Author: D. G. H. James, J. van Doorn and S. McLeod  
Author Address: smcleod@csu.edu.au  
Title: The contribution of polysyllabic words in clinical decision making about children's speech  
Year: 2008  
Journal: Clinical Linguistics and Phonetics  
Volume: 22  
Issue: 4-5  
Pages: pp345-353  
ISSN: 0269-9206  
URL: http://dx.doi.org/10.1080/02699200801919240  
DOI: Keywords: Speech, phonology  
mono-  
di- and polysyllabic words  
phonology assessment  
phonological processing  
Abstract: Poor polysyllabic word (PSW) production seems to mark paediatric speech impairment as well as impairment in language, literacy and phonological processing. As impairment in these domains may only manifest in PSWs, PSW production may provide unique information that is often excluded from clinical decision making because insufficient PSWs are included in speech tests. A 5-stage model of PSW acquisition is described. The model, grounded in optimality theory, expresses a reciprocal relationship between the relaxation of markedness constraints and the contraction of faithfulness constraints from 12 months of age to adolescence. The markedness constraints that persist to the age of 7; 11 years are associated with non-final weak syllables and within-word consonant sequences. Output changes are argued to reflect increasing specification of phonological representations with age, liberating information for motor planning and execution, resulting in increasingly accurate output. The clinical implications of PSWs in assessment and therapy are discussed.  
CSU ID: CSU310459
THE CONTRIBUTION OF POLYSYLLABIC WORDS IN CLINICAL DECISION MAKING ABOUT CHILDREN'S SPEECH

Deborah G. H. James\textsuperscript{1,2}, Jan van Doorn\textsuperscript{3,2}, Sharynne McLeod\textsuperscript{4}

\textsuperscript{1}Flinders University, Australia; \textsuperscript{2}The University of Sydney, Australia; \textsuperscript{3}Umeå University, Sweden; \textsuperscript{4}Charles Sturt University, Australia

Running head: Contribution of polysyllabic words
Abstract

Poor polysyllabic word (PSW) production seems to mark paediatric speech impairment as well as impairment in language, literacy and phonological processing. As impairment in these domains may only manifest in PSWs, PSW production may provide unique information that is often excluded from clinical decision making because insufficient PSWs are included in speech tests. A 5-stage model of PSW acquisition is described. The model, grounded in optimality theory, expresses a reciprocal relationship between the relaxation of markedness constraints and the contraction of faithfulness constraints from 12 months of age to adolescence. The markedness constraints that persist to the age of 7;11 years are associated with non-final weak syllables and within-word consonant sequences. Output changes are argued to reflect increasing specification of phonological representations with age, liberating information for motor planning and execution, resulting in increasingly accurate output. The clinical implications of PSWs in assessment and therapy are discussed.

Key words: phonology, mono-, di- and polysyllabic words, phonology assessment, phonological processing
Introduction

When children name pictures of polysyllabic words (PSWs)\(^1\), different information about their phonology is available for clinical decision-making than when they name short words, that is, monosyllabic words (MSWs) and di-syllabic words (DSWs) (James, 2006). In this article, the unique information that PSWs yield is delimited, followed by a description of a model of PSW acquisition and some of its clinical implications.

The unique information that PSWs yield

PSWs differ from short words because they usually contain more and different phonological constituents than short words do. For example, they usually contain more sounds, more syllables, more levels of stress, within-word weak syllables and within-word consonant sequences that abut syllable boundaries (Katz, 1986; James, 2006). Part of the value of PSWs is that mismatches associated with these constituents will only occur in PSWs.

Developmental mismatches

Typically developing children, aged 1 to 7 years, exhibit more consonant and vowel mismatches in PSWs than in short words (Ingram, Christensen, Veach, & Webster, 1980; Kenney & Prather, 1986; Echols & Newport, 1992; James, van Doorn, & McLeod, 2001; 2002; Vance, Stackhouse, & Wells, 2005). Echols and Newport reported lower percentages of phonemes correct in individual syllables from PSWs than DSWs for three children, aged 1;5, 1;5 and 1;7 years. Significantly lower consonant and vowel accuracy have been reported in PSWs compared with short words for children aged 3;0 to 7;11 years (James et al., 2001; 2002; Vance et al., 2005). Ingram et al. reported that 73 typically developing children, aged

---

\(^1\) The term polysyllabic words refers to words of three or more syllables whilst acknowledging it is used in differing ways within the literature. It is sometimes used to denote words comprised of three or more syllables (Katz, 1986; Vihman, 1996; Savinainen-Makkonen, 2000) and sometimes used to denote words of two or more syllables (e.g. (Cutler & Carter, 1987)).
Contribution of polysyllabic words

1;11 to 5;8 years, erred on fricatives and affricates more frequently in PSWs than in DSWs and MSWs.

