SEGMENTAL COARTICULATION STUDY IN DISYLLABIC CONTEXT IN STANDARD CHINESE

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Introduction Coarticulation usually has two kinds of type,one is anticipatory ,the other is carryover . There are different forms in many languages.According to the previous study(1988,sun&wu)in Standard Chinese, intersyllabic anticipatory coarticulation is more evident than carryover coarticulation in Standard Chinese.The aim of this experiment was to research the range of anticipatory coarticulation in C1V1C2V2 in Standard Chinese and consider to give formant transition pattern according dufferent place of consonant C2.The last is to study how to cue the the place of articulation with an equation?

Öhman (1966) first made a wide range study about coarticulation in Swedish, English and Russian in VCV context.His result showed there were coarticulation from V to C ,also from C to V .And "the initial vowel influences the medial stop-to-final vowel transition across the intervocalic consonant" between V to V.Also,there were the phenomena which the final vowel influencing the medial stop to first vowel from his figures.Whether does it appear in Standard Chinese?This experiment would look for this phenomena whether the V2 affect consonant to V1in Standard Chinese.

Delattre etc.(1952) supposed that that b p m w might have the second-formant locus correspond their common place of production.Whether is it the same occasion in Standard Chinese?This experiment would reaearch the matter and give the acoustic pattern in Standard Chinese.

Furthermore,this experiment would try to give a formant transition regression equation according to the formant transition, which it is contacted with the articulation place of consonant .Sussman (1991) has gotten the locus equation in English.Locus represents the charcters of uaspirated stop.Sussman gave a locus eqution and got different slopes and intercepts for three articulation places of consoant.Some papers about locus equation made in the case of CV in different languages.But the locus can mean the place of consonant not only the transition of vowel following the consonant but also preceding the consonant,they present the mirror phenomena though there are differences between them.

Wu&Sun (1988) have researched the intersyllabic coarticulation of stops in Standard Chinese.It is the first paper for this field .They gave the acoustic patterns of formant transition.This experiment would further consider the range of coarticulation ,whether formant transition is presented by equation for articulation place of consonant.This is the different part from that paper.

Material and Method The materials were gotten from the database of phonetic lab.Institute of Linguistics,CASS.They included one speaker's recording.The two-syllable group structure was C1V1C2V2.V1 included 22 vowel final in Standard Chinese,C2 included liabl consonant /p,ph,m,f/, dental consonant /t,th,n,l/ and velar consonant /k,kh,x/.V2 included vowels /a,i(ɤ),u/.All the material was 22x11x3=726 .

One male speaker was as the subject produced all the materials.The recording was made in recording room of phonetic lab. with high level kenwood taperecorder .The recording materials

were made into sonagrams with Kay 5500 Sonagragh.

Using an measuring procedure (made by Yan),the first fthree formants were measured from the beginning point of transition of V1 to C2 to the end point and the data were analyzed .Ststistical analysis were made .

Result and discussion The result showed as following:

1.*the range of anticipatory coarticulation*

Fig.1 give an example about transition forms.The first two-syllable group is "fada,dadi",the transition of formant is similar,the second is "laba,fabi",the transition of F2 is not similar.The F2 of /a/ in "fabi"was influenced by /i/.

According to the transition of F2,there are two forms among these materials.

	V1transition-liable	V1 transition-alveolar	V1 transition-dorsovelar
C2-V1	*	*	*
V2-C2-V1	*		

2.Acoustic pattern

According to the formants data ,the formant transitions of V1 to C2 were gotten.Three parts were gotten corresonding to the C2.The first part were that which C2 were liabl consonants,the second part were that which C2 were dental consonants and the third part were that which C2 wer velar consonants.There were 34 groups in lialbe type.But there were 22 types in dental groups and there were also 22 groups in glotal types.

A.Liable type:C2 were /p,ph,m,f/,V1 were 22 vowels and V2 were /a,i,u/.The formant transition of V1 to C2 were divided 34 group,

As V2 were /a,u/,C2 were lable consonants,V1 was divided 22groups.As V2 was /i/,part of them was divided to the 22 groups ,the other were divided another groups.

Fig.2.a: V1 are /a/-/p(a,u)/,/a/-/pi/,/o/-/p(a,u)/,/o/-/pi/,/e/-/p(a,u)/,/e/-/pi/,/i/-/p(a,i,u)/,/u/-/p(a,u)/sequences.F1 transition of V1 was the same ,F2 of that varied in two forms such as /a/,/o/,/e/,falling as V2 were /a,u/.but rising as V2 was /i/.F3 transition of V1 fall all.

