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Research Report

Improved vocabulary production after naming therapy in aphasia: can gains in picture naming generalise to connected speech?

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Abstract

Background: Naming accuracy for nouns and verbs in aphasia can vary across different elicitation contexts, for example, simple picture naming, composite picture description, narratives, and conversation. For some people with aphasia, naming may be more accurate to simple pictures as opposed to naming in spontaneous, connected speech; for others, the opposite pattern may be evident. These differences have, in some instances, been related to word class (for example, noun or verb) as well as aphasia subtype. Given that the aim of picture-naming therapies is to improve word-finding in general, these differences in naming accuracy across contexts may have important implications for the potential functional benefits of picture-naming therapies.

Aims: This study aimed to explore single-word therapy for both nouns and verbs, and to answer the following questions. (1) To what extent does an increase in naming accuracy after picture-naming therapy (for both nouns and verbs) predict accurate naming of the same items in less constrained spontaneous connected speech tasks such as composite picture description and retelling of a narrative? (2) Does the word class targeted in therapy (verb or noun) dictate whether there is 'carry-over' of the therapy item to connected speech tasks? (3) Does the speed at which the picture is named after therapy predict whether it will also be used appropriately in connected speech tasks?

Methods & Procedures: Seven participants with aphasia of varying degrees of severity and subtype took part in ten therapy sessions over five weeks. A set of potentially useful items was collected from control participant accounts of the Cookie Theft Picture Description and the Cinderella Story from the Quantitative Production Analysis. Twenty-four of these words (twelve verbs

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and twelve nouns) were collated for each participant, on the basis that they had failed to name them in either simple picture naming or connected speech tasks (picture-supported narrative and unsupported retelling of a narrative). These were placed in a larger cohort of verb and noun sets for therapy. Post-therapy assessments examined naming accuracy and speed of target items in single-word picture-naming and naming accuracy in connected speech contexts.

Outcomes & Results: There was a step-wise decrement in naming accuracy over the three naming contexts following targeted therapy. Simple pictures elicited the most correct names, followed by picture-supported narratives and lastly unsupported narratives. Picture-naming accuracy significantly predicted naming in the connected speech contexts for the group as a whole. The speed of picture naming after therapy did not predict the extent to which items were named in composite picture description and narrative tasks.

Conclusions & Implications: The findings suggest that gains in naming accuracy obtained through picture-naming therapy may generalize to naming of the same items in more linguistically and cognitively demanding connected speech tasks. Demonstrating this generalization is methodologically challenging and the method utilized in this study may serve as one starting point for gathering a larger database in order to answer the question posed by this paper more robustly.

Keywords: Aphasia, assessment, expressive language, narrative, therapy.

What this paper adds

What is already known on this subject

Some people with aphasia appear to be better at naming in single-word picture-naming tests rather than in connected speech, while others may show stronger naming skills in connected speech rather than to pictures. Such differences may relate to the type of aphasia or vary across different word forms such as nouns and verbs.

What this study adds

The paper presents some preliminary data that suggest that gains in picture-naming achieved in therapy can generalize to naming of the same items in connected speech tasks. Both nouns and verbs showed this pattern of carry-over. There were step-wise reductions in naming accuracy as the elicitation method became more demanding (picture naming > picture-supported narrative > unsupported retelling of a narrative).

Introduction

Word-finding difficulties are a pervasive and challenging symptom for many people with aphasia and, as a consequence, a frequent target in therapy. The most common intervention used for word-finding difficulties is picture-naming therapy. Whilst there is now a considerable database on various picture-naming therapies and their success in improving confrontation naming per se, there is a paucity of information about the relationship between post-therapy picture naming and generalization to connected speech. Whilst this question is a straightforward and important one, the logistics of undertaking such studies are more complex and require attention to various assessment and psycholinguistic-related issues. These factors are reviewed briefly, below.

Assessment of naming skills in aphasia has typically been implemented through confrontation naming tasks based on picture stimuli carefully designed to elicit a single-word response. In most cases, these target words have been nouns but more assessments examining verb or action naming have been published. These have included the Object Action Naming Battery (Druks and Masterson 2000) and the Verb and Sentence Test (Bastiaanse *et al.* 2003). Single-word naming assessments of both word types are useful to clinicians and researchers alike as they are simple and quick to administer and offer reliable and replicable results, allowing comparison across and within participants over time. However, picture-naming tests have been criticized for lacking ecological validity (Ferguson and Armstrong 1996) in that they may not necessarily predict success in less controlled contexts (such as taking part in conversation) which are functionally relevant for people with aphasia. Spontaneous speech samples can be obtained through a variety of means, some of which may be relatively directive in nature — for example, the Cookie Theft composite picture description task (Goodglass *et al.* 2001) or retelling of a set narrative such as the Cinderella story (Saffran *et al.* 1989) — or non-directive such as sampling conversational data (Perkins *et al.* 1999). Each of these, however, can be methodologically problematic for studies wanting to quantify naming skills and, in particular, changes in word-finding ability in connected speech contexts after therapy. For example, even in picture description tasks, controls show a wide range of sentence structures and vocabulary choices when describing the picture (Bird *et al.* 2000). Even when the topic is predetermined (as in retelling of a set narrative) and where different speech samples on the same topic are collected over time, there is wide variation in possible responses (Armstrong 2000). Consequently, generalization from gains in picture-naming therapy to production of the *same* or related exemplars in spontaneous speech may be difficult to determine without examining naming in a variety of contexts; for example, composite picture description, retelling of a narrative and conversational data.

Before we consider the effects of therapy on measures of naming skills across different elicitation contexts, we need to consider some of the factors which might lead to differences in measures of naming skills between picture naming and samples of connected speech. Firstly, we need to establish whether naming skills do indeed vary across elicitation tasks. Where studies have examined the effect of naming context (i.e., confrontation versus spontaneous speech) on chronic naming accuracy in aphasia, the evidence has been equivocal. Where variation has been found, it might reflect differences in elicitation methods rather than linguistic ability such as naming skill. Pashek and Tompkins (2002) compared picture naming scores against naming in a video narration task (telling a story having watched the story depicted in a video format) in 20 aphasic and ten control participants. All participants had greater difficulty with noun and verb retrieval in the picture-naming task than in the video narration task. Video narration is a relatively constrained method for eliciting connected speech relative to conversational data. Herbert *et al.* (2008) quantified naming in conversation on the part of participants with aphasia. They then compared the results against scores from picture-naming tasks and found strong correlations across the two contexts. This was true both for noun naming and content word retrieval, where the latter included nouns, verbs, adjectives, adverbs and numerals. Given that the various elicitation methods can produce different results when measuring naming in connected speech, we adopted two tasks in the present study to ensure the general applicability of our findings: picture-supported

narration (composite picture description alone and then in a story sequence), and unsupported narrative retelling — see the Methods section.

