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Intervention for children with word-finding difficulties: a parallel group randomised control trial

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Abstract

Purpose: The study investigated the outcome of a word-web intervention for children diagnosed with word-finding difficulties (WFDs).
Method: Twenty children age 6–8 years with WFDs confirmed by a discrepancy between comprehension and production on the Test of Word Finding-2, were randomly assigned to intervention ($n = 11$) and waiting control ($n = 9$) groups. The intervention group had six sessions of intervention which used word-webs and targeted children's meta-cognitive awareness and word-retrieval.
Result: On the treated experimental set ($n = 25$ items) the intervention group gained on average four times as many items as the waiting control group ($d = 2.30$). There were also gains on personally chosen items for the intervention group. There was little change on untreated items for either group.
Conclusion: The study is the first randomised control trial to demonstrate an effect of word-finding therapy with children with language difficulties in mainstream school. The improvement in word-finding for treated items was obtained following a clinically realistic intervention in terms of approach, intensity and duration.

Keywords: *intervention*; *word-finding difficulties*; *phonology*; *semantics*; *naming*

Introduction

Word-finding difficulties (WFDs) affect us all on occasion; however, in children diagnosed with this clinically, they represent an ongoing language impairment with a clear and direct impact on everyday communication. They often occur in the context of wider specific language impairment/developmental language disorder (SLI/DLD). There is ongoing debate about the terminology for children with developmental language needs (Ebbels, 2014), in this paper we use the term Developmental Language Disorder (DLD) generally to reflect recent consensus (Bishop, Snowling, Thompson & Greenhalgh, 2017) and SLI where we are referring to previous research which has used this term and defined inclusion in this way.

When persistent, WFDs can influence self-esteem, the building of relationships, educational attainment and wider-life chances. When asked for her views about the everyday impact of her word-finding difficulties, a participant in the current study said:

> It can be quite annoying at home, because my sister speaks over me. At school, I get really angry, because I forget and can't tell the answer... People say things instead of me.

The nature of WFD

Children with WFDs exhibit retrieval difficulties in single word and discourse contexts. When attempting to retrieve target forms during picture naming, children may make errors e.g. producing semantically-related words, such as "triangle" for "square" or phonologically-related responses such as "cocoon"

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for "coconut". Such errors are sometimes self-corrected (e.g. target: ruler; response: "measurer... oh, it was a ruler. I just couldn't recognise it."). Children with WFDs often demonstrate variability in naming the same target on different occasions and may be able to "cue themselves in" to their final naming attempts several seconds after seeing a picture: for example using orthography: "Starts with a 'b'...brackets". In discourse, word–finding behaviours can include repetitions, revisions, substitutions, fillers, delays, empty words and insertions ("I know it but can't think of it") (German & Simon, 1991). Children can also produce circumlocutions containing partial information about the target word (Best, 2005). Estimating the prevalence of WFDs is not straightforward. However, it is well established that between 5 and 7% of children have SLI and that around a quarter of children in language support services have WFDs (Dockrell, Messer, George, & Wilson, 1998).

The literature is consistent with the idea that WFDs may arise at several processing levels within models of language production (in line with models that have been used to account for naming errors in acquired aphasia such as that proposed by Dell, Schwartz,Martin, Saffran & Gagnon. (1997); see also Goldrick (2006) for a model with more limited interaction between levels of processing). Word-finding difficulties have been understood as resulting from a range of difficulties, from less elaborate semantic processing (e.g. McGregor & Appel, 2002, Messer & Dockrell, 2013) through to difficulty in processing, accessing or assembling the phonological form (e.g. Constable, Stackhouse and Wells, 1997, German and Newman, 2004). Thus, WFDs may arise for a variety of reasons within a complex developing language production system and the pattern of strengths and difficulties can differ across children; furthermore an individual child's clinical profile may not reflect just one level of difficulty (Best, 2005; German and Simon, 1991).

For the purposes of this study, WFDs are defined as a discrepancy between comprehension and production of specific words as measured by the Test of Word Finding-2 (German, 2000) that is, difficulty in retrieving words that are in the children's receptive vocabulary.

Intervention studies

There are relatively few well-controlled studies investigating intervention for word-finding problems in children. The studies that exist tend to be single case (e.g. Marks & Stokes, 2010), case series (e.g. Best, 2005; Bragard, Schelstraete, Snyers & James, 2012) or small group studies (e.g. German, Schwanke & Ravid, 2012; Hyde Wright, Gorrie, Haynes & Shipman, 1993 and Wing, 1990). This may be for a variety of reasons, perhaps including the time taken to deliver, analyse and report this type of research and the recruitment of suitable children. Motsch and Marks (2015) carried out a randomised control trial (RCT) ($n = 157$) to compare the effectiveness of their Lexicon Pirate therapy programme against a control group who received alternative vocabulary support. However, this research is not directly comparable, as it focussed on a broader range of lexical disorders; including receptive as well as expressive vocabulary difficulties. To date, the largest study to focus specifically on children with word-finding difficulties included 15 children (Ebbels et al., 2012).

