Proceedings of DiSS'05, Disfluency in Spontaneous Speech Workshop. 10–12 September 2005, Aix-en-Provence, France, pp. 7-11.

Characteristics of final part-word repetitions

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Abstract

In an earlier paper, we have described final part-word repetitions in the conversational speech of two school-age boys of normal intelligence with no known neurological lesions. In this paper we explore in more detail the phonetic and linguistic characteristics of the speech of the boys. The repeated word fragments were more likely to be preceded by a pause than followed by one. The word immediately following the fragment tended to have a higher word frequency score than other surrounding words. Utterances containing the disfluencies typically contained a greater number of syllables than those that did not; however, there was no reliable difference between fluent and disfluent utterances in terms of their grammatical complexity.

1. Introduction

Final part-word repetitions (FPWRs) involve the repetition of one or more sounds from the end of a word. When FPWRs have been reported in adults, the disfluency seems to have been associated with neurological impairment [4,5,6,7,8,9]. Stansfield [5] described four adults with learning disabilities who produced FPWRs, prolongations and blocks, although the majority of their repetitions were word-initial. Lebrun and Van Borsel [4] reported various disfluencies in the speech of a 17-year old girl with Down's syndrome, including word-final consonant repetition. Word-final repetitions have been observed (among other disfluencies) in the speech of adults with right-hemisphere brain injuries [8,9].

In the majority of studies that have described FPWRs in children, the repetitions have involved single word-final consonants [1,2,3,4]. In normally-developing children aged younger than three years, the disfluent behaviour was transient, lasting only a matter of months, with spontaneous recovery [1,2,3]. Lebrun and Van Borsel [4] reported the case of an eight-year-old with average IQ who repeated word-final consonants while reading (in addition to producing more typical stuttering-like disfluencies). The boy was aware of his disfluencies, which were often accompanied by grimaces.

Van Borsel, Van Coster and Van Lierde [10] reported the case of a nine-year-old Dutch-speaking boy, T, whose FPWRs were not confined merely to single consonants. As well as repeating individual consonants (e.g. *nooit t t*), the boy repeated word-final consonant clusters (*lucht cht*) and vowels (*toe oe*), whole syllables (*diamanten ten*), and word-final nucleus-coda sequences (*stap ap*). The repetitions occurred only on content words and mainly when the boy was speaking spontaneously (monologue or dialogue), although one instance was observed when he was reading aloud. The repetitions did not occur during singing or when the boy repeated words spoken by the researcher. In addition, the boy produced a relatively high number of 'broken words' in which 'phonation or airflow is stopped within a word' [11]. The boy in this study had sustained left fronto-parietal brain damage due to a fall from a window when he was aged 3 years 10 months, and small sub-cortical lesions were evident on MRI scans taken when he was nine years old.

McAllister & Kingston [12] reported FPWRs in the speech of two seven-year-old boys, E and R. These subjects differed from the majority of older children described in earlier reports of this behaviour in that their disfluency was not associated with neurological problems. Their general language abilities were normal for their ages, as indicated by their performance on a standard clinical test. Both boys produced similar disfluencies in reading, sentence repetition and spontaneous speech.

A range of normal non-fluencies (e.g. filled and unfilled pauses, single and multiple word repetitions, and revisions) occurred with typical frequency in the speech of the boys, but in addition, they produced broken words and FPWRs. Examples of the latter were

a. *I'm just* [ʌst] *wondering* [ɪŋ] *why* [ai] *is all that going on there* (produced by R)
b. *I don't think* [ŋk] *we got the whole way through those.* (E)
c. *They thought the Nutcracker was about* [ʊt] *to attack them* (E)
d. *There are only* [i] *three* [i] *little pod things.* (E)
e. *And then she can* [n] [n] *lift things without touching them* (E)

Neither child appeared aware of the presence of the repetitions or of any other disfluencies in their speech; they produced no visible sign of increased muscle tension and no apparent avoidance strategies.