Relative strength in naming verbs and nouns in different contexts (for example, confrontation naming or naming in spontaneous speech) has also been associated with certain profiles of language impairment. Williams and Canter (1982) and Williams and Canter (1987) investigated naming of both nouns and verbs in large groups of participants with aphasia. No *overall* differences were found in naming skills across picture-naming and spontaneous speech tasks. Differences were apparent, however, in different aphasic subgroups; specifically, participants with fluent aphasia showed better naming skills in spontaneous speech than in confrontation picture-naming, while those with non-fluent aphasia showed the opposite pattern.

One could imagine that these differences might reflect, in part, differential word-finding abilities for nouns and verbs across aphasia type (verbs, for example, might be especially important in connected speech production). Traditionally, agrammatic non-fluent aphasia has been associated with relatively poorer verb than noun production in picture-naming tasks (Miceli *et al.* 1984). The opposite pattern (noun $<$ verb production) has been associated with fluent aphasia subtypes such as anomic and Wernicke's aphasia. However, a recent large group study (Luzzatti *et al.* 2001) found that relative performance in noun and verb picture naming corresponded only loosely with aphasia classification. While non-fluent aphasic speakers showed a tendency to perform more poorly with verbs, some did not. The pattern was more mixed with fluent aphasia, where there was a tendency, albeit weaker, to perform worse with nouns. Overall, it appears unlikely that dissociations between noun and verb picture-naming skills across subgroups of people with aphasia alone will adequately explain differences between noun and verb naming skills amongst these subgroups in connected speech.

One explanation proposed to account for dissociations between picture naming and naming in spontaneous speech has been stronger verb than noun retrieval. Zingeser and Berndt (1988) argued that poor verb naming skills led to poor sentence production in those with agrammatic aphasic symptoms. However, Bastiaanse and Jonkers (1998) reported differences between noun and verb naming skills in spontaneous speech *without* a corresponding difference in single-word confrontation naming. These authors argued that separate factors were influencing verb retrieval in spontaneous speech in their two subgroups of participants. For the agrammatic group, difficulties in generating morphological verb inflections were the source of the picture naming versus spontaneous speech differences; these difficulties restricted the use of verbs in spontaneous speech, but not in single-word picture-naming. In the anomic group, the discrepancy between action naming to simple pictures and use of verbs in spontaneous speech was simply ascribed to their greater difficulty retrieving verbs in spontaneous speech than in isolation.

Another factor which could account for differences in naming skill across naming context are properties specific to verbs, but not to nouns, which might make the transition from verb picture-naming in therapy to verb use in spontaneous speech particularly difficult. Marshall and Cairns (2005) focused on the status of words named after therapy and explored the relationship between increased picture naming accuracy and gains in naming the *same* words in spontaneous speech contexts. They described a therapy programme with EM, a participant with agrammatic speech, in which the discrepancy between improved verb naming to simple pictures and lack of improvement in spontaneous speech was striking.

Specifically, EM showed marked improvement in naming a corpus of targeted verbs but showed no improvement in naming of these verbs in a narrative task designed to facilitate their use in spontaneous speech. Marshall and Cairns (2005) attributed their finding to deficits in 'thinking for speaking' on the part of their participants in that simple action pictures provided an external constraint on the participant's perception of an event while more open forms of discourse did not. Consequently, participants may lose focus on pertinent actions when the message-level demands of retelling a narrative have been increased because they cannot adjust their 'thinking for speaking' to the linguistically appropriate aspects of the event. This account is consistent with studies which have noted the relatively higher cognitive demands of verb as opposed to noun naming. In particular, verb naming from static pictures has been shown to demand greater executive resources, perhaps because a dynamic event has been reduced to a static depiction (D'Honincthun and Pillon 2005).

The greater influence of cognitive control mechanisms for verbs rather than nouns has also been highlighted in some recent neuropsychological investigations. Silveri *et al.* (2003) conducted a large-scale study comparing single-word verb processing in participants with frontotemporal dementia, Alzheimer's disease, and control participants. This study demonstrated that executive dysfunction (related to frontal lobe damage) impacts on verb processing.

A further interesting aspect of Marshall and Cairns's (2005) study was that it focused on the status of words named after therapy. Specifically, they explored the relationship between this increased accuracy in picture naming and possible gains in naming the *same* words in spontaneous speech contexts. In this way, this study differed from the others described above in two important ways: (1) the previous studies compared naming skills across picture naming and other elicitation contexts, regardless of therapy — in other words, the chronic expressive vocabulary of the person with aphasia; and (2) Marshall and Cairns used an item-based analysis (comparing the same items in therapy versus connected speech) rather than investigating overall levels of naming across participants in the two tasks. With regard to items named post-therapy, naming therapy studies have typically found that generalization from treated to control (untreated) items has been weak or non-existent (Nickels 2002). This has led various authors to argue that therapy targets in such naming studies should be based on personally relevant, functionally driven therapy targets which would provide optimal functional benefit for participants (Herbert *et al.* 2003, Raymer *et al.* 2007). However, this presumes that successful naming in the therapy task, usually picture naming, will automatically generalize to production of the same items, or related exemplars, in spontaneous speech (or at least outside of a picture-naming task). This is a clinically vital question for such key word therapies. Given the potential discrepancies between picture naming and production in spontaneous speech reviewed above, the assumption of extension from therapy target in picture naming to production of the same targets in spontaneous speech, warrants investigation.

In considering which therapy items may generalize to connected speech production, one potentially important factor might be speed of naming. The time taken for people with aphasia to carry out language tasks such as naming has been relatively neglected in the aphasiology literature (Crerar 2004) and it was a topic we were keen to examine in the present study. In a previous naming therapy study which examined errorless versus errorful therapy techniques (Conroy *et al.* forthcoming 2007b), measures of naming speed were obtained but these did not

appear to differ according to the therapy technique, i.e. neither therapy produced faster naming responses than the other. Normal, fluent speech is characterized by fast and accurate word retrieval (around 100 words per minute on the Cookie Theft description: for example, Bird *et al.* 2000). Consequently, it seems reasonable to hypothesize that generalization from picture-naming therapy to connected speech will only occur when the target word is produced both quickly as well as accurately — that is, post-therapy named items which are named more quickly will be those more likely to be named in connected speech contexts.