The majority of published studies focus on building a child's phonological and/or semantic processing skills, with the rationale that – at least in part – it is the unelaborated representations of words that makes accessing names difficult for language-impaired children. Studies are inconsistent as to whether semantic or phonological approaches are more effective (Hyde Wright et al., 1993; Wing 1990). Importantly, children may have difficulty in accessing word-forms regardless of the strength of their lexical representations (Friedmann, Biran & Dotan, 2013; McGregor 1994). Improvement has been found in children of a wide age range (e.g. Wing, 1990, 6–7 years; Hyde Wright et al., 1993, 8–14 years) and the effect of intervention for WFD can be maintained (Bragard et al., 2012; German, 2002; McGregor, 1994).

Ebbels et al. (2012) employed an RCT to investigate the effectiveness of a semantic therapy for adolescents with WFDs occurring in the context of severe DLD. Activities included picture-sorting, discussion and comparison of semantic attributes. The therapy group made significant progress on the Test of Adolescent/Adult Word-Finding (German, 1990). The waiting control group did not progress, however after the intervention they too made significant progress. The authors suggest that these older children may have been able to use a meta-cognitive approach to build and strengthen semantic links between words.

While developing a child's expressive vocabulary by focussing on retrieval of specific targeted words is valuable, in clinical practice, the optimum outcome would be a change to generalise both untreated words and connected speech. Studies have generally found limited generalisation to untreated control items and few investigate carry over to connected speech (Bragard et al., 2012; Marks & Stokes, 2010). We return to this issue in the discussion.

Rationale for intervention approach, duration and outcome measure

The intervention involved the use of word-webs, focussing on elaborating phonological or semantic features of the target words. This is a technique

widely used in UK clinical practice (see, for example, Commtap, n.d.). Whilst published resources are available (e.g. Word Whizzer, n.d.), there are no experimentally-controlled group studies investigating the use of word-webs with children with word-finding difficulties. Similar techniques are however, used with adults experiencing anomia as part of their aphasia (e.g. Boyle, 2004; Coelho, McHugh & Boyle, 2000; Leonard, Rochon & Laird, 2008). Both word-webs used in paediatric clinical practice and those used with adults emphasise meta-cognitive awareness and our intervention included this as part of the protocol.

The duration and intensity of intervention delivered in the studies reviewed in the previous section varied from six sessions over six weeks (Best, 2005) to thirty sessions over ten weeks (Wing, 1990). In the present study a six week block of intervention was used. This aligns readily with school half terms and the level of a block of provision typically available clinically in the UK often on a cyclical basis, outside specialist education provision such as language resource bases and special schools.

We employed picture naming as a primary outcome measure. It is one of the best-studied paradigms in language production research (Funnell, Hughes & Woodcock, 2006; Masterson, Druks & Gallienne, 2008), involves all stages of language production and is widely used with children. The study is novel in its use of different subsets of items for different children, matched for baseline naming and psycholinguistic variables.

The inconsistencies in the results of previous intervention studies with children with WFDs are likely to reflect the heterogeneous nature of the disorder. The current study therefore also included preliminary analyses investigating the relationship between chronological age and performance on background language tasks, with the outcome of the intervention.

Overview and research question

In summary, WFDs are a common feature of DLD and can occur as an isolated language difficulty. While there is evidence that interventions can improve word finding, there is no previous RCT involving children with WFD in mainstream school. Use of word-webs is common in clinical practice, but their effectiveness has not been explored in previous research. We therefore investigated whether children assigned to an intervention group using word-webs would demonstrate an improvement in word-retrieval that was greater than that for a non-treated control group. The literature (e.g. Bragard et al., 2012, Ebbels et al., 2012; Hyde Wright et al., 1993; Wing 1990) led us to predict the intervention group would make greater gains than the control group.

Method

Participants

Children were referred by the Special Educational Needs Co-ordinators/Inclusion Managers at their schools and recruited from a total of 10 mainstream primary schools in London, UK with the exception of one child who was referred by his mother via our project website. Twenty four children were referred to the study and 20 were included. Three were excluded as they did not show significant word-finding difficulties in conversation, as assessed by the first and second authors, both experienced Speech-Language Pathologists (SLPs). A fourth child was not put forward to randomisation because the parents chose for him not to take part on the grounds of the time required. The children were aged from six to eight years and had WFDs based on their performance on the Test of Word Finding, Second Edition (TWF-2; German, 2000). All children scored in the normal range on the comprehension component of the test, with a word-finding quotient of below 90, which is indicative of word-finding problems (German, 2000, p54).

None of our sample had a diagnosis of dyspraxia, autism spectrum disorder, attention deficit hyperactivity disorder or global developmental delay according to school or parent/carer report. Our consideration of WFDs does not entail that WFDs are the sole language deficit that these children experienced, although for many of the children in the study, it was the most salient. Full eligibility criteria are provided in Supplementary material Appendix 1. Children were not recruited if they were having one-to-one intervention for language during the period of the study.

The majority of assessment and intervention sessions were carried out at school to minimise disruption for children and to facilitate liaison with teaching staff. The number of children seen in each school ranged between one and five, with a maximum of two in one class. One child was seen throughout the study at a university clinic and at home, and four others had occasional assessment or intervention sessions at home where these needed to take place in school holidays.

Participant data for the intervention and waiting control groups

Individual data for participants, including language and non-verbal ability scores, are provided in Table I. The group of 20 children had an average *t*-score on the British Ability Scale (BAS) pattern completion subtest in line with that of the general population, suggesting the children in the study had difficulties specific to language. The group mean standardised score for the Test of Word Finding (TWF-2) was 69.15, i.e. two standard deviations

Table I. Participant data for children in the intervention and waiting control groups.

