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Shanghai Vowels

Jan-Olof Svantesson

In this article I present acoustic data on Shanghai vowels, and make an analysis of the system of vowel phonemes based on these data.

THE VOWEL SYSTEM

My investigation is based on Sherard's 1980 description of the Shanghai vowel system. He describes Shanghai as having the following fourteen vowels:

i	y	ɿ	ʅ		u
ɪ	ʏ				
e		ɚ		ɤ	o
ɛ					ɔ
		a			

(The correspondence between my symbols and his is: ɪ=y, y=ü, ʏ=ö, ɿ=i̇, ʅ=ï, ɚ=ər, ɤ=ɔ̈.)

Not all of these are phonemes, however: from the table of Shanghai syllables given by Sherard, it can be seen that the apical vowels [ɿ] and [ʅ] occur only after dental/alveolar sibilants and affricates (his [s], [z], [ts], [ts^{h}]), while [i], [ɪ] and [y] never occur in this position. Thus, [ɿ] and [ʅ] can be regarded as allophones of the corresponding non-apical vowels /i/ and /y/.

The vowel [ɚ] may be regarded as a syllabic [ɹ̩]. Like the syllabic nasals [m̩], [n̩] and [ŋ̩], it has a restricted distribution, not combining with initial consonants, but always forming a syllable on its own.

There is a contrast between what are traditionally called 'clear' and 'muddy' syllables in Shanghai. This is a prosody which affects both the vowel and the initial consonant: in muddy syllables, the first part of the vowel has a special phonation sometimes referred to as voiced aspiration, and obstruent consonants have shorter duration in muddy than in clear syllables. Furthermore, initial sonorants are preglottalized in clear, but not in muddy syllables. Muddiness will be symbolized by ˍ written under the vowel. In

clear syllables which do not end in a glottal stop, there are two contrasting tones, high (¯) and falling (ˆ). In other types of syllables the tone is predictable: muddy syllables have low tone if they end in a glottal stop and rising tone otherwise, and clear syllables ending in a glottal stop have high tone.

The relatively many monophthongic vowels in Shanghai (and other Wu dialects), compared with other Chinese dialects, can be explained historically by phonological processes which have created monophthongs from earlier combinations of a vowel and a final consonant. Shanghai has only two final consonants: *ʔ*, the reflex of earlier **-p*, **-t* and **-k*, and *-ŋ*, which is most often realized as nasalization of the preceding vowel. Middle Chinese **-ŋ* always became *-ŋ* in Shanghai, while **-m* and **-n* (both retained as *-n* in Standard Chinese) either became *-ŋ* or disappeared, changing the quality of the preceding vowel. The environments for these changes can be described succinctly by means of Pulleyblank's 1984 Late Middle Chinese reconstruction: **-m* and **-n* disappeared when preceded by **a*, and became *-ŋ* otherwise, as seen in the following examples, where also Standard (Peking) Chinese forms are given for comparison:

	Late Middle Chinese	*Shanghai*	*Standard Chinese*	
山	*ʂaan	ˋsɛ	¯ʂan	'mountain'
见	*ˋkjian	¯tɕɪ	ˋtɕiɛn	'to see'
端	*tuan	ˋtʏ	¯tuan	'to bring'
三	*sam	ˋsɛ	¯san	'three'
本	*ˊpun	¯pəŋ	ˬpən	'origin'
巾	*kin	ˋtɕiŋ	¯tɕin	'scarf'
森	*ʂəm	ˋsəŋ	¯sən	'forest'
今	*kim	ˋtɕiŋ	¯tɕin	'today'

Thus, the vowels *ɛ*, *ʏ* and *ɪ* are reflexes of Middle Chinese finals ending in **-m* or **-n*. Similarly, *ɔ*, *ɤ*, *e*, and also some occurrences of *ɛ* have developed from combinations of vowels and the final glides **-w* and **-j*:

