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Syllables per word in typical and delayed speech acquisition

PETER FLIPSEN JR

Department of Audiology and Speech Pathology, University of Tennessee, Knoxville, TN, USA

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Abstract
A number of authors have presented data on the word length (measured in syllables) in the spontaneous speech of children across the developmental period. These data suggest a developmental trend of increasing length with age. The current study sought to examine this possibility in more detail. Conversational speech data from 320 children with normal (or normalized) speech confirmed that the number of syllables per word in conversational speech increases significantly from age 3–8 years. Data from the conversational speech of 202 children with speech delay however showed no such trend. Reasons for the differences between the two groups are discussed.

Keywords: *Speech acquisition, word length, syllables per word*

Introduction

Most of the literature on phonological development is devoted to the acquisition of individual speech sounds. Considerably less attention has been devoted to the acquisition of aspects of the speech system ''higher'' than the level of the segment. The current study attempts to add to our knowledge base in this area by reporting data on the number of syllables per word in children's conversational speech from 3–8 years of age. In addition, it attempts to add to our understanding of the nature of delayed speech by providing syllables per word data from the conversational speech of children with delayed speech sound development in that same age range.

A number of authors have presented data on the word length (measured in syllables) in spontaneous speech across the developmental period. Dyson (1988) reported data from conversational interaction during play from two groups of 10 typically-developing children tested twice over a 6 month interval (ages 2;0 and 2;5 for Group 1; 2;9 and 3;3 for Group 2). The distributions of word lengths in the samples were reported, and calculations by the current author suggest values ranging from 1.13 to 1.16 syllables per word (SPW). Yaruss (2000) proposed a value of 1.15 SPW which he obtained by examining the conversational speech of 50 children age 3–5 years (30 typically-developing children and 20 children who stutter). Kowal, O'Connell, and Sabin (1975) measured the spontaneous narratives

Correspondence: Peter Flipsen, Jr, Department of Audiology and Speech Pathology, University of Tennessee, Knoxville, 425 South Stadium Hall, Knoxville, TN 37996, USA. E-mail: pflipsen@utk.edu

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produced by 168 typically-developing children in kindergarten through 12th grade and reported that the words ranged from 1.2 to 1.3 syllables long. Drieman (1962) presented data from picture descriptions produced by eight graduate students and reported an average of 1.335 SPW. Andrews and Ingham (1971) summarized some earlier reports of adult speech, concluding that a value of 1.4 SPW may be appropriate. Venkatagiri (1999) presented word and syllable range data from picture descriptions and talking about self productions by 16 normal adults (19–31-years-old) that suggested word lengths ranging from 1.27 to 1.46 syllables.

Taken together the findings from these studies suggest a developmental trend with values rising from approximately 1.13 SPW in very young children to as many as 1.46 SPW in adults. Such a trend would not be surprising as one would expect to see the use of longer words becoming more frequent with age. However, the above studies themselves do not completely support such a conclusion; Yaruss (2000) for example, reported no significant differences among the three age groups in his data set. Kowal et al. (1975) did not specifically examine the question of age-related changes in length and did not present any age or grade-specific values. Thus, the goal of the present study is to provide information on developmental aspects of word length, information that has implications for both theory and treatment.

Method

Speakers

Two speaker groups were used for the current study. Both groups had been included in the reference data set described in Shriberg, Austin, Lewis, McSweeny, and Wilson (1997). As noted in Shriberg et al. (1997) the children had participated in a variety of cross-sectional and longitudinal studies (only one conversational speech sample per child was used in the latter cases). The studies were conducted in Wisconsin but also included samples obtained in several other states. All of the children were from monolingual, English-speaking homes and all were speakers of the General American English dialect.

The conversational speech samples were all analyzed using the Speech Disorders Classification System (SDCS; Shriberg et al., 1997) running as a subroutine of the PEPPER software (Shriberg, Allen, McSweeny, & Wilson, 2001). The system classified participants into two classes based on the error targets and error types for reference to their age and sex. The children in the Normal (or Normalized) Speech Acquisition (NSA) were either typically-developing (having been part of study control groups) or had previously been speech-delayed; in the latter case their conversational speech performance was in the normal range (as defined by the SDCS) at the time of sampling for the current study. The children in the Speech Delay (SD) group had either been recruited through a speech-language pathologist or had been identified as meeting the criteria for SD during the course of a study. Children in the SD Group presented with predominantly omission and substitution errors in their conversational speech.

The NSA Group included 320 children (170 males; 150 females) who ranged in age from 3;1–8;10 (mean=5;6; SD=1;3). The SD Group included 202 children (145 males; 57 females) who ranged in age from 3;0–8;5 (mean=4;9; SD=1;1). The distribution of the two groups by age and sex is shown in Table I. Age groups were defined using age at last birthday. Note that the unequal sex ratio seen in the SD Group (approximately 2.5:1) is consistent with what is typically seen in this population (Shriberg, Kwiatkowski, Best,

Table I. Participant distribution by group and age.