Group	Gender	Age (months)	CELF-4 Core Language Standard Score	BAS Non-V T-score	TWF-2 naming Standard Score	TWF-2 Comp. Raw Score	TROG Standard Score	CN Rep Standard Score	Number of language tests at or more than 1.25 SD below average
Intervention group									
Child 1	F	90	**81**	42	**60**	68	94	**51**	3
Child 2	M	81	**75**	47	**62**	66	85	**72**	3
Child 4	F	72	**56**	40	**62**	64	82	[a]	2
Child 5	M	89	**56**	44	**60**	61	**72**	**70**	4
Child 8	F	88	**72**	57	**68**	64	**77**	**<50**[b]	4
Child 9	M	85	97	53	82	67	111	**78**	1
Child 10	M	88	97	53	**75**	69	104	83	1
Child 15	F	92	84	36	**75**	67	90	**70**	2
Child 16	F	81	**81**	49	**62**	67	**71**	83	3
Child 17	M	86	93	46	**70**	64	104	83	1
Child 19	M	83	88	51	**62**	64	90	**73**	2
Mean		85	80	47.09	67.09	65.55	89.09	73.67	
SD		5.6	14.39	6.30	7.49	2.34	13.35	10.15	
Control group									
Child 3	F	91	**60**	44	**60**	65	86	**52**	3
Child 6	M	103	**67**	47	**75**	68	**80**	**<46**[c]	4
Child 7	M	91	**81**	50	**60**	63	**80**	**75**	4
Child 11	M	75	96	45	**68**	64	87	**62**	2
Child 12	M	76	**67**	41	**65**	64	85	**75**	3
Child 13	M	95	**75**	54	**78**	68	**68**	**<46**[c]	4
Child 14	F	88	85	44	**79**	69	**80**	**63**	3
Child 18	F	77	**78**	47	**74**	68	91	**78**	3
Child 20	F	80	88	47	86	65	87	**78**	1
Mean		86.22	77.44	46.56	71.67	66.00	82.67	69.00	
SD		9.76	11.48	3.78	8.99	2.24	6.71	10.07	

Key: F: female, M: male, SD: standard deviation, CELF-4: Clinical Evaluation of Language Fundamentals (Semel, Wiig & Secord, 2003), BAS Non-Verbal - pattern construction subtest from the British Ability Scales Edition II (Elliot, Smith & McCullouch, 1996), TWF-2 - Test of Word Finding (German, 2000), TROG – Test for the Reception of Grammar (Bishop, 1989), CN Rep - Children's Test of Nonword Repetition (Gathercole & Baddeley, 1996).

[a]child did not complete the task, [b]raw score was 6, the lowest raw score in the manual for this age is 8, [c]standardised scores only available for a raw score of 19 and above at this age, as children scored below this an exact standard score is not provided.

(SD) below average. On the Children's Test of Non-Word Repetition (CN Rep), three children scored below the range for which standardised scores were available and one child did not complete the task. The mean standardised score for the remaining children was 71.63, showing that overall the group experienced considerable difficulty with this task. The Test for Reception of Grammar (TROG) resulted in a standardised score of 86, just less than one standard deviation below average. Finally, the core language score on the broader Clinical Evaluation of Language Fundamentals (CELF-4) averaged around 79, a standard score more than 1.25 SD below average, reflecting wider language difficulties beyond word retrieval. The children had different patterns across the tasks and this is illustrated in the final column of Table I, which shows the number of language assessments on which each child's standardised score was more than 1.25 SD below the average. These are highlighted in bold in the table.

There were four girls and five boys in the control group and five girls and six boys in the intervention group. Independent *t*-tests were used to look for differences between the groups on the background measures. None of the differences were significant.

Trial design

This parallel group randomised trial compares naming performance for a group of children who received word-finding intervention and a waiting control group. This study forms the first phase of an ongoing experimental case series study (the WORD project) comparing phonological and semantic intervention, in which each child acts as his/her own control. Each child was assessed three times before and once following intervention/waiting and children were randomly assigned to the intervention or control conditions. Accuracy in naming 100 pictures was tested for each child at each assessment point (i.e. at the three pre- and one post- intervention/wait points). Subsets of items were constructed from the experimental picture set for each of the twenty children. The subsets of items, which differed for each child, were matched for pre-intervention naming accuracy and for the following psycholinguistic variables: spoken frequency, imageability, visual complexity, number of phonological neighbours and word-length in phonemes. One subset of 25 items was treated for each child in the intervention group. The remaining pictures were divided into two sets comprising (1) untreated control items ($n = 25$), which were not involved in the intervention

but were named at the start of each intervention session and (2) unseen control items ($n = 50$), which were assessed only at the pre- and post-intervention assessments. Findings are reported, with minor adjustments required for publication, in line with the updated guidelines for reporting parallel group randomised trials (Schulz, Altman, & Moher, 2010).

Materials

Naming stimuli were 100 black and white line drawings taken from Funnell et al. (2006) and Druks and Masterson (2000). Stimuli were presented on computer and the task was programmed using the experimental software DMDX (Forster & Forster, 2003). A laptop with a 15.4 inch screen was used for administration. Naming responses were recorded using an external microphone connected to the laptop. Children were asked to provide a single word for each picture. Responses were noted on a score sheet at the time of testing and checked later from the recording. For the intervention group there were also a set of child-specific items assessed only once at the start of the intervention and again post-intervention. The latter were selected by the child, parent or teacher, to reflect individual interests and words from the current school curriculum and ranged in number from 4–10 items per child. A diverse range of words was chosen reflecting the children's individual interests (e.g. television programmes, fashion, wrestling, football and food) and including words from the school curriculum (relating variously to maths, science, history and geography).

