

Word-finding intervention for children with specific language impairment:

A multiple single-case study

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Abstract*Purpose:*

This study examined the effectiveness of a combined phonological and semantic intervention for children with specific language impairment with word-finding difficulties.

Method:

To evaluate the intervention, a multiple single-case design was implemented with four children, aged 9:6 to 13:9 years, with word-finding difficulties participating. Some items were trained with a phonological intervention while others were trained with a semantic one. Lexical access outcomes were measured using a picture-naming task at pre and post testing.

Results:

Three children exhibited a significant reduction in word-finding difficulties on the intervention words after six sessions. These effects were present at posttest and six months later only for the treated words and not the control words. Each child responded differently to the intervention, and these response patterns seemed to be related to each child's linguistic profile.

Conclusion:

This intervention seemed to achieve long lasting reductions in word-finding difficulties. The differential responses to phonological and semantic intervention imply the need to tailor intervention for differing children, by matching it to their linguistic profile.

Keywords: word-finding difficulties, intervention efficiency, SLI, lexical access

Word-finding intervention for children with specific language impairment:**A multiple single-case study****Introduction**

Interventions for word-finding difficulties (WFDs) for children with specific language impairment (SLI) usually focus on semantics or phonology; separately or together. These interventions reflect hypotheses that impaired underlying semantic and/or phonological representations cause WFDs. This study aims to enrich the understanding of causes of WFDs by considering how children with different linguistic profiles respond to an intervention that combines semantics and phonology.

Intervention focusing on semantics (semantic intervention) assumes that WFDs reflect inadequate or underspecified *semantic representations*. Semantic intervention aims to enhance knowledge of specific word attributes to strengthening the corresponding semantic representation. For example, activities to enrich the concept of a *banana* may focus on developing knowledge about its attributes such as appearance and function. Semantic intervention may also aim to increase interconnections between vocabulary items by developing knowledge of synonymy, antonymy and hyponymy, that is, words of similar and opposite meanings, and how words interrelate, respectively. Such intervention simultaneously develops self-cuing skills (Wing, 1990; Wittman, 1996) as participants can name these attributes whilst retrieving the target word. For example, when a child cannot name a cherry, he or she can self-cue by saying, “It’s round, it’s red, it is a fruit; I’ve got some in my garden....oh yes, it’s a cherry”. Four sources of evidence support semantic intervention. Firstly, children with WFDs are slower and less accurate in naming than their typically developing peers and frequently use semantic substitutions (Dockrell, Messer, & George, 2001). Secondly, their word definitions are less precise, contain fewer information units and

more redundant information than those of their typically developing peers (Dockrell, Messer, George, & Ralli, 2003). Thirdly, they include less information when drawing pictures of words than their typically developing peers do (McGregor & Appel, 2002; McGregor, Newman, Reilly, & Capone, 2002). Finally, semantic intervention that aims to enhance semantic representations decreases response time latency in naming pictures (Bragard & Maillart, 2005).

Intervention focusing on phonology (phonological intervention) assumes that WFDs reflect inadequate or underspecified *phonological representations* of words. Phonological intervention aims to enhance and fortify the underlying representation, by improving phonological awareness or teaching self-cueing through metalinguistic tasks, such as recalling the first sound of the target word (Wing, 1990; Wittman, 1996; Wright, 1993). Two sources of evidence support phonological intervention. Firstly, children with WFDs fail phonological tasks but not semantic ones (Constable, Stackhouse, & Wells, 1997). Faust, Dimitrovsky, and Davidi (1997), using the tip-of-the-tongue paradigm, reported that 14 children with WFDs, aged 7;8 to 8;9 years, provided equivalent semantic information but less phonological information about words they could not correctly retrieve than their typically developing peers. Secondly, phonological intervention seems beneficial. McGregor (1994) reported that two 5-year-olds reduced their phonological and semantic WFDs in response to phonological intervention alone. This intervention developed knowledge of words with regard to their onsets and the number of syllables. Similarly, German (2002) reported that two 8-year-old boys reduced their WFDs in response to phonological intervention that involved metalinguistic reinforcement, phonemic neighbor cues and rehearsal strategies.

