Interactions of Length, Rate, and Complexity in Children's Disfluent Speech

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Introduction

- Linguistic factors, such as grammatical complexity and utterance length have been found to make demands on children's fluency (Bernstein Ratner & Sih, 1987; Yaruss, 1999; Zackheim & Conture, 2003).

- The effects of rate on stuttered speech have been inconclusive. Yaruss (1997) found no significant relationship found between articulation rate and stuttering in individual utterances of children who stuttered. Logan and Conture (1995) also examined individual utterances of children who stuttered, categorizing them as either "high" or "low" in the parameters of rate, length and grammar. Stuttered utterances were more often rated as "high" in length and/or grammatical complexity, but were not characterized by fast speaking rates.

- To determine the influences on disfluency in a long speech sample, Sawyer, Chon, and Ambrose (2006) examined group data for 14 children described in Sawyer and Yairi (2006). A comparison of group means in the first and fourth sections of a 1200-syllable sample for articulatory speech rate in syllables, number of clausal constituents, and mean length of utterance (MLU) revealed that MLU was significantly greater in the fourth section of the sample. There were trends for more clausal constituents and a slower speech rate.

Purpose of the study

Explore factors contributing to stuttering-like disfluencies in a single speech sample, specifically

- the effects of sample size on stuttering-like disfluencies, holding MLU constant
- the influence of length across a long speech sample
- the interactions of rate, utterance length, and grammatical complexity and their influence on speech at the utterance level.

Method

Participants

14 children who stuttered, ages 33-57 months were selected from the Sawyer and Yairi (2006) study described earlier. These children showed a 12% minimum increase in SLD

per 100 syllables in the final 300 syllables as compared to the first 300 syllables of the 1200-syllable speech sample (M = 75%, range = 12 – 250%).

Procedure

- To determine the influence of sample size on disfluency, the length of each utterance in morphemes was calculated for each child for the first 300 syllables of speech (sample A) and for the last 300 syllables of speech (sample B). The number of utterances containing SLD for each length was calculated, and samples A and B were compared.

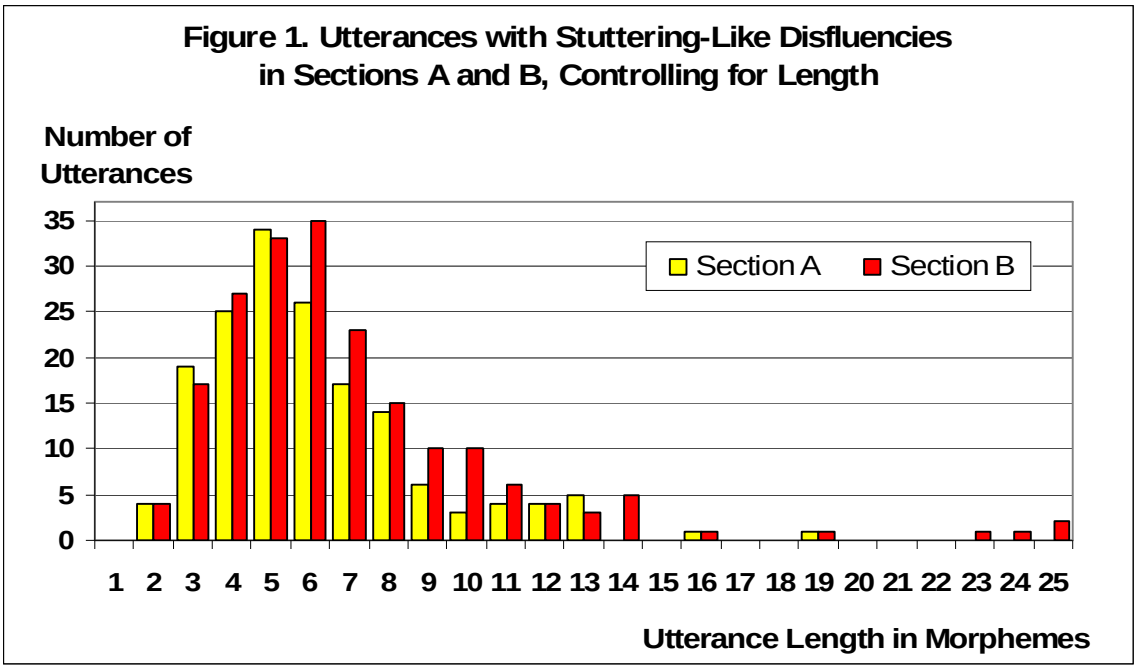
- To determine further influences of length, a comparison of each child's MLU for the entire speech sample was compared to the child's MLU in samples A and B (similar to Zackheim & Conture, 2003).