Recruitment and participant flow

Recruitment to the study spanned three years (2011–2013). All 20 children included were retained and they completed the study in their original randomly assigned groups. Participant flow is illustrated in Figure 1.

Randomisation

Participants were recruited to the study by the teams at two different institutions in London. When initial assessment was completed and a child was considered suitable for inclusion in the study, the first or second author sent the child's anonymous project ID to the ninth author, who performed the randomisation. The random allocation of participants to intervention/waiting control condition was carried out using a pre-determined excel spreadsheet. The allocation of items to matched subsets and random allocation of subsets to conditions was also carried out by the same co-author. The result of randomisation was revealed to the first and second author only.

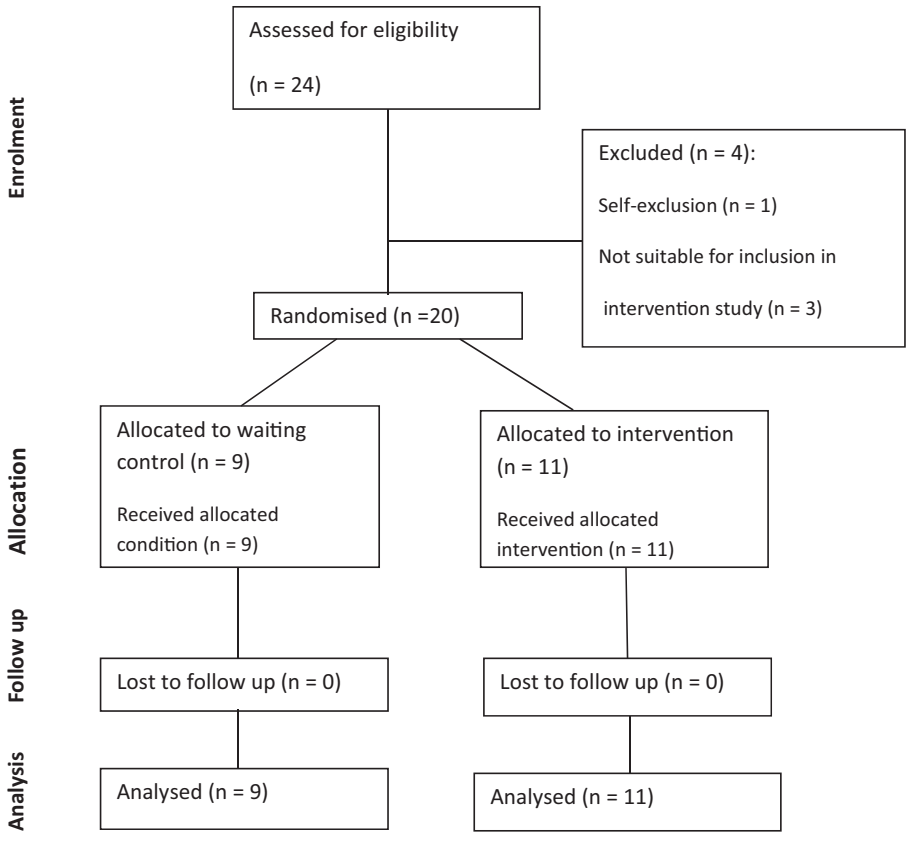

Figure 1. Participant flow diagram.

It was not possible or appropriate to include blind participants for group allocation, the children were well aware of when they were taking part in the intervention and of its aim to improve their ability to retrieve words.

Intervention procedure

The primary aim of the WORD research intervention is for children to improve their word-finding skills. The principles of encouraging reflection and use of word finding strategies run through the programme, with an increasing focus on meta-cognition and on using words to communicate rather than to name pictures as the sessions progress. In the current study we did not evaluate the different (phonological and semantic) components of the intervention separately. The wider WORD project case series study entails a comparison of semantic and phonological approaches; however, in the first phase of the study reported here, too few children had participated in the different approaches to draw clear conclusions. The two are very strongly related and both adhere to the protocol and principles of delivery but with a focus respectively on meaning or sound.

The intervention took place once a week for six weeks with sessions planned to last just under 30 minutes. Sessions were conducted in line with the WORD protocol (see Supplementary material Appendix 2 and Best, Hughes & Shobbrook, 2015 for full web-based protocol). Each of the sessions involved working with items from the 25-item intervention subset that the child was unable to name at the start of the session, as well as the child-specific items.

The study employed a multi-component intervention with a focus on word-webs. Children were encouraged to generate semantic or phonological features of words (e.g. appearance, first sound) and if unable, a choice was provided by the SLP (e.g. Is it made of wood or metal? Does it have 2 or 3 syllables/beats?). Each feature formed a part of the web and the intervention involved progressing round the web in a consistent order. Once the child and SLP had completed webs for all the target words and the child had become familiar with the format which took the first two or three sessions, the remaining sessions involved supporting the children to identify and use relevant attributes to cue their own word-finding. In order to do this, barrier games were introduced in which the child had to guess the words from the SLP's selective cues (in the form of attributes of the word) and had to give cues for the SLP to guess. These activities were designed to increase awareness of word-retrieval processes in general (e.g. what gave the biggest clues?) and which features of a word helped each individual child with retrieval.

