SOCIAL DISTRIBUTION OF LONG-TERM AVERAGE SPECTRAL CHARACTERISTICS IN VANCOUVER ENGLISH

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ABSTRACT
This project examines differentiation in voice quality setting across varieties of English in urban Vancouver, Canada. Two different techniques of long-term average spectral (LTAS) analysis are used to investigate extended samples of continuous text across groups collected in a sociolinguistic survey. The first procedure uses smoothed spectra and canonical discriminant analysis. The second procedure uses nonsmoothed spectra and the SDDD dissimilarity measure. Results thus far suggest that overall SES effects are greater than aging effects, particularly for the MMC group.

1. THE VANCOUVER SURVEY
Data are drawn from the Survey of Vancouver English, conducted in 1979-80 [4] [5]. Analysis focuses on 192 randomly-selected male and female English speakers native to the Vancouver region, in the three age groups of the survey: O (over 60), M (35-60) and Y (16-34). Four socioeconomic status (SES) categories, middle and upper working class (MWC/UWC) and lower and middle middle class (LMC/MMC), are compared. The sample text is drawn from a reading passage with local content.

2. INITIAL LTAS PROCEDURE
2.1. Method
In the initial LTAS procedure, frames below voicing threshold (silences and voicelessness) are discarded, and FFT power spectra of voiced speech with smoothing applied are integrated over successive nonoverlapping 20 ms windows of the first 60 s of the survey reading text [2]. LTAS distributions are compared using principal component and canonical discriminant analysis to compute the Mahalanobis distance. Initial analysis focuses on the older and middle-aged groups.

The relationship of SES-group spectra with the LTAS of articulatorily modelled settings (by the first author) are expressed in generalized squared distance. Categories of the phonetic description of voice quality settings used to compare and evaluate LTAS results from the sample are those defined by Abercrombie [1] and Laver [10]. Sets of models for LTAS analysis based on these categories have been assessed by Nolan [11] and Harmegnies, Esling & Delplancq [9].

2.2 Results
Results of initial LTAS analyses are summarized in TABLES 1 and 2. The generalized squared distance measure of intragroup variability in LTAS indicates that SES groups are more homogeneous for female subjects than for male subjects in the survey in general. For middle-aged males, only the LMC and MMC groups are differentiated by the LTAS analysis of voiced speech used in this study, corroborating the significant separation between LMC-MMC men found using vowel formant data.

Classification of each model setting by group is inconclusive. The association of the velarized setting with UWC males is tentative.

Middle-aged MWC and UWC women contrast in LTAS with middle-aged MMC women, in conformity with the vowel-formant distributions separating these groups. Other LTAS relationships, however, do not confirm over the long term the more vowel-specific findings of formant analyses [3]. LTAS peak locations suggest a similarity between older MWC women and middle-aged MMC women. Middle-aged MWC women, on the other hand, contrast with the LTAS pattern of both older MWC and MMC speakers, as well as with the middle-aged MMC distribution.

Older MWC women, where the formant shift suggests tongue retraction as for uvularization or pharyngalization, are classified together with the faucalized, uvularized and velarized models in descending order of probability.

3. SDDD LTAS PROCEDURE
3.1. Method
The second LTAS analysis procedure adopts the SDDD statistical techniques introduced by Harmegnies & Landercy [6] [7] [8] to improve the reliability of interspeaker LTAS comparisons.

The 192 speakers in the survey were split into categories according to three main variables: sex (male, female), age (younger, middle, older) and socioeconomic status (middle working class, upper working class, lower middle class, middle middle class). A full factorial partitioning model was used, and therefore resulted in 24 subsamples (2 sexes x 3 ages x 4 SES categories) of 8 speakers each.

Interspeaker comparisons of the speakers' LTAS were performed by means of the SDDD dissimilarity index. This was considered the dependent variable of the study.

Age and SES were, in turn, each considered as the independent variable of the study. Both these analyses were performed separately in the male and in the female group.

TABLE 1. LTAS relationships between middle-aged and older male groups. Canonical Discriminant Analysis; Probability > Mahalanobis Distance. (Figures in bold represent groups which are significantly separated.)