The topics summarized above led us to the following research questions for the present study. First, we aimed to establish the extent to which increases in naming accuracy after picture-naming therapy would predict accurate production of the same items in more spontaneous connected speech tasks. Given the potential differences that can arise between various speech sampling methods (see above), we considered word production in both picture descriptions (narratives constrained/prompted to some degree by picture stimuli) and a more open-ended narrative (retelling of the Cinderella story). We predicted that measures of naming skills for treated items would show drop-offs in naming accuracy between picture naming and naming in picture-supported narratives, and also between picture-supported narratives and unsupported narratives for the same therapy items. Secondly, we aimed to investigate whether word class (verb or noun) would be a significant variable in the 'carry-over' of items from therapy to connected speech tasks. The literature on verb–noun differences has pointed to disadvantages for verbs in terms of the processing load for people with aphasia. On this basis, we hypothesized that verbs might show less proportionate carry-over than nouns to connected speech tasks. Lastly, we examined the role of speed of picture naming in predicting naming of therapy targets in connected speech tasks. When one considers the rapid speed at which words are retrieved in connected speech, our hypothesis would be that only those therapy targets which are named promptly in the picture naming context would then be available in the narrow time window required for connected speech.

Method

Participants

Seven participants with chronic aphasia including word retrieval impairment took part in a 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.* forthcoming 2007b). Participants varied in their aphasia symptoms, severity and time since cerebral vascular accident (CVA). All were monolingual English speakers. Participants were recruited from National Health Service (NHS) Speech and Language Therapy services within Shropshire, England. Inclusion criteria were devised to eliminate the likelihood of spontaneous recovery and ensure a stable neurological profile. Participants had to be at least six 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 and Masterson 2000). These were 20 nouns and 20 verbs, with each

set matched for significant variables including frequency, imageability, and visual complexity. 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 *et al.* 1992), participants were required to score at least 75% correct. This was in order to ensure that an errorless therapy, which required reliable word repetition skills and was the focus of a study which ran in parallel with the present study, 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 (BNT) (Goodglass *et al.* 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 and months since CVA. In addition, Table 1 contains baseline naming scores in the subset of *matched* nouns and verbs from the Object Action Naming Battery (Druks and Masterson 2000). 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 (Wilcoxon $W=21$, two-tailed, $p=0.03$). 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 focussed on single-word processing skills in the domains of naming, phonology and semantics.

Naming

The full Object Action Naming Battery (Druks and 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:

- 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 and Patterson 1992)

This test required participants to match pictures on the basis of semantic relatedness, for example, for a *pyramid*, the participant should select a *palm tree* and not a *fir tree.*

Table 1. Participants: naming score, age, description of aphasic symptoms

Participant	KP	PM	PO	JT	RH	DR	WE
Age (years)	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 in education	10	13	13	16	12	13	16
Occupation	Administrator	Secretary	Business manager	Teacher	Housewife	Engineer	Teacher
Months since cerebral vascular accident (CVA)	59	55	16	19	20	40	65
Baseline naming score (BNT: maximum=60)	0	3	24	28	29	35	40
Baseline naming of matched noun–verb sets (20 nouns, 20 verbs)	Verb=3 Noun=1	Verb=3 Noun=2	Verb=10 Noun=8	Verb=12 Noun=8	Verb=14 Noun=14	Verb=18 Noun=16	Verb=16 Noun=12
Description of aphasia	Fluent anomic	Non-fluent	Fluent jargon	Non-fluent	Non-fluent	Fluent anomic	Agrammatic

BNT, Boston Naming Test (Goodglass et al. 2001).

Table 2. Results of language assessments across participants

Participants: Assessments:	Maximum	KP	PM	PO	JT	RH	DR	WE	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
Non-word reading	24	1	0	3	0	13	18	22	n.a.
Word repetition	80	55	**79**	**78**	74	76	66	**80**	78–80
Non-word 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

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

Table 3. Results of cognitive assessments across participants

Participants: Assessments:		Maximum	KP	PM	PO	JT	RH	DR	WE
CMT (pictures)	Score	30	25	28	30	26	28	30	29
	Percentile		4.7	13	100	7.1	15.7	100	37.8
CMT (words)	Score	25	13	21	19	17	25	25	20
	Percentile		<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
	Percentile		<1	<1	>16	<1	>16	>16	2–5
Rey Imm Recall	Score	36	3	5	11	6	22	20	7
	Percentile		1	<1	12	24	86	86	4
Rey Delayed Recall	Score	36	6	7	11	4	22	21	7
	Percentile		4	<1	10	8	88	92	3
WCST: number of categories	Score	6	2	1	5	0	2	3	3
	Percentile		>16	2–5	>16	11–16	6–10	>16	>16
WCST: items to first category	Score	0	21	27	14	94	28	26	20
	Percentile		>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
	Percentile		5	1	10–25	5–10	1	10–23	5
Self-assessment of naming	%	100	100	90	66	80	100	100	100

CMT, Camden Memory Test; Percentile, percentile score; Rey Copy, Rey Complex Figure Test — Copy subtest; Rey Delayed Recall, Rey Complex Figure Test — Delayed Recall subtest; Rey Imm Recall, Rey Complex Figure Test — Immediate Recall subtest; TEA, Test of Everyday Attention; WCST, Wisconsin Card Sorting Test.

The three-picture version of The Kissing and Dancing Test (Bak and 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; for example, for *kissing*, the participant should select *dancing* and not *running*.

The Synonym Judgement Test (Jefferies *et al.* in press)

The Synonym Judgement Test 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; for example, 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 versus low frequency; low, medium and high imageability).

The Noun Verb Comprehension Test

The Noun Verb Comprehension Test is an adapted version of a comprehension test supplementary to the Object Action Naming Battery (Druks and 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 (for example, UMBRELLA: *raining*, *roof*, *hat*, *bucket* or *plug*; and 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.

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 and Meyers 1995)

This test required participants to copy a complex geometric figure, then to draw this figure from memory five minutes later, and then again 30 minutes later.

Executive and attention skills

The Wisconsin Card Sorting Test (Grant and 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 *et al.* 1994) were used: 'elevator counting' which requires sustained attention, and 'elevator counting with distraction' which requires divided attention. Elevator counting requires participants to listen and count a set of tones at random time intervals from one to several seconds apart. Elevator counting with distraction requires participants to listen to sets of tones but to count only the low pitch ones whilst 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 nouns (50) and verbs (50) from the Object Action Naming Battery (Druks and 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.

Table 4. Self-monitoring of naming: percentage correct and number of items on which self-monitoring was carried out

Participants: Assessments:	Maximum	KP	PM	PO	JT	RH	DR	WE
Percentage 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 is made		44	58	87	84	50	90	91

Item selection

In order to ascertain whether improvements in picture naming would generalize to production in connected speech contexts, we embedded a set of suitable items within a larger picture-naming therapy study. The results from that study are reported elsewhere (Conroy *et al.* forthcoming 2007a). A selection of possible nouns and verbs which might be useful for the connected speech tasks was drawn up.

