PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY B

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Review

Cite this article: Marshall CR. 2014 Word production errors in children with developmental language impairments. *Phil. Trans. R. Soc. B* **369**: 20120389.
http://dx.doi.org/10.1098/rstb.2012.0389

One contribution of 17 to a Discussion Meeting Issue 'Language in developmental and acquired disorders: converging evidence for models of language representation in the brain'.

Subject Areas:
cognition

Keywords:
word production, specific language impairment, lexical retrieval, derivational morphology, nonword repetition, British sign language

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Royal Society Publishing

Word production errors in children with developmental language impairments

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This review focuses on the errors that children with developmental language impairments make on three types of word production tasks: lexical retrieval, the elicitation of derivationally complex forms and the repetition of non-sense forms. The studies discussed in this review come principally from children with specific language impairment, and from children who are English-speakers or deaf users of British sign language. It is argued that models of word production need to be able to account for the data presented here, and need to have explanatory power across both modalities (i.e. speech and sign).

1. Introduction

The average English-speaking child produces their first word at around 10–12 months of age, and by 16 months has a productive lexicon of around 40 words and understands around 150 [1]. However, individual children vary considerably: children at the 10th percentile produce only around 10 words at 16 months, whereas those at the 90th percentile produce around 180 [1]. Children with developmental language impairments are likely to be at the low end of this variation [2]. An extreme case, a boy with grammatical-specific language impairment (SLI), is reported as producing just three words at the age of 5 [3].

Not only do children with developmental language impairments tend to know fewer words, but they also have limited depth of word knowledge, as measured, for example, by the amount of information that they give when defining words [4] and by the number of semantically related answers in word association tasks [5]. Furthermore, as Nation [6] demonstrates in her paper, children with developmental language impairments are likely to have difficulties learning new words and difficulties with spoken word recognition.

This review focuses on how children with developmental language impairments *produce* words, whereby 'words' comprise both real-words and novel-word forms. Real words can, in turn, be morphologically simple or complex (either through inflection, i.e. modification of the word to indicate grammatical information, e.g. *run* → *runs*, or derivation, i.e. modification to create a new word, e.g. *run* → *runner*). Both real and novel words can be phonologically simple or contain complex phonological structures (such as consonant clusters).

It has been argued that no existing models of word production are developmental in nature [7], and this review does not seek to present a new model. Instead, the aim of this review is to discuss examples of the sorts of developmental data that models of word production need to be able to account for. Just as word production errors in aphasic adults are valuable for testing models of word production (discussed by Schwartz [8]), so too are error data from children with language impairments. In turn, better models of word production can help us to better understand the nature of language impairments [7]. The studies discussed here come principally from children with SLI. The participants in these studies are, unless specified otherwise, hearing children who speak English or deaf children who use British sign language (BSL).

One of the most important findings of the past few decades of research on human languages is that the sign languages used by deaf communities are natural languages with their own grammars and, despite being produced in a different modality to spoken languages, they have an abstract level of phonological organization [9]. Also of note is that signs are processed by the same

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neural systems as spoken languages [10]. Given that SLI has been identified across so many different spoken languages, an obvious question is whether it can also be identified in sign languages. Only in the last few years has work been carried out to explore this issue, in two unrelated sign languages, American sign language [11] and BSL [12]. The linguistic characteristics of deaf children with SLI have been most fully investigated in BSL, even though this work is in its infancy compared with the work that has been carried out in spoken languages. Nevertheless, two studies of word production in children who have SLI in BSL will be discussed in this review.

Examples of word production errors made by children with SLI include

— 'The boy climb up' (Boy with SLI, aged 11;2, in the context of a narrative elicitation task; target verb form: 'climbed' [3].)
— 'Mouse in wheel (gesture: scurrying action) . . . you know . . . (delay of seven seconds) . . . hamster' (Deaf girl with SLI in her signing, aged 14;10, in the context of a semantic fluency task in BSL [13].)
— 'Mudder' (Boy with SLI, aged 10;9, in the context of a task eliciting derived forms; target: 'muddier' [14].)
— 'Frillsy' (Boy with SLI, aged 9;9 in the context of a task eliciting derived forms; target: 'frilly' [14].)
— 'Flebitis' (*'flɛbɪtɪs*; Boy with SLI, aged 12;8, in the context of a nonword repetition test; target: 'feblitist' (*'fɛblɪtɪst*) [15].).