Three issues about intervention for children with WFDs remain unanswered. Firstly, as children respond positively to semantic intervention (Bragard & Maillart, 2005), phonological intervention (German, 2002; McGregor, 1994) or both (McGregor & Leonard,

1989; Wing, 1990; Wright, 1993), this leaves open the question of whether both types of intervention are needed or whether one form of intervention can be used. To date, the relative efficiencies of these interventions are unknown because the findings of relevant studies are equivocal. Wing (1990) reported that phonological intervention was effective and semantic intervention was not. Wright, Gorrie, Haynes and Shipman (1993) reported the converse and Wittman (1996) reported that both interventions were equally effective. A second issue is that generalization is limited. Wright (1993) reported improvement on one outcome measure, *the Test of Word Finding* (German, 1989) but not in tasks other than confrontation naming tasks. Best (2005) reported that intervention for five children, aged 6;10 to 10;7 years with WFDs, involving a computerized aid that converted letters to sounds, did not generalize to untrained words. However, two of the five participants showed a significant reduction in WFDs in discourse. Thirdly, intervention gains do not seem to be sustained over time. Wittman (1996), using a self-cuing intervention, reported a marked improvement in naming control and treatment pictures but this improvement was not sustained two months post treatment. Wright (1993) reported that the generalization for confrontation naming tasks was also not sustained after intervention.

One reason that may account for these differences in intervention outcomes and the lack of generalization is the children's differing linguistic profiles. The hypotheses that WFDs reflect speech processing problems in the semantic and/or phonological domains (German, 1984; Lewis & Speake, 1998) implies that intervention should address both these components. Examining the responses of children with different linguistic profiles to an intervention that combines phonology and semantics may help to illuminate (a) the nature of lexical deficits, (b) the different responses to intervention and (c) the variations in maintenance of gains over the long term. The present study aims to do this by addressing the following four questions:

- a) Do children presenting WFDs benefit more from a semantic or a phonological intervention?
- b) If improvement occurs, is it related to the individual child's linguistic profile?
- c) If improvement occurs, are the effects maintained for 6 months?
- d) Does an intervention that incorporates phonological and semantic training help children to generalize to untrained items?

To answer these questions, a multiple single-case study was implemented, with each child acting as his or her own control. One reason for selecting this design was its capacity to isolate the impact of children's individual linguistic profiles on the intervention outcomes.

Method

Participants

Four Belgian, French-speaking children, aged 9;6 to 13;9 years, participated in this study. The inclusion criteria confirming SLI included (a) typical hearing, (b) typical nonverbal cognition indicated by a standard score of more than 85 of the Leiter non verbal intelligence test (Leiter, 1980), (c) no evidence of a pervasive developmental disorder or neurological impairment, as judged by a medical team and (d) confirmed WFDs, based on the judgments of teachers and speech-language pathologists (SLPs). These results are presented in Table 1 along with those of the language evaluation.

WFDs are failures to temporarily access words in the lexicon, despite the speaker knowing the intended word (Dockrell, et al., 2001; German, 1984). WFDs are not stable, as different words are usually affected when the stimulus task is repeated. The indicators of WFDs for this study were (a) *semantic substitutions* (e.g., “piano” instead of “guitar”), (b) *phonological substitutions*, (c) *indeterminate responses* (e.g., “thing”, “stuff”), (d) *visual approximations or unrelated*, (e) *circumlocutions* (e.g., “it’s for war, for launching missiles” in response to a picture of a canon) and (f) *delays* in naming. The teacher’s and SLP’s

judgments of the participants' WFDs were based on their responses to a questionnaire, adapted from Mc Gregor and Windsor's (1996) checklist.