- To determine interactions among rate, grammatical complexity, and length across the two speech sections, a median split procedure described by Logan and Conture (1995) and Yaruss (1997) was used to categorize utterances as either "high" or "low" in each of the three parameters. Comparisons were across three different contrasts using the "high" and "low" criteria: complexity and rate, complexity and length, and length and rate. Complexity was measured in terms of the number of clausal constituents.

Results

1. Influence of sample size on disfluency, controlling for length.

With MLU held constant, it was not more likely that utterances which contained stuttering-like disfluencies would occur at the end of a long speech sample (at the .05 level, repeated measures ANOVA, F (1,13) = 4.137, p =.063).



2. Influence of length across a speech sample.

Most of the children spoke "over" their MLU for the entire speech sample in Section B, and "under their MLU for the entire sample in Section A.

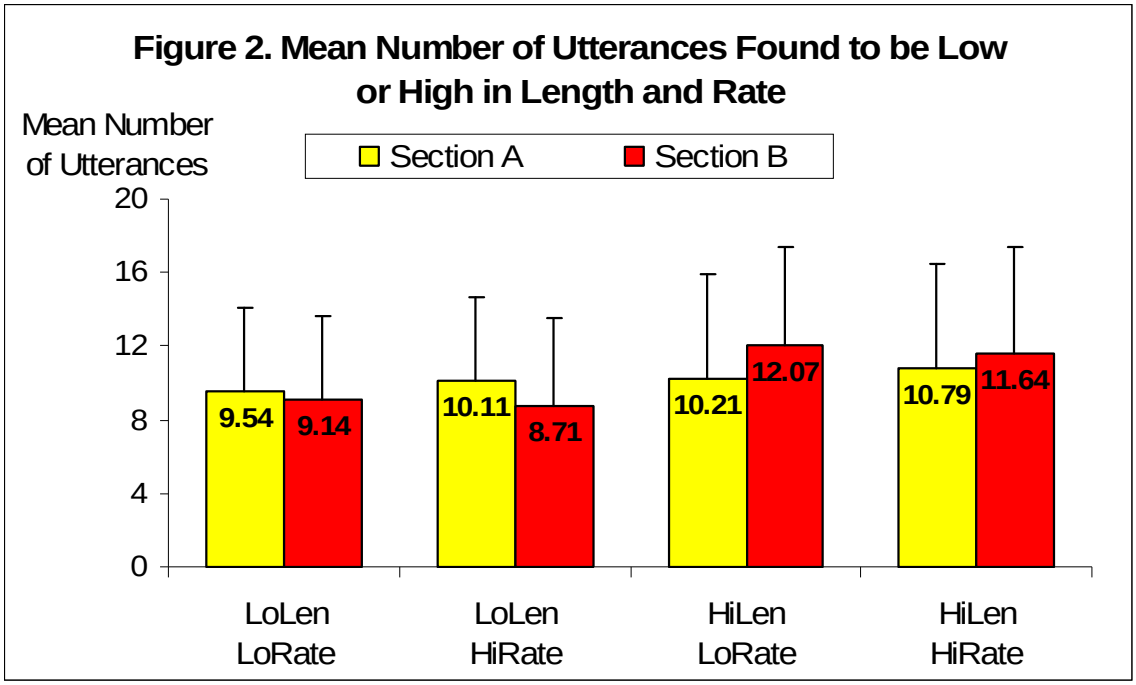
Table 1. *Individual Age, Expected MLU (SD), MLU for 1200 Syllables, and MLU for Sections A and B, Including Means and Standard Deviations, with Items in* ***Bold*** *Indicating Where MLU for the Section Exceeded MLU for the 1200-Syllable Speech Sample*