	NSA Group			SD Group		
Age	Male	Female	Total	Male	Female	Total
3 years	22	30	52	36	12	48
4 years	28	19	47	51	24	75
5 years	59	49	108	37	17	54
6 years	45	31	76	15	3	18
7 years	9	14	23	5	1	6
8 years	7	7	14	1	0	1
Total	170	150	320	145	57	202

Hengst, & Terselic-Weber, 1986; Shriberg & Kwiatkowski, 1994). None of the children in either group had any known cognitive, craniofacial, sensory-motor, or developmental disabilities. The children in the SD Group therefore fit the definition of Speech Delay of Unknown Origin or what has historically been termed Functional Articulation Disorder.

It should be noted that neither sample of children used in this study was in any way randomly ascertained. As such, the data from these groups does not meet conventional criteria for a normative sample and therefore would not be appropriate to use for clinical decision-making.

Conversational speech samples

Conversational speech samples were collected from all the children using procedures described in Shriberg (1986, 1993). All samples included at least 96 intelligible words; for the NSA group the mean was 198.4 words (SD=40.0 words), and for the SD group the mean was 251.8 words (SD=134.3 words). Note that an integral part of these procedures is that where possible the examiner "glosses" or repeats any utterance by the child that is of questionable intelligibility. For the current study, this approach offers the advantage of maximizing the number of words that could be reliably transcribed and analysed. Such glossing is, of course, a common clinical practice when assessing young children.

Transcription and analysis

All of the samples were transcribed using the narrow phonetic transcription conventions from Shriberg and Kent (1982, 1995). The transcripts were formatted so that analysis could be carried out using the previously described SDCS (Shriberg et al., 1997, 2001). Only fully intelligible words were used in the current study. A data extraction algorithm was developed for PEPPER that counted the number of fully intelligible words (a word being defined as a string of characters in the transcript surrounded by spaces), and the number of intelligible syllables. An intelligible syllable was defined as the presence of any vowel, diphthong or syllabic consonant. It should be noted that some cases of "mixed words" were encountered. Such words involved cases in which one or more of the syllables in the word could be transcribed, but at least one syllable was not intelligible. Such words were deemed to be unintelligible for purposes of the current study. At least one mixed word was observed in each of 13/320 (4.1%) of the samples in the NSA Group and 37/202 (18.3%) of the samples in the SD Group.

Syllables per word (SPW) values were calculated for each speaker by dividing the number of intelligible syllables by the number of intelligible words. Regression analyses (age by SPW) were then used to check for developmental trends in SPW values for both groups.

Reliability

Separate reliability studies were not undertaken for the current study. Transcription reliability for the samples and transcribers used in the current study is reported elsewhere (Shriberg & Lof, 1991; McSweeny & Shriberg, 1995; Shriberg et al., 2005).

Results

Values of SPW for the NSA Group ranged from 1.06 to 1.42 (mean=1.20; SD=.05). A two-sample t-test revealed no statistically significant difference ($t(317)=.77$, $p>.05$) between males and females. Values of SPW for the SD Group ranged from 1.06 to 1.41 (mean=1.18; SD=.06). A two sample t-test also revealed no statistically significant difference ($t(122)=.83$, $p>.05$) between males and females. A comparison of the two groups (NSA vs. SD) using a two-sample t-test indicated significantly fewer SPW in the SD Group ($t(404)=-4.85$, $p<.001$).

A linear regression of SPW against age in months for the NSA Group yielded a statistically significant relationship ($p<.001$) indicating that SPW significantly increased with age from 3;1 to 8;10 in this reference sample. The regression line is shown in Figure 1. The regression equation (shown below) accounted for 12.1% of the (adjusted) variance in