Six non-brain damaged control participants were digitally audio-recorded as they carried out the two connected speech tasks: Cookie Theft Picture Description (Goodglass *et al.* 2001); and, retelling of the Cinderella narrative (Saffran *et al.* 1989). These connected speech elicitation tasks were chosen because they provided established methods of obtaining highly constrained samples of connected speech, with relatively narrow ranges of probable key words which would make their production by the participants with aphasia as likely as possible. Nouns and verbs which were produced by at least three of the six control participants formed a corpus of potential therapy targets. There were 27 nouns and 14 verbs in total. Static pictures were then collated to elicit these items as simple picture-naming targets. Wherever possible, the picture used in the picture naming test was taken from its source (for example, 'plate' or 'overflowing' in the Cookie Theft Picture Description, 'pumpkin' or 'sweeping' from the pictures used to remind participants of the Cinderella narrative). In some instances this was not possible. For example, the picture which could have elicited 'falling' from the Cookie Theft Picture Description was a boy standing on a stool which was leaning and clearly about to fall; however, dissected from its visual setting in the kitchen, this was less obvious. Therefore, in cases where the dissected picture was not usable, a similar picture, with characters similar in appearance and situation, was used.

This new picture naming test was conducted three times in order to collate therapy targets for our participants with aphasia. A noun or verb had to be failed three times in order to be included as an item for therapy. Furthermore, the connected speech tasks were also carried out with our participants with aphasia to make sure that they did not produce these items in the connected speech tasks. For each participant, 24 items (twelve nouns and twelve verbs) were selected on this basis for inclusion in their therapy study. We opted to take just one baseline sample of the three connected speech tasks (the Cookie Theft Picture description and retelling of the Cinderella narrative both without and with the picture stimuli). This avoided the risk of the participants improving on naming accuracy of target 'plant' items through repeated exposure to the connected speech stimuli and their repeated efforts to use these to convey the narrative or composite picture description. Francis *et al.* (2002) found that naming for specific items was trained through circumlocution-induced practice. Arguably, this effect would be stronger where circumlocutions were based in a set narrative where the story familiarity, picture stimuli, as well as the sentence frames used by participants could act as extra facilitators on key word retrieval. Taking one baseline sample only of the connected speech samples meant that we were unable to be sure that naming in the connected speech sample was stable. The drawbacks of taking one baseline sample of the connected speech tasks are reflected upon further in the Discussion.

These target items were then included as a part of two therapy sets used for comparing decreasing cue therapy (a form of errorless therapy) and increasing cue

therapy (a more typical hierarchical cueing therapy). Each set consisted of 20 nouns and 20 verbs (40 words in each set, 80 words in total). Six of the 20 nouns and six of the 20 verbs in each set were taken from this novel picture naming test. The two therapy sets were matched for key psycholinguistic variables such as length (number of phonemes), imageability, frequency and word class. Because verbs are systematically lower in imageability than nouns, verbs and nouns within each set were not matched.

The items contained within the matched sets of nouns and verbs used in the baseline testing (Table 1) represented the very limited overlap between nouns and verbs for imageability and thus there were no more available for the therapy sets.

In addition to the targets taken from the novel picture naming test, the two therapy sets were filled out by items which each participant had consistently failed to name three times from the Object and Action Naming Battery (Druks and Masterson 2000), the action naming subtest from the Verb and Sentence Test: VAST (Bastiaanse *et al.* 2003) and the Boston Naming Test for nouns. An additional, third group of items (20 nouns and 20 actions) served as an untreated control set. This control set, however, did not contain any vocabulary items which might have been useful for the participants with aphasia to use in their description of the Cookie Theft Picture or in retelling of the Cinderella narrative. There were no control 'plant' items because we had no expectation that they would appear in the post-therapy connected speech samples without having appeared in therapy sets.

Therapy methods

Following assessment, participants received ten sessions (twice weekly for five weeks) of decreasing cue therapy and increasing cue therapy for noun and verb targets in parallel, i.e. both therapies were conducted 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 which used parallel-administrations of the therapies (Fillingham *et al.* 2005a, 2005b). Although, some studies have found that priming effects can have a facilitatory or inhibitatory effect on naming of a limited set of phonological or semantically related items (Schnur *et al.* 2006), there were two factors which made this unlikely in the present study. Firstly, 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 the next section).

Therapies

Both therapies were conducted in each of the therapy sessions. The order of the therapies was counterbalanced, that is, 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, with five naming attempts per picture presentation. This amounted to ten naming attempts per word target per session and 100 overall across the therapy sessions.

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:

- Picture plus its written and spoken name given with a request to repeat initially twice, listen again, then three more times.
- Picture plus a substantial grapheme and phoneme cue (CV in CVC words; a CVC cue was given for bisyllabic words).
- Picture plus a minimal grapheme and phoneme cue (C in CVC words; CV cue for bisyllabic items).
- Picture plus a semantic cue in the form of brief definition of action or object.
- 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 minimizing 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 ten 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 minimizing 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 used in the decreasing cue therapy but in reverse order. This therapy was designed to allow the participant to have a go at naming and providing cues until the participant named the item successfully. Thus the five-stage cueing hierarchy which consisted of the following:

- Picture only.
- Picture plus a semantic cue in the form of brief definition of action or object.
- Picture plus a minimal grapheme and phoneme cue (C in CVC words; CV cue for bisyllabic items).
- Picture plus a substantial grapheme and phoneme cue (CV in CVC words; a CVC cue was given for bisyllabic words).
- 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 whilst the decreasing cues would keep the rate of errors much lower.

Post-therapy assessments

Post-therapy single-word picture naming of the verbs and nouns was assessed at one week post-therapy. 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 this rather labour-intensive method (in comparison to voice-key trigger) as it allowed us to include naming times from trials in which the participants initially misnamed an item or had a false start before eventually naming the item correctly. As the three sets of items were matched for word length, this would not interfere with the speed of naming results across the sets.

Generalization to connected speech post-therapy was tested in two contexts: picture-supported narratives and an unsupported narrative. For each target word for each participant, only *one* instance of naming in the connected speech tasks was required in order for an item to be scored as having been named accurately. The specific methods for each form of sampling are given below:

Picture-supported narratives. The Cookie Theft Description was collected in the standard way and, in addition, the participants were asked to recall the Cinderella story with the sequence of pictures available to them as they progressed through the story. In this way, both connected speech samples were potentially supported and influenced by the presence of the picture material. The 24 items selected for therapy in each participant were distributed across the two samples. In order to compare picture naming and picture-supported connected speech, we scored accuracy in confrontational naming and correct production of the target items within the two speech samples, combined.

Unsupported (free) narrative. We also asked the participants to recall the Cinderella story as per the standard instructions within the Quantitative Production Analysis. Consequently, these connected speech samples are not supported/constrained concurrently by the presence picture material. Whenever possible we tried to ensure that the therapy items, for each participant, were contained in the Cinderella story as this allowed us to compare picture naming, picture-supported and unsupported narratives directly. It was not possible, however, to select 24 items for every participant in this manner and the selected items were made up to the $n=24$ target by including items from the Cookie Theft descriptions. Consequently, the number of directly comparable items varied across participants between 13 and 17, and thus the results are reported in terms of proportion correct.

