Analysis of the Acoustic Changes Within Speech as a Result of Aging

UNIVERSITY OF ALBERTA
DEPARTMENT OF LINGUISTICS

Anna Wright and Benjamin V. Tucker

Alberta Phonetics Laboratory

Introduction

- Most people are able to estimate the age of a speaker when only listening to their voice [1]
- As people age, their voices change; these changes are due to different factors which can include biological changes as well as health conditions
- Studies have investigated how the voice changes, but most tested different age groups, and there are few longitudinal studies (with the same person over a long period of time)
- Voice characteristics can be investigated acoustically to learn how they change over time

Purpose:

- Investigate how a single person's voice changes over time

Research questions:

- How does an individual's voice change over a 37-year period?
- Does data from a longitudinal study from a single male speaker match data from studies using speaker groups at different ages?

Method

- Forced alignment of five 5-minute selections from speeches in different decades (1950, 1962, 1970, 1980 and 1987), made by the same speaker in a similar setting
- **Speaker**: Ezra Taft Benson (1899-1994), [2]
  - Born in Idaho, lived in Iowa, California, Idaho, Washington DC and Utah
  - Benson was the US Secretary of Agriculture and an apostle of the LDS church. He gave speeches regularly, of which the data used was gathered from
- Formant values, pitch and the durations of the vowels and words was extracted from the aligned spectrogram

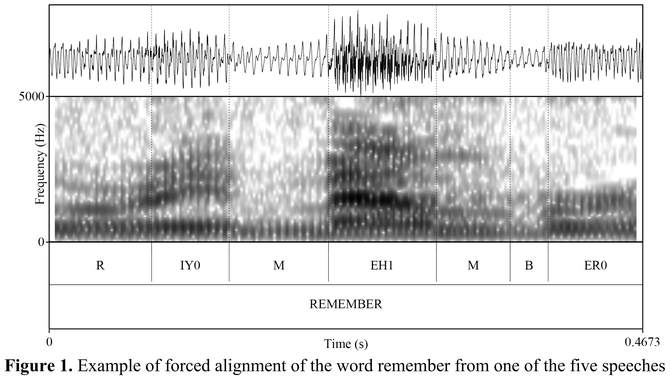

Figure 1. Example of forced alignment of the word remember from one of the five speeches used

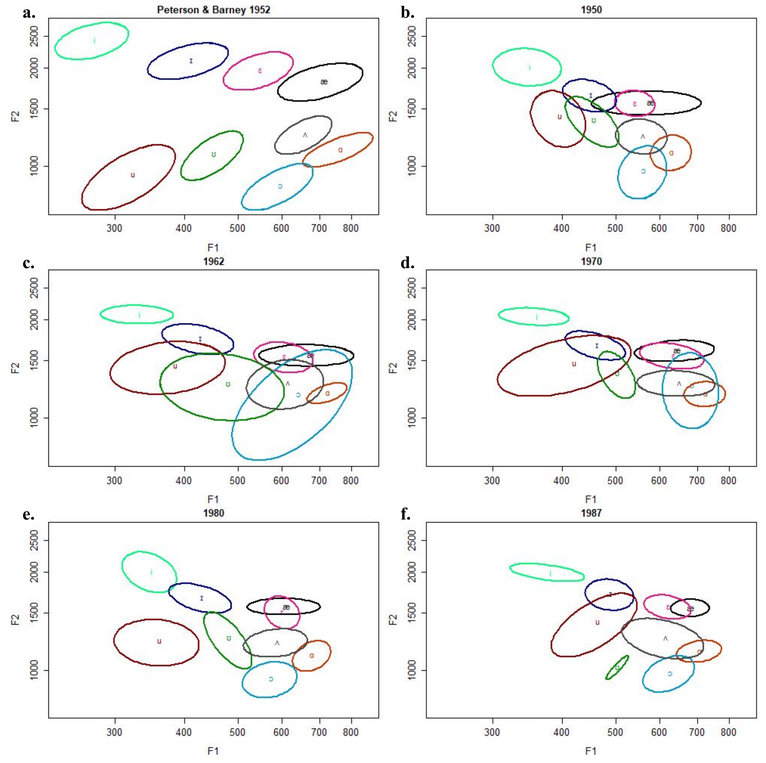

Figure 2. First and second vowel formants for each year. In a. the data comes from the normed Peterson & Barney (1952) dataset. b-f are plots of samples from decades where speeches were given..