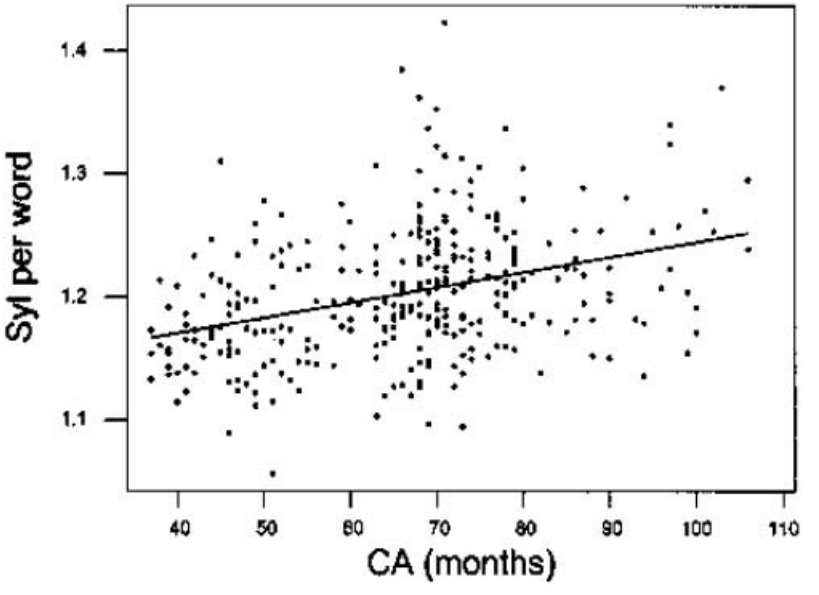

Figure 1. Syllables per Word versus Age for the NSA Group.

the relationship. Thus, there appears to be a significant developmental trend for SPW in children with normal speech.

$$\text{SPW} = 1.2136 + .0012277(\text{age in months})$$

The regression for the SD Group was not statistically significant ($p > .05$) and accounted for none (.0%) of the (adjusted) variance in the relationship. SPW does not appear to change significantly with age across the range of 3;0–8;5 for children with speech delay. The relationship between age and SPW for the SD Group is shown in Figure 2.

Discussion

Findings indicated that for children with normal (or normalized) speech, the number of syllables per word in conversational speech increases significantly with age. This is consistent with other studies that also report increases in unit length with age in children. For example, Flipsen (2002) reviewed studies documenting increases in phonetic phrase length with age in children, Brown (1973) and Miller and Chapman (1981) presented data on increases in utterance length measured in morphemes in preschool children, and Loban (1976) demonstrated increases in utterance length measured in words in school-age children.

One concern raised by the current results for the NSA Group is that, despite being statistically significant, the obtained regression equation for age and SPW in normal speech accounted for only a relatively small percentage of the variance (12.1%) in the relationship. It must be recalled however that the data for the current study were obtained from a variety of studies and included a variety of examiners and topics of conversation. The diversity of word choices by the children would by definition be quite large. Alternatively (or perhaps in

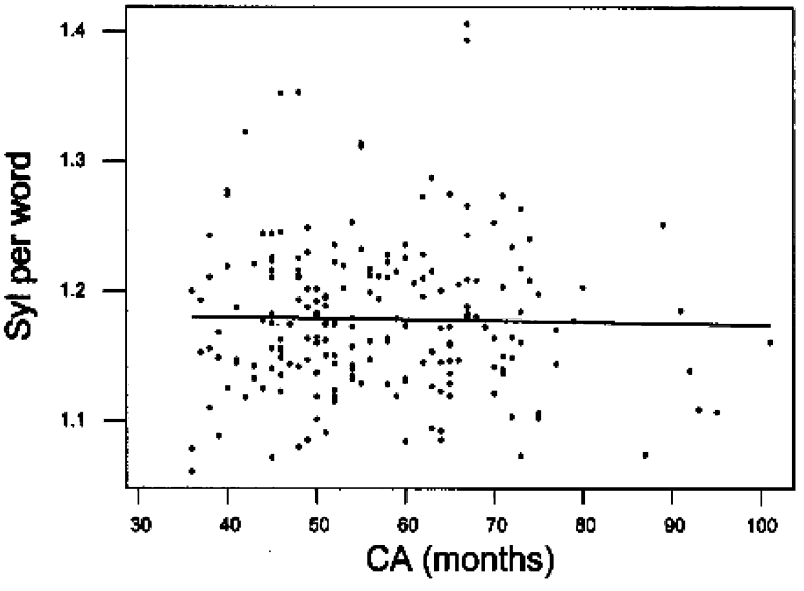

Figure 2. Syllables per Word versus Age for the SD Group.

addition) the weak nature of the relationship may have been influenced by syntactic factors. Dobrich and Scarborough (1992) note that particularly during the early preschool years children elaborate their utterances by adding closed-class words such as determiners, conjunctions, and auxiliary verbs which are largely monosyllabic. This might dampen the impact of an expanding lexicon of open-class words (nouns, verbs, adjectives etc.) which would include a greater proportion of polysyllabic forms.

There are several possible reasons why the present findings of a statistically significant relationship between SPW and age for the NSA Group contrasts with the findings reported in Yaruss (2000). First, the difference between Yaruss' findings and those of the current study may simply reflect statistical power constraints with Yaruss' total sample size of 50 being notably smaller than the 320 used herein.