	Late Middle Chinese	*Shanghai*	*Standard Chinese*	
高	*kaw	ˋkɔ	¯kaw	'high'
口	*kʰəw	¯kʰɤ	ˬkʰow	'mouth'
累	*ˊlyj	lɐ̯	ˬlej	'to accumulate'
来	*ləj	lɐ̯	ˊlaj	'to come'

According to Yuán et al. 1960:64, Hú 1978, Shěn 1981, Xǔ et al. 1982, etc., there is some variation in the vowel system between speakers, conditioned by age and also by geographical origin and perhaps social factors. These sources say that young and middle-aged speakers do not contrast unrounded [ɿ] and rounded [ʯ], but pronounce only [ɿ]. Older speakers have kept this distinction, and also contrast these vowels with [i] and [y] after sibilants. The contrast between [i] and [ɪ] (the latter often given as [iɪ] or [ie] in Chinese sources) is also said to have disappeared for young speakers.

EXPERIMENTAL PROCEDURE

The material for the vowel investigation was a list of words (or, rather, morphemes) consisting of open syllables illustrating each monophthong, with one example of each vowel in each of the three possible combinations of tones and phonation types. The word list is given in Appendix 2. Whenever possible, a dental stop or sibilant was chosen as initial consonant. The test words were embedded in the carrier sentence 这个字__交关有用 /tsəʔ ¯ku si̯ __ ˋtɕɔˋkuɛ jɤ̯jo̯ŋ/ 'The character __ is very useful'. The whole list was read twice, so that six tokens of each vowel were recorded for each speaker (in some cases they were fewer due to technical or other reasons). The informants were three male Shanghai speakers, born in 1941, 1937 and 1964. They were born in Shanghai and had lived there until less than a year before they were recorded. The recordings were made in the sound studio at the Department of Linguistics in Lund. Spectrograms were made on a Kay digital spectrograph, and the frequencies of the first three formants were measured from them. The results are shown in Appendix 1 and in Figures 1-6.

RESULTS AND DISCUSSION

As seen in Appendix 1 and the formant frequency diagrams, the Shanghai vowel space is rather crowded. Figures 1, 3 and 5 are plots of F_2 against F_1 for each speaker, and Figures 2, 4 and 6 are plots of F_3 against F_1. All vowels are plotted on the F_1-F_2 diagrams, but on the F_1-F_3 plots only those vowels

are shown where F_3 is particularly important by separating vowels with approximately the same F_1 and F_2. That is the case for [i], [ɪ], [e] and [y], and for the pair [ʏ] and [ɞ].

Tones and phonation types were not found to have any systematic influence on the formant frequencies of the vowels; if there is such an influence it must be rather small, so that a specific investigation of this problem is necessary to detect it.

The vowel which is here written [ʏ] is given as [ø] (or [ö]) by Sherard 1980, 1982, and also in recent Chinese descriptions (*Jiāngsū*... 1960, Hú 1978, Shěn 1981, Xǔ et al. 1982, Mǐn et al. 1986). The auditory impression of this vowel is quite different from that of the cardinal vowel [ø], and from [ø] in languages such as Swedish, German or French, from which it differs particularly by having lower F_1. For this reason I write it as [ʏ].

The acoustic difference between [ɿ] and [ʮ] is, if it exists, very small for all speakers. The hypothesis that the formant frequencies are equal was tested by a t-test for each formant and speaker. The results of these tests are given in the following table, together with the mean values of the formants for each speaker:

	Speaker 1			Speaker 2			Speaker 3		
	[ɿ]	[ʮ]	*test*	[ɿ]	[ʮ]	*test*	[ɿ]	[ʮ]	*test*
F_1	363	358	n.s.	353	352	n.s.	257	277	n.s.
F_2	1363	1362	n.s.	1480	1452	n.s.	1725	1747	n.s.
F_3	2927	2868	n.s.	2742	2748	n.s.	2882	2882	n.s.
n	6	5	df=9	6	6	df=10	4	6	df=8

n=number of tokens for each vowel; n.s.=not significant (i.e. p≥5%); df=degrees of freedom for the test.