The intervention sessions were carried out by the second author with the exception of one child for whom three of the six sessions were with the first author. Both therapists were registered with the UK Health and Care Professions Council and had considerable experience working with children with speech, language and communication needs.

Fidelity

A fidelity checklist included session length, key aspects of the protocol and qualitative aspects of the therapy sessions. The fidelity check was carried out by a student SLP external to the project. Ten intervention sessions were chosen at random from 66 possible sessions (11 children; six sessions each). The average length of the therapy sessions was 22.09 minutes, excluding set-up and clear-up time. In 100% of the sessions, the therapist followed the protocol accurately by helping the child to "think around the word" using (a) word-webs and (b) asking the child to provide features of the target.

The qualitative section of the fidelity check involved evaluating the overall level of engagement and tone of each session in order to assess "quality of delivery" (Caroll et al., 2007). Nine of the ten sessions were rated as 1 – the highest score for engagement, while one session was rated as 3, indicating the child was not very engaged in the therapy. Separately, 8 out 10 sessions were rated as 1 for tone: "Child shows enjoyment and child and therapist work well together". One session received a rating of 2 and one a rating of 3: "Child shows disinterest and is distractible, e.g. the therapist has to remind the child very often to keep the focus on the therapy".

Outcomes and analysis of data

The outcome measure for examining the effectiveness of the intervention was the children's ability to name the 100-picture experimental set. Naming of the experimental set was assessed at the end of the half-term of wait or intervention. Assessments were carried out by a researcher employed at a different institution who was blinded to randomisation and to the nature of the intervention. Responses that were immediately correct or were correct within ten seconds were included in the total correct for each child.

The picture naming scores of the intervention and waiting control groups for the full 100-item set at baseline assessments and at post-test were entered in a mixed factor ANOVA. In order to take a conservative approach and to reduce the variance inherent in pre-therapy testing of word-retrieval, we used the highest pre-intervention score for each child as the pre-test measure. Time was the within-groups factor with two levels (Baseline vs. Post-test) and Group was the between-groups factor (Intervention vs. Waiting Controls). The pre-test to post-test change in naming for the two groups of children on each sub-set was compared using independent

t-tests (1-tailed) and Cohen's *d* was calculated to provide a measure of effect size. The outcomes for the children's personally chosen items are also reported. There was no experimental control for these sets. However, outcomes are important because they set the findings within the clinical context and enable readers to gauge the scale of change for individual children from six sessions of therapy when change on both experimental and personally chosen items is considered. There were no changes to the administration or scoring of the primary outcome and picture naming, after the study commenced.

Result

The results are presented for naming the experimental set of 100 pictures and for the individual subsets followed by change in naming accuracy for the children's personally chosen items. The fidelity check demonstrated that the intervention protocol was followed

Change in naming accuracy for the 100-item set

The individual scores for each assessment are given in Table II. The result of the mixed ANOVA with the 100 items revealed that the effect of group was not significant, $F(1,18) = 1.758$, $p = 0.201$, $\eta_p^2 = 0.089$. The effect of time was significant, $F(1,18) = 4.734$, $p = 0.043$, $\eta_p^2 = 0.208$, with the children naming more pictures correctly at post-test than at pre-test. The interaction of group and time was significant, $F(1,18) = 5.201$, $p = 0.035$, $\eta_p^2 = 0.208$. The interaction was explored with repeated measures *t*-tests looking at the difference in scores between pre- and post-test for the intervention and waiting control groups separately. On average, for the 100 item set the intervention group gained 4.73 items (pre-test mean = 56.91, SD = 7.38, post-test mean = 61.64, SD = 9.34), this contrasts with the waiting control group where there was no numerical gain (pre-test mean = 54.78, SD = 6.85, post-test mean = 54.67, SD =7.95). The effect of time was significant in the case of the intervention group ($t(10) = 2.815$, $p = 0.018$) but not in the case of the control group ($t(8) = 0$ .099, $p = 0.924$).

Table II. Pre- and post-test naming accuracy scores on the 100-item experimental set for the intervention group and the waiting control group.

ID	Group	Baseline 1	Baseline 2	Baseline 3	Post-test
1	I (P)	49	51	54	65
2	I (S)	69	67	62	77
4	I (S)	43	54	52	52
5	I (P)	53	51	54	52
8	I (S)	51	50	56	57
9	I (P)	61	57	60	65
10	I (P)	62	61	68	75
15	I (S)	55	55	56	70
16	I (S)	42	42	40	51
17	I (P)	49	58	55	56
19	I (P)	44	54	54	58
Mean		52.55	54.55	55.55	61.64
SD		8.61	6.47	6.92	9.34
3	C	31	47	41	42
6	C	54	57	56	60
7	C	48	48	46	50
11	C	43	53	47	52
12	C	45	42	38	46
13	C	57	55	62	59
14	C	52	52	58	54
18	C	53	59	59	64
20	C	62	64	64	65
Mean		49.44	53.00	52.33	54.67
SD		9.07	6.71	9.50	7.95

Note: The table provides child's ID, intervention (I) or control group (C) allocation, the former sub-divided according to the nature of the word attributes which formed the focus of therapy P- phonological, S- Semantic. For naming there are three pre-intervention assessments and a single post-test score from immediately after intervention or wait.