Fig.2b.:V1 are /u/-/pi/,/y/-/p/(a,i,u)/,/i/-/p(a,u)/,/i/-C2/i/,/i/-C2/(a,i,u)/,/er/-C2/(a,i,u)/, /ai/-C2/(a,i,u)/,/ao/-C2/(a,u)/ sequences.F1 transition of V1 is flat all.F2 of V1 varies.F2 fall as V1 are /i/,/er/,/ai/,but rise as V2 are /u/,/ao/,F3 falls.

Fig.2c:the structure of V1 to C2 V2 are /ao/-C2/i/, /ou/-C2/(a,u)/,/ou/-C2/i/,/ei/-C2/(a,i,u)/. /ia/-C2(a,u)/,/ia/-C2/i/,/ie/-C2/(a,i,u)/. F1 transition of V1 flat all.F2 transition of V1 vaired as /ou /, /ia /, /ao /. F3 transition of V1 fall all.

Fig.2d:the structure of V1C2V2 are /ua/-C2-/(a,u)/,/uo/-C2/i/,/ye/-C2/(a,i,u),/iao/-C2/(a,u)/,/iao/-C2/i/,/iou/-C2/(a,u)/,/iou/-C2/i/.F1 fall as V1is /ua/,the others are f;at,F2 rise as V1C2V2 are /uo/-C2-/(a,u)/,/iao/-C2/(a,u)/,/iou/-C2/(a,u)/,the others fall.

Fig.2e: The structures of V1C2V2 are /uai/-C2/(a,i,u)/,/uei/-C2/(a,i,u)/.F1,F3 varies consistently,F2 is affected only by C2.(limited by paper,this figure is not shown)

It seems that F1 and F3 varies consistently in this part.F2 varies diffferent as V2 varies.

B.Alveolar type:there are 22 groups according C2.

Fig.3a:the strucuture of V1C2V2 is /a/,/o/,/ər/,/i/,/u/,/y/,/ɿ/,/ʅ/, /ər/,/ai/,/ao/,/ei/,/ia/,/ie/,/ua/,/uo/, /ye/,/ou/,/iao/,/iou/,/uai/,/uei/

F1There were the same tendency in V1's transition as V2 were /a,i,u/.So,there were 22 groups in F2 on this type.Also,they would be incorporated into a little groups.

C.Dorso-velar type:there are 22 groups according C2.

Fig.4a:the vowels of V1 are /a/,/o/,/ɤ/,/i/,/u/,/y/,/ɿ/,/ʅ/.

Fig.4b:the vowels of V1 are /er/,/ai/,/ao/,/ei/,/ia/,/ie/,/ou/,/ua/.

Fig.4c:the vowels of V1 are /ye/,/uo/,/iao/,/iou/,/uai/,/uei/.

There are an evident vary of F2 and F3 in this group,especially F3.It is different from the previous two groups.It is caused by the consonant C2.

3.Duration

Three parts fo duration was given.Transition duration,the rate of transition duration/V1 duration,gap duration.They were showed in table.

Table 2 The avertage entire duration of V1(V1T),the average duration of transition(TT),the ratio of TT/V1T

TYPE	V_1T*	TT**	TT/V_1T (%)
Liable	22(av)20.9(sd)	46(av)5.8(sd)	17
Alveolar	267(av)34(sd)	54(av)11(sd)	13
Dorso-velar	268(av)42(sd)	58(av)11(sd)	16.7

4.Formant transition regression equation

How to find the invariant from the acoustic manifestation.It is always the trouble problem."Locus" proposed by Delattre etc. Was an abstraction concept.It was a supposed point.But Lindblom(1963)made a function to describe the place of consonant.It is convient for speech process.Ssuman(1991) made an experiment to give the locus equation of English.The locus equation is y=kx+b,x is the stability part of F2.y is the beginning point of F2 transition.k is the slope and b is the intercept.Certainly it was in CV environment.It may be similar to VC environment.

This experiment would give the formant regression equation from V to C.So,the x is the stability part of F2,y is the end point of F2 transition.There were different slopes and intercepts among liable,alveolar and dorso-velar.

A.Liable consonants had two types corresponds to V2,one is the first as V2 is /a,u/,the other is the second as V2 is /i/. It seems the slope is different.Intercept is small.It meaned that the transition of F2 varied little than that in dental.

B.The transition of F2 varied evidently in this type.It showed the dental of consonants affected the preceding vowel .

C.The slope of it is the most but the intercept is not the largest.