Participant	Age	Expected MLU (SD*)	MLU for 1200 syllables	MLU A	MLU B
1	40	3.47 (0.756)	5.39	4.55	**5.63**
2	33	2.85 (0.633)	3.69	3.52	**3.82**
3	41	3.78 (0.817)	3.57	3.30	**4.22**
4	40	3.47 (0.756)	5.47	5.49	**5.65**
5	54	5.02 (1.064)	4.02	**4.43**	3.82
6	33	2.85 (0.633)	4.82	4.34	**5.52**
7	36	3.16 (0.694)	4.70	3.51	**5.05**
8	36	3.16 (0.694)	4.93	4.41	**5.58**
9	34	2.85 (0.633)	3.93	3.80	**4.03**
10	51	4.71 (1.002)	5.74	4.44	**7.67**
11	41	3.78 (0.817)	4.26	3.82	**4.53**
12	37	3.16 (0.694)	6.05	4.35	**6.95**
13	48	4.4 (0.94)	5.51	5.40	5.10
14	49	4.4 (0.94)	4.80	4.80	4.43
M	40.93	3.65	4.78	4.30	5.14
SD	6.94	0.73	0.79	0.66	1.14

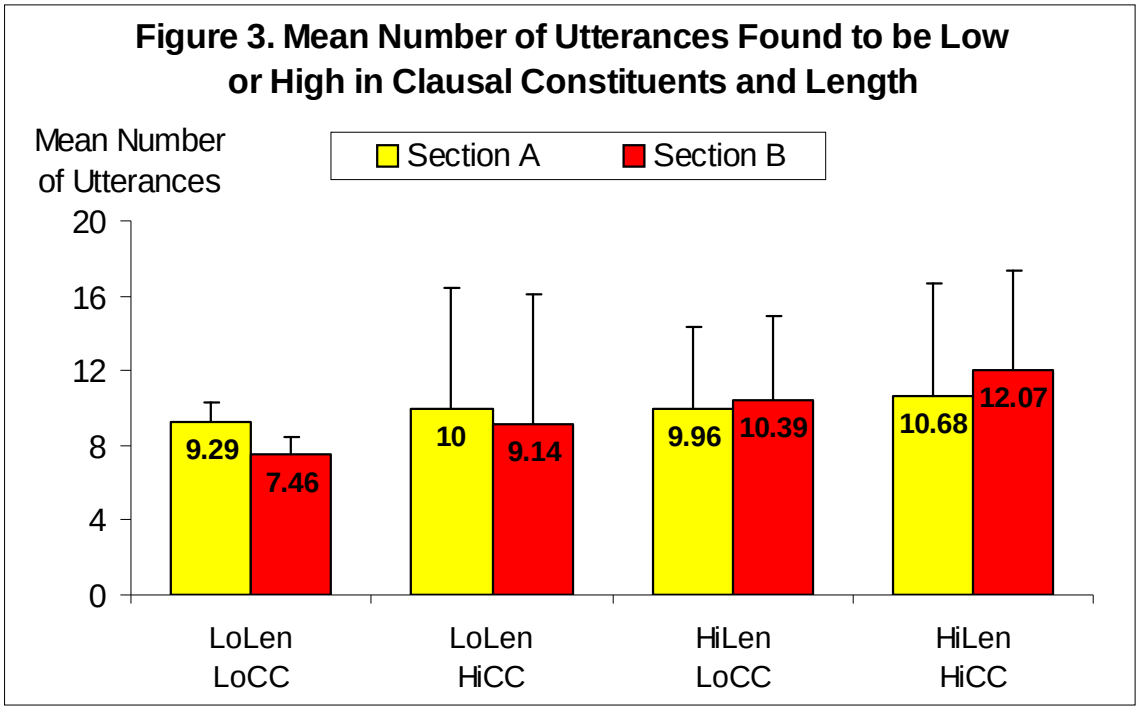
* Values are from Miller, J. F. (1981).