Pre- and post-test naming accuracy for individual picture sets

In this section the results for naming the treated, untreated-named and untreated-unseen picture sets are presented (the "treated" items for the waiting control group were those that would be treated after waiting). Since there were different numbers of items in the sets (25 in the treated, 25 in the untreated-named and 50 in the untreated-unseen sets) the results are presented in terms of percent correct. Figure 2 gives pre- and post-test percentages correct for the intervention and waiting control groups, for the treated set, untreated-named set and untreated-unseen set.

The children who received intervention showed a larger improvement on the items in the treated set than the children in the waiting control group. The intervention group mean pre-test score was 13.55 (SD = 1.84) and at post-test it was 19.45 (SD = 3.64), an average gain of 5.90 items. The waiting control group pre-test mean was 12.74 (SD = 1.78) and at post-test it was 14.22 (SD= 2.11), an average gain of 1.48 items. The change in naming on this set differed significantly between the two groups ($t(18) = 4.95$, $p < 0.0001$, $d = 2.30$). Thus on the treated experimental set the intervention group gained four times as many items on average as the waiting control group, a large difference. It was important to investigate whether the change observed in naming accuracy for the intervention group was also found on the untreated named items, in order to be able to ascertain whether the intervention had an effect over and above that of repeated naming attempts. The results for both groups of children revealed little change between pre- and post-test scores on the 25 untreated named pictures (intervention group pre-test mean = 13.42, SD = 1.77, post-test mean = 14.45, SD= 2.38, control group pre-test mean = 12.85, SD= 1.94, post-test mean = 13.56, SD = 3.09). The change in naming this picture set did not differ between the two groups of children

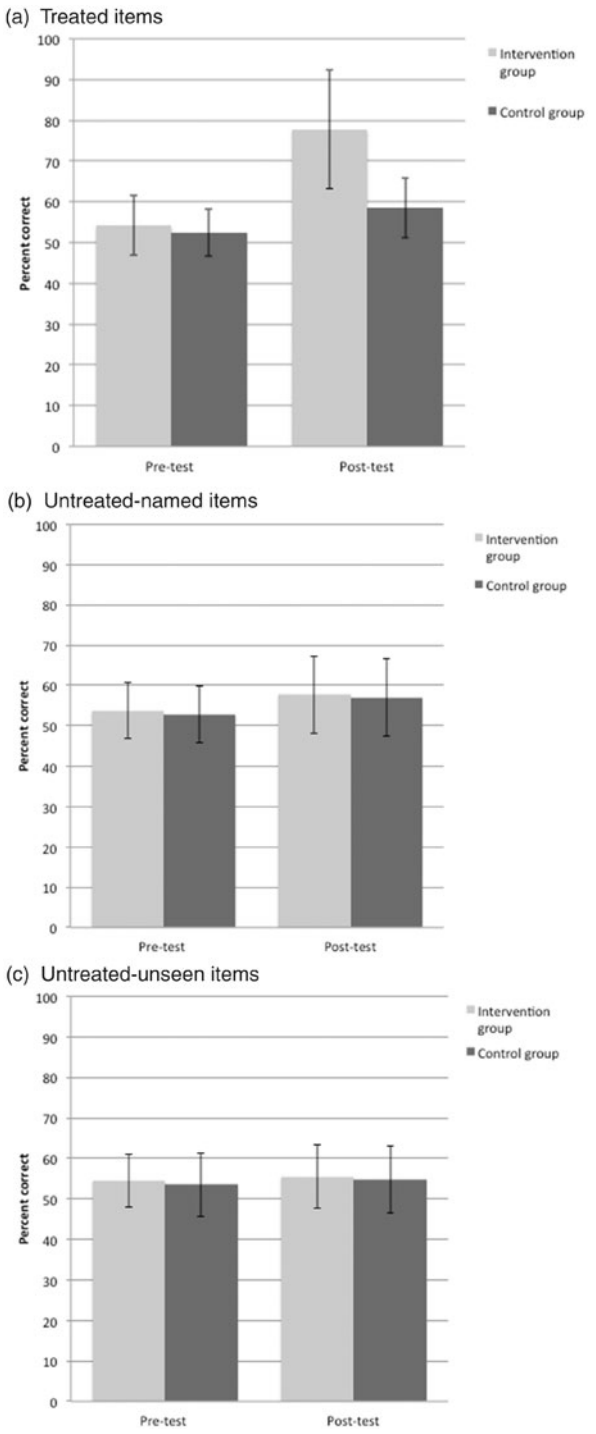

Figure 2. Pre- and post-test mean naming accuracy (percent correct) and standard error bars for the individual picture sets for the intervention and waiting control groups.

($t(18) = 0.43$, $p = 0.335$, $d = 0.195$). Similarly, for the 50 untreated unseen items, only small changes were observed (intervention group pre-test mean = 27.24, SD = 3.27, post-test mean = 27.73, SD = 3.93, control group pre-test mean = 26.00, SD = 4.31, post-test mean =26.89, SD= 4.11). The change in naming this set did not differ significantly between the two groups of children (t (18) = 0.41, $p = 0.345$, $d = 0.185$).

