Therapy for word finding in aphasia: Working at the syntactic level.

The production of spoken words requires the translation of meaning into sound. Aphasia can disrupt this process. Traditionally therapy for such deficits has targeted semantic and phonological processing with improvements shown in picture naming when therapy targets semantics (e.g. Howard, Patterson, Franklin, Orchard-Lisle, & Morton, 1985) or phonology (e.g. Hickin, Best, Herbert, Howard & Osborne, 2002). However there may be more to spoken word production than this. In order to produce a spoken word it may be necessary to access its syntax. The syntactic or lemma level (Kempen & Huijbers, 1983) forms part of the architecture of current theories of spoken word production (e.g. Levelt, Roelofs & Meyer, 1999). Brain damage may impair this level. A spoken word production deficit arising in neither semantics nor output phonology may be better explained with reference to a lemma level deficit.

We investigated word finding in people with aphasia using a model incorporating three levels of representation: semantic, syntactic and phonological. Using tasks designed specifically for this investigation, we explored possible deficits at the syntactic level. We used a set of count and mass nouns as in English the two types differ in terms of their syntax. Participants were asked to name the items, and to make syntactic judgements. For example, shown a picture of garlic, the person was then asked which determiner combines best with that word, 'some' or 'a'. The study also investigated the effectiveness of therapy targeting noun syntax. We assessed the outcomes of therapy in terms of picture naming and syntactic knowledge.

Method

Participants

MH is a 71 year old woman who sustained a single left hemisphere stroke six years prior to her involvement in this study. AV is a 48 year old woman who sustained a single left hemisphere stroke five years prior to her involvement in the study. Both participants present with a predominantly expressive aphasia with frequent word-finding problems. Spoken output is non-fluent and agrammatic.

Procedure

We investigated knowledge of naming and noun syntax as follows. Participants were presented with pictures of 80 nouns to name (40 count and 40 mass nouns) on a laptop computer. After attempting to name each item they heard and saw 'some' and 'a/an'. They selected the best determiner for that item by pressing the corresponding button on the computer. We completed this assessment at two points prior to therapy, after each of two therapies, and at follow-up six weeks later.

After the assessment phase participants underwent two therapies, each consisting of one session per week for a period of six weeks. In therapy one a subset of the nouns were treated with phonological cues (Figure 1). The person was presented with the picture to name. If they were unable to name it they heard the first phoneme plus schwa. If they remained unable to name it they then heard the first phoneme plus first vowel. If still unable to name it the whole word was presented for repetition.

Insert Figure 1 about here

In therapy two a subset of the nouns was treated with the aim of increasing awareness of the noun's syntax. Participants saw a picture. At the same time they saw and heard a sentence fragment: 'The woman can see'. The written sentence had two spaces to the right of the fragment for the determiner and noun (see Figure 2). In the first two sessions the experimenter said the correct determiner ('some' or 'a/an') and the participant provided the noun. In the third and fourth sessions the participant was given a choice of determiners, and then produced the noun. In the fifth and sixth sessions the participant produced the determiner plus noun to complete the sentence. Items were allocated to sets in the two therapies as shown in Figure 3.

Insert Figure 2 about here

Insert Figure 3 about here

Results

Picture naming plus syntax and phonology judgements.

Both MH and AV present with a deficit in picture naming (see Table 1). They both have mildly impaired semantic processing, and make semantic errors in naming. They can access output phonology from input phonology through word repetition.

Insert Table 1 about here

Table 2 shows production of the set of 80 nouns, and the syntactic judgement data. MH shows a differential impairment for mass nouns. This deficit is mirrored in her syntactic knowledge: she assigned count syntax to most nouns. AV has an equal impairment for mass and count nouns[1]. In the syntax judgement task she showed some impairment for both sets.

Insert Table 2 about here

The data suggest that for both MH and AV there is a mild impairment in processing at the level of semantics and a deficit at the lemma level.

Therapy results

Figures 4 and 5 show the results for both participants for two assessments prior to therapy (A1 and A2), post therapy one (A3), and post therapy two (A4), for both picture naming and syntax judgements.

For MH therapy one was effective leading to gains in picture naming for the set. Viewing the set as a whole there was no improvement after therapy two. After therapy two there was however an improvement in the treated items, and a corresponding deterioration in the untreated items (Figure 6)[2]. MH had a deficit for syntax prior to therapy, selecting count noun syntax on most trials. She made no improvement in this aspect of processing after either the phonological or the syntactic therapy.

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[1] Although mass nouns are slightly more impaired this is not statistically significant (Fisher Exact z=0.58, n.s.)

[2] This finding is similar to that seen in some of the participants described in Herbert Best Hickin Howard and Osborne (2003) which also occurred in the context of two consecutive therapies being applied to one set of items.