As this test shows, no difference could be ascertained. Furthermore, when these speakers' recordings of the words [sɿ] 'written character' and [sʮ] 'tree' were played to other Shanghai speakers, they could not distinguish them in a way that was significantly better than random guessing. Thus it seems safe to conclude that the speakers in this study do not differentiate between [ɿ] and [ʮ], but have only one vowel, unrounded [ɿ], acoustically similar to the corresponding vowel in Standard Chinese (see Svantesson 1984 for formant frequencies of Standard Chinese vowels). As mentioned above, [ɿ] can be regarded as an allophone of /i/.

A similar study was made of the acoustically similar vowels [i] and [ɪ], with the following results:

	Speaker 1			Speaker 2			Speaker 3		
	[i]	[ɪ]	*test*	[i]	[ɪ]	*test*	[i]	[ɪ]	*test*
F_1	280	240	n.s.	278	298	n.s.	263	273	n.s.
F_2	2208	2320	p<1%	2485	2397	p<5%	2633	2647	n.s.
F_3	3342	3527	p<1%	3485	3460	n.s.	3367	3403	n.s.
n	6	6	df=10	6	6	df=10	6	6	df=10

There are significant differences in F_2 and F_3 for Speaker 1, and also, although only at a higher level of significance, in F_2 for Speaker 2.

This suggests that Speaker 3 (the youngest speaker) does not differentiate between [i] and [ɪ], whereas Speaker 1 most probably does. For Speaker 2, the result is inconclusive. Speaker 2 has the expected relations between the formant frequencies of these vowels: [ɪ] has higher F_1, but lower F_2 and F_3 than [i]. For Speaker 1, however, these relations are reversed. Since he is the only speaker who differentiates clearly between these two vowels, the description of them as [ɪ] and [i] seems to be wrong, but more data is needed to clarify this point.

A third distinction that has been tested is that between [u] and [o], which seem to have merged in the speech of the youngest speaker (Speaker 3). These vowels are differentiated clearly by the other speakers, especially by the F_1 value. The result of a t-test for Speaker 3 was:

	Speaker 3		
	[u]	[o]	*test*
F_1	383	353	n.s.
F_2	955	917	n.s.
F_3	2725	2823	n.s.
n	6	6	df=10

Thus the test could not detect any difference between his [u] and [o], both being pronounced as [o]. This merger is not mentioned in the Chinese descriptions of phonological variation within Shanghai, and more data are needed to decide the question of whether or not it is typical for young speakers.

In conclusion, this investigation has shown that there is considerable variation in the vowel systems of different Shanghai speakers, in accordance with the descriptions of Hú 1978, Shěn 1981 and Xǔ et al. 1982. The vowel systems found consist of 9-11 phonemes (not counting the four syllabic consonants with a restricted distribution):

i	y	[ɿ]		(u)
(ɪ)	ʏ			
e			ɤ	o
ɛ				ɔ
		a		

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APPENDIX 1. Formant frequencies of Shanghai vowels.

