#### **Measuring Speech Rates** in Fluent and Disfluent Utterances

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#### Introduction

## Why Speech Rate?

- Rate is a significant theoretical and clinical characteristic in stuttering and motor speech disorders. (Flipsen, 2002; Hall, Amir, & Yairi, 1999; Walker & Archibald, 2006)
- In stuttering, clinically, parents' speech rate may influence their children's disfluencies. (Guitar, 2006; Yairi & Ambrose, 2005; Zebrowski & Kelly, 2002)
- As a part of treatment, adults who stutter (AWS), children who stutter (CWS) and/or parents of CWS are often asked to slow down their speech. (Conture & Melnick, 1999; Guitar, 2006)

The experimental design and the metric employed may account for some of the discrepancies in past findings.



- Even though speech rate is an important paralinguistic behavior, research findings have been inconclusive.

Why are results inconclusive?



- · What is measured
- · Quantified elements (linguistic, time measurements)
- Measurement techniques
- Selection of utterances
- Selection of participants

# Selection of Utterances

Speech rate using perceptually fluent utterances:

Some investigations have studied speech rates using only perceptually fluent speech on the assumption that taking out the disfluencies might be complicated due to the effects of pauses and/or coarticulation.



Logan & Conture (1995) showed a trend that stuttered utterances were relatively slower than fluent utterances. Also, Andrade, Cervone, and Sassi (2003) showed people who have more severe stuttering had significantly slower speech rate.

# Selection of Utterances (cont'd)

· Speech rate using both fluent and disfluent utterances:

For measuring speech rate, disfluent speech was excluded but no explanation about pauses was given. (Logan & Conture, 1995; Kelly, 1994; Kelly & Conture, 1992)



The pause following disfluencies, especially if the disfluencies were shown in the middle of utterances, could influence the speech rate. This means that if the pause was not excluded, the speech rate could be over- or under- estimated.

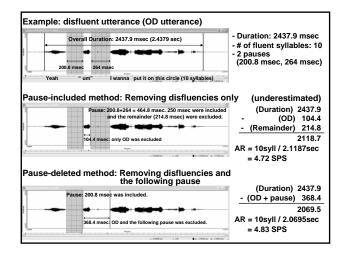
#### Articulation rate

 Defined as the number of perceptually fluent syllables in each utterance divided by the duration (seconds) of the utterance removing all instances of stuttering like disfluencies, other disfluencies, and pauses greater than 250 milliseconds (syllables per second: SPS).

(Chon, Ko, & Shin, 2004; Hall, Amir, & Yairi, 1999; Miller, Grosjean, & Lomanto, 1984; Walker, Archibald, Cherniak, & Fish, 1992; Yaruss, 1997)

 Related to temporal aspects of motor speech and the motor transition ability.

(Andrade, Cervone, & Sassi, 2003; Walker et al., 1992)



# Rationale & Purpose of the study

- (1) To determine the <u>characteristics of speech rate</u> in stuttering.
- (2) To seek an <u>additional, more refined analysis of speech rate</u>, especially for children near onset of the disorder.

#### Study Question 1

Do the different types of utterances (perceptually fluent utterances, normally disfluent utterances and abnormally disfluent utterances) yield different articulation rates?

- (a) <u>Pause-included method:</u>
  Removing disfluencies only,
  articulation rates among three
  types of utterances were
  compared.
- (b) Pause-deleted method:
  Removing disfluencies and the following pause, articulation rates among three types of utterances were compared.

# Disfluency types

(Ambrose & Yairi, 1999)

Other Disfluencies (OD)	Interjection
	Revision/abandoned utterance
	Phrase repetition
	Multisyllabic word repetition
Stuttering Like Disfluencies (SLD)	Single syllable word repetition
	Part-word repetition
	Disrhythmic phonation (blocks/sound prolongations)

#### Study Question 2

Does manipulation of pauses in each disfluent utterance influence articulation rate?

- (c) The result of the pause-included and that of the pause-deleted method was compared.
  - The articulation rate of utterances containing SLD using the two different methods
  - The articulation rate of utterances containing OD using the two different methods

# Hypotheses

- (a) When CWS stutter, because their motor transition ability might be disrupted, the utterances containing SLD (SLD utterances) would have slower articulation rates than the perceptually fluent utterances regardless of method of pause manipulation.
- (b) The utterances containing normal disfluencies (OD utterances) would have similar articulation rate to the perceptually fluent utterances regardless of method of pause manipulation.