This review does not cover the first type of error, i.e. the errors of suffix omission that are so characteristic of regular past tense verb production in children with SLI, at least in English; Bishop [16] covers those errors in her paper. Section 2 of this review presents studies of lexical retrieval, including a study of semantic fluency in BSL, §3, studies of derivational morphology, and §4, studies of nonword and non-*sign* repetition. Section 5 summarizes some of the issues with respect to models of word production that are raised by the studies presented in §§2–4.

2. Lexical retrieval errors

Hesitations, pauses and circumlocutions are all reported in the spontaneous speech of children with SLI [17]. Furthermore, unspecific, general purpose words are overused [17], and this is particularly the case for verbs, with an over-reliance on items such as 'get', 'put', 'make' and 'do' [18]. These verbs are all frequent in the input, phonologically simple, and non-specific with respect to their semantics, characteristics that could aid retrieval. A child might say, for example, 'I have to make names' instead of 'I have to write names', even when he has 'write' in his lexicon and has used it accurately in other sentences [18].

In picture-naming tasks, many studies have revealed that children with SLI are less accurate than their typically developing peers [17,19–21]. Compared with typically developing children, children with SLI produce more phonological and semantic errors (i.e. words that sound similar or are related in meaning to the target [19], and more 'no response' errors [22]). They also name pictures more slowly [23].

As Schwartz [8] discusses in her paper, models of word production invoke two discrete, serial stages: selection of a word ('lemma') from the mental lexicon, followed by selection of the phonological form that goes with the lemma. Hence, slow retrieval and retrieval errors can theoretically arise from selection of either the lemma or the phonological form (or, indeed, both). In practice, however, it is not always straightforward to determine whether naming errors arise from an underlying semantic or phonological deficit.

Several researchers have claimed that the naming impairment is semantic in origin. For example, McGregor *et al*. [4,20] have found that children with SLI produce less detailed drawings, and give poorer definitions, of lexical items and they interpret these results as revealing that children with SLI have limited semantic knowledge. Seiger-Gardner and Schwartz used a very different type of methodology, cross-modal picture–word interference, whereby children have to name pictures as quickly as they can while ignoring the phonologically and semantically related interfering words that are presented auditorally before the onset of the picture, at the same time as the picture, or after the onset of the picture. They actually found very similar patterns of lexical access in typically developing children and children with SLI [21]. Both groups exhibited early semantic and phonological inhibition effects followed by later phonological facilitation effects. However, word retrieval in children with SLI was inhibited by semantically interfering words presented after the onset of the picture, which the authors interpreted as resulting from a slow decay rate of semantic alternatives or inadequate/inefficient suppression of semantic alternatives.

Other researchers claim that the naming impairment is phonological in origin. In a study of Hebrew-speaking children with language disabilities, Faust *et al*. [17] examined 'tips of the tongue' in a picture-naming task. Children with language disabilities did not differ from typically developing children in the amount of semantic information that they were able to provide for the words that they could not retrieve. Nevertheless, they provided less accurate phonological information for such words (for example, providing the wrong initial phoneme). The authors argued that as well as supporting a two-stage model of word retrieval, their results supported a phonological cause of naming errors. More recent evidence that poor phonology affects lexical retrieval comes from a study showing phonological effects on rapid naming, whereas phonotactic frequency has no effect on the naming of typically developing children, children with SLI are slower to name words with rarer sequences of sounds [24].

Another type of word-retrieval task is semantic fluency, in which participants generate items from a particular semantic category, for example, 'animals', in a limited period of time (usually 1 min). This is a different task to picture-naming, because there is no one correct target answer—any lexical items that belong to the target category are accepted as correct. Furthermore, the task also reveals how lexical items are semantically and phonologically linked. A great many studies carried out with a range of child and adult populations, and in a variety of spoken languages, have demonstrated that lexical items are retrieved during the course of the minute in characteristic ways (see [13] for a summary of previous studies). Words are produced in temporal bursts, within which items tend to be semantically related ('clusters'). For example, to the category 'animals', people might produce 'dog', 'cat', 'horse', 'sheep', 'cow', 'goat', 'hen', 'duck', 'whale', 'shark', etc., with identifiable clusters of pets, farm mammals, farm birds and water animals. The number of responses declines over course of the minute, with most items being produced in the first quadrant of the minute (i.e. the first 15 s) and fewest in the final quadrant.

