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2pSC8. Sociological effects on vocal aging: Age related F0 effects in two languages

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Introduction

Speech and advanced aging

Fundamental frequency (F0)

- Female: Mean F0 of females decreases with advanced aging (Krook, 1988; Xue & Mueller, 1996; Xue & Deliyski, 2001; Xue, Neeley, Hagstrom, & Hao, 2001).
- Male: Mean F0 of males tends to increase with advanced aging (Hollien & Shipp, 1972; Mysak, 1959; Mysak & Hanley, 1958; Xue & Deliyski, 2001).

Speech rate

- Elderly speakers tend to speak slow (Mysak, 1959; Ramig, 1983; Smith, Wasowicz, & Preston, 1987).

Perception of talkers' age

- Listeners can estimate the age of a speaker fairly accurately from their speech (Ptacek & Sander, 1966; Shipp & Hollien, 1969; Ryan & Burk, 1974).

Acoustic factors

- Acoustic properties related with voice qualities are known as strong cues to perceive talker age (Ryan & Burk, 1974; Braun & Rietveld, 1995).
- Relationship between F0 and perceived age is controversial: some studies show that mean F0 does not influence age perception (Braun & Rieveld, 1995); while others showed a significant F0 effect (Hartman & Danhauer, 1976; Horii & Ryan, 1981).
- Speech rate is sometimes a weak cue (Ryan & Burk, 1974), and sometimes a strong cue (Braun & Rietveld, 1995; Ptacek & Sander, 1966; Shipp, Qi, Huntley, & Hollien, 1992).

Socio-cultural factors

- Stereotypes of speech associated with a certain age group might be different in different cultures.
- Listeners' familiarity with a certain age group might affect accuracy of age perception. The three-generation family is more common in Japan than in the US [24.5% vs. 5%].
- Pitch can convey various linguistic aspects of speech. Japanese females tend to employ higher portion of their pitch ranges. This is generally considered to be a socio-cultural constraint on females in Japanese society (Loveday, 1981, Ohara, 1992).

→ ***Do these sociological factors cause a difference in age perception?***

Research Questions

- Is there any relationship between pitch level and stereotypical speech associated with aging?
- Do both Japanese and English talkers show the same relationship between pitch level and speech stereotypes?
- How effective are stereotypical variations at conveying age to listeners, especially when the listeners do not share a social background with the talkers?

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Production Experiment

Talkers

- 60 talkers.
- Subdivided by Language (English or Japanese), Age (Young, Middle-age, or Elderly), and Sex (Female or Male).
- Only middle-age talker data will be presented here.

Language	English						Japanese					
Age	Young		Middle-age		Elderly		Young		Middle-age		Elderly	
Sex	M	F	M	F	M	F	M	F	M	F	M	F
Age range	24-30	25-30	54-60	55-60	80-86	80-86	24-30	25-30	55-60	55-60	80-86	80-85
N	5	5	5	5	5	5	5	5	5	5	5	5

- No talkers reported prior and present speech or hearing problems.
- Japanese talkers had long residence in Kansai area in Japan. English talkers had a long residence in Bloomington, IN.

Speech materials

The target phrase "*BCC*" is spoken similarly in both languages.

English: "The answer was **BCC** [bisis] Corporation."

Japanese: "Kotae-wa **BCC** [biɕiɕi] kooporeeshyon datta-yo."

Procedure

- Each talker read the same sentences in three styles.

Control condition: Read aloud in a normal manner.

Maturation condition: Read as if they are **20 years older** than they are.

Rejuvenation condition: Read as if they are **20 years younger** than they are.

Analysis

- Mean F0 values and Durations of the target phrase were measured with the PRAAT.
- The target phrase (*BCC*) measured from the burst of /b/ to the ending of third vowel.
- Three-way ANOVAs were performed on F0 and durational data (3-levels of Styles, 2-levels of Language, and 2-levels of Talker sex).

Perception Experiment

Listeners

- 27 native English speakers (Mean age = 21 years old).
- 24 native Japanese speakers (Mean age = 19 years old).

Stimuli

- The target phrase (*BCC*) was cut out of each utterance.

Task

- Direct age estimation of a talker for each target phrase in the 3 styles.
- Age range used for responses: 1 ~ 100 years old.

Production Results

Rejuvenation vs. Control

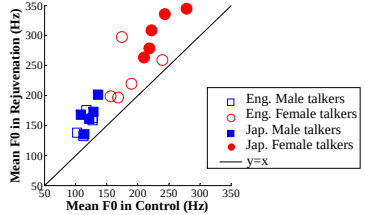

Figure 1a. Mean F0 values of each talker in the Rejuvenation condition against the values in the Control condition.

Maturation vs. Control

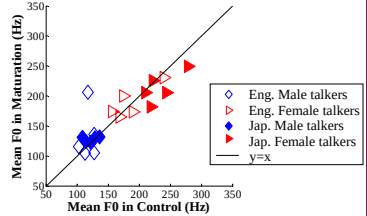

Figure 1b. Mean F0 values of each talker in the Maturation condition against the values in the Control condition.

1. When talkers pretend to be 20 years younger, their mean F0 values were increased for all groups.
2. Japanese females exhibited higher F0 values than English females. Men did not exhibit such differences.

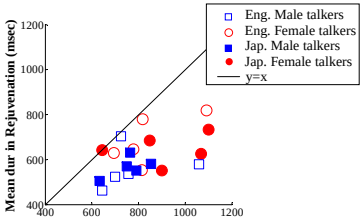

Figure 2a. Mean durations of each talker in the Rejuvenation condition against the values in the Control condition.