The repeated fragments occurred after monosyllables and polysyllabic words, and after function words and content words. They occurred following words at all sentence positions (initial, medial and final), though predominantly sentence-medially. Both boys had been observed on occasion to produce two or three iterations of the repetition (e.g., example e above), though only E did so during the recordings.

Describing the phonological form of the repeated fragments, McAllister & Kingston noted that each child was following an individual but highly predictive set of rules which determined the form that the fragment would take. Neither child repeated complete word-final syllables. R almost always repeated the rime (i.e., syllabic nucleus and coda)[1] of the word preceding the fragment, for example, 'scientist [ist]', 'home [əʊm]', 'party [i]'. For E, the form of 91% of the repetitions could be predicted by a more complex set of rules: When the last syllabic nucleus of the word consisted of a diphthong, he repeated the second vowel of the diphthong plus the coda, if any (e.g., 'out [ʊt]', 'say [i]', 'Yugioh [ʊ]'). Otherwise, he repeated the last syllabic element of the word, that is, the nucleus if the word ended in a vowel (e.g. 'army [i]', 'more [ɔ]'), or the coda alone when it ended in one or more consonants (‘off [f]’, ‘think /ŋk/’. Both boys disregarded the number of syllables in the word and its morphological structure when applying their rules. In keeping with the overall consistency of these forms, when the same word occurred on several occasions with word-final disfluency, the repeated fragment took the same form; for example, there were five occasions when R produced the word *card* with a FPWR, and each time, he said [kɑːd kːɑ]; and E produced ‘out’ as [ɑʊt ʊt] twice.

In this paper, we describe some further characteristics of FPWRs produced by R and E. One analysis is concerned with the pause pattern in the context of the repeated word fragment. McAllister & Kingston [12] noted that an audible pause always occurred between the target word and the repeated word fragment which followed it; for example, E produced the utterance *But I don’t think* [pause] *–nk we got the whole way through those*. By contrast, pauses occurred relatively infrequently between the repeated fragment and the following word. Figure 1 shows a typical example, from the utterance *she can also* /ʊ/ *send these green* /n/ *slicing disks*. This pause pattern is investigated in more detail below.

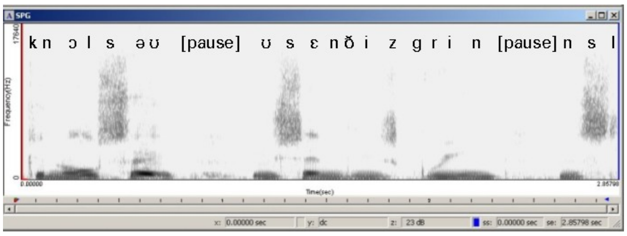

Figure 1: Spectrogram showing typical pause pattern in an utterance containing FPWRs

There is disagreement about whether FPWR should be classified as stuttering. As far as more generally-accepted forms of stuttering are concerned (e.g. word repetitions, word-initial sound repetitions, prolongations, blocks), much is known about the loci or linguistic environments in which these tend to occur. Bernstein Ratner [13] pointed out that although ‘stuttered moments’ sound qualitatively distinct from normal disfluencies, they share many of their distributional and situational characteristics. She also noted that although some researchers had focused their attention on the characteristics of the current word (e.g. the word whose initial sounds are repeated, or which immediately follows a block), the psycholinguistically relevant event might actually occur later in the sentence. In her list of factors that precipitate stuttering, Bernstein Ratner includes word frequency (words of lower frequency are associated with stuttering), lexical class (content word versus function word; adults stutter more on the former and young children on the latter), and syntactic factors (e.g. more stuttering on complex than on simple structures) [14].