## Hypotheses

(c) The articulation rate of each utterance (both SLD and OD utterances) would be significantly different between the two methods. This means that both SLD and OD utterances would be under- or over-estimated in the pause-included method.

#### Method

#### **Participants**

- 11 Children Who Stutter: 7 boys and 4 girls (Mean age = 40 months; Age range 33 - 54 months)
- Severity of stuttering: 4 mild, 4 moderate, 3 severe
- Regarded by parents as having a stuttering problem
- Regarded by two certified speech pathologists as exhibiting stuttering
- Exhibiting at least 3 SLDs per 100 syllables
- No history of neurological disorders or abnormalities

#### Data Collection

- Each participant interacted with a parent or an investigator playing with Play-Doh in a sound-treated booth.
- Audio- and video- taped
- The first 10 minutes of conversational speech were excluded and the following 51 utterances were collected.
- Simultalk, unintelligible talk, or utterances with fewer than three consecutive words were excluded.

  (Hall Amir & Vairi 1999: Logan & Conture 1995: Varies 1997:

(Hall, Amir, & Yairi, 1999; Logan & Conture, 1995; Yaruss, 1997; Yaruss & Conture, 1995)

#### Analyses

- Transcription: Transcribed using the Systematic Analysis of Language Transcripts (SALT) Program.
   (Miller & Chapman, 1996)
- · 3 types of utterances
  - Perceptually fluent utterances: fluent utterances
  - Utterances containing SLD: SLD utterances
  - Utterances containing OD: OD utterances
- Converted to wave files and put into the Computerized Speech Lab (CSL: model 4500 by Kay Pentax)

# Analyses (cont'd)

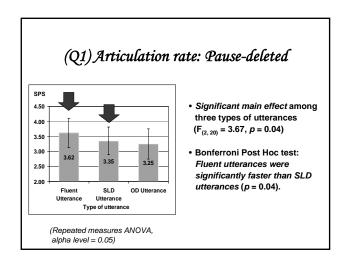
- Duration: Overall duration, pauses and disfluencies in each utterance were measured following the 2 methods (pause-included, pause-deleted).
- Duration of pause < 250 milliseconds: included
- Duration of pause > 250 milliseconds: only 250 ms were included and the remainder were removed.
- 283 fluent utterances, 221 SLD utterances, and 57 OD utterances were analyzed (total 561 utterances).

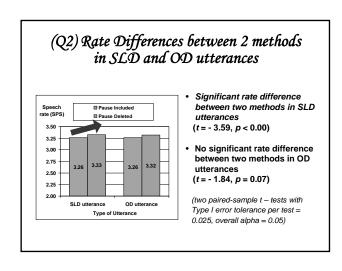
Articulation rate (SPS: syllables per second) The number of syllables of fluent speech

The duration (second) of fluent speech

#### Results

# (Q1) Articulation rate: Pause-included SPS 4.50 4.50 4.50 3.50 3.50 3.62 3.29 3.20 SIgnificant main effect among three types of utterances (F<sub>(2, 20)</sub> = 5.5, p = 0.01) Bonferroni Post Hoc test: Fluent utterances were significantly faster than SLD utterances (p = 0.02). (Repeated measures ANOVA, alpha level = 0.05)





# Discussion

#### (Q1) Articulation rates among the utterances

(1) Fluent utterances were significantly faster than SLD utterances regardless of analysis methods.

This result supports the hypothesis that when children stuttered, because their speech motor system was disrupted, their speech was slowed down. Logan and Conture's (1995) study showed the same trend, but it was not significant.

Clinically, training children who stutter (CWS) to slow down may not be productive, since their stuttered speech is already slower than their fluent speech.

(2) Articulation rate was not significantly different between fluent utterances and OD utterances.

This result supports different qualitative features between SLD and OD in that both stuttering people and normally fluent people have normal disfluencies that would not disrupt the speech motor system.

# (Q2) Rate Differences between 2 methods in SLD and OD utterances

(3) The SLD utterances showed a significantly faster articulation rate under the pause-deleted method than under the pauseincluded method (pause-included method: underestimated).

This result supports the hypothesis that pauses influence children's speech rate so it would have to be controlled when measuring speech rate.

(4) The OD utterances showed relatively faster articulation rate under the pause-deleted method than under the pause-included method, but the result was not significant.

Because two subjects had only one OD utterance in 51 utterances, the result might not represent rate differences between the 2 methods. More data would be needed to characterize the speech rate of OD utterances.

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