Phonological processes also seem to occur more frequently in PSWs than in short words. James (2006) documented the occurrence of seven phonological processes when she further analysed the speech of the 283 children, aged 3;0 to 7;11 years, reported by James et al. (2001; 2002). For the five phonological processes that can occur in MSWs, DSWs and PSWs being final consonant deletion (FCD), cluster reduction, epenthesis, metathesis and assimilation, a syllable effect was present with all phonological processes occurring more frequently and with later resolution in PSWs than in MSWs and DSWs. The ages of resolution of these behaviours are listed in table 1. Notably, metathesis only occurred in PSWs, persisting until 7;11 years. Also, weak syllable deletion (WSD) and tensing lax vowels in weak syllables, which can only occur in words of two or more syllables, persisted until the age of 7;11 years. The observations that metathesis, WSD and vowel changes are still occurring at 7 years is at variance with the consensus that these patterns have resolved before this age (e.g. Grunwell, 1981; Stoel-Gammon & Dunn, 1985; Vihman, 1998; Dodd, Holm, Hua, & Crosbie, 2003).

In summary, more developmental mismatches occur in PSWs than in short words and are evident at later ages in PSWs than in short words. Thus, PSWs appear to capture more of the ongoing development that occurs in children from ages 5 to 11 years than MSWs and DSWs do. Therefore, they may be a useful medium for measuring developmental changes in speech, especially in school age children. If so, this observation supports the case for the inclusion of PSWs in routine assessment (Stackhouse, 1985; Young, 1991; 1995; James, 1997; Watts, 2004).
**Impairment**

In addition to capturing developmental changes, PSW production also indicates impairment, sometimes exclusively, in

- speech (Hargrove, 1982; Klein & Spector, 1985; Pollock, 1991; Lewis & Freebairn, 1992; Dodd et al., 1993; Leitão, Hogben & Fletcher, 1997; Lewis et al., 2000; Bernhardt & Major, 2005)
- language (Gathercole & Baddeley, 1990; James et al., 1994; Dollaghan & Campbell, 1998; Ellis Weismer et al., 2000; Aguilar-Mediavilla et al., 2002; Gray, 2003)

The significance of the listed studies is that impairment was either only apparent in PSWs or was more severe in PSWs than in MSWs and DSWs. Thus, if speech testing in these studies had been confined to typical tests of phonology and articulation, such as the *Goldman-Fristoe test of articulation* (Goldman & Fristoe, 1986; 2000) that contain few, if any PSWs, then impairment may have been concealed or underestimated. (See James (2006) for an in-depth discussion.)

Thus, it seems that if PSWs are excluded from routine testing, then impairment may be underestimated or concealed. This point is highlighted when considering an observation that Magnusson and Nauclér (1990) made. They noted that the subtle mismatches of speech, such as metatheses, correlated more highly with serious literacy problems than the more obvious segmental mismatches which correlated with less serious literacy outcomes. These findings further support the case for the inclusion of PSWs in routine testing.
The unique information that PSW productions yield is summarised in the schematic in figure 1. This indicates that significant differences between younger and older age groups and impaired and non-impaired groups might not emerge until PSWs are used.

**The model of PSW acquisition**

The model of PSW acquisition was developed from the literature and from the results of a study of 283 typically developing, English speaking children, aged 3;0 to 7;11 years (James, 2006). In this study, children named pictures, yielding up to 166 planned words; 71 MSWs, 56 DSWs and 39 PSWs. All five *a priori* patterns of production were present with syllable number and age effects. Specifically, the deletion and addition of sounds and syllables in words as well as the alteration of the sequence of sounds and syllables in words all decreased with increasing age as did changes to consonants, such as substitutions, whereby the phonotactic pattern of the target words was preserved. By contrast, tensing of lax vowels increased with increasing age. Syllable effects were usually present for all five patterns with more mismatches in PSWs than in short words. These results are displayed in table 1 and figure 2.