Semantic fluency has been less well-studied in children with SLI than picture-naming. In one study, Weckerly *et al.* [25] found that children with SLI produced fewer responses compared with controls (18 versus 21). However, their clusters were of the same size, which Weckerly and co-workers interpreted as indicating that the underlying organization of the lexicon did not differ between the two groups, and that the groups were equally efficient in terms of their access to semantic knowledge. For a different group of children, those with word-finding difficulties, Messer & Dockrell [26] report very low semantic fluency scores compared with typically developing children. The children with word-finding difficulties did, however, score within the average range on phonological tasks, leading the authors to argue that their poor semantic fluency performance resulted from a semantic processing or semantic representational deficit rather than a phonological deficit.

Marshall *et al.* [13] published the first semantic fluency study in signers, using the categories 'animals' and 'food'. They tested two groups of deaf children: those with typically developing BSL skills, and those with SLI in their BSL. The deaf children with SLI performed very similarly to those without, on measures such as the overall number of items produced, the number of errors (i.e. repeated items; items from the wrong category) and the number and size of clusters. For the 'animals' category, for example, they produced the same clustering of animals around subcategories such as pets, farm animals and water animals as the control children.

There were, however, two differences between the two groups. The group with SLI was slower at producing responses in the first 15 s compared with the group without SLI (an average of six signs for the SLI group and eight for the controls), and they also produced some word-finding errors (which none of the control group produced). For example, one child signed 'orange but not horse', and never found the correct sign for the animal she was searching for. Another child signed 'mouse in wheel', gestured a scurrying action, signed to the researcher 'you know', and seven seconds later retrieved the sign 'hamster'. In a different type of error, a third child with SLI produced the sign for 'egg', which is generally fingerspelt in BSL as 'egg' using the manual alphabet, but which he produced instead as 'ggee', due perhaps to unfamiliarity either with the overall shape of the fingerspelt sign or with the orthography of the English word.

Marshall *et al.*'s [13] interpretation of these data is that the organization of animal and food items in the deaf signers with SLI is not appreciably different to that of the control signers, but that these children access signs less efficiently. Whether this is due to slower access to the lemma, or to less efficient mapping from the semantic to the phonological form of the sign, resulting in slower or unsuccessful retrieval of the phonological form, is not yet clear. What is clear is that some of the deaf children with sign SLI had sign-finding difficulties, which is consistent with the overlap between SLI and word-finding difficulties in hearing children as reported by other researchers [26,27].

Given similarities between lexical retrieval in speech and sign, and given the existence of sign-finding difficulties in deaf children with SLI, it appears that models of word production need to be able to account for the production of both spoken words and manual signs, even though lexical items are articulated differently in those two modalities. I would go further and venture that models also need to take gesture into account, given that gesture facilitates lexical retrieval (see [28] for a review of this area and a model). Certainly, in children's early language development, gesture production and word production are closely linked, with single gestures emerging before single words, and combinations of gesture + word emerging before combinations of two words (see [29] for a review). There is little work on gesture in children with SLI. However, one study has shown that they are more likely to gesture in Piagetian conservation tasks compared with typically developing controls, demonstrating that they understood concepts such as height and width even if they did not know or could not retrieve the spoken word, and that they were able to create gestures on the fly to communicate this information [30]. The multi-modality of communication cannot be ignored.

3. Errors of derivational morphology

There has been considerably less exploration of derivational morphology compared with inflectional morphology, both in language development generally and with respect to children with developmental language disorders more specifically. This is despite the undeniable importance of derivational morphology for language development in later childhood and adolescence [31], and in particular for the learning of specialized, academic vocabulary [32].