Table 3 The different slopes and intercepts of the regression equation on the F2 transition of V1 as C2 are different consonants

	/p/	/p`/	/m/	/f/	/t/	/t`/	/n/	/l/	/k/	/k`/	/x/
intercept	134	73	277	64	611	548	584	583	127	203	73
slope	0.79	0.83	0.70	0.84	0.62	0.66	0.63	0.59	0.83	0.77	0.85

It seems that there are different slope and intercept for different articulation places of C2.There are evident differ for alveolar from liable and dorso-velar.

According to the result it can be gotten :different place of articulation affected Formant transition clearer than that of manner of articulation.There were two occasions in coarticulation strategy.One was the most occasion which C2 affected V1 directly,the other was V2 affected V1 undirectly but through C2.Ohman have found that V1 may affect V2,reversely.It meant C2 has different manifestation.Only liable consonants have the phenomena.

The results show (a)anticipatory coarticulation has two forms ,one is C2 to V1, the other is V2 to V1 through C2.(b) there are different transition as C2 are diffenent places of articulation.There were no evident differences as C2 are the same place but different articulation manner.(c)Also the formant transion equation can be given according to the different places of articulation.

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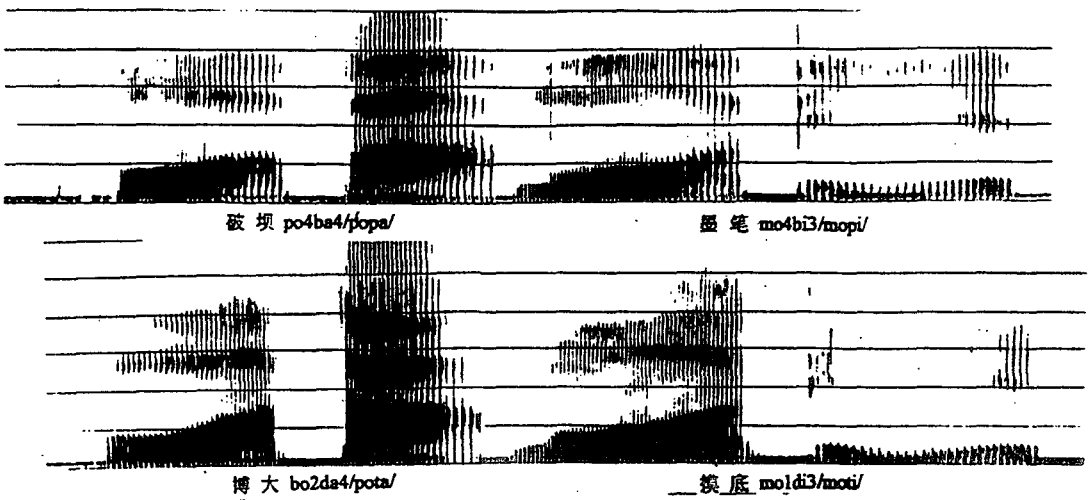

Fig.1 The wideband sonagrams of "/poba/,/mopi/,/pota/,/moti/". The transition direction of /o/ is different

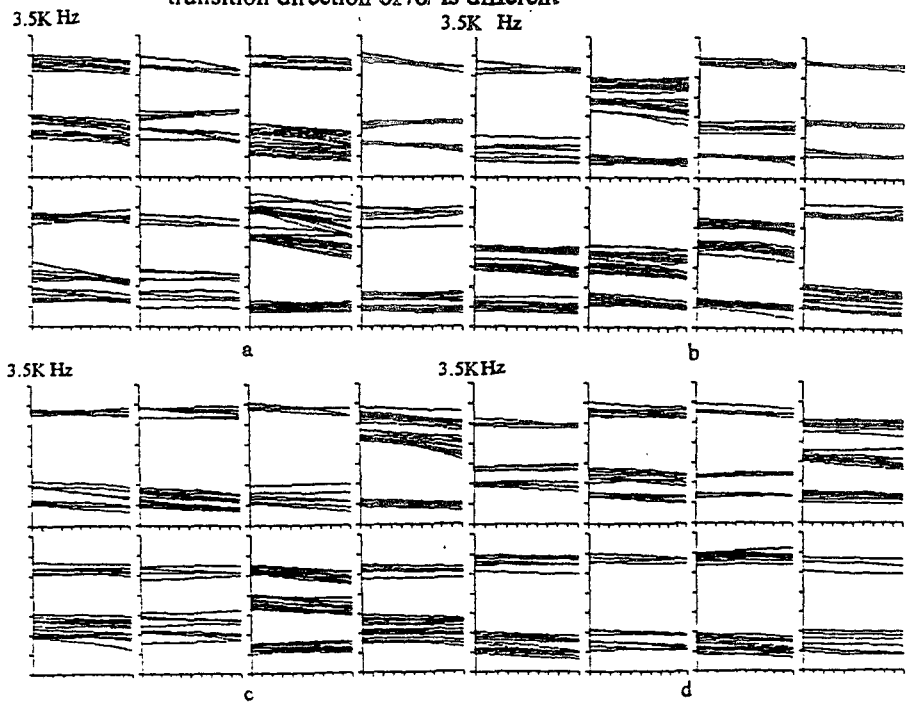

Fig.2 The transition patterns of the first formants of V1 to C2as C2 being labial consonants