Children's individually chosen items

In addition to the 100 experimental items, 58 individually chosen items had been targeted across the 11 intervention children using the therapy protocol. The number of items chosen per child ranged from four to ten. These items were named incorrectly in the first intervention session. At post-intervention assessment, 35 of the 58 items were named correctly, i.e. a gain of 60% in accuracy.

Discussion

The study was the first randomised control trial to compare the progress of children in intervention and control groups on word-finding in mainstream primary schools. We employed the WORD approach entailing word-webs and meta-cognitive processing within which children reflected on what aided their own word retrieval. The intervention effect was statistically significant, with children in the intervention group gaining in accuracy in naming more than four times as many treated experimental items as the waiting control group. There was very little change for either the intervention or waiting control group on untreated but repeatedly named control pictures or on control pictures that were only employed in the assessment sessions.

The study falls between an exploration of efficacy (intervention under optimal conditions) and effectiveness (testing intervention under clinical conditions; Pring, 2005). While intervention was carried out according to a strict research protocol with reduced flexibility compared to clinical practice, it was delivered by experienced practitioners in a clinically realistic setting and mirrored local practice in terms of duration and intensity for a single half-termly block of therapy.

Participants

Strengths of the study lie in the randomisation of participants and sets of items and the blinded reassessment of children and lack of attrition from either arm. The inclusion of twenty children with language needs makes this a relatively large-scale study within the intervention literature and the largest with children with WFD.

The children who participated all attended mainstream school, and as a group performed as well as the general population on an assessment of non-verbal ability. The majority experienced difficulty in finding words in the context of wider language impairment; language assessment identified a variety of patterns of strengths and needs. This is reflective of the wider literature on WFDs (Messer & Dockrell, 2013). If recruitment had been restricted to those with a narrower profile, such as only children diagnosed with DLD, it would limit the generalisability of the findings. The randomisation resulted in two groups that were well matched for

gender, age and scores on non-verbal and language tests. The intervention group had numerically slightly higher picture naming scores than the control group prior to intervention, but the groups did not differ significantly. A key feature of WFDs, being able to retrieve words on one occasion but not another, is demonstrated by the variability shown by individual children over the baseline phase (Table II). While this is well known clinically, it is not documented in previous research for this number of children.

Improvement in naming the experimental picture sets

The main effect of time in the analysis of naming accuracy for the overall picture set reflects children naming more items at the post-test assessment. The only significant change in accuracy across the time points was for the intervention group who named significantly more items at post-test than at the final baseline assessment. This analysis, including all 100 picture naming stimuli, biased against finding a large effect because only 25 of the items were included in the treatment set, and of these only a portion of items were associated with word-finding difficulties for each child.

Focusing on the 25 treated items, before intervention the children named on average just over half the items. Items children named correctly at the start of intervention sessions were not treated in that session. This means that on average less than 12 items were treated per session. The control children successfully named 5.90 extra items at post-test, while the intervention group named an average of 1.48 more items than at pre-test. This gain of around 50% on treated items is considerable.

Gains were not limited to experimental items, improvement of 60% also occurred on the children's personally chosen words. It is likely that success in retrieving words chosen according to children's individual interests and needs at school will have the most impact on communication, making the inclusion of these additional items of particular clinical relevance. Furthermore, the relative stability on the untreated items suggests improvement on the child's own set is likely to be a result of intervention. However, since there was no experimental control for the personally chosen items, this finding should be interpreted with caution and awaits further research.

While the lack of change on untreated items is in line with extant literature (e.g. Bragard et al., 2012), ideally the children would have shown generalisation to naming of untreated items. This lack of change on a particular set of untreated items presented for naming does not necessarily preclude gains in word-finding in connected speech (Best, 2005). Future studies could explore whether children are able to apply the strategies to their learning and retrieval of new words. It would also be interesting to know whether generalisation to items related in meaning or sound to the treated words occurred. Wilson et al. (2015) conducted an intervention study targeting semantics, including category decisions and semantic questions, e.g. "what do you do with it?". Participants, who had severe and complex speech, language and communication needs, were aged between seven and eleven years. Significant improvement was seen on treated items, as well as on related items (i.e. untreated items from the same semantic category that were not directly targeted, but were nevertheless included in the tasks). Control items (from the untreated category) did not show significant improvement. The authors suggested that in this case the semantic intervention was effective and may generalise across words due to encouraging of fine-grained semantic distinctions and development of children's semantic representations. This was not explored in the current study where the items used to test for generalisation in naming were not systematically related to the target words.

The language representations and processing links activated during the therapy sessions enabled the child to independently retrieve the picture names at reassessment without the word-webs present. This change in retrieval of treated items is likely to reflect the development or strengthening of representations and processes necessary for language production including of the connections between semantic representations and lexical forms for individual words (see, for example, Dell et al., 1997, Goldrick, 2006, McGregor, 1994). Increased activation of targets through repeated retrieval may also have reduced activation of competing words. In the current study, one subset (naming controls) of pictures was presented for naming at the start of each intervention session. As there was no significant improvement on these items that were not included in the word-web intervention, the significant effect for treated items was unlikely to have arisen as a result of simply activating the links between semantic and lexical representations. Instead, change appears to have resulted from other aspects of the intervention. Reflection on aspects of the word's meaning or phonology using the word-webs together with the production of the word form in this context are likely to have produced the therapy effect.