In typical development, children start to acquire derivation at an older age than inflection [33], and they are later to use it productively [34]. Many factors influence the rate of acquisition of suffixes, including frequency, semantic complexity, allomorphy and the existence of irregularity [35]. Because derivational suffixes are more irregular and constrained, and the relationship between form and meaning is often less transparent, they are applied less consistently than inflections. For derivational morphemes, exposure to written language plays a significant role in acquisition [36].

Although inflectional suffixes are often omitted by English-speaking children with SLI [37,38], it appears that certain productive derivational suffixes are not omitted, at least in elicitation tasks. Marshall & van der Lely [14] found that children with SLI aged 9 years and above did not omit comparative *-er* (e.g. 'short' → 'shorter'), superlative *-est* ('short' → 'shortest') or derivational *-y* (which forms adjectives from nouns, e.g. 'sand' → 'sandy').

Children with SLI did, however, produce non-target forms with all those suffixes. On occasions, they truncated the stem in target forms such as 'muddier' and 'muddiest', so that a two-syllable form resulted, e.g. 'mudder' and 'muddest'. Marshall & van der Lely [14] interpreted this as an example of the maximal word constraint (which limits outputs to a two-syllable form [39]) acting on word production. The maximal word constraint also acted to reduce three-syllable comparative and superlative word-forms produced by younger typically developing controls, but these children achieved two-syllable forms in a different way, by omitting the suffix (e.g. 'muddy' remained 'muddy'). In other words, the pressure to limit the output to a two-syllable form was present in both groups, but the groups responded differently. For the group with SLI, the favoured strategy was to truncate the stem and retain the suffix, whereas for typically developing children the favoured strategy was to omit the suffix and retain the stem-final weak syllable. Therefore, comparative and superlative suffixes are more vulnerable to omission in typically developing children (in this study, aged 4;06–6;11) than they are in older children with SLI (aged 9;10–16;08, mean age 12;01).

Non-target forms were also produced in Marshall and van der Lely's *-y* elicitation task, where the child was shown a picture and given a lead-in sentence, such as 'This fish has lots of scales. This fish is very . . . ' (with the aim of eliciting 'scaly'). Children with SLI sometimes included the plural inflection *-s* inside their *-y* forms (e.g. 'scalesy', 'frillsy', 'holesy'). Not all children made this type of error (only four out of 12 did), and the overall percentage of such errors in the SLI group was low (just over 8%), but nevertheless significantly higher than for language-matched controls (below 2%). Marshall & van der Lely [14] interpreted their results as suggesting that children do not always correctly analyse the plural input as being morphologically complex, and so do not strip off the *-s* suffix before adding *-y*.

Related data come from a study by van der Lely and Christian, who elicited compound forms (e.g. *mouse-eater*, *rat-eater*) from children with SLI and language-matched typically developing children [40]. Typically developing children, when told that a puppet ate rats, for example, hardly ever called it a 'rats-eater', and used instead the singular form of the noun, 'rat-eater'. By contrast, the children with SLI in that study used the plural form, 'rats-eater', approximately 35% of the time. Both groups, however, called a puppet who ate mice a 'mice-eater'. Hence, the typically developing children followed the same pattern as adult English-speakers in not allowing inflectional suffixes inside of compounding (but allowing *ir*regular plurals there, e.g. 'mice' in 'mice-eater'), but the children with SLI did not follow that constraint. Oetting & Rice [41] carried out a similar study, although they found that a smaller proportion of children with SLI (three out of 14, 21%; compared with 14/16, 88%, in van der Lely & Christian's study) produced the 'rats-eater' form.

Both van der Lely & Christian [40] and Marshall & van der Lely [14] interpreted their data as indicating a difficulty at the level of inflectional morphology rather than with compounding or derivational morphology *per se*. Furthermore, the errors in both tasks (i.e. 'scalesy' and 'rats-eater') were interpreted within a model that makes a distinction between 'words' and 'rules' and claims that words with irregular morphology are stored in the lexicon ('words'), whereas regularly inflected forms are created de novo by rule [42,43]. These two different word production systems are in turn claimed to be underpinned by two different memory systems, namely declarative and procedural memory [44]. The availability of inflected plural forms for derivation and compounding is consistent with children with SLI preferentially relying on declarative memory to compensate for a deficit in procedural memory and therefore retrieving stored regular plural forms from the lexicon [45].