	Speaker 1			Speaker 2			Speaker 3		
	F_1	F_2	F_3	F_1	F_2	F_3	F_1	F_2	F_3
[a]	750	1390	2810	1050	1450	2580	990	1510	2720
	790	1360	2810	1000	1400	2640	1000	1420	2730
	740	1270	2820	1030	1630	2630	980	1600	2710
	770	1330	2750	910	1490	2620	1010	1670	2820
	830	1340	2630	860	1200	2610	990	1610	2680
	810	1190	2910	1000	1320	2650	960	1580	2750
[ɛ]	500	2160	2900	430	2190	2900	470	2310	3000
	500	2050	3000	500	2180	2890	480	2130	2910
	490	2170	2720	510	2160	2770	490	2380	2950
	510	2080	2760	490	2130	2820	510	2190	2870
	490	2050	2940	450	2140	2900	540	2160	2980
	470	2130	3050	460	2150	2950	500	2250	2950
[e]	330	2160	3030	370	2350	2920	320	2500	2850
	380	2330	3000	370	2300	2940	400	2590	2920
	320	2230	3060	370	2300	2880	400	2300	2780
	330	2230	2900	310	2400	3000	390	2530	2980
[ɪ]	220	2290	3490	320	2500	3530	250	2600	3500
	210	2340	3470	300	2360	3500	270	2710	3510
	230	2330	3530	300	2460	3400	250	2740	3450
	280	2420	3520	290	2290	3400	290	2610	3240
	280	2300	3520	300	2430	3250	290	2610	3430
	220	2240	3630	280	2340	3680	290	2610	3320
[i]	220	2240	3380	320	2420	3470	300	2550	3220
	370	2220	3170	310	2460	3590	230	2720	3500
	260	2160	3370	260	2550	3400	280	2640	3310
	270	2130	3370	270	2510	3600	280	2590	3450
	220	2260	3400	270	2500	3430	230	2700	3290
	340	2240	3360	240	2470	3420	260	2600	3430
[ʯ]	380	1430	2910	390	1400	2770	290	1660	2870
	310	1370	2890	330	1450	2760	290	1730	2880
	370	1320	2910	380	1430	2710	280	1800	2820
	340	1330	2800	320	1410	2710	280	1820	2910
	390	1360	2830	380	1520	2770	270	1750	2900
				310	1500	2770	250	1720	2910
[ɿ]	370	1390	3000	400	1500	2740	240	1840	2870
	380	1320	2920	330	1470	2750	240	1750	2910
	370	1360	2910	370	1470	2730	270	1640	2920
	340	1300	2920	320	1500	2760	280	1670	2830
	370	1410	2910	340	1480	2780			
	350	1400	2900	360	1460	2690			

[y]	280	2080	2730	260	2110	2610	250	2330	2780
	310	2090	2840	230	2080	2520	270	2220	2780
	240	2090	2780	260	2170	2610	250	2220	2820
	250	2040	2860	240	2100	2650	290	2100	2710
[ʏ]	350	1710	2210	280	1790	2500	300	1690	2690
	390	1720	2270	300	1870	2450	300	1710	2660
	320	1730	2220	320	1860	2490	330	1810	2710
	320	1730	2310	310	1880	2480	380	1830	2760
	280	1740	2210	300	2010	2580	380	1830	2720
	280	1700	2170	290	1840	2230	390	1860	2670
[ɤ]	420	1250	2660	390	1610	2690	440	1220	2810
	440	1310	2600	380	1430	2520	470	1230	2830
	390	1230	2750	380	1530	2700	410	1150	2810
	350	1200	2450	480	1600	2610	490	1220	2790
	390	1260	2620	410	1630	2640	390	1170	2750
	430	1230	2500	370	1580	2500	440	1110	2910
[u]	360	640	2900	320	810	2830	350	900	2820
	290	710	2830	270	810	2850	390	900	2700
	310	670	2760	310	760	2740	360	900	2810
	300	710	2760	310	910	2710	410	1080	2660
	330	710	2870	400	930	2730	300	980	2750
	320	700	2790	310	720	2630	490	970	2610
[o]	400	790	2830	400	910	2820	350	950	2780
	370	750	2860	380	780	2950	390	820	2880
	390	770	2910	380	810	2930	320	1050	2720
	450	750	2890	410	800	2750	360	850	2960
	400	700	2820	400	830	2940	300	870	2720
				400	800	2830	400	960	2880
[ɔ]	500	830	1800	630	950	2610	480	820	2880
	630	900	1910	600	800	2680	540	990	2910
	470	720	1760	620	940	2690	510	890	2810
	500	800	1870	560	810	2590	540	980	2900
	580	800	1820	620	920	2520	400	720	2880
	580	920	1930	650	900	2600	510	940	2990
[ɐ]	520	1360	2500	490	1580	2260	500	1600	2500
	490	1470	1960	530	1480	2130	480	1820	2680
	590	1360	1960	490	1520	1920	530	1620	2450
	490	1320	1880	400	1630	2510	530	1700	2590

APPENDIX 2. Word list.