The five-stage model, displayed in figure 3, covers the period from the onset of first words at about 12 months of age to adolescence. The model is grounded in optimality theory; a theory that centres on a reciprocal relationship between markedness and faithfulness constraints (Kager, 1999). Faithfulness means that the output matches the ambient language so any alteration to sounds is a violation of faithfulness. Markedness means the output is simplified and the simplifications are motivated by the perceptual and articulatory characteristics of sounds as well as by their frequency and distribution patterns in the ambient
Contribution of polysyllabic words

language. Sounds that are difficult to perceive or produce or occur infrequently are marked and their occurrence violates markedness (Kager, 1999). Faithfulness and markedness exert opposing forces on output as faithfulness results in the inclusion of phonological features whereas markedness results in their exclusion and word production inevitably involves constraint violation. The output is optimal with reference to the ranking of constraints at the time and changes in the output reflect constraint re-ranking. Developmentally, this implies that faithfulness constraints are promoted and markedness constraints are demoted until the output matches the adult target.

The key output feature in the first stage of the model, from the age of 1;0 to 2;3 years, is faithfulness to the stressed syllable and duration of the whole word. This stage of the model was derived from evidence in the literature (e.g. Carter & Gerken, 2004). (Also see James (2006) for a discussion of this.) The key output feature in the second stage of the model, from the age of 2;4 to 3;11 years, is faithfulness to the number of syllables. This notion is supported by the converging evidence that the greatest decline in the occurrence of syllable structure processes of weak syllable deletion, cluster reduction and final consonant deletion occurs over this time with a concomitant increase in the occurrence of onsets and rimes (e.g. Haelsig & Madison; 1986; Young, 1991; James, 2006). (Also see James (2006) for a discussion of this.) This implies that the markedness constraints associated with these syllable structures are demoted, resulting in better formed syllables in the output. The key output feature in the third stage of the model, from the age of 4;0 to 6;11 years, is faithfulness to all the phonemes in words with dysprosody. This notion is supported by the converging evidence of increasing consonant accuracy consequent to greatest quantum decreases in substitution and assimilation processes (Haelsig & Madison, 1986; Khan & Lewis, 1986; James, 2001) as well as increasing occurrence of tensing lax vowels in non-final weak syllables (see figure 2).
Contribution of polysyllabic words

(James, 2006). Again the associated markedness constraints are demoted, facilitating the production of more output features. Also, tensing lax vowels in non-final weak syllables seems to ensure inclusion of the vowel in the weak syllable meaning increased faithfulness. This permutation of behaviours suggests that faithfulness of phonemes outranks faithfulness to word prosody. It is proposed that in the fourth stage of the model, from the age of 7;0 to 10;11 year, faithfulness to word rhythm is paramount and that that the timing features of words are refined and non-final weak syllables are realised with reduced vowels rather than full ones. James (2006) provided some evidence for this notion because there was reduction in tensing the lax vowel over the age range of six to seven years. James also reported that the mismatches occurring up to the age of 7;11 years (the limit of the data set) were associated with non-final weak syllables and within-word consonant sequences at abutting syllable junctions. These two contexts included clusters, anterior-posterior movements, sounds that shared place and/or manner features and liquid and velar sounds, severally or together. These features are considered some of the markedness constraints that are demoted during this stage so the output is increasingly faithful to the ambient language. The final refinement of timing is proposed to occur in the fifth and final stage of the model, from the age of 11 years to adolescence, when word timing matures and equates adults (Vihman, 1998).

James (2006) concluded that the markedness constraints present over the age range of 3;0 to 7;11 years preclude the development of adequate phonological representations to drive the motor components for the output. This argument also implies that the quality of the PSW output may be an index of the quality of phonological representations and the level of phonological awareness. This argument is now applied clinically.
Clinical implications

Assessment

Two sets of assessment implications are described. Firstly, given that typically developing children and children with impairments err on productions of PSWs, performance on PSWs outside tolerances described here for typically developing children may indicate impairment (see James (2006) for details). For example, metathesis in MSWs and DSWs did not occur in this cohort of children and it was rare in the word *elephant*. Thus, use of metathesis in MSWs, DSWs and *elephant* by children aged 3 to 7 years may indicate impairment.