All participants attended special education classes for children with SLI and they continued to receive their usual twice-weekly literacy support during the intervention. The oldest participant, Bastien¹, aged 13;9 years, had weak phonological and lexical abilities, as well as expressive morpho-syntactic difficulties. His WFDs manifested as circumlocutions in his conversation. He began attending a special education class for children with SLI at the age of 9 years, with ongoing language support since then. Alex, the second oldest participant, aged 13;3 years, had severe morpho-syntactic receptive and expressive difficulties. He also had phonological difficulties but was intelligible in conversation. His WFDs were indeterminate responses and semantic substitutions such as saying *pear* for *tomato*. His WFDs, indicated by the discrepancy between his expressive and receptive lexical skills, appeared to have a semantic basis because he failed a semantic judgment task² (experimental task in Bragard & Schelstraete, 2008). He started attending a special education class when he was six-years-old. His language intervention focused on WFDs, morphosyntax and literacy focusing on phonological awareness and sound confusions. Emma, the third oldest participant, aged 12;3 years had severe phonological and morpho-syntactic receptive and

¹ Pseudonyms are used to protect the children's identity.

² A semantic judgment task was used to test semantic representation accuracy. The participants simultaneously looked at a picture and listened to a word, produced by a computer and indicated if they matched. Each word was presented three times: once with the correct picture, such as a dog, once with a semantic distracter, such as wolf and once with an unrelated picture, such as an apple. To pass, participants had to respond correctly to the three presentations.

expressive difficulties. Her conversation was intelligible but was marked by WFDs manifesting as indeterminate responses, circumlocutions and naming delays. Like Alex, her WFDs - indicated by the discrepancy between her expressive and receptive lexical skills- appeared to have a semantic base because she failed the aforementioned semantic judgment task. She started attending a special education class when she was seven-years-old but had been receiving language intervention since she was four-years-old. Her language intervention focused on receptive vocabulary and phonology but not on WFDs. The youngest participant, Charlie, aged 9;6 years, exhibited phonological and morpho-syntactic receptive and expressive difficulties. His conversation was not always intelligible and contained WFDs that were mostly indeterminate responses. The discrepancy between his expressive and receptive lexical skills indicated the presence of WFDs. His WFDs appeared to have a phonological basis because he failed a phonological judgment task³ (experimental task in Bragard & Schelstraete, 2008). Charlie began attending a special education class when he was six-years-old. The goals of his language intervention were receptive and expressive phonology and morphosyntax. Notably, phonological cues helped all the participants to retrieve words.

TABLE 1 ABOUT HERE

The measures

³ The phonological judgment task was used to determine the status of the phonological representation and required the participants to decide if a spoken presentation of a word matched the picture (i.e: [dʒərəv] instead of [dʒərəf] for the picture of a giraffe). This task was presented as a game in which the computer was learning how to speak and the child had to detect its errors.

The first outcome measure was a picture-naming and pointing test (Bragard, Schelstraete, Collette, & Grégoire, 2010). The test contained 80 color photographs that were divided into four subsets of 20 words according to previously determined age of acquisition data (Chalard, Bonin, Meot, Boyer, & Fayol, 2003)⁴. The words were selected to control for two factors affecting picture naming; phonological complexity and word length (Cycowicz, Friedman, Rothstein, & Snodgrass, 1997). Normative data were developed from around 140 children, 20 for each year-of-age within the age range of 7 to 13 years (Bragard, et al., 2010). Picture-naming involved naming pictures displayed on a computer screen, as rapidly as possible. Participants were prompted to say the word after an 8-second delay with its first phoneme, and if this clue did not help, the first syllable, for bi-syllabic words, was supplied. Three scores were determined for each word. The *naming accuracy* score was the tally of correctly named items, each attracting a score of 1. Only the first response participants gave was scored, with any subsequent names ignored. Prompted items were ignored for scoring but this information was coded qualitatively. The second score was the *mean latency time* to name the pictures. The third score was a *classification of the naming error*. The classifications were the aforementioned ones: semantic, phonological, indeterminate, visual or circumlocutions.