¯tʰi	剃	'to shave'	sa̤	柴	'firewood'	`tu	都	'all'
`ti	低	'low'	`ʔy	迂	'pedantic'	tṳ	涂	'to smear'
ti̤	地	'earth'	ny̤	女	'woman'	¯so	社	'society'
¯tɪ	店	'shop'	¯tʏ	短	'short'	`so	沙	'sand'
`tʰɪ	天	'heaven'	`tʏ	端	'to bring'	so̤	蛇	'snake'
tɪ̤	甜	'sweet'	tʏ̤	断	'to cut off'	¯tɔ	岛	'island'
¯te	对	'towards'	¯sɿ	四	'four'	`tɔ	刀	'knife'
`te	堆	'pile'	`sɿ	诗	'poem'	tɔ̤	逃	'to flee'
¯tɛ	旦	'dawn'	sɿ̤	字	'character'	¯tʰʏ	透	'to penetrate'
`tɛ	单	'single'	¯tsɿ	主	'main'	`tʰʏ	偷	'to steal'
tɛ̤	但	'but'	`sɿ	书	'book'	tʏ̤	头	'head'
¯tʰa	太	'too'	sɿ̤	树	'tree'	ə̤	儿	'child'
`tʰa	他	'he'	¯tsu	祖	'ancestor'			

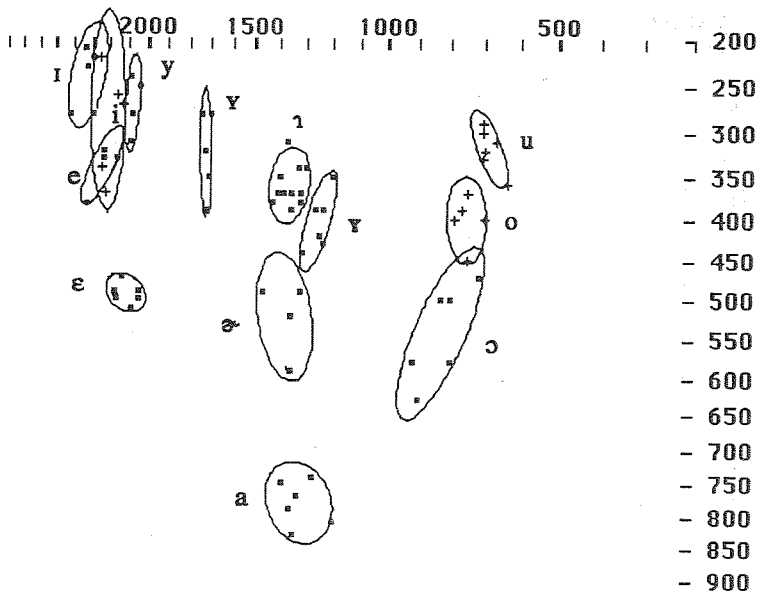

Figure 1. F_1-F_2 diagram for Speaker 1.

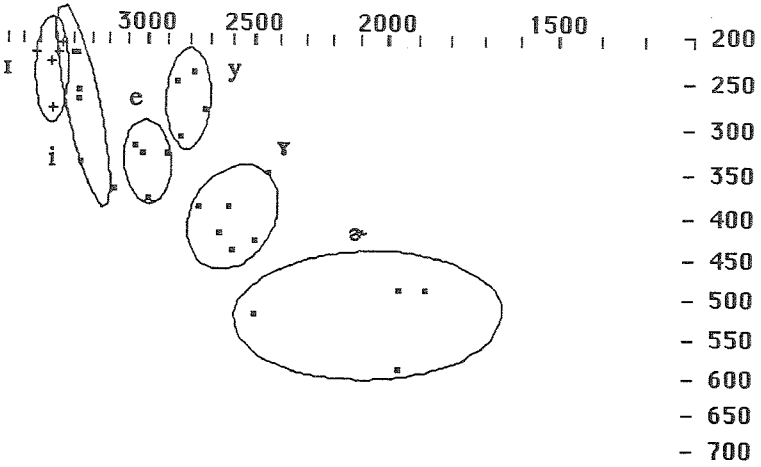

Figure 2. F_1-F_3 diagram for Speaker 1.