The Cookie Theft Description and the unsupported Cinderella story narrative were collected one week after the post-therapy picture naming assessment. In order the minimize priming between the two Cinderella story narratives, the picture-supported version was collected in the following session (one week later).

Results

The naming therapies (both decreasing and increasing cue therapies) improved confrontation naming performance on treated items in all participants to a statistically significant extent (all: McNemar, one-tailed, $p<0.02$) (Figure 1). There was no

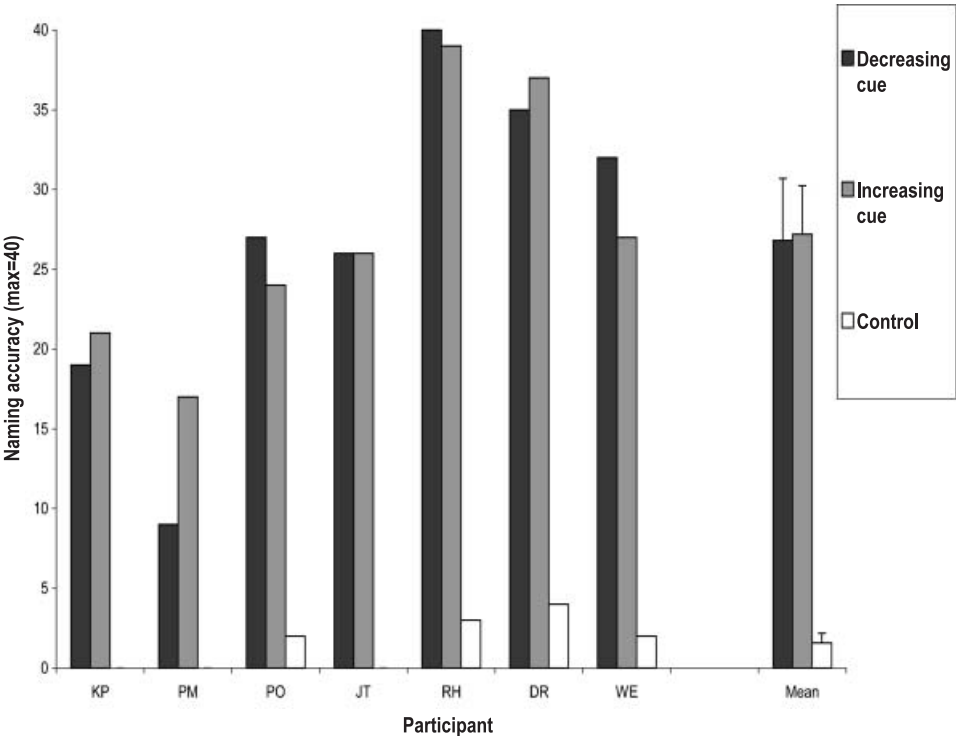

Figure 1. Post-therapy naming of all therapy targets ('planted' and 'non-planted' nouns and verbs) across decreasing cue and increasing cue therapies.

significant improvement in naming of the control items for any participant. Therefore, only the naming therapies improved naming accuracy from stable picture-naming baselines (zero accuracy) and any generalization from picture-naming post-therapy to naming in the connected speech tasks was likely to derive from therapy also.

Clinical observation suggested that most of the participants were successfully generalizing at least some of the therapy items to their connected speech. The data obtained from their baseline and post-therapy Cookie Theft picture descriptions are shown in Table 5, with therapy vocabulary underlined (although each token of a target word produced was underlined, only one correct production was required per target word). The first formal analysis compared naming/production of the 24 target words in confrontation naming versus picture-supported connected speech (see Figure 2:

Table 5. Cookie Theft picture description before and after naming therapy for each participant

Baseline	Post-therapy
KP: It's a cookie, cookie jar, getting the dinner, getting the what's name, getting a drink, getting the …, she's washing up and getting the … like going to the …, washing in there, oh there it is, something to eat, he was getting on the … PM: Cookie, … lady, oh dear	KP: doing the *water* in there, pouring out, and the woman trying to do that, trying to get the things done, water going down there. She went in to get on there, she's getting from there, she nearly fell down off there. Who's this one, looking at her, the *girl*, nearly fell down, getting the cookie. PM: Cookie,. … dropping it, … wipe, … spill, … no.
PO: She's filling the bowl of water. He's slipping off the __ on the ground, having to say, he's going to the ground. I think there's only two things to manage. He is, he is, she is going to … going to say 'surprise', look she is noticing. [__=unintelligible utterance]	PO: Well, there's a … it is washing up, is falling down, the cookie, he is *falling* the boy is falling, I can't think there's any more. She is having a cookie, but she is falling. There's two things that's gonna happen.
JT: Go on the chair, and the boy cuffling, mother's washing up and the sinks overflowing, the plates going up RH: It's the um, coming off the … (points to the sink) it's the water coming over the sink, and it's outside trying to come in. It's the boy which is climbing up for the cookie jar which … its, ehh, wanting to turn over. DR: The woman is by the kitchen, stuff is running over onto the floor. She is …, she cannot …, the young fellow has got up to the cupboard and is about to fall off the seat. The young girl is after some from this lad.	JT: Washing up and going to the … and its … swishing down. And the … water's going over, … em, … a door, getting up you know, … kitchen? RH: The sink's *running* over. Mummy is washing up and she's *drying* up. Oh, he's … got up on a *stool* and he's *taking* the biscuit from the jar. And he goes 'whoops' and the *stool*, its over. And, it's … and this girl goes 'oh' and the stool topples over. DR: *Taking* this *cookie* out of the cupboard, he's falling off the stool. The woman is by the …, she's getting *water* off the … can't say it, the *water* is out of the sink all over the floor. She's doing the pot. Little girl's asking for a *cookie* off the little fella, so he's going to give her one. He's falling off. *Water*'s all over the floor.
WE: Woman having a bath, no, washing up, yes and plate and leaking, leaking? Hedge, yes, and window, and boy, boy (points at the chair) … leaving the chair, the chair, leaving the chair and, girl (points at the cookie) … two of the boys leaving, yes?	WE: *Drying* up … and water *overflows* … and em, man no, boy keeps on *falling* down, and. … Wom, ehh … girl keeps em, mu- mutter on and … *drying* up, *overflowing*, *falling* down, and muttering.

For each target word for each participant, only *one* instance of naming in the connected speech tasks was required in order for an item to be scored as having been named accurately.