Little is known about the loci of FPWRs. Van Borsel et al [10] noted that T, the boy whom they studied, produced the disfluencies only on content words, while McAllister & Kingston reported that R and E repeated the ends of both content words and function words. For T [10], E and R, FPWRs appeared irrespective of the number of syllables or morphological composition of the words they followed. However, other information about the loci of FPWRs is lacking. In this paper, we will explore the syntactic and lexical environments of the repetitions produced by R and E.

2. Method

2.1. Participants

R, a right handed, monolingual speaker of English with no known sensory or neurological impairment, was aged between 7 years 9 months and 8 years 1 month during the period when the data described below were collected. He was born after a normal full term pregnancy, the fourth of five children. The pattern of disfluency described by McAllister & Kingston [12] was first observed by a speech and language therapist when he was aged 7 years 2 months, as part of a routine checkup following earlier referrals for mild phonological delay and mild disfluency in the form of some monosyllabic word and initial part-word repetitions. Both of these problems had resolved completely by the time the FPWRs were observed.

E, a right-handed monolingual speaker of English with no known sensory or neurological impairment, was aged 7 years 6 months and 7 years 10 months at the times of data collection. He was born after a normal, full-term pregnancy, the youngest of three children. His speech and language development had been completely unexceptional apart from the emergence, when he was approximately five years old, of the disfluency pattern described by McAllister & Kingston [12].

Neither child had ever suffered any illness other than common childhood ailments, and routine hearing and vision screening yielded normal results. There had never been any educational concerns, and both performed at or above the expected level for their ages in national tests in English, mathematics and science taken by English schoolchildren at age seven.

2.2. Procedure

Two samples of spontaneous speech were recorded from each child. The children were recorded in free one-to-one conversation with the second author, an experienced specialist in disorders of fluency. She guided the conversation onto topics which she knew would be of interest to them, such as Pokemon and Yu-Gi-Oh game cards, of which there were examples available in the room, and children’s TV programmes. The first recordings lasted approximately 30 minutes and the second approximately 15 minutes in each case.

2.2.1. Transcription, coding and measurement

Transcription: All the recordings were orthographically transcribed by the first author and checked by the second author.

Classification of disfluencies: Once the authors had arrived at an agreed transcription, they listened independently to the recordings to identify instances of disfluency. They compared their analyses and listened carefully to the recordings to resolve any disagreements as to classification. Disfluencies were classified using a system based on that of Van Borsel et al. [10], as follows. *Interjections* were hesitation noises such as *uh* and *um*. An example of a *single-word repetition* is *At the end of that episode the the memory was Kaiba*. An example of a *multi-word repetition* was *He didn’t fuse them when he when he had them out*. *Revisions* were self-interrupted utterances containing a correction such as *They thought the whole - the two armies were joined together*. *Incomplete* *phrases* were self-interruptions that did not contain a correction. *Prolongations* were defined as speech segments which had greater than expected duration given their linguistic and phonetic context. *Blocks* were defined as inappropriate stoppages of airflow or voice. *Initial part-word repetitions* involved the repetition of one or more segments from the start of a word, e.g. *The grownups* ha-had *their eyes closed*. *Broken words* involved cessation of airflow or phonation within a word, e.g. *I can't* te-ll *all of it*. *FPWRs* involved the reiteration of some portion of the end of the word (see examples a-*e* above).

Pause pattern: Pause durations in FPWRsn were measured at two locations – between the preceding word and the repeated fragment (pre-fragment pause), and between the fragment and the word following it (post-fragment pause). For example, in the utterance *I'm just* [ʊst] *wondering*, a pause between *just* and [ʊst] would be a pre-fragment pause, and a pause between [ʊst] and *wondering* would be a post-fragment pause.