3. When talkers pretend to be 20 years older than their age, they did not change F0 significantly.

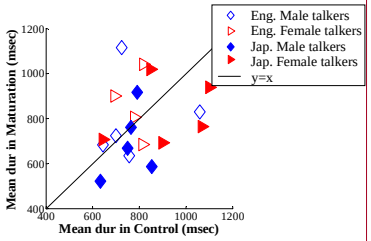

Figure 2b. Mean durations of each talker in the Maturation condition against the values in the Control condition.

4. All the talkers spoke faster in the rejuvenation condition. Sex and language differences seem to disappear.

Table 2a. Sheffe's post-hoc test results for F0 values

Conditions	Rejuvenation	Control	Maturation
Rejuvenation		-	-
Control	p <0.001		-
Maturation	p <0.001	*n.s.* (p = .980)	

5. Some slowed down, and some sped up, but, overall duration was not systematically changed in the maturation condition.

Table 2b. Sheffe's post-hoc test results for duration

Conditions	Rejuvenation	Control	Maturation
Rejuvenation		-	-
Control	p < 0.01		-
Maturation	p < 0.01	*n.s.* (p = .935)	

Perception Results

- Mean age difference was calculated by subtracting talkers' chronological age from listeners' mean perceived age.

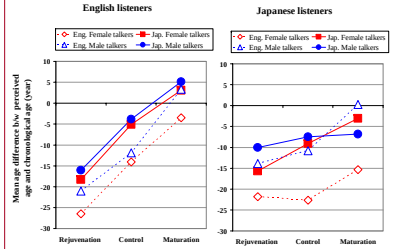

Figure 4. Mean age differences in each condition for English (Left) and Japanese listeners (Right)

6. Talkers' age manipulation (younger or older) was successfully perceived such to listeners: Except English women always sounded young to Japanese listeners.
7. Age perception differed somewhat between two listener groups. This suggests that age perception is not specified only by physiologically-determined factors.
8. Despite small F0 and temporal differences, all talkers succeeded to be perceived as older in the maturation condition for both listener groups. This suggests that other acoustic properties (e.g. jitter, shimmer, amplitude, etc.) signal talkers' age than the variables measured here.

SUMMARY

- For most of the talkers (especially females), higher pitch is associated with younger talkers. Lower pitch seems to be associated with older talkers for some female talkers, but not for male talkers. These relations are similar for both Japanese and English talkers.
- Fast speaking rate seems associated with younger speech. However, slow rate speech is not necessarily related with older speech.
- In general, listeners consistently and appropriately perceive the age differences introduced by talkers in the age-disguised speech.
- English and Japanese listeners performed somewhat differently. Age perception is partly culturally determined.

References

Braun, A., & Rietveld, T. (1995). The influence of smoking habits on perceived age. In *Proceedings of the 13th International Congress of Phonetic Sciences* (Vol. 2, pp. 294-297).

Hartman, D. E. & Danhauer, J. L. (1976). Perceptual features of speech for males in four perceived age decades. *JASA, 59 (3),* 713-715.

Hollien, H., & Shipp, T. (1972). Speaking fundamental frequency and chronological age in males. *Journal of Speech and Hearing Research, 15*(1), 155-159. Krook, M. I. P. (1988). Speaking fundamental frequency characteristics of normal Swedish subjects obtained by glottal frequency analysis. *Folia Phoniatrica, 40,* 82-90.

Horii, Y., & Ryan, W. J. (1981). Fundamental frequency characteristics and perceived age of adult male speakers. *Folia Phoniatrica, 33,* 227-233.

Loveday, L. (1981). Pitch, politeness and sexual role: An exploratory investigation into the pitch correlates of English and Japanese politeness formulae. *Language and Speech, 24,* 71-89.

Mysak, E. D. (1959). Pitch and duration characteristics of older males. *Journal of Speech and Hearing Research, 2*(1), 46-54.

Mysak, E. D., & Hanley, T. D. (1958). Aging processes in speech: pitch and duration characteristics. *Journal of Gerontology, 13,* 309-313.

Ohara, Y. (1992). Gender-dependent pitch levels in Japanese and English. *The Second Berkeley Women and Language Conference, 2,* 469-477.

Ptacek, P. H., & Sander, E. K. (1966). Age recognition from voice. *Journal of Speech and Hearing Research, 9*(2), 273-277.

Ramig, L. A. (1983). Effects of physiological aging on speaking and reading rates. *Journal of Communication Disorders, 16*(3), 217-226.

Ryan, W. J., & Burk, K. W. (1974). Perceptual and acoustic correlates of aging in the speech of males. *Journal of Communication Disorders, 7*(2), 181-192.

Shipp, T., & Hollien, H. (1969). Perception of the aging male voice. *Journal of Speech and Hearing Research, 12 (4),* pp. 703-710.

Shipp, T., Qui, Y., Huntley, R., & Hollien, H. (1992). Acoustic and temporal correlates of perceived age. *Journal of Voice, 6,* 211-216.

Smith, B. L., Wasowicz, J., & Preston, J. (1987). Temporal characteristics of the speech of normal elderly adults. *Journal of Speech and Hearing Research, 30*(4), 522-529.

Xue, S. A., & Deliyski, D. (2001). Effects of aging on selected acoustic voice parameters: preliminary normative data and educational implications. *Educational Gerontology, 27,* 159-168.

Xue, A., & Mueller, P. B. (1996). Speaking fundamental frequency of elderly African-American nursing home residents: preliminary data. *Clinical Linguistics and Phonetics, 10*(1), 65-70.

Xue, S. A., Neeley, B., Hagstrom, F., & Hao, J. (2001). Speaking F0 characteristics of elderly Euro-American and African-American speakers: Building a clinical comparative platform. *Clinical Linguistics and Phonetics, 15*(3), 245-252.