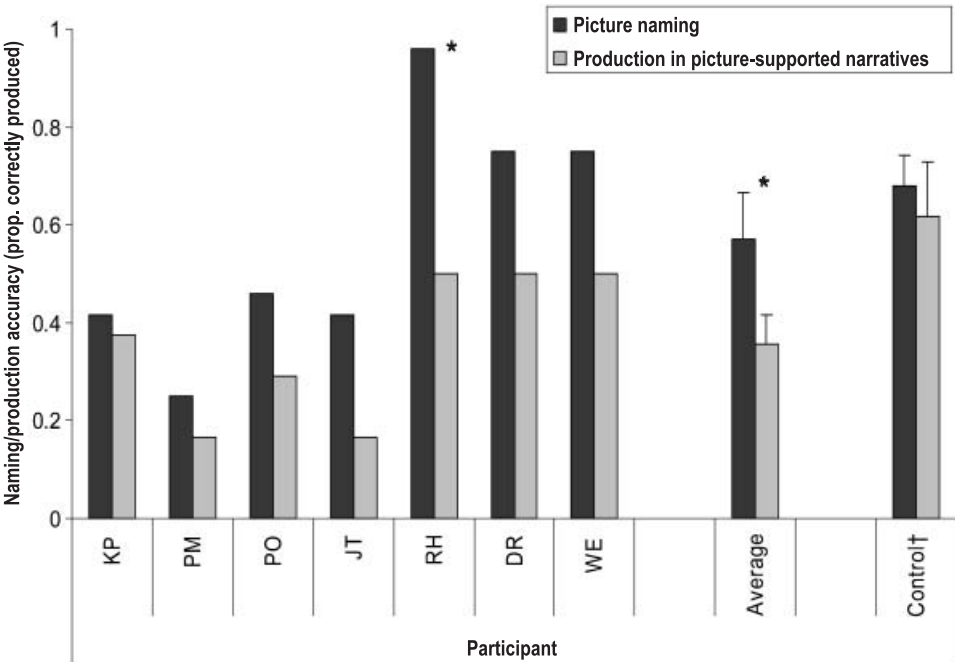

Figure 2. Impact of naming therapy on picture naming versus production in picture-supported narratives (post-therapy scores). (1) Error bars denote the standard error of mean performance. (2) An asterisk denotes a significant difference between picture naming and production in narrative. (3) Baseline (pre-therapy) scores were zero throughout (see the text). (4) A dagger (†) means the estimated rate of production in control participants (see the text).

participants are ordered left-to-right in terms of naming accuracy from the background testing — see Table 1). Pre-therapy, baseline naming/production is omitted from this figure because only unnamed items had been selected (see the Methods section) and thus naming/ rates of production accuracy were zero in all cases.

Embedded within the therapy sets were 'planted' items, which had been selected and then trained with a view to establishing whether they would be named in connected speech contexts, as well as to simple picture post-therapy. The picture-naming therapy did also produce improved target vocabulary use in the picture-supported narratives (Figure 2). These specific gains were significant for five of the seven participants (KP, PO, RH, DR and WE: McNemar, one-tailed, $p<0.008$) and approached significance for the other two (PM and JT: McNemar, one-tailed, $p=0.07$). The impact of picture-naming therapy on subsequent vocabulary use in connected speech was supported by two further analyses. First, across participants the levels of naming/ degree of accurate production for the two elicitation contexts was highly correlated (Spearman's $\rho=0.89$, $p=0.006$). Secondly, there was a relationship between whether items were used/named in both contexts (combining the therapy items from all participants: $C=0.32$, $p<0.001$). A direct comparison of post-therapy naming and production in picture-supported narratives found that, at the group level (see Figure 2 group averages), the participants were more likely to produce the therapy items in picture naming than picture supported narratives (Wilcoxon: $W=28$, two-tailed,

$p=0.02$). This difference was not large enough to be significant in individual data (all: McNemar, one-tailed, $p>0.07$) with the exception of the largest difference exhibited by RH (McNemar, one-tailed, $p<0.002$). In summary, the naming therapy improved picture naming and this led the participants to use many of the same items in their picture-supported narratives but not to quite the same levels as one might have expected from their picture naming performance post-therapy.

Interpretation of the direct comparison between confrontation naming versus production in connected speech is potentially complicated, however. Perfect levels of generalization might be reflected in equivalent levels of naming/ degrees of accurate production across the two contexts. However, the less constrained nature of connected speech means that it is not obligatory to produce all 24 target words in the narrative. In addition, the vocabulary used in these tests (including action verbs) can be hard to picture in a way that ensures perfect name agreement and thus control performance on confrontation naming is not at ceiling. In order to estimate the expected levels of normal performance, therefore, we took control performance for the 41 vocabulary items contained in the novel naming test from which each participants' therapy targets were selected. In constructing this study (see the Methods section), control participants had been asked to produce the Cinderella and Cookie Theft narratives in the standard fashion and then the 41 possible therapy targets were tested in single picture naming. We combined the two forms of connected speech narrative to give an estimate for the degree of accurate production in narratives and compared this to the naming accuracy for the same items. The average naming/ accurate production levels for these items in confrontation naming and connected speech samples are shown alongside the participants' data in Figure 2. This indicated that on average the degree of accurate production in picture naming and connected speech was (1) very similar (68% in picture naming versus 62% in connected speech) and (2) below ceiling levels. These data provide a useful backdrop to the results for the participants with aphasia; some of these more mildly naming-impaired participants' post-therapy performance approached or even (for example, RH) exceeded the normal average (the latter presumably due to a priming effect for the vocabulary represented by the pictures and to be included in the narratives). Given that picture naming and vocabulary production in connected speech was comparable in the control data, the moderate yet significant drop in performance between picture naming and narrative production shown by the participants with aphasia is a meaningful one. In conclusion, the results from this analysis suggest that when participants with aphasia improve their naming accuracy of items in picture naming, they do generalize to connected speech samples but not to normal levels.

The previous analysis compared production for the $n=24$ therapy items in either picture naming or picture-supported narratives. Next, we repeated the same analysis but this time focussed upon the subset of vocabulary contained within the Cinderella story (see the Methods section). This licensed a three-way comparison between picture naming, picture-supported and unsupported narratives. The results are shown in Figure 3 and indicate a similar pattern to that found in the previous analysis. Despite approximately similar levels of production by control participants in picture naming and connected-speech narratives, the therapy gains were not even across the participants with aphasia. Therapy had the biggest impact on picture naming. The gains generalized to production in the picture-supported version of the Cinderella narrative but to a lower extent, whilst there was a further drop in production levels in the unsupported narrative. Formal statistical analysis confirmed