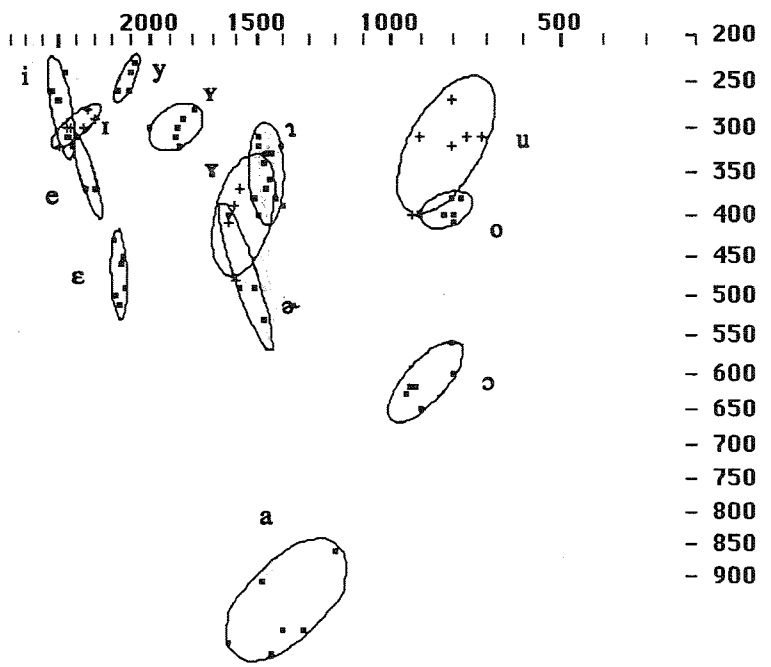

Figure 3. F_1-F_2 diagram for Speaker 2.

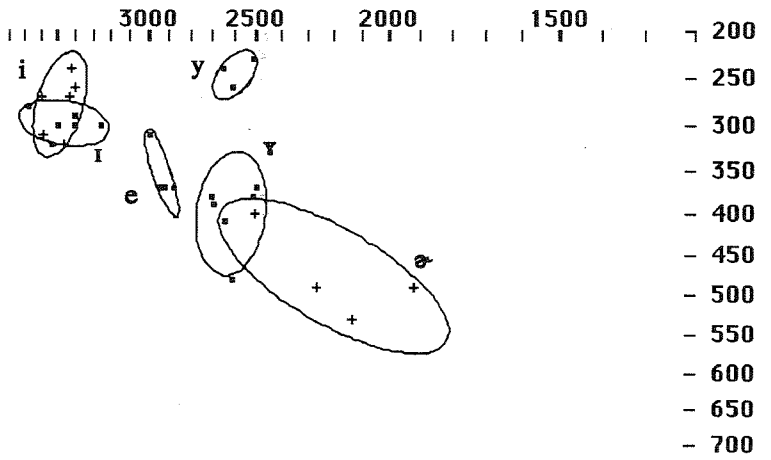

Figure 4. F_1-F_3 diagram for Speaker 2.