Word frequency: One possible reason for the occurrence of a FPWR is that the speaker is experiencing a problem with the formulation of an upcoming part of the utterance, e.g. lexical access of a low-frequency word. It might be predicted that words following the fragment would be of lower frequency that words preceding the fragment. To examine this hypothesis, we used the MRC Psycholinguistic Database to calculate the word frequency of the three words preceding the fragment and the three words following the fragment. We labelled the words as shown in the following example (for the utterance *And then she can* [n] [n] *lift things without touching them*) :

Word -3: then
Word -2: she
Word -1: can
Word +1: lift
Word +2: things
Word +3: without

Syntactic complexity and utterance length: This analysis followed the procedure described by Melnick & Conture[15], who found that utterances containing stuttered disfluencies were longer and more grammatically complex that those containing no such disfluencies. Based on Melnick & Conture, utterances were defined as "a string of words that (a) communicates an idea; (b) is set apart by pauses; (c) is bound by a single intonation contour". Twenty-five utterances containing FPWRs were randomly selected from the speech of each child, along with 25 utterances which contained neither FPWRs nor broken words. Utterance length was calculated by counting the number of syllables in the utterance, excluding the FPWRs themselves. Grammatical complexity was calculated by counting the number of clausal constituents (subject, verb, object, complement and adverbial) that the utterance contained.

3. Results

3.1. Frequency of disfluency types

Since preliminary analysis indicated a similar distribution of disfluency types in each spontaneous speech sample, in this section the two are combined for each child. Across the two samples, R spoke 4062 syllables and E spoke 4058 syllables. Frequencies of the disfluency types defined in 2.2.1. is shown in Table 1.

Table 1: Frequency of disfluency types per 100 syllables in the speech of R and E.

Disfluency type	R	E
Interjection	0.06	1.15
Single-word repetition	0.22	0.54
Multi-word repetition	0.02	0.19
Revision	1.46	1.86
Incomplete phrase	0.37	0.31
Prolongation	0.00	0.02
Block	0.00	0.00
Initial part-word repetition	0.11	0.28
Broken word	0.26	0.69
Final part-word repetition	1.15	2.47
TOTAL	3.64	7.49

3.2. Pause pattern

Twelve items were considered unsuitable for analysis and were omitted, because they involved either overlapping speech or multiple iterations of the repetition; this analysis was therefore based on 96 items for E and 49 items for R. Durations of the pauses is shown in Table 2.

A 2-way ANOVA (Child x Pause Position) was conducted on the measurements for all words. Overall, pre-fragment pauses were reliably longer than post-fragment pauses ($p < 0.0001$), and R's pauses were longer than E's pauses ($p < 0.0001$); the variables did not interact. As was noted above, although pre-fragment pauses occurred in every case, post-fragment pauses were relatively unusual. When the analysis was confined to just those less typical items where there was a post-fragment pause, the pre-fragment pause was still dependably longer than the post-fragment pause ($p = 0.0180$); the means for the two children differed reliably, and the interaction was non-significant.

Table 2: Durations of pre-fragment and post-fragment pauses.

	R		E	
	Pre	Post	Pre	Post
All words	599	152	436	158
Words with no post-fragment pause	558	-	706	-
Words with a post-fragment pause	699	523	601	476

3.3. Word frequency

The mean frequencies of the words preceding and following the repeated fragments is shown in Figure 2. A 2-way ANOVA (Child x Word Position) was conducted. The difference between the children was insignificant, as was the interaction. There were significant differences among the frequency values for the different word positions relative the the repeated fragment; specifically, the word preceding the fragment was of reliably lower frequency than the other words, and the word following the fragment was of higher frequency, but the other values did not differ significantly from each other.

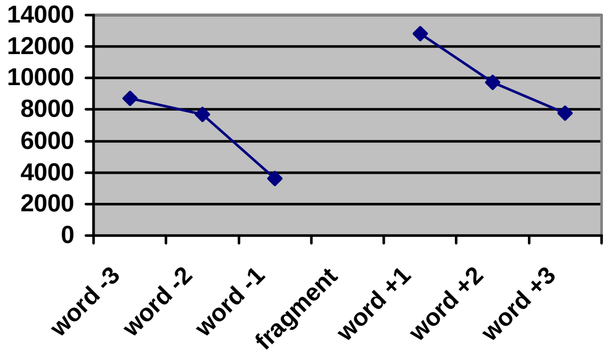

Figure 2: Frequencies of words preceding and following the repeated fragment

Contrary to the hypothesis that the disfluency might reflect a processing problem associated with the relatively low frequency of a word following the fragment, the mean frequency of word immediately following the fragment is higher than the mean frequency of the words preceding the fragment.