The same 80 items were then used for the picture-pointing task, whereby the participants chose the correct picture from five displayed on the computer screen in response to a name presented using a voice recorded on the computer. Four distracters were associated with each target item: a semantic one (e.g., “donkey” for “horse”), a phonological one that

⁴ The first set words are usually acquired before the age of three, the second set between 3;0 to 5;6 years, the third set between 5;7 and 8;6 years, and the last set of 20 words after 8;6 years.

rhymed with the target word (e.g., “house” for “mouse”), a phonological one, beginning with the same sound (e.g., “camera” for “chameleon”) and an unrelated item (e.g., “artichoke” for “pair of compasses”). Sometimes, the distracters were targets for other items. The participants indicated their choice by pressing the key corresponding to it⁵. Two scores were determined for each word. The first score was an *accuracy score* whereby correct items attracted a score of 1. The second scores was a *classification of the pointing error* according to the type of distracter chosen: semantic, phonological-rhyme, phonological-first phoneme, or unrelated.

The picture-naming task was administered at the first and second pretest and at the first and second posttest (Figure 1) whereas the picture-pointing task was only administrated at the first pretest. These measures also served as a secondary confirmation of WFDs at the first administration. To be included in the study, participants had to perform at least 2 standard deviations below the mean on picture-naming (either for naming accuracy or for mean time latency) but had to perform better on the picture-pointing task than on the picture-naming task⁶.

The second outcome was the test of the *specific targeted skills*. The data regarding each participant’s performance were collected before and after each intervention task. This test measured the participants’ improvement on the intervention tasks, described below,

⁵ Five color stickers were placed on the keyboard (letters Q, D, G, J, L on a AZERTY key board), each one corresponding on one picture presented on the screen.

⁶ Results were respectively 65% for the picture-naming task and 91.3% for the picture-pointing task for Emma; 60% and 87.5% for Charlie; 82.5% and 92.5% for Bastien and 66% and 86% for Alex.

whereas the first outcome measure, the picture-naming test, measured more global enhancement in word retrieval.

The intervention

To learn new words, the participants analyzed the phonological form of the word, derived its meaning and connected the two, to establish a representation of the word for storage in the lexicon. The intervention assumed that word learning involves specifying a concept phonologically and semantically (Barrett, 1995) and was then designed to achieve this. Phonological and semantic components were also included because weaknesses in them may cause WFDs (e.g., Constable, et al., 1997; Dockrell, et al., 2003; Faust, et al., 1997; Lewis & Speake, 1998; McGregor & Appel, 2002; McGregor, et al., 2002).

FIGURE 1 ABOUT HERE

Implementation

The study involved five components, outlined in Figure 1. The first, fourth and fifth components were pre- and post-testing sessions and the second and third components were the intervention phases.

The pre-testing comprised two sessions, one week apart, using the picture-naming test to determine the baseline and stability of the participants' picture-naming skills⁷. Their scores

⁷ Whilst the global scores were similar for each participant between the first and the second picture-naming task, qualitative analysis revealed the presence of inconsistent naming: some misnamed pictures were correctly named and other correctly-named pictures subsequently misnamed. Since this study deals with WFD, it seems obvious that some inconsistency would be present, a word-finding difficulty occurring “when a target word is present in a child's receptive vocabulary but the child is unable to produce that word quickly and easily on demand” (Constable, 2001, p. 330).

were stable across the two measurement points because there were no significant differences between them, indicated by the McNemar test ($p=0.48$ for Emma, $p=0.08$ for Charlie, $p=0.27$ for Bastien and $p=0.79$ for Alex)⁸.

The second and third components were the intervention phases; each of five weekly, individual, sessions. The first and last session of each intervention phase was devoted to testing the *specific targeted skills*. The remaining sessions were consecutive, intervention ones, commencing with 15 minutes of phonological intervention followed by 15 minutes of semantic intervention. The same experimenter, the third author, implemented all intervention sessions, ensuring that only phonology intervention occurred in the phonology component and semantic intervention occurred in the semantic component. All the intervention tasks were presented as games, with feedback (described in Appendix A).