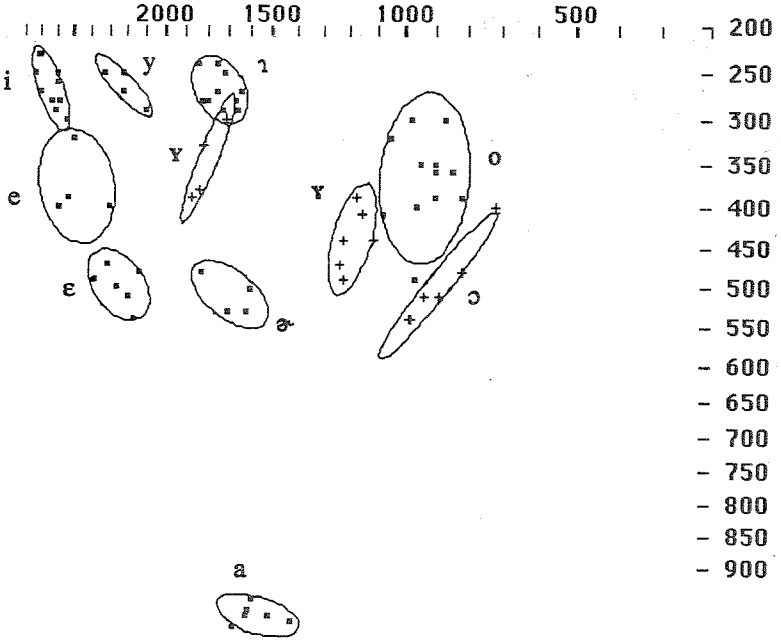

Figure 5. F_1-F_2 diagram for Speaker 3.

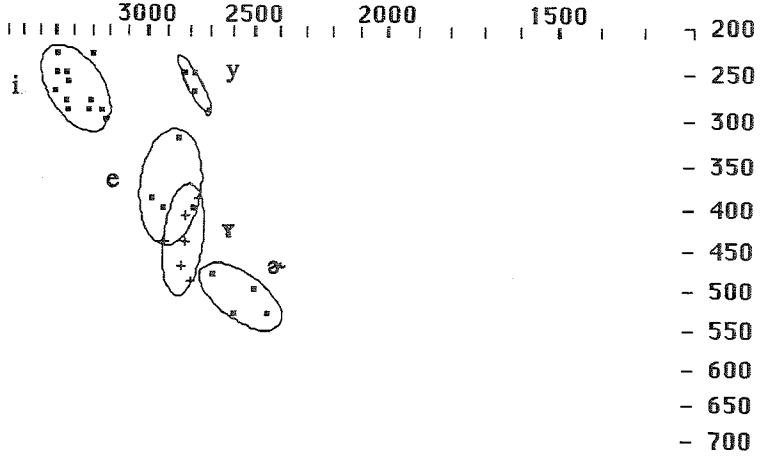

Figure 6. F_1-F_3 diagram for Speaker 3.

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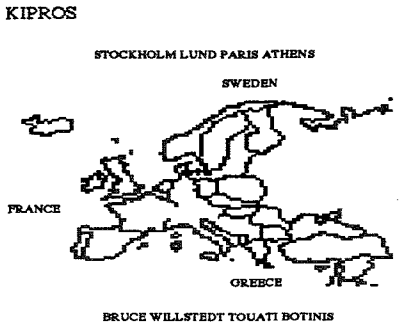

De la Prosodie Française du Dialogue Rapport du Projet KIPROS

Paul Touati

INTRODUCTION

Cet article présente une recherche en cours consacrée à la description de la prosodie du français telle qu'elle est employée dans le cadre de l'interaction verbale constituée par un dialogue. Cette étude de la prosodie dialogale du français est effectuée dans le cadre du projet KIPROS, acronyme basé sur le titre suédois du projet *Kontrastiv Interaktiv Prosodi* ou en français 'Prosodie Interactive Contrastive' (cf. Bruce et al. 1988). Le projet est soutenu financièrement par la Fondation du Tricentenaire de la Banque de Suède. L'objectif de ce projet est double. Il s'agit d'une part d'étudier dans une perspective contrastive la prosodie interactive du suédois (suédois standard et scanien), du grec et du français, langues dont la prosodie présente, on le sait, des différences structurelles intéressantes. D'autre part, le projet a pour ambition finale de développer un modèle générale de prosodie interactive.

En ce qui concerne notre contribution, disons que son effort principal a porté jusqu'à présent sur la mise au point d'une méthodologie susceptible de répondre à trois questions concernant l'analyse prosodique des dialogues du français.