4. Nonword and non-sign repetition

Nonword repetition requires the encoding, storage and retrieval of phonological representations such as 'perplisteronk' and 'blonterstaping', which have no meaning. The task therefore taps phonological and motoric aspects of word production, independent of semantics [46]. A marked impairment in nonword repetition is characteristic of SLI [47]. Children with dyslexia likewise find this task difficult [48], as do children with autism [49].

Although a link between nonword repetition and word-learning has been proposed, and poor nonword repetition is a plausible constraint on word-learning (see [50] for a review), the ability of young children's nonword repetition scores to predict word-learning at later ages has been disputed [51]. Nor is nonword repetition as strong a predictor of later grammatical morpheme production as was initially proposed [52]. Nevertheless, nonword repetition scores are strongly correlated with *concurrent* receptive vocabulary [51] and grammatical morpheme production scores [52], so the nature of these relationships remains uncertain.

Traditionally, studies of nonword repetition in children with SLI have focused on manipulating the number of syllables in nonwords and have replicated Gathercole and Baddeley's [47] classic finding of a particular difficulty repeating longer, i.e. three- or four-syllable, nonwords. Those authors argued that a limited short-term memory capacity in children with SLI explained their findings [47]. However, nonword repetition involves, in addition to short-term memory, phonological skills such as speech perception, phonological encoding, phonological assembly and articulation, each of which can be impaired in children with SLI [53]. Recently, studies have begun to investigate not just the amount of phonological material that children are able (or unable) to repeat, but how the actual structure of that material influences production accuracy [54–56].

Marshall & van der Lely [55] devised a set of three-syllable nonwords, each of which contained an onset cluster. The cluster was either located word-initially (e.g. 'kletafa' (*'klɛtəfə*)), or word medially (e.g. 'fakleta' (*fə'klɛtə*)), and either in a stressed syllable or in an unstressed syllable. They found that children with SLI, dyslexia, and comorbid SLI + dyslexia (all mean age 11 years) all repeated the cluster less accurately when it was word medial than when it was word initial, even though for younger typically developing children there was no such positional disadvantage. Intriguingly, the pattern with respect to stress was different for children with SLI and those with dyslexia and SLI + dyslexia. The latter two groups repeated onset clusters less accurately in unstressed (i.e. weak) syllables compared with stressed (i.e. strong) syllables, but stress had no effect of production accuracy in children with just SLI or in typically developing children.

Given the considerable heterogeneity in the SLI population, the replication of results—particularly when group sizes are small—is critical. Williams *et al.* [15] repeated Marshall and van der Lely's study using a larger set of three-syllable nonwords, and with an additional set of four-syllable nonwords, all of contained an onset cluster that was located either word initially or word-medially. In addition to a new group of children with SLI (mean age 12 years), they tested a group with autism spectrum disorder + language impairment (mean age 12 years) and a group of verbal mental-age-matched control children (mean age 6 years). This time there was a main effect of word position across all three groups—the SLI and control groups both repeated medial clusters less accurately than initial clusters, and this comparison was marginally significant for the ASD + LI group. However, there was also a group × position interaction. None of the groups differed in their ability to repeat initial clusters (which they did with about 90%

accuracy). By contrast, they differed in their ability to repeat medial clusters, with the SLI group (approx. 50% accuracy) being significantly less accurate than the ASD + LI and control group (approx. 80% accuracy for both). This study therefore succeeded in replicating the word position effect on the accuracy of cluster production in children with SLI.

The studies by Marshall & van der Lely [55] and Williams *et al.* [15] not only considered errors on the target cluster, but also considered errors where a cluster had been created elsewhere in the nonword. For example, a nonword such as 'flebitist' (*'flɛbɪtɪst*) was on occasion repeated as 'feblitist' (*'fɛblɪtɪst*; with a medial rather than an initial cluster), and a nonword such as 'feblitist' (*'fɛblɪtɪst*) was on occasion repeated as 'flebitist' (*'flɛbɪtɪst*; with an initial rather than a medial cluster). Marshall and van der Lely found that for all the groups in their study—SLI + dyslexia, SLI and dyslexia, as well as typically developing controls, the latter error—i.e. the production of the cluster word-initially instead of in word-medial position—was more common than the reverse, and was particularly common in the children with SLI [55]. Williams *et al.* [15] also found that children with SLI created new clusters more frequently than children with ASD + LI and their language-matched controls, although they did not compare whether clusters were more likely to be created initially or medially.