For AV phonological therapy was effective leading to gains in picture naming. Since she reached ceiling with this set after therapy one, there was no room for a further therapy effect, although the effect of therapy one was maintained. Of great interest is the change shown in syntactic judgements after therapy two (syntactic therapy). There was no improvement in this task after therapy one, where syntax was not targeted, but a significant change after therapy two (Jonckheere Trend Test: $z = 3.5$, $p<0.001$).

Discussion

The two participants with aphasia present with word finding difficulties. They both have a mild semantic impairment, but good access to output phonology from input phonology. They both show impaired syntactic knowledge of nouns. The likely source of the word finding deficit in both cases is a mild semantic and a more severe syntactic impairment. Both participants responded to the phonological cueing therapy, providing further evidence of relatively preserved processing at this level.

After the syntactic therapy MH showed an improvement in items treated but this was offset by losses in those left untreated. Her syntactic knowledge of nouns did not improve. This evidence supports the claim that MH has a severe syntactic impairment for nouns. Her noun production can be cued by syntax, but the therapy could not restore the syntax itself. It may be that more intensive therapy may be necessary.

AV was at ceiling on naming the noun set prior to undertaking therapy two, thus naming could not improve. AV's syntactic knowledge improved significantly. This indicates that a syntactic deficit can be effectively remediated, but that it may be necessary to treat it only in the context of nouns whose phonological forms are already available to the participant. Remediation of noun syntax potentially affects noun retrieval in connected speech. Further analyses are underway to identify the effects of the therapies on conversation.

References

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Table 1. Language assessment results for MH and AV

Task	MH	AV
Picture naming		
All pictures (n=80)	0.39	0.84
Predominant error type	semantic	semantic
Semantic processing		
Word to picture matching: spoken (CAT) (n=30)	0.93	0.90
Word to picture matching written (CAT) (n=30)	0.83	0.90
Pyramids and Palm Trees three pictures (n=52)	0.92	0.98
Phonological output		
Reading aloud words (n=182)	0.54	0.74
Reading non words aloud (n=26)	0.00	0.04
Repetition words (n=182)	0.94	0.98
Repetition non words (n=26)	0.50	0.81

Table 1 shows participants performance on the following tests: CAT (Comprehensive Aphasia Test: Swinburn, Porter & Howard, 2004); Pyramids and Palm Trees (Howard & Patterson, 1992).The remaining assessments are unpublished.

Table 2. Picture naming and syntax test results for MH and AV

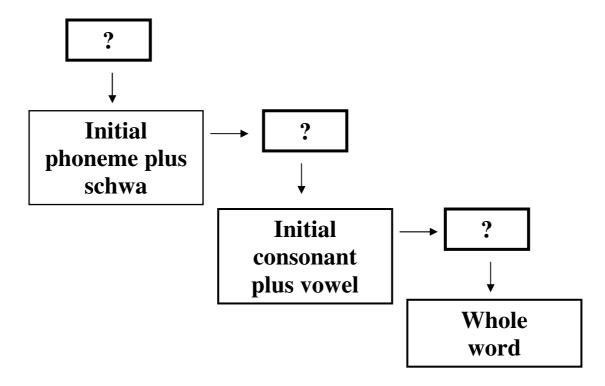| Task	MH	AV
Picture naming		
All pictures (n=80)	0.39	0.84
Subset count nouns (n=40)	0.48	0.86
Subset mass nouns (n=40)	0.30	0.79
Syntactic knowledge		
All pictures (n=80)	0.54	0.64
Subset count nouns (n=40)	0.81	0.65
Subset mass nouns (n=40)	0.26	0.64

The picture naming set consists of 80 nouns, 40 count and 40 mass, matched for concreteness, imageability, age of acquisition, frequency, familiarity, word length. No animate items are included in either set.

Figure Captions

Figure 1. Procedure for administration of therapy one

Figure 2. Cue format for therapy two

Figure 3. Allocation of items to sets for therapy one and therapy two

Figure 4. Therapy results for MH overall (n=80). Number of items correct pre therapy (A1 and A2), post therapy one (A3) and post therapy two (A4).

Figure 5. Therapy results for AV overall (n=80). Number of items correct pre therapy (A1 and A2), post therapy one (A3) and post therapy two (A4).

Figure 6. Therapy two results for treated and untreated sets for MH (n=40 per set), at pre therapy two (A3) and post therapy two (A4).

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Initial phoneme plus schwa → **?**

↓

Initial consonant plus vowel → **?**

↓

Whole word

The woman can see

some

a

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                        ┌─────────────────┐
                        │   80 PICTURES   │
                        └─────────────────┘
                         ╱               ╲
                        ╱                 ╲
                 Therapy One              ╲
                    ╱                       ╲
   ┌──────────────────────┐        ┌──────────────────────┐
   │     40 TREATED       │        │    40 UNTREATED      │
   └──────────────────────┘        └──────────────────────┘
        ╱        ╲                       ╱        ╲
       ╱          ╲     Therapy Two     ╱          ╲
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│ 20 Treated │ │ 20 Untreated │ │ 20 Treated │ │ 20 Untreated │
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