		Older				Middle-aged		
		MWC	UWC	LMC	MMC	UWC	LMC	MMC
Middle-aged	MWC	0.76	0.59	0.46	0.38	0.07	0.33	0.45
	UWC	0.12	0.39	**0.01**	0.31		0.35	**0.004**
	LMC	0.15	0.84	**0.02**	0.12			**0.01**
	MMC	0.42	0.06	0.94	0.23			
Older	MWC		0.31	0.40	0.65			
	UWC			0.12	0.37			
	LMC				0.39			

TABLE 2. LTAS relationships between middle-aged and older female groups. Canonical Discriminant Analysis; Probability > Mahalanobis Distance. (Figures in bold represent groups which are significantly separated.)

		Older				Middle-aged		
		MWC	UWC	LMC	MMC	UWC	LMC	MMC
Middle-aged	MWC	0.09	0.33	**0.05**	**0.002**	0.36	0.52	0.13
	UWC	**0.01**	0.27	**0.04**	**0.001**		0.46	**0.02**
	LMC	0.20	0.86	0.42	**0.03**			0.43
	MMC	0.84	0.28	0.31	0.34			
Older	MWC		0.19	0.25	0.47			
	UWC			0.74	**0.04**			
	LMC				0.20			

TABLE 3. Average SDDD values for intra- and inter-age comparisons (96 male subjects)

AGE		O	M	Y
AGE	O	5.4	5.7	5.8
	M		5.7	5.8
	Y			6.0

TABLE 4. Average SDDD values for intra- and inter-age comparisons (96 female subjects)

AGE		O	M	Y
AGE	O	6.3	5.9	6.4
	M		5.4	5.7
	Y			6.0

TABLE 5. Average SDDD values for intra- and inter-SES-class comparisons (96 male subjects)

SES CLASS		MWC	UWC	LMC	MMC
SES CLASS	MWC	5.7	5.7	5.8	5.9
	UWC		5.9	6.2	6.4
	LMC			5.9	5.7
	MMC				5.3

TABLE 6. Average SDDD values for intra- and inter-SES-class comparisons (96 female subjects)

SES CLASS		MWC	UWC	LMC	MMC
SES CLASS	MWC	6.0	6.4	6.2	5.8
	UWC		6.0	6.1	6.4
	LMC			6.0	6.0
	MMC				4.7

3.2 Data Analysis - Age Effects

Both inter- and intra-age-class comparisons are considered. Each comparison of one class to another involves 496 interspectral dissimilarity measures. Each figure in TABLES 3 and 4 is therefore the average of 496 values.

The intraclass dissimilarity is, on the average, slightly less than the interclass on (males: 5.69 < 5.78; females: 5.89 < 6.04), suggesting overall weak aging effects: the LTAS drawn from a given age group tend to be more similar to one another than they are to spectra drawn from other age groups.

The greater intraclass homogeneity is nevertheless most sensitive for middle-aged subjects (both males and females), and older males: in those cases, the intraclass value is less than all the interclass values involving the considered class.

3.3 Data Analysis - SES Effects

Both inter- and intra-SES-class comparisons are considered. Each comparison of one class to another involves 276 interspectral comparisons. Each figure in TABLES 5 and 6 is therefore the average of 276 values.

The intraclass dissimilarity tends, on the whole, to be less than the interclass one (males: 5.65 < 5.95 ; females: 5.69 <

6.14), suggesting overall SES effects greater than the aging effects.
The relationship is particularly strong in the MMC both for males and females, and also for UWC females.

4. DISCUSSION

LTAS distributions are found to contrast across social varieties of Vancouver English for some SES groups, particularly for middle-aged female UWC and MMC speakers. These results suggest that long-term voice quality settings differ systematically between the respective social groups, at least in acquired oral-reading style.

These descriptive relationships will be subject to further examination using inferential analysis to determine probabilities. The results and methodologies of both the SDDD dissimilarity measure and the initial LTAS procedure will also be compared in relation to group-by-group vowel formant class analyses [3] for age and SES classes.

5. REFERENCES

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