The first phase of the phonological intervention focused on phoneme segmentation and the second phase focused on recall of the first phoneme of the word. These tasks were selected because they are associated with greater accuracy in picture naming after training for some children with WFDs (McGregor & Leonard, 1989). As phoneme segmentation is pre-requisite to recalling the first phoneme of a word, it occurred in the first phase. Phoneme segmentation required participants to associate each phoneme of the word with a token, providing visual support. If participants could not name the picked picture, the experimenter supplied the missing word. In the recall of the first phoneme task, participants selected a picture from the stock and then attempted to remember the first phoneme to self-cue. If they could not recall the phoneme name, the grapheme was supplied. If they did not recall a word, the experimenter did not supply the missing word. Rather, to emphasize retrieval, the participants were encouraged to find the word by self-cuing with the first 'letter'.

⁸ Data taken into account for the pretest refers to the ones collected the first time.

The first phase of the semantic intervention was semantic association and the second phase was defining words. These tasks were selected because of the evidence that (a) learning about similarities and differences between semantically related words facilitates word-finding skills (McGregor & Leonard, 1989) and (b) defining words increases vocabulary knowledge (Nash & Snowling, 2006). In the semantic association task, participants selected two pictures and explained how they were associated. For each association using a new semantic attribute, the experimenter placed a picture of the attribute on the table. If the participants could not describe any associations, the experimenter provided some clues to direct the participants' attention to a particular feature. In the word definition task, participants selected a card and defined the illustrated word so the experimenter could guess its identity. Cards illustrating the different attributes the participant used were placed on the table. The experimenter completed the child's explanation, supplying the correct attributes and emphasizing the features that distinguished one item from another (e.g., the back differentiated a chair from a stool).

The fourth and fifth components were post-testing, occurring one week and six months after the completion of intervention. The picture-naming test was used in both sessions.

Intervention pictures

A subset of the items from the 80-item picture naming/pointing outcome measure previously described were used in the intervention, but were colored pictures rather than photographs (Appendix B). All the colored pictures were selected from the pictorial set developed by Rossion and Pourtois (2004) or from the "Père Castor" (1995) set. There were three sets of 24 words; one for phonological intervention, one for semantic intervention, and a control set. A unique feature of the design of this study was the inclusion of these three groups of words because they allowed for determining the impact of the phonology

intervention and the semantic intervention. The first 12 cards from each set was used for the first session of each intervention phase and the second 12 cards from each set was used in the second session of each phase. Both sets of cards were used in the last session in each phase.

Scoring and analyses

Each item from each of the phonological tasks was coded 1 if accurate and 0 if inaccurate. The semantic association items were scored according to the attributes used to associate items. For example, if “cherry” was associated with “tomato” because they were red, 1 point each was credited for “cherry” and “tomato” because this characteristic was relevant for both words. By contrast, if “boot” and “radish” were associated because they were red, 1 point was attributed for the “radish” but nothing for “boot” because not all boots are red. Similarly, the items for the definition task were coded for the number of attributes given (e.g., color, shape, function, size). For example, a participant who defined the word *cherry* “as a little red fruit” obtained a score of 3 because of the relevance of three pieces of information provided (size, color and the semantic category). There was no maximum result for the semantic tasks.

The McNemar test (Siegle, 1956) was used to determine if the differences between pre- and post-testing were significant. This chi square test for matched pairs allows examining for the direction of change between pre- and post-testing. It also indicates the extent to which the observed direction in the change is caused by chance. To ensure that any intervention gains were attributable to increased word retrieval and not to word learning, only correct items for the picture-pointing task were included in statistical analyses, assuming that incorrect response indicated the meaning of the words was not known. The number of items taken into account was then different for each child.

Results

Specific targeted skills

All participants made significant improvements for the *specific targeted skills*, as displayed in Table 2 and confirmed by the McNemar test. All participants made significant progress on the phoneme segmentation task but none improved their retrieval of the first phoneme. Three of the four participants (Emma, Charlie and Bastien) demonstrated significant improvements on semantic associations and all participants improved their skills to define words.

TABLE 2 ABOUT HERE

Picture naming

Number of words correctly named

WFDs significantly decreased for all participants on at least one of the three sets of words, confirmed by the McNemar test and displayed in Table 3. Two participants (Emma and Alex) displayed significant gains on the phonological intervention that were present at both posttests. Two participants (Charlie and Alex) displayed significant gains on the semantic intervention present at both posttests. No participants showed any changes for the control words.