3.4. Syntactic complexity and utterance length

Scores for syntactic complexity are shown in Table 3. Though the means suggest a tendency for utterances containing FPWRs to be more complex,in a 2-way ANOVA (Child x Fluency), all differences failed to reach statistical significance.

Scores for utterance length are shown in table 4. A2-way ANOVA (Child x Fluency) indicated that E's utterances were reliably longer than R's ($p = 0.0003$) and that utterances containing FPWRs were longer than fluent utterances ($p = 0.0178$); the interaction was non-significant.

Table 3: Syntactic complexity of utterances as indicated by mean number of constituents

	R	E
Containing FPWRs	4.8	5.76
Without FPWRs	4.36	5.04

Table 4: Mean length of utterances (syllables)

	R	E
Containing FPWRs	11.28	16.20
Without FPWRs	8.28	12.96

4. Discussion

McAllister & Kingston [12] had already established that the FPWRs produced by E and R could occur regardless of the preceding word's lexical status (content versus function word), length (monosyllable or polysyllable) or morphological status (monomorphemic or polymorphemic). The form of the repeated word fragments could be predicted according to phonological rules specific to each child.

In the analyses reported here, we have described some further characteristics of the children's speech. The repeated fragments were always preceded by a pause lasting on average about 600 msec; in the majority of cases, no pause occurred after the fragment, but when it did, it tended to be shorter than the pre-fragment pause. In the speech of these children, the occurrence of the disfluency did not appear to be related to lexical access difficulties inherent in the processing of an upcoming low-frequency word, because the words following the fragment are if anything of higher frequency than the words preceding it. It is tempting to suggest that the frequency pattern that is observed may reflect some structural aspect of the sentences (e.g., that the high frequency of words at position +1 may reflect their status as function words, which might occur at the start of new phrases). This notion deserves further investigation, although it should be noted that the analysis of grammatical complexity does not strongly support the idea that the disfluencies might be associated with difficulties in encoding more syntactically complex sentences. On the other hand, the occurrence of FPWRs was associated with the encoding of phonologically lengthier sentences.

FPWRs may or may not be a form of stuttering; however, in terms of explaining the behaviour within a model of speech production, perhaps such classification is unimportant, since some researchers have sought to explain both stuttering and other forms of disfluency using similar frameworks. Kolk & Postma [16] have grounded their Covert Repair Hypothesis of stuttering within Levelt's [17] theory of speech production. Within this framework, the repeated word fragments might arise at the phonetic spellout stage because of anomalous persistence of activation of rimes (for R) or of the final syllabic constituent (for E). Levelt's account of phonetic spellout is motivated in part by research into sound substitution errors; in the light of E's treatment of items containing diphthongs, it is interesting to note Levelt's comment that substitution errors in which the components of diphthongs are split, though rare, do occur. At least one theory of stuttering [18] proposes that one factor in such disfluency could be a failure on the part of speakers to respect the integrity of syllables.

It is, however, perhaps premature to speculate about the mechanisms through which FPWRs arise. Before a convincing explanation can be provided, a more thorough qualitative and quantitative description of the phenomenon needs to be produced.

5. Acknowledgements

Thanks to R and E, and to Sally Wynne.

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Notes

1. The nucleus is the peak of prominence in a syllable, and usually consists of a vowel; the onset is the set of consonants, if any, preceding the nucleus, and the coda is the set of consonants, if any, following the nucleus. The nucleus and coda together form the rime.