



Listener Perceptions of Varying Vowel Durations

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Abstract

Vowel duration, one component of speech altered in stuttering treatment, contributes to speech naturalness judgments. To determine the range of vowel durations that are considered to be natural and unnatural, 10 speech samples were created with manipulated vowel durations ranging from 150 msec to 600 msec. Naïve listeners judged the vowel durations using a paired comparison task and a 9-point scale. Results found a change in naturalness ratings occurred from approximately 250 to 350 msec, supporting previous research. These findings have implications for the speech targets that clinicians use in fluency treatment, providing clinicians with additional data to help enable their clients to establish natural sounding speech.

Background

- The speech quality following treatment for stuttering often has been described as being "unnatural."
- Reduced speech rate and longer vowel duration have been identified as components altered after stuttering treatment.
- Speech naturalness has been measured through paired comparison tasks and by using a 9-point scale.
- Few studies have investigated the relationship between vowel duration and naturalness ratings.

Research Questions

1. At what vowel duration do naturalness judgments change to unnaturalness judgments?
2. To what degree are naturalness ratings and vowel durations related?
3. Can naïve listeners reliably rate the speech naturalness of prolonged vowel durations using a 9-point scale and a paired comparison task?
4. How does a paired comparison task relate to a 9-point scale task?

Method

Participants

- 41 subjects (30 females, 11 males)
- Age range: 22 to 58 years (mean = 29.4; SD = 9.14)
- Native English speakers with normal hearing
- No frequent contact with a person who stutters

Speech Samples

- One phrase "You can keep that book"
- Spoken by a male without speech or language problems
- 10 vowel durations in 50 msec intervals ranging from 150 to 600 msec (See Figure 1)

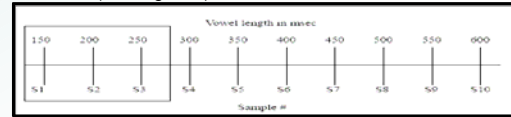


Figure 1: Vowel lengths of 10 samples (box indicates "normal" range)

Listening Tasks

- Paired Comparison Task: Discrimination task
- 9-Point Scale Task: Identification task
- Randomized samples through MATLAB

Data Analysis

Paired Comparison Task

- Thurstone's Law of Comparative Judgment: z-scores found greatest psychological distance between sample 4 (250 msec) and 5 (300 msec)
- Intra-rater reliability: 83%; 87% within 1 sample interval

9-Point Scale Task

- z-test: z-scores found greatest psychological distance between sample 3 (200 msec) and 4 (250 msec)
- Pearson correlation coefficient: Significant at 0.778, demonstrating vowel duration is correlated with naturalness judgments
- Inter-rater agreement: 21%, 56% within 1 sample interval; Intra-rater agreement: 39%, 81% within 1 sample interval

Results

z scores were compared to determine the greatest psychological distance for each of the two tasks. A relationship exists between naturalness ratings and vowel duration, for both tasks.

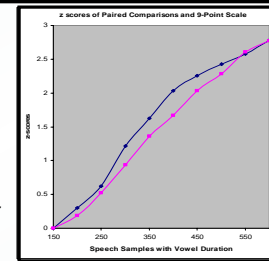


Figure 2: z-scores for Paired Comparison and 9-Point scale tasks

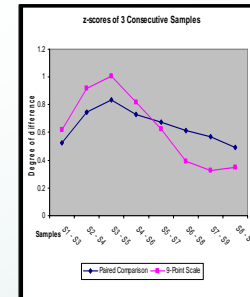


Figure 3: z-scores compared across 2 samples for Paired Comparison and 9-point scale data

Measures of central tendency reveal a clear relationship between naturalness and vowel duration using the 9-point scale, with longer vowel durations receiving greater unnaturalness ratings (Figure 4).

Intra-rater and inter-rater reliability for the 9-point scale was poor, suggesting that the 9-point scale may not be a sensitive tool for measuring naturalness when a minimal difference exists between samples.

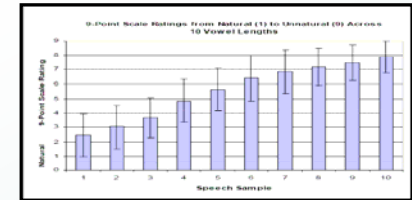


Figure 4: Mean and standard deviation values for each sample, using the 9-Point scale

Intra-rater agreement was highly variable when samples within 1 sample interval were compared. More agreements were found when a greater range of samples were compared (Figure 5).

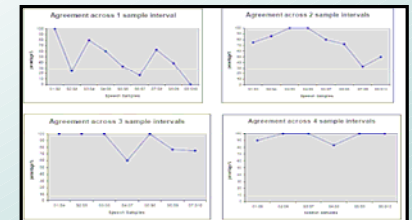


Figure 5: Intra-rater reliability for Paired Comparison Task comparing 1,2,3 and 4 samples

Conclusions

Listener variability exists in naturalness ratings of vowel duration, with most listeners experiencing a change with 250 to 350 msec.

Clinicians should aim for speech targets with a vowel duration that is perceived naturally to minimize risk of relapse, especially for severe stutterers.

Paired comparison tasks yield more reliable results than did the 9-point scale task.

Perhaps more reliable ratings could be obtained using a greater time interval between samples (>50 msec).