Factors that may have affected the effectiveness of intervention: child variables

The heterogeneity in outcome for the intervention group in this study enabled us to ask preliminary questions about the relationship between background variables and effectiveness of the intervention. Results must be interpreted with care, as they are based on data for only eleven children, but they provide some interesting pointers for further investigation. We examined whether there was any

relationship between children's chronological age and also severity of language difficulties and the extent of improvement in naming. It might be predicted that word-finding would change more for younger children, due to the established benefits of early intervention (Dockrell, Stuart & King, 2004; Stothard, Snowling, Bishop, Chipchase, & Kaplan, 1998) or else for older children who would perhaps be more able to make use of the meta-cognitive strategies available in intervention (Ebbels et al., 2012). Secondly, children with relatively less difficulty acquiring language might be more likely to show change over the study based on emerging evidence linking language impairment with limitations in wider cognitive and verbal memory skills (Baird, Dworzynski, Slonims, & Simonoff, 2010; Lum, Conti-Ramsden, Page, & Ullman, 2012).

We found no significant relationship between age and extent of improvement in naming across the group of children as a whole (Pearson $r = 0.003$). The lack of relationship between age and change in naming overall is perhaps unsurprising, as even the youngest child in the study was 6:0 (child 4). The finding that the three who showed most benefit from the intervention (children 1, 10 and 15 in Table I) were among the oldest in the intervention group confirms that this should be included as a possible predictor of outcome in future studies. In contrast, there was no obvious link between degree of language impairment and change in word retrieval for this sample. From Table I we can see that children can be subdivided by the number of language tests on which they score more than 1.25 SDs below the mean (a widely used criterion for language impairment, e.g. Leonard et al., 2007). Five of the 11 children in the intervention group were in this category on three or on all four language tasks. Of these, three children made large improvements in naming (children 1, 2 and 16). The remaining six children in the intervention group fall more than 1.25 SDs below the mean on only one or two of the language tests. Of these six, two make large improvements in naming (children 10 and 15). Thus, from this small sample, there is no clear relationship between performance on these language tasks and ability to benefit from the WORD intervention.

Factors that may have affected outcome: type of approach, intensity of intervention

Previous research could predict greater effectiveness of an approach that focussed on either semantic or phonological features of target words (Hyde Wright et al., 1993; Wing, 1990). The results of the current study revealed no clear difference in outcome between the semantic and phonological variants of the intervention. Two of the six children whose intervention focussed on phonological attributes made large improvements in naming (child 1 and child 10) and a third made some change (child 19). Three of the five whose intervention focussed on semantic attributes made large improvements (children 2, 15 and 16). However, this factor remains to be investigated since larger numbers may reveal differences. In the forthcoming case series study each child will have taken part in both semantic and phonological interventions, allowing for comparison of the effectiveness of the two. With respect to the current results, as different children may respond optimally to different approaches (Bragard et al., 2012), the inclusion of two different types of intervention biased against our finding a significant intervention effect for the group overall.

The significant improvement occurred after six sessions. It may be the case that ongoing intervention and home practice could lead to further gains. Since independent use of word-finding strategies and metacognitive work were part of the protocol, it seems likely that confidence and proficiency might increase after more use in the child's own environment. However, we did not investigate this in the present study. Previous studies that have reported gains beyond the treated items have involved a longer period of intervention, with children seen more than once a week (e.g. Ebbels et al., 2012; Wing, 1990). The "dosage" necessary for change and for generalisation to untreated items should be explored in future studies.

Limitations

A limitation of the current study is the lack of repeated testing on a standardised outcome measure of word retrieval. Future research should also include a control set of items systematically related to the target words (Wilson et al., 2015).

A closely related study was that conducted by Ebbels et al. (2012), in which older children with DLD participated in semantic therapy. The researchers found improvement for the group overall on a standardised naming task that included very largely untreated items. Looking at the data for the individual participants, only five of the 15 improved on more than three items. The significant effect of intervention was largely due to two participants who made considerable gains of 9 (T2) and 10 (WC5) items. Comparable results for the present study are difficult to determine as we did not re-administer the standardised Test of Word Finding. It would have been inappropriate to re-test after each phase of the longer case-series study, also picture naming was already being assessed on 100 items at each testing point and this is, by definition, not an easy task for the children. In the present study patterns of change in naming for individual children do not universally reflect those for the group. Further detailed analyses, beyond the group analysis required for a RCT, at the level of the individual case, are

important to explore the variation between children.

Conclusion

The findings from our study are potentially generalisable to children meeting the inclusion criteria; that is, those with difficulty in retrieving words that are in their receptive vocabulary, who score within the normal range for comprehension on the TWF-2 and who have no other significant developmental diagnosis. The intervention, carried out over six weeks and employing word-webs, was found to be effective in improving retrieval of treated items. The approach involves encouraging active participation so that children produce or choose features of words and in later sessions reflect on what helps them retrieve words. In the domain of word-finding intervention, the study is the first RCT for children aged 6-8 years and the first involving children attending mainstream school rather than specialist language provision. This is important, as WFDs are a common problem for primary-aged children with language needs. Further studies comparing the effect of this with other approaches to intervention for word-finding difficulties and including multiple phases of intervention will be informative. In addition, further research is necessary to determine whether semantic or phonological approaches are more useful for individual children with different language profiles, and to investigate potentially wider effects, e.g. on children's narrative, conversation and quality of life.

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Supplementary material

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