decreasing cue therapy for the very reasons predicted: it made success in naming more likely; episodes of failing to name were very brief; it gradually challenged those who did improve in naming as therapy progressed; and it continued to support those who were not progressing so well in therapy. For example, those who were poorer at self-monitoring (e.g., PO) benefited from having their errors managed externally by this procedure. The decreasing cue therapy was also quicker to administer in therapy sessions, particularly in the earlier stages of therapy when the initial cues in the increasing cue therapy were typically not useful in supporting accurate naming for the participants.

With respect to word-class effects across the therapies, both naming speed and accuracy were important factors when considering differences between verbs and nouns in the present study. In the previous case-series study with these participants (Conroy et al., 2008), a small but significant post-therapy noun advantage (i.e., participants improved more with noun than verb targets) was found for the group as a whole and this was significant individually for some of the more severely naming-impaired participants. In the present study the post-therapy noun-naming advantage in accuracy was evident across participants with both mild and severe degrees of baseline naming impairment. The difference was also found in speed of naming post-therapy, with verbs being named more slowly after therapy than nouns (although this might have reflected the shorter length of successfully named nouns). Overall, the noun–verb naming data from both the previous and present study point to two types of *relative* difficulty in verb naming in aphasia: difficulty in improving in naming during therapy for verbs; and difficulty in retaining these improvements after therapy ceases. The slowing of naming between immediate and follow-up assessment might be a precursor to decreases in accuracy over time. Future studies will be required to test this hypothesis. Finally, we note that the interpretation of these word-class differences should be treated with some caution. None of our participants had shown greater noun- than verb-naming accuracy when the target words were matched for imageability, frequency, and visual complexity (see Table 1). Given that it proved impossible to match the therapy sets on imageability as well as other factors (see Method and Results) this emergent difference between nouns and verbs after therapy might reflect either a true word-class effect or the underlying differences in terms of imageability (Bird, Lambon Ralph, Patterson, & Hodges, 2000).

Finally, an important consideration in evaluating the merits of naming therapies is the implications for both the participant and the clinician. We have noted the preference expressed by the participants in the present study for decreasing over increasing cue therapy. It should be pointed out, however, that decreasing cue therapy required a substantially greater effort on the part of the clinician, relative to increasing cues. Specifically, decreasing cue therapy required monitoring of the performance of participants, both within and across sessions, and making necessary adjustments to cues to ensure accurate naming. In contrast, increasing cue therapy was relatively straightforward to administer for the clinician. Once the hierarchy of increasing cues has been established, during therapy the participant carries out the "work" of progressing through the cueing hierarchy. So, an important practical question in regard to decreasing cue therapy is whether this greater clinician effort is worthwhile. This question becomes especially significant given that the accuracy scores at the end of decreasing cues were no better than for increasing cues. One answer to this is that the practicalities of decreasing cue therapy may not be justified by naming results but may be by perceived benefits for participant engagement in therapy. This could well be more important for longer-term therapy outcomes rather than those of relatively brief research trials. A further question relates to whether this increased engagement could also be secured through techniques that do not require such active and constant monitoring of performance as well as adjustment of cues by clinicians. Spaced retrieval, for example, is one error-reducing approach that focuses on establishing naming over increasingly longer units of time (Fridriksson, Holland, Beeson, & Morrow, 2005). It reverts to "pure" errorless/word-repetition therapy in instances where naming accuracy fails. It could be informative, therefore, to compare

decreasing cues with spaced retrieval in terms of both accuracy results and clinician effort. More broadly, there are further formulations of errorless therapy in aphasia that could usefully be compared and evaluated in future research, relative to errorful therapies and also to each other. In particular, there may also be more work to be done to enable therapists to select one learning method over another given the participants' varying linguistic and cognitive profile.

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APPENDIX

	Imageability	*Frequency*	*Age of acquisition*	*Familiarity*	*Phonemes*	*Visual complexity*
Noun picture						
judge	4.25	16	4.41	2.09	3	4.6
conductor	4.36	0	4.09	2.69	8	4
knot	4.58	19	2.86	3.4	3	2.95
stool	4.75	16	2.78	4.73	4	2.78
slide	4.78	65	2	2.7	4	2.88
picture	4.83	273	1.76	5.03	5	5.15
whistle	4.86	68	2.54	2.56	5	2.65
hammock	5.11	11	4.02	1.98	5	3.2
saddle	5.14	24	3.38	2.28	5	3.63
picnic	5.36	227	2.54	2.84	6	6.15
pocket	5.36	78	2.23	4.83	5	3.68
king	5.36	698	2.48	2.11	3	5.23
devil	5.42	0	3.41	1.83	5	4.58
shower	5.42	22	2.93	6.05	3	3.2
fruit	5.42	133	2.26	5.53	4	4.7
sword	5.44	24	3.04	1.81	3	2.25
waitress	5.44	5	3.83	3	6	5.03
brain	5.47	32	3.22	5.37	4	4.55
ticket	5.47	11	3.04	5.49	5	3.18
chain	5.47	24	3.19	2.98	3	3.68
MEAN	5.11	87.30	3.00	3.47	4.45	3.90
SD	0.39	155.24	0.71	1.46	1.29	1.07
Verb picture						
skating	4.61	32	3.23	2.1	6	3.5
kicking	4.69	65	2.1	2.69	5	4.28
ironing	4.78	8	3.23	3.86	5	5.3
jumping	4.78	157	1.85	3.4	6	3.93
flying	4.81	233	2.5	3.98	5	4.28
dancing	4.86	95	2.35	4.36	6	4.7
fishing	4.89	100	3.35	2.05	5	5.6
running	4.89	265	1.88	4.55	5	3.58
skiing	4.92	5	4.03	2.05	5	3.88
painting	4.92	154	2.1	3.52	6	3.83
bleeding	4.97	3	2.45	3.69	6	4
raining	5.03	57	2.13	5.48	5	2.6
drinking	5.08	41	1.5	6.48	7	4
driving	5.14	32	2.83	5.64	6	4.88
walking	5.14	108	1.68	6.45	5	3.53
swimming	5.17	154	2.43	4.21	6	4.33
smoking	5.31	3	3.1	4.71	6	4.38
snowing	5.42	30	2.18	3.26	6	4.35
smiling	5.44	41	1.43	6.19	6	3.45
kissing	5.47	3	1.83	5.48	5	3.55
MEAN	5.02	79.30	2.41	4.21	5.60	4.10
SD	0.25	73.52	0.68	1.53	0.59	0.7

Sets of 20 nouns and 20 verbs and their psycholinguistic properties taken from Object Action Naming Battery (Druks & Masterson, 2000) and matched for imageability, frequency, age of acquisition, familiarity, number of phonemes, and visual complexity.