TABLE 3 ABOUT HERE

Response times

None of the participants decreased their response times on the training items between pre and posttest 1, indicated by the McNemar test, and displayed in Table 4. However, two participants (Charlie and Alex) decreased their response times between posttests 1 and 2 on the semantic set.

TABLE 4 ABOUT HERE

Error analysis

The two most frequently occurring error types did not vary in ranking for all participants but the less frequently ones did. However, each participant's individual profile

of errors differed, indicated by changes in the percentage of each error type and/or changes in their rankings, displayed in Table 5. Semantic substitutions increased for three participants but decreased for one whereas the frequency of phonological substitutions did not seem to change. Indeterminate responses decreased for two participants and visual approximations/unrelated errors percentage were variable for all participants. Finally, circumlocutions increased for three participants and decreased for one.

TABLE 5 ABOUT HERE

Emma' profile changed, with semantic substitutions and indeterminate responses decreasing and circumlocutions increasing. The changes in her profile contrasted with those of Charlie's and Alex's, as their semantic substitutions and circumlocutions increased and indeterminate responses decreased, which was a similar pattern to their typically developing, same-aged peers (Bragard, et al., 2010). By contrast, Bastien's profile showed the least change, with the only change being circumlocution decreasing. He showed the opposite error pattern to typically developing children because he used more indeterminate responses than semantic substitutions. Bastien was the participant who made the fewest errors in picture naming.

Discussion

This study examined the effectiveness of an intervention designed to reduce WFDs in SLI, using a multiple single-case design. Four participants with confirmed SLI and WFDs, aged 9 to 13 years, took part. Each of the six intervention sessions commenced with 15 minutes of phonological intervention followed by 15 minutes of semantic intervention. Three participants experienced significantly fewer WFDs on trained words, with maintenance apparent six months later but no generalization to untrained words. The phonology intervention seemed more effective than the semantic intervention for two participants and the converse for one other participant.

Do children presenting WFDs benefit more from a semantic or a phonological training program?

This study indicated that intervention incorporating phonology and semantics was effective in reducing WFDs for three participants. Markers of phonology intervention effectiveness were that all participants significantly improved their phoneme segmentation after three sessions, and Alex and Emma had significantly more accurate picture naming scores for the phonology intervention words. This intervention may have reinforced their phonological representations and strengthened the linkages between the lexical and phonological forms (Best, 2005). If so, this is consistent with the lexical restructuring model that Metsala and Walley (1998) proposed, whereby more richly specified words for phonological representations are more easily accessed. However, there are some indicators implying that the phonology intervention was not effective. Firstly, none of the participants had improved recall of the first phoneme of words. However, this lack of change may reflect ceiling effects because the pretest scores were close to the maximum. Secondly, Charlie and Bastien did not improve naming pictures for the phonology intervention words.

The semantic intervention was effective because three participants made significant improvements on the word association task and all participants made significant gains in defining words. More precise word definitions and the inclusion of more semantic attributes were the indicators of improved word definitions and these may reflect more fully specified semantic representations. Also, Charlie and Alex had significantly better picture naming scores for the semantic intervention words although Emma did not.

Is improvement related to the individual's language profile?

Each participant responded differently to the intervention, suggesting their individual profiles influenced intervention outcomes. Whilst this is so, these response patterns were counter-intuitive because participants with apparently semantically based WFDs, (Emma and

Alex) responded better to the phonology intervention than to the semantic intervention whereas Charlie, with apparently phonologically based WFDs, responded better to the semantic intervention. Bastien appeared to make no changes but this may be an artifact of high pretest scores.