Together, the results of these two studies are not consistent with the locus of the nonword repetition difficulties in children with SLI lying in perception or articulation. Children would not be expected to create clusters if they were unable to perceive clusters in the nonword or were attempting to avoid clusters because of their articulatorily challenges (see Archibald *et al.* [46] for a discussion of the limited contribution of articulatory difficulties to poor nonword repetition). Instead, the results are more consistent with a difficulty at the level of phonological representations [57]. This interpretation is in turn consistent with the phonological errors that children with SLI make on a different task, novel-word learning. Ellis Weismer and Hesketh taught children with SLI novel words that were either CVC or CVCC in shape (where C = consonant and V = vowel [58]). They found that children with SLI made more errors to the phonological structure of these novel words than did typically developing controls, but found that errors did not invariably decrease syllabic complexity (e.g. 'koob' produced as 'koo', i.e. CVC → CV) but on occasion increased it too (e.g. 'koob' produced as 'kroob', i.e. CVC → CCVC).

The word production mechanisms that might account for these patterns are not yet known. However, it *is* well-known that, cross-linguistically, word-initial and stressed positions allow a large number of phonological contrasts and resist phonological simplification—they are what are termed 'strong' positions. Word-medial and unstressed positions are both cross-linguistically 'weak', in that they allow a smaller number of contrasts and are more likely to yield to phonological simplification. However, it has been argued that strong positions gain their strength for different reasons: initial positions are *psycholinguistically* strong (they are the most important part of the word in lexical access) and stressed positions are *phonetically* strong (in English, stressed syllables are more prominent than unstressed syllables because they have increased pitch, duration and volume relative to neighbouring syllables, and full vowel quality) [58]. Hence, it is not surprising that complex phonological structures, including onset clusters, are more error-prone in word-medial and unstressed syllables.

It is not known whether cluster location effects found in nonword repetition would also influence the accuracy of *real*-word production. However, it seems likely that they would do, because other phonological similarities between nonword and real-word production have been documented. For example, Roy & Chiat [60] found that typically developing 2- to 4-year olds, when repeating both real-words and nonwords, omitted large numbers of unstressed syllables, particularly when those unstressed syllables occurred before a strong syllable (i.e. a weak–strong pattern; 'machine' → 'chine'; 'banana' → 'nana'; 'balloon' → 'boon'). Such a pattern of syllable omission is also known to affect young children's spontaneous word production (e.g. 'broccoli' → 'bocci'; 'giraffe' → 'raffe' [39]). In follow-up work, using the same test of real-word and nonword repetition, Chiat & Roy [60] found that these syllable omission patterns were even more evident in 2- to 4-year olds with language impairment. The relationship between phonological accuracy in nonword repetition and in real-word production in children with different developmental language impairments still requires further investigation.

An equivalent task to nonword repetition in sign languages is non-*sign* repetition. Given that nonword repetition tasks tap phonological representations and phonological processing, an obvious question is whether sign languages have a phonology. Despite not using speech as the medium of transmission, sign languages do indeed have a phonology, where phonology is taken to mean 'the level of linguistic structure that organizes the medium through which language is transmitted' [9, p. 114]. Signs consist of three basic phonological categories or 'parameters': handshape, movement and location [9]. These terms are fairly self-explanatory. 'Handshape' denotes the particular shape that a hand makes in a sign, and handshapes vary in the number of fingers that are selected and how those fingers are flexed or extended. There are two classes of movement—'path' movements, which involve movement of the hand and arm, and 'hand-internal' (sometimes termed 'local') movements, which involve just the fingers or wrist. Signs have to contain either a path movement, and internal movement, or both. Signs can be produced in a neutral location in front of the signer, or on the non-dominant hand, face or torso.

Just as nonwords are created by combining phonemes into sequences that are allowable in that particular language but those sequences are meaningless, so the same can be done for sign languages: combinations of the different phonological parameters, handshapes, locations and movements, can be assembled which are meaningless in the particular sign language being investigated, but which phonologically could be real signs. Mann *et al.* [62] created such a test, consisting of 40 non-signs, for BSL, and did so by creating non-signs that varied in handshape and which contained either a single path or internal movement, or which contained two movements.