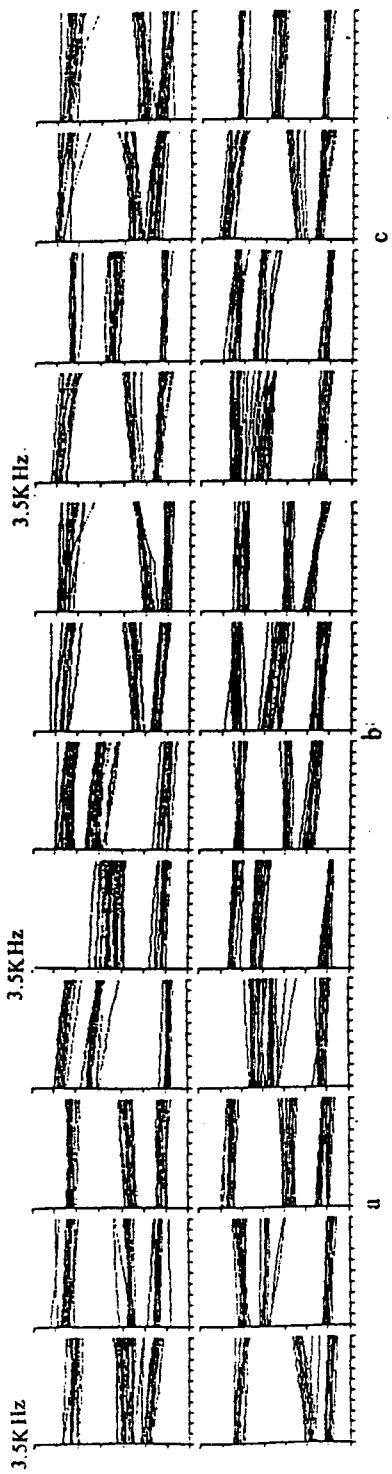

Fig.3 The transition patterns of the first formants of V1 to C2 as C2 being alveolardental consonants

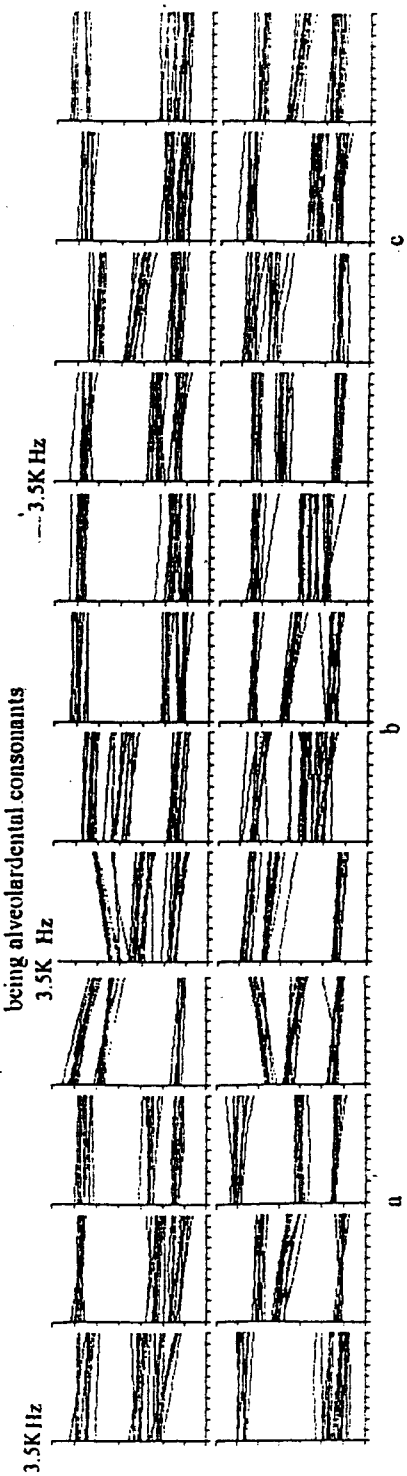

Fig.4 The transition patterns of the first formants of V1 to C2 as C2 being velar consonants