The participants' differential responses to the different tasks support the idea that WFDs occur at varying locations within the speech processing system (Lewis & Speake, 1998; Thomas et al., 2006). They are also consistent with the findings for adults with acquired WFDs (for a review, see Nickels, 1997). Thus, these findings provide further evidence that intervention for WFDs needs to be tailored to individuals' linguistic profiles (McGregor & Leonard, 1995). This points to the need for more research to refine understanding about the causes of WFDs and illuminate why, for example, only some children with underspecified phonological representations also have WFDs (Maillart, 2003). Single case studies lend themselves to investigating this interaction between weak phonological representations and semantic deficits because of its capacity to explore the individual responses (Bragard & Schelstraete, 2007; Bragard, Schelstraete, & Lefèvre, submitted).

Generalization: does training program help children on untrained words?

This intervention did not facilitate generalization because naming the control pictures did not improve for any of the participants. This lack of generalization is consistent with and corroborates findings from other studies (Best, 2005; German, 2002; McGregor, 1994). An area of future research endeavor is to determine whether longer periods of intervention achieve generalization.

Maintenance: do the effects of the intervention remain after 6 months?

This intervention achieved maintenance of gains with effects present six months after intervention ceased. This is a noteworthy finding because it is a longer period than that

reported in other studies of three, four or 10 weeks post intervention (Best, 2005; German, 2002; McGregor & Leonard, 1989). Whilst similar in period to the eight months that Marks and Stokes (2010) reported, it is more robust because no diminution in gains occurred between the post-intervention and follow-up testing whereas Marks and Stokes found one. This stability in gains found in the present study may be attributable to the intervention used but replication of these findings is needed to determine this.

Limitations

The study findings need tempering to account for its limitations. First, the first-phoneme retrieval task showed a ceiling effect, which suggests that a different task should have been used, such as searching for the target word's phonological neighbors in order to facilitate retrieval (McGregor & Leonard, 1995). Related to this point, there was more capacity for changes on the semantic tasks than on the phonological tasks. Secondly, this design does not permit full separation of the effects of phonology intervention from those of the semantic intervention (McGregor & Leonard, 1989). The participants may use a phonological strategy when naming the words in the semantic intervention and vice versa. Nevertheless, Zens (2009) demonstrated that children with SLI who received phonological-awareness intervention prior to semantic intervention were more efficient in learning new words than children who received the interventions in the reverse order. These findings support the choice of providing phonological intervention before semantic intervention. Thirdly, the need to balance the word sets for word length and age of acquisition may have compromised the participants in that the words may not be the ones they use in everyday talking tasks. The fourth limitation relates the focus on picture-naming and not on discourse; the functional setting where WFDs usually occur (McGregor & Leonard, 1995). Future studies could include discourse as an outcome measure, such as that used by Marks and

Stokes (2010). The final weakness was that the assessors were not blind to the participant's status, so this may have influenced the findings.

Clinical implications

Several clinical implications arise from this study. Firstly, this intervention can significantly reduce WFDs after a short period of intervention-six 30-minute sessions- with changes maintained for six months. Secondly, children's linguistic profiles may influence their responses to intervention such that semantic intervention improves phonologically based WFDs and vice-versa. If this relationship stands, it implies that surface level semantic errors do not necessarily imply a semantic deficit (Aubin, Belin, David, & de Partz, 2001; Hillis & Caramazza, 1995) and accounts for some of the results. It accounts for Emma and Alex making more improvement with the phonological intervention than the semantic one when their WFDs were seemingly semantically-based. Charlie exhibited the opposite pattern in that he presented with phonologically based WFDs and only exhibited improvement in the semantic intervention condition. These different responses to intervention indicate the importance of closely monitoring children's responses to intervention. They also indicate the need to work from children's strengths rather than on their weaknesses.

The lack of generalization reported in this and other studies underscores the need to provide intervention on the words that are relevant for the child (McGregor & Leonard, 1995) because if their improvements are confined to words that are treated, they need to be words that are part of the child's repertoire. This underscores the importance of involving the parents in the selection of intervention targets (Best, 2005). It also underscored the need to target a substantial number of words in intervention to help children in their everyday lives (Wright, 1993).

The positive findings are encouraging, particularly the maintenance of gains. They also provide further evidence that the origins of WFDs vary and the need for different

interventions and careful monitoring of progress during intervention. Whilst these findings need future replication, they also indicate some future research directions.

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