3. Interactions among rate, grammatical complexity, and length.

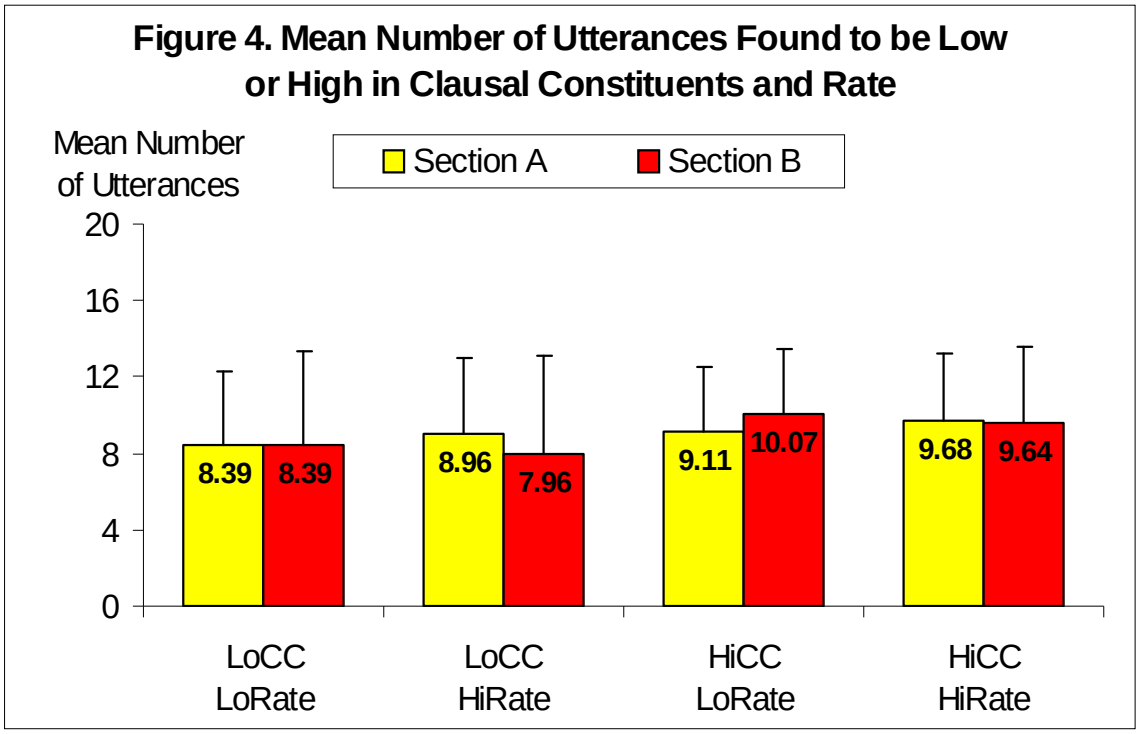
Utterance Length and Rate. The mean number of utterances in Sections A and B classified as either "high" or "low" in utterance length, measured in morphemes, and articulation rate are found in Figure 6. Four paired *t*-tests revealed one significant difference between the two sections. The mean number of utterances that were classified as "high" length / "low" rate was significantly larger in Section B than A (t = -2.38; p = .025). There was a trend for more utterances of "low" length/ "high" rate to occur in Section A than B, but this difference was not significant (t = 1.07; p = .295).



Grammatical Complexity and Utterance Length. Figure 5 shows the contrast between Sections A and B in the mean number of utterances of "high" or "low" grammatical complexity, measured in the number of clausal constituents, and utterance length, measured in morphemes. The two sections were similar in the number of utterances across all four categories, with no significant differences noted in four paired *t*-tests. There were trends noted for "low" length/ "low" complexity and "high" length/ "high" complexity, with Section A having more utterances in the former and B having more utterances in the latter category, but these differences were not significant (t = 1.44; p = .160, and t = -1.85; p = .075, respectively).



Grammatical Complexity and Rate. Figure 4 shows the mean number of utterances in Sections A and B classified as either "high" or "low" in grammatical complexity, measured by the number of clausal constituents per utterance, and in articulation rate. Four paired *t*-tests indicated no significant differences in the two sections in any of the categories. There were more utterances in Section A than B that were in the "low" complexity / "high" rate category, but these differences were not significant (t = .829; p = .414). In addition, there was another trend for more utterances with "high" complexity / "low" rate to occur in Section B than A, but this difference was not significant (t = -1.06; p = .297).



Discussion and Conclusions

- **An examination of utterance length at the beginning and end of the speech sample did not add support to sample size being a factor in the production of stuttering-like disfluencies.** With utterance length held constant, the position of the utterance in the speech sample did not have an effect on stuttering-like disfluency.

- **Mean length of utterance appeared to be a contributing factor to children's disfluencies at the end of a long speech sample.** Most of the children talked "over" their MLU at the end of a long speech sample. This result was similar to that of Zacheim and Conture (2003), who found that disfluencies increased as children talked at levels greater than their typical MLU.

- **There appeared to be an interaction between utterance length and rate at the end of a long speech sample.** The difference in utterance length in the two sections was robust. Section A was characterized by utterances of low length, and low or high complexity, and low or high rate. Section B was characterized by high length, with a significant difference in utterances which had high length/low rate. Future studies of different types of utterances (i.e., perceptually fluent, those with stuttering-like disfluencies, and those with typical disfluencies), and measurements of correlation among articulation rate, disfluencies and utterance length using a larger sample size would be helpful.

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