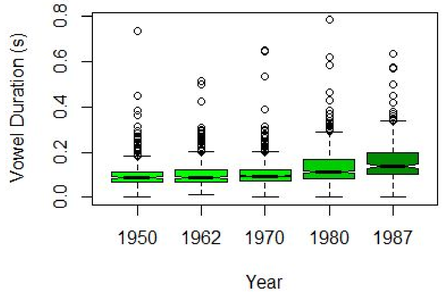

Figure 3. Boxplot of average vowel duration for each year

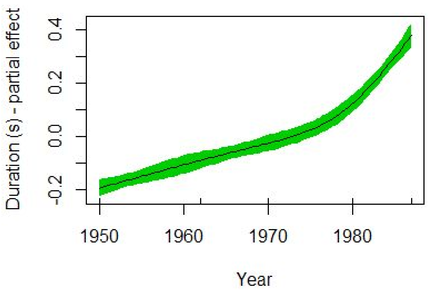

Figure 4. Modeled non-linear figure of average word duration as a function of year

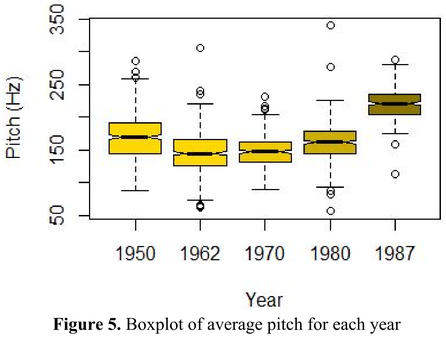

Figure 5. Boxplot of average pitch for each year

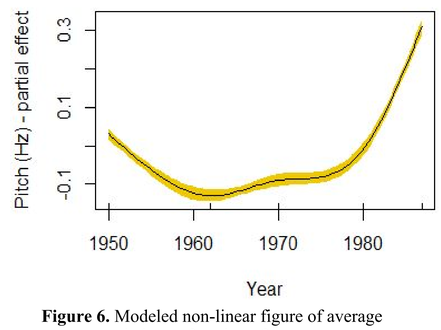

Figure 6. Modeled non-linear figure of average pitch as a function of year

Results

- Vowel formants
  - Benson's formants are very different from PB52
  - Lots of /u/ fronting
  - An acoustic merger of his /ɛ/ 'pet' and /æ/ 'pat' (though duration can be used to distinguish them)
  - We don't see any changes over time with his vowel space
- Average vowel duration and word duration increases over the 37 year period which is consistent with the age group data [1]
  - From 1950 to 1970 the average vowel and word duration increases (Fig, 3 & 4)
  - Between 1970 and 1980 the slope of the increase becomes steeper for word duration (Fig. 4)
  - The variability in the durations also increases over time (Fig. 3)
- Average pitch (Fig. 5 & 6)
  - From 1950 to 1962 shows a decrease in pitch
  - From 1962 to 1970 the pitch starts to increase slightly
  - From 1970 to 1987 the slope becomes steeper and the average pitch increases substantially

Conclusions

- The effects of aging seem to be more apparent in his speech between 1970 and 1987 (age 71-88) which could be due to the beginning of a decline in his health
- We have confirmed that in accord with the group studies that as men age, the overall vocal pitch and word duration increases
- We also see that the effect of pitch change is not linear, which is not found in the group studies. This means that for Benson pitch first gets lower before it gets higher.

References:

[1] Kent, Ray D., and Robert Burkard. "Changes in the acoustic correlates of speech production." Aging: Communication processes and disorders (1981): 47-62.

[2] Searle, D. L. (n.d.). President Ezra Taft Benson Ordained Thirteenth President of the Church. Retrieved from https://www.lds.org/ensign/1985/12/president-ezra-taft-benson-ordained-thirteenth-president-of-the-church?lang=eng&_r=1

Acknowledgements:

Enormous thanks to Pearl Lorentzen! Special thanks to the Alberta Phonetics Laboratory.

This research project was sponsored by NSERC Promo Science.

Contact: anwright@ualberta.ca

WISEST Celebration of Research - August 16, 2017

WISEST women in scholarship, engineering, science & technology

NSERC CRSNG