Secondly, if the quality of PSW productions reflects the status of phonological representations, then they may provide information about the specification level of the phonological representations and the level of phonological awareness. For example, WSD in a word may imply less well-specified phonological representations than FCD in the same word. For example, if *computer* is realised as [k/1106pjut/1106], then WSD may imply that syllable level phonological awareness is not fully developed because the syllable is absent from the output. By contrast, if *computer* is realised as [k/1106pjut/1106], the FCD in the first syllable may imply that the syllable is represented in the output because the onset and rime is present. The presence of this syllable, albeit in reduced form, suggests syllable level phonological awareness. In another scenario, complete final cluster reduction may imply less well-specified phonological representations than final cluster reduction. This is so because complete final cluster reduction may mean the coda is not specified whereas final cluster reduction may mean it is because a consonant is present in the coda. In this scenario, complete final cluster reduction may imply phonological awareness at the intra-syllabic level whereas final cluster reduction may mean higher intra-syllabic level phonological awareness for the coda. Finally, consonant...
substitution in words may imply less well-specified phonological representations of words than metathesis. Substitutions imply missing features from segments in the output whereas metathesis implies their presence because the correct sound is present; it is merely in the wrong slot (James, 2006). For example, when /r/ is substituted with [w] in *caravan*, said as [mæw ʌvæn], the liquid feature for /r/ is missing. By contrast, when /r/ and /v/ are transposed in *caravan*, said as [mæv ʌræn], all segments and their features must be present in the phonological representation because they are all present in the output. Thus, metathesis may imply phonemic level phonological awareness.

In conclusion, age appropriate use of the five patterns in PSWs may indicate age appropriate phonological representations and phonological awareness whereas variation outside these tolerances described by James (2006) may indicate phonological representations and phonological awareness that are not age appropriate.

**Therapy**

The implications described in the section on assessment could be used for selection of therapy goals. If overuse of WSD in PSWs implies underdeveloped specification of syllables, then goals of therapy should be syllables so that they are represented in the output. In contrast, overuse of consonant deletion and assimilation in PSWs may indicate under-specification of syllable constituents and that the onset and rime should be the therapy goals. Overuse of substitutions may imply goals of sound features, such as place or manner. By contrast, overuse of tensing lax vowels may imply that phonological representations are specified at the level of the phoneme but there are problems with speech timing because tense vowels are usually longer in duration than lax vowels (Cox, 2006) thereby implying that the goals of therapy are motoric.
Conclusions

PSWs may not only provide unique information about production skills but may also provide information about phonological processing. If PSW productions prove to be a reliable indicator of phonological awareness, this may reduce the need for specific testing of this domain, creating clinical efficiencies. The model of PSW development appears to facilitate clinical decision-making grounded in and integrating speech production and processing, which, in turn, may assist in determining whether to focus treatment at the level of syllable or sound.

Acknowledgments

This work is based on part of the first author’s PhD at The University of Sydney which was supervised by the remaining authors. The work was funded by a grant from the South Australian Channel 7 Children’s Research Foundation Inc.

References


Contribution of polysyllabic words


Contribution of polysyllabic words


Ingram, D., Christensen, L., Veach, S., & Webster, B. (1980). The acquisition of word-initial fricatives and affricates in English between 2 and 6 years. In G. Y. Yeni-Komshian &
Contribution of polysyllabic words


Contribution of polysyllabic words


### Table 1. Resolution of speech patterns (based on James, 2006)

<table>
<thead>
<tr>
<th>Age (yrs)</th>
<th>WSD</th>
<th>FCD</th>
<th>CR</th>
<th>Epenthesis</th>
<th>Metathesis</th>
<th>Assimilation</th>
<th>Tensing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3+</td>
<td>1</td>
<td>2</td>
<td>3+</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>NA</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>5</td>
<td>NA</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>6</td>
<td>NA</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>7</td>
<td>NA</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

**Key:** WSD = Weak syllable Deletion; FCD = Final consonant deletion; CR = cluster reduction; 1 = monosyllabic word; 2 = disyllabic word; 3+ = polysyllabic word; NA = not applicable; ✓ occurring; ✗ not occurring

**Notes:** FCD and CR typically occurred within words such as ambulance and pumpkin; Epenthesis in MSWs usually involved the epenthesic schwa in word-initial liquid clusters whereas in DSWs and PSWs a consonant was added within the word.
Figure 1. Schematic representation of syllable number, age, group and interaction effects on word production (from James, 2006)
Figure 2. The median scores in PSWs for each of the five patterns by age (from James, 2006)

**Key.** DSS Deletion of sounds and syllables; ASS Addition of sounds and syllables; SEQ Alteration of the sequence of sounds and syllables; PP Preservation of phonotactics; AT Alteration of timing (tensing lax vowels)
Figure 3. The model of PSW acquisition (based on James, 2006)