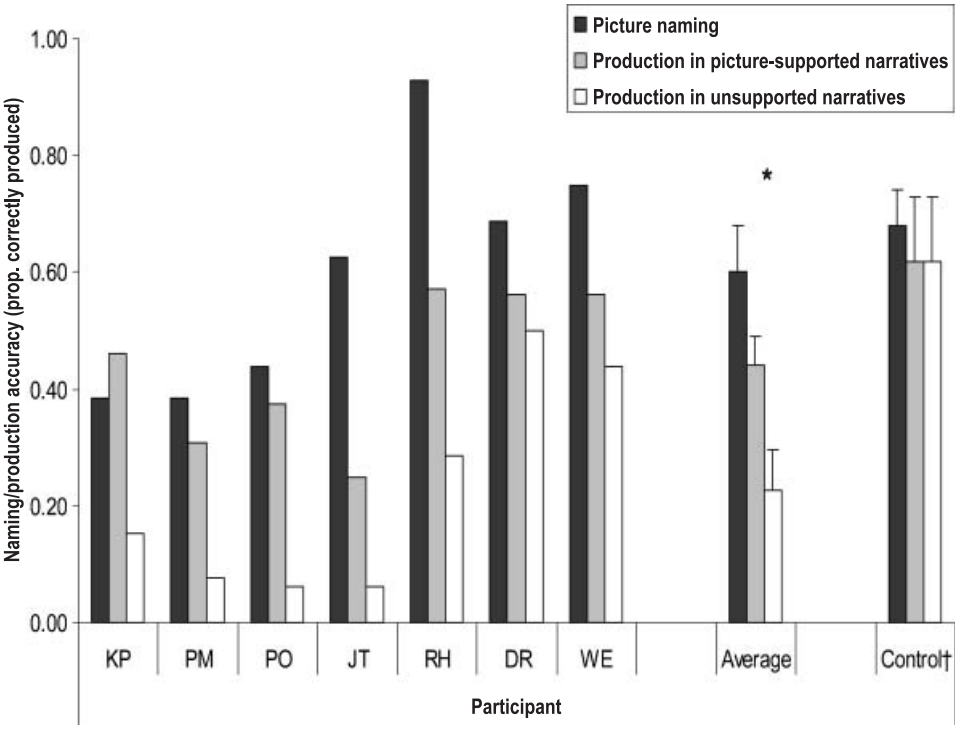

Figure 3. Comparison of picture naming, production in picture-supported and unsupported narratives after naming therapy. (1) Error bars denote the standard error of mean performance. (2) An asterisk denotes significant differences across an elicitation context. (3) Baseline (pre-therapy) scores were zero throughout (see the text). (4) A dagger (†) means the estimated rate of production in control participants (see the text).

the pattern apparent in Figure 3. At the group level there was a significant effect of elicitation context on production/naming accuracy (post-therapy picture naming versus production in supported-narratives versus in unsupported narratives: Friedman's test, $\chi^2=12.3$, degrees of freedom (d.f.)$=2$, $p=0.02$; pairwise comparisons: picture naming versus supported narratives — Wilcoxon $W=25$, two-tailed, $p=0.06$; supported versus unsupported narratives — Wilcoxon $W=28$, two-tailed, $p=0.02$). Despite the drop in accuracy/production across elicitation contexts, there was a significant link across all three: (1) performance across the contexts was correlated (picture naming versus picture-supported narratives: Spearman's $\rho=0.71$, $p=0.07$; supported versus unsupported narratives: Spearman's $\rho=0.82$, $p=0.02$). Secondly, there was a strong relationship in the vocabulary use across each elicitation context (combining the therapy items from all participants: picture naming versus unsupported narratives — $C=0.29$, $p=0.002$; supported versus unsupported narratives — $C=0.50$, $p<0.001$).

We also explored whether this pattern held for both noun and verb therapy targets as one could imagine differences across word class in terms of likely generalization to connected speech. Although the numbers of items were somewhat limited, we took the data summarized in Figure 3 and split it down further by word class. A repeated-measures analysis of variance (ANOVA) on the group data revealed a main effect of elicitation context (as per Figure 2 and confirming the

previous analyses: $F(2,12)=21.6$, $p<0.001$) but no main effect of word class ($F(1,6)=1.91$, $p=0.21$) nor an interaction ($F(2,12)=1.49$, $p=0.26$).

We have noted that all participants made some gains in noun and verb naming post-therapy. One benefit of the case-series design in this type of therapy study has been to allow comparisons of background language and cognitive measures against the eventual therapy outcomes (Fillingham *et al.* 2005a, 2005b, 2006). Although there are only seven cases available for such analysis and therefore the power was limited, an exploratory correlation was carried out where the data were collapsed across both therapy types. Comparisons (using Spearman's rho 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 6. 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. Therefore, these background language and cognitive measures predicted the degree of naming success in the picture-naming study which compared decreasing versus increasing cueing therapies. Indirectly, they also predicted the degree of generalization in the results in the present study with respect to the carry-over of naming from the picture-naming context to both supported and unsupported narrative contexts, given the strong correlations noted between naming across these elicitation contexts. The main difference between the participants with aphasia in the present study was the varying degrees of naming success in the post-therapy picture naming assessments. Both Figures 2 and 3 show that the bar on the left for each participant, representing gains in picture naming post-therapy, showed a wide range of improvement. For example, in Figure 2 (showing the impact of naming therapy on picture naming versus production in picture-supported narratives), this range was 25% increased naming accuracy post-therapy at the lowest level of therapy success (participant PM — see Figure 2) and 95% (for participant RH — see Figure 2) at the highest (with a mean gain across the participants of 57%). However, beyond this

Table 6. Significant correlations between therapy gains, language and cognitive scores ($n=7$)

	Total gain immediately post-therapy		Total gain at follow-up	
Test	Correlation coefficient	Significance (two-tailed)	Correlation coefficient	Significance (two-tailed)
Boston Naming Test (BNT)	0.786	0.036*	0.821	0.023*
Word reading (PALPA)	0.857	0.014*	0.821	0.023*
Non-word reading (PALPA)	0.793	0.033*		
Pyramids and Palm Trees (three 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*

difference in post-therapy picture naming, there was a striking degree of homogeneity across the participants with respect to the relative changes in naming accuracy across the naming contexts. Two exceptions to this were participant RH (Figure 2) who showed a significant drop-off between picture naming and naming in picture-supported narratives (McNemar, one-tailed, $p<0.002$) and participant KP (Figure 3) who showed a non-significantly lower naming accuracy score for picture naming compared to naming in picture-supported narratives. Furthermore, despite the differences between the participants with respect to the description of their aphasic symptoms as contained in Table 1 (fluent anomic, fluent jargon, non-fluent, agrammatic), there was no evidence of the naming results in Figures 2 and 3 varying according to such factors. This was also the case with the noun and verb naming results across the different elicitation contexts, where again the degree of post-therapy picture naming success was the varying measure, around which the other measures (picture-supported and unsupported narratives) lined up in similar proportions across the participants.