Second, the Yaruss study included a narrower participant age range (3;2–5;10) than the range included the current study (3;1–8;10). Perhaps the number of syllables per word does not change significantly during the period from age 3 years to 5 years; the above comments from Dobrich and Scarbarough (1992) about the potential impact of syntactic factors may be especially relevant for this age range. To examine the age range question, the linear regression in the current study was repeated using only those 207 children (108 males; 99 females) from the NSA Group who ranged in age from 3;1–5;11 (mean=4;10; SD=0;11). In this case the regression continued to be statistically significant ($p<.001$) and accounted for 13.4% of the (adjusted) variance in the relationship. This suggests that the narrower age range was not entirely the issue.

Another third possible source of the differences in findings between that of Yaruss and the current study may have been that 20 (40%) of the 50 children in Yaruss' study were children who stuttered. Although no significant differences were found between children who stutter (CWS) and typical-speaking children in Yaruss' study, the reported mean value of SPW for CWS (1.145) was smaller than that of typically-speaking children (1.154). Recall also that in the current study no significant regression was obtained between age and SPW for the SD Group. This lack of a relationship may also exist for other speech-disordered populations. It is therefore conceivable that Yaruss might have observed a significant correlation between age and SPW if he had limited his analysis to typically-developing children.

At least four factors might account for the failure to find a statistically significant relationship between age and SPW in the SD Group. The first possibility is the existence of co-morbid language impairments. The fact that up to 60% of children with preschool children with speech delay have co-existing expressive language impairments (Shriberg & Austin, 1998) may mean that a significant number of these children had less well-developed lexicons than the typically-developing children. Unfortunately the significantly reduced intelligibility of many of the children in the SD Group made this a question that could not be reliably examined.

Second, severity of involvement may have masked any possible age-SPW relationship in the SD Group. Perhaps the relationship does not hold for the most severely involved individuals with speech delay. Shriberg and Austin (1998) have speculated for example that co-morbidity may be more likely in those with more severe speech involvement. To examine the possible impact of severity, each child in the SD Group was classified using the severity categories proposed by Shriberg and Kwiatkowski (1982) which are based on Percentage of Consonants Correct (PCC) from conversational speech. Two children were rated as mild (PCC>85), 105 as mild-moderate (PCC 65–85), 76 as moderate-severe (PCC 50–64) and 19 as severe (PCC<50). Each of the severity categories included a

relatively wide range of ages of children. The two children rated as mild were 5;7 and 7;9 respectively; the mild-moderate group ranged in age from 3;0–7;8; the moderate-severe group ranged in age from 3;0–8;5, and the severe group ranged in age from 3;3–6;2. Linear regressions of age by SPW were then repeated separately for all but the mild category, but none of the three regressions was statistically significant (all ps$>$0.05). Thus, it is unlikely that severity of involvement was confounding the ability to find an age-SPW relationship in the SD Group.

A third possible explanation for the lack of an age-SPW relationship in the SD Group may have been word avoidance. Children with speech delay experience frequent breakdowns in communication and occasional negative reactions to their speech sound errors which may result in avoidance of particular words or word forms. It has been suggested that very young typically-developing children tend to avoid words that don't contain sounds already in their speech sound inventories (Ferguson & Farwell, 1975; Schwartz & Leonard, 1982). If the problem being experienced by these children is best characterized as delay rather than deviance (Shriberg, Gruber, & Kwiatkowski, 1994), it is conceivable that such avoidance may simply continue for a longer period in speech-delayed children because of their continuing difficulty with speech sounds. Such avoidance may also be more likely in children who are more severely involved, and the combination of severity and avoidance may have worked together to neutralize any age-SPW relationship. Additional support for the possibility of word avoidance comes from Faircloth and Faircloth (1971) who presented 10 case studies of children with cleft palate. These authors found that one strategy that some of these children appeared to use to improve the intelligibility of their speech was to reduce ''…sentence length, word length, and sentence complexity'' (p. 738). This pattern of adjustment may also be made by children with speech delay.

Finally there may have been no age-SPW relationship in the SD Group because a significantly greater proportion of the polysyllabic words being attempted by the children in the SD Group might have been among the unintelligible words. The significantly smaller value of SPW in the SD Group (compared to the NSA Group) observed in the current study is consistent with this possibility. As well, it has been shown that children with speech delay produce more speech-sound errors on polysyllabic words than monosyllabic words (Klein & Spector, 1985; Shriberg et al., 1986). By extension, it would be reasonable to expect that polysyllabic words also might be more likely to be unintelligible. The net result would be fewer SPW within the intelligible portion of the samples compared to the unintelligible portions.

The difference in SPW between the NSA and SD groups raises the question of whether SPW might qualify as a diagnostic marker for speech delay (or some subtype thereof). Examining such a possibility is beyond the scope of the current paper but even if it were not, the non-random nature of the current data sets would make establishing clinical criteria problematic (Shriberg et al., 1997). Further examination of this question would appear justified however.

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