Despite predicting that deaf signing children with SLI would find non-sign repetition very difficult (given the challenge of nonword repetition tasks for hearing children with SLI), only four of the 13 children tested by Mason *et al.* [12] actually performed worse than 1 s.d. below the mean for their age. The task was not as challenging as expected. Errors were identical to those found in typically developing deaf children, namely simplifications of handshape and deletion of a movement in a two-movement sign [62]. The unexpected findings were interpreted by Marshall *et al.* [63] as being owing to task difficulty, which resulted in low means and large standard deviations even for deaf children with typically developing signing skills, and therefore which made detecting impaired performance more difficult than in the case in spoken nonword tasks (which are easy for typically developing children). In turn, Marshall *et al.* [63] explained this as being due to the greater phonological unpredictability of sign phonotactics compared with spoken language phonotactics, which places a greater load on short-term memory for meaningless signed material.

5. Conclusion

The aim of this paper has been to discuss some of the data from children with language impairments which need to be taken into account by models of word production. Children with developmental language impairments make errors in retrieving known words during production, producing morphologically complex forms and repeating non-sense forms, and they do so in systematic ways. A model of word production needs to be able to account for these errors, in addition to the characteristic errors of inflectional suffix omission, in a cohesive way.

With respect to the retrieval of known words, for example in a picture-naming task or semantic fluency task, children with SLI are often less accurate than, and not as fast as, typically developing children. Whether this reflects an impairment solely in lemma retrieval or solely in retrieval of the phonological form is unlikely, as there is evidence that both might be affected (as is the case in aphasia, see Schwartz [8]).

In contrast to the severe impairment in inflectional (and in particular tense) morphology (Bishop [16]), the few existing studies suggest that the use of the relatively productive derivational English suffixes is not impaired, at least in children with SLI aged 9 years old and above. These studies have used elicitation tasks, and it remains to be discovered how readily children with SLI use derivational suffixes in spontaneous speech, whether they make the same sorts of non-target forms that are found experimentally, and whether derived forms are retrieved from the lexicon or created de novo.

The repetition of novel phonological forms with no semantics is particularly difficult for children with SLI. How children repeat nonwords, and the types of errors they make, has potential to reveal rich information about the phonological aspects of their word production system. But getting at this information requires careful construction of materials and a more detailed scoring system than binary scoring (i.e. a score of 1 for a correctly repeated and 0 for an incorrectly repeated nonword) or calculating the percentage of phonemes repeated correctly. A more careful scoring of stimuli that have been constructed in order to explore particular phonological phenomena—for example, the repetition of onset clusters in different word and different stressed positions—indicate that it is not just the amount of phonological material that is important for accurate repetition by children with SLI, but also how that material is structured.

Finally, the discovery of SLI in deaf children who sign [12] allows us to compare SLI in two very different modalities, speech and sign. This work is in its infancy, and our conclusions can only be tentative at this stage, yet children with SLI in both modalities show word-retrieval difficulties in semantic fluency tasks, suggesting that models of (impaired) lexical retrieval need to account for both modalities. And yet results should not be expected to be comparable across the full range of word production tasks, because the phonetics of communication in the visuo-gestural modality are very different to the phonetics of oral–aural communication. Ultimately, a complete model of word production has to be able to account for all the data discussed here, and needs to be compatible across cognitive and neurological levels of explanation.

Acknowledgements. I have had the great fortune (and joy) to collaborate with many wonderful colleagues on the work discussed in this paper: Heather van der Lely, Gary Morgan, David Williams, Heather Payne, Wolfgang Mann, Katherine Rowley, Kathryn Mason, Rosalind Herman, Joanna Atkinson and Bencie Woll. I thank them all. I am especially indebted to Heather van der Lely and Gary Morgan for their extraordinarily supportive mentorship, and for introducing me to the wonders of researching language development in hearing and deaf children, respectively. I am also grateful to Dorothy Bishop and Michael Ullman for their thorough and thought-provoking reviews of previous versions of this paper.

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