In the last analysis we explored the possible relationship between speed of naming and use in connected speech. From the previous analyses it was clear that the participants made use of many, but not all, of the vocabulary items in which they had improved naming accuracy. In this analysis, therefore, we considered whether speed of naming, post-therapy, predicted which of the successfully named items post-therapy were used in the participants' narratives. This hypothesis was based on the notion that for use in connected speech, vocabulary has to be retrieved both accurately and efficiently — especially if it is to be incorporated into fluent production (normal participants produce around 100 words per minute on the Cookie Theft picture description: equating to around half a second per word). An item-based analysis was conducted by combining all of the items that the participants with aphasia had named post-therapy and comparing this to whether or not they used the item in the picture-supported narrative. The picture naming time for these items was used as the dependent measure. An ANOVA found that there was an effect of word class on naming speed (nouns — $m=3.2$ seconds (standard deviation (SD)$=2.7$) versus verbs — $m=4.7$ seconds (SD$=3.2$): $F(1,92)=6.2$, $p=0.01$) but no effect of whether the item was included in the participants' picture-supported narratives ($F<1$) nor an interaction ($F(1,92)=1.76$, $p=0.18$). When production in unsupported narratives was used as the independent measure, again no effect was found ($F<1$).

Discussion

This study investigated whether increases in naming accuracy after picture-naming therapy would improve production of the items which had been targeted in therapy in more spontaneous connected-speech tasks such as composite picture description or retelling of a story. In addition to this main aim, we also investigated whether word class (verb or noun) and speed of naming influenced the likelihood that post-therapy gains in picture naming would generalize to connected speech. Seven participants with aphasia of varying subtypes and naming severity took part in this case-series therapy study. As part of a larger, successful naming therapy study in the same group of participants (Conroy *et al.* forthcoming 2007a), 24 words were included in their therapy regime. These 24 words were selected on the basis that (1) control participants, without language impairments, often used these vocabulary in

retelling the Cinderella story or in the Cookie Theft Picture Description task; and (2) the participants with aphasia had been unable to name these items as pictures, nor produce them in their own baseline connected speech sample.

As expected, picture-naming therapy improved confrontation naming accuracy in all participants. This provided us with the opportunity to look at generalization to connected speech in all seven cases. Estimates from the control participants indicated that production of these target vocabulary items was as likely in picture naming as connected speech, suggesting that perfect generalization from naming therapy to use in connected speech would be reflected in equal levels of production across elicitation contexts. Typically, one might expect production of target vocabulary to be more likely in picture naming (where a specific name is depicted) than in connected speech, where production of specific vocabulary is not obligatory and core vocabulary can be substituted or circumlocuted. In this study, the naming scores were very similar across elicitation contexts, perhaps because the items had been selected first from spontaneous speech samples and then turned into a picture naming tasks. Further samplings of connected speech tasks at baseline would provide an indication of any greater variation of the use of these items and the nature of the circumlocutions. The positive outcome from this study was that the participants did make use of newly trained vocabulary in their connected speech. Indeed, we found that the degree of improvement in confrontation naming correlated with gains across the other types of elicitation and that items produced, post-therapy, in picture naming were most likely to be the vocabulary items included in the connected speech of the participants with aphasia. The more negative finding, however, was that the generalization of naming therapy was graded across elicitation contexts: therapy improvements were greatest for picture naming, then for composite picture-supported narratives and least for unsupported narratives.

This gradation of generalization across elicitation contexts may reflect a number of different factors. First, therapy focused on picture naming as both its within-session aim and as its post-therapy outcome measure which clearly predisposed participants to scoring most highly in this naming context. Although item selection was such that production rates in control participants was roughly equivalent across elicitation contexts, it is possible that the more open-ended nature of narratives is such that the participants with aphasia are more likely to substitute or omit vocabulary that control participants tend to include. Given that fluent speech production of a complete narrative or story is highly linguistically, cognitively and pragmatically demanding, it may not be so surprising if people with aphasia show greater differences between picture naming and vocabulary production in connected speech. Generalization may have been encouraged in the composite picture-supported narratives because, wherever possible, we had selected images from these composite pictures for the therapy materials. Given the number of factors that make narrative production so demanding, the fact that accuracy in picture naming did generalize to other production contexts was all the more striking.

Also noteworthy was the finding that, having been trained in naming therapy, verbs were as likely as nouns to generalize to connected speech, despite the linguistic and cognitive factors that might disadvantage verbs in processing terms (Bird *et al.* 2003, Black and Chiat 2003, Marshall 2003, Conroy *et al.* 2006). This is interesting given that these participants with aphasia, like many others, demonstrated poorer action than object naming in their baseline assessments with *non-matched* sets of verbs and nouns (that is, when verbs were effectively more difficult to name by virtue of

their lower imageability scores) — see the OANB (Druks and Masterson 2000) results in Table 2. This finding would suggest that therapy can be targeted not only at simpler vocabulary, but also at intrinsically more difficult items (in this study, verbs) and, if picture naming accuracy is improved, gains across both simpler and more difficult items may generalize to different naming contexts.

In this study, we failed to find any relationship between speed of successful naming post-therapy and subsequent generalization to connected speech. This null result might reflect insufficient data — in that we had to combine responses across participants to gain a sufficiently sized corpus for formal analysis. In addition, this means that variation across participants might have clouded any underlying relationship. It is, of course, also possible that picture naming and naming in propositional speech are very different processes from a psycholinguistic perspective, as has been argued by researchers from linguistic and discourse perspectives (Ferguson and Armstrong 1996). While the two forms of speech production are clearly very different in form and demands, we think it is likely that they share common processes, including activation of target vocabulary. If the processes were completely divorced then it seems unlikely that we would have observed any generalization from picture-naming therapy to connected speech. The topic of the relationship between picture naming, factors such as speed of naming, and naming in connected speech clearly warrants further research.

Overall, the results point to a potentially positive role for picture-naming therapies as part of the rehabilitation of people with aphasia. However, given some of the limitations imposed on the present study, in particular, the single sampling of connected speech tasks at baseline, the results can only be seen as preliminary but do warrant further investigation in future empirical studies. The aim of the study was to establish whether items trained through picture-naming tasks would also be produced in connected speech tasks post-therapy. This contrasts with the many impairment-focused therapies which have aimed to affect much more systematic and generalized improvements to the expressive language of participants with aphasia (Nickels 2002). Clearly, the potential gains in communicative effectiveness we expected to see in the present study were limited to those that we sought to train, that is, use of specific items for use in specific communicative situations. Notwithstanding this, the results here might predict that future studies of picture-naming therapy carried out on items of high personal relevance and significance to the person with aphasia, would result in more use of those items in a connected speech context. Whilst this is not the case for all groups with acquired language impairments — for people with semantic dementia the benefits or picture-naming therapy are confined to its treatment context (Jefferies and Lambon Ralph 2006, Sage *et al.* 2007) — the current findings provide some support for the contention that word-targeted therapy (for verbs and nouns) may be functionally beneficial to people with aphasia in practical everyday speaking situations.

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