



## 2aSC6. Strategies used to increase speech clarity by normal-hearing children

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## Study Rationale

It is common for clinicians to ask children to produce their "best speech" during intervention. This study is part of a larger project to examine the acoustic changes that result from these instructions to children with normal hearing, hearing aids, or cochlear implants.

There have been several studies of the acoustic consequences of asking adults to produce "clear" speech (e.g., Picheny, Durlach & Braida, 1986; Krause & Braida 2004). By comparing adult and child productions of clear speech, we can investigate whether children have an idea of what "best speech" is and what strategies are effective for obtaining clearer speech. Subsequent comparisons with hearing-aided and cochlear-implanted children will allow us to ascertain if these strategies are dependent on the nature of the auditory signal.



## Subjects

- ❖ 7 males and 7 females
- ❖ Age range: 7 to 12 years of age
- ❖ Normal audiogram; Quick screening of perception and production; No history of speech therapy



## Stimuli



Subjects were instructed to read the following sentences:

Dad got a dog.	Pat the cat's head.
Go get the cake.	Pete has a shoe and a boot.
His feet are fat.	Put the pop back.
I saw a bat at the zoo.	She knows what to do.
Keep the good top.	The deep pot is hot.

## Data Collection



Children were told that we were testing a new computer program that understood children's speech.



### 1) Normal Speech:

After practicing reading sentences on the screen, children were asked to read the sentences again in their normal speech in order to "train" the program. A running spectrogram was displayed during all productions.

### 2) Best Speech:

Next, the children were told to test the program's ability by reading the sentences again using their "BEST, CLEAR speech." At the end, the program "calculated" a percent correct score of 60% for all the children.

### 3) Very Best Speech:

Every child was told that their score was good but were asked to read the sentences again using their "VERY BEST, VERY CLEAREST speech" to see if the computer could understand even more. An 80% correct score was presented.

## Acoustical Analyses

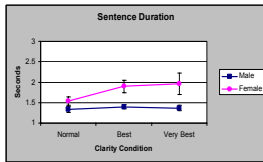
Means calculated for each child (across all relevant instances). ANOVA computed on means.

- ❖ Duration: sentences, between word pauses, vowels
- ❖ VOT: overall means, voiced-voiceless differences
- ❖ F0: vowel midpoints
- ❖ Intensity: vowel midpoints
- ❖ Vowel Space Size: area of /i/, /a/, /u/ triangle, total vowel to vowel distance (5 vowels)

## Duration Results

### Sentence Duration:

- ❖ Effect of clarity condition not significant
- ❖ 2 females significantly longer for best and very best conditions
- ❖ Females longer than males (1.80 s vs. 1.37 s) and more variable



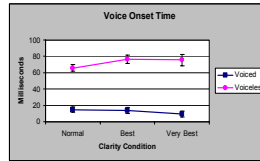
### Between Word Pause Duration:

- ❖ Effect of clarity condition not significant
- ❖ 3 females significantly longer for best and very best conditions
- ❖ Females longer than males (59 ms vs. 15 ms) and more variable

### Vowel Duration:

- ❖ Effect of clarity condition not significant
- ❖ 3 males and 2 females significantly longer for best and very best conditions
- ❖ Females longer than males (187 ms vs. 161 ms)

## VOT Results



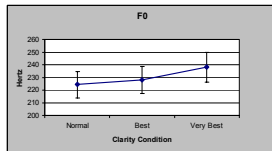
- ❖ The average difference in VOT between voiced and voiceless stops increased from **normal** (51 ms) to **best** (63 ms) to **very best** (66 ms).
- ❖ This enhancing of the phonetic distinction was a result of lower voiced and higher voiceless VOT (individually, the children varied one or the other).
- ❖ No gender effects.



## F0 and Intensity

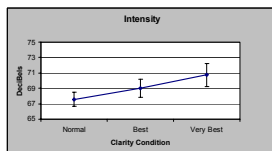
### F0:

- ❖ Significant increase with instructions to provide better speech
- ❖ No gender effects

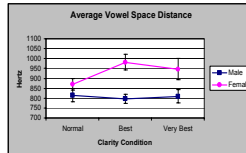


### Intensity:

- ❖ Increase in intensity with instructions to provide better speech
- ❖ No gender effects



## Vowel Space Size

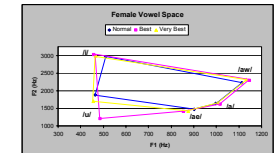
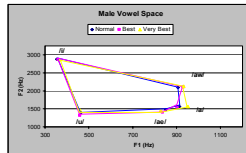


### Average vowel category distance:

- ❖ Gender by clarity interaction. Females show increase in size from normal to best conditions. Males do not. Females spaces larger than males on average.

### Area of /i,a,u/ triangle:

- ❖ No effect of clarity or gender



## Summary

- ❖ Instructions to normal hearing children to produce their "best" speech does lead to acoustic changes. Some of these changes are also witnessed in adults producing "clear" speech (Picheny et al. 1986; Krause & Braida, 2004).
  - Differences in VOT between voiced and voiceless stops are enhanced
  - Intensity increases
  - F0 increases
- ❖ Some differences relative to adult results were noted:
  - No decrease in average speaking rate. Sentence, vowel, and pause duration did not change.
  - Vowel space expansion was present for females, but not males.
- ❖ This pattern of results probably does not lead to much more intelligible speech.
  - Lower speaking rates and vowel expansion have been shown to be important to intelligibility (Bradlow, Toretta & Pisoni, 1996) but higher f0 and vowel amplitude do not necessarily enhance intelligibility.
- ❖ Gender differences in speaking rate and average vowel space size are apparent in 7-12 year olds (with equal f0s). Gender differences in strategies for best speech are also apparent.



## Acknowledgements and References



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- Krause, J.C. & Braida, L.D. (2004). Acoustic properties of naturally produced clear speech at normal speaking rates. *Journal of the Acoustical Society of America*, **115**, 362-378.
- Picheny, M.A., Durlach, N.I., & Braida, L.D. (1986). Speaking clearly for the hard of hearing II: Acoustic characteristics of clear and conversational speech. *Journal of Speech and Hearing Research*, **29**, 434-446.

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