Coarticulatory Perception

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Abstract

The article aims at investigating the coarticulatory perception in ten normal adults using synthetic speech formed by altering various parameters of the stop consonant preceding the vowel in four Kannada words. The results were compared to the coarticulatory development in children. The results indicated better perception of the vowel when the transition was presented.

Introduction

The articulatory characteristics, features or properties of one sound are modified by another sound which is known as coarticulation (Sharf & Ohde, 1981). In the broader sense, coarticulation refers to the fact that in the production of adjacent or near adjacent speech sounds, the movement associated with one sound are sometimes made simultaneously with movements associated with another. Coarticulation helps in maintaining the continuity & the rate of speech. In the recent years, research has been directed towards clarifying the influence of context on the production of error sounds by children & the coarticulatory basis for the same (Sharf & Ohde, 1981). The contextual effects in adults speech has been variously studied across fricatives, stops & nasals. While the production of coarticulation has been studied extensively, studies on the perception of coarticulation are recent & are a few. AN et. al., (1971), Lehiste & Shockey (1972), Repp & Mann (1980), Fowler (1981a, 1981b), Nittrouer & Whalen (1989) have studied the coarticulatory production & La Riviere et. al., (1970), Parnell & Amerman (1978), Nittrouer & Studdert - Kennedy (1986), Nittrouer (1989), Sereno & Liberman (1987) have studied coarticulatory perception. The results of these studies have indicated that the coarticulation perception depends upon several cues. The present study aims at investigating the coarticulatory perception of vowels following stop consonants in adults & to compare it with that of children. Specifically, the various parameters of the stop consonants preceding the vowel are altered to investigate their role in the perception of the vowel.

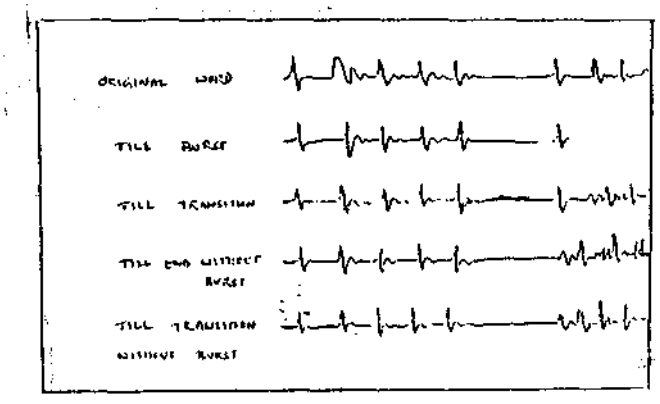
Methodology :

Material: Four voiceless stop consonants (k, t, p) in the medial position of four meaningful Kannada words (pa:pa, pa:ta, pa:ta, pa:ka,) were s.elected. These words as utterd by a 22 year old Kannada male speaker were digitized in to a computer memory using a 12 bit A/D converter at a sampling frequency of 8000 Hz. Five synthetic stimuli for each word were prepared using the DWSSLC software developed by the Voice & Speech Systems, Bangalore. These stimuli were as follows :-

1. Original word
2. Stimuli from the beginning of the word till the burst
3. Stimuli from the beginning of the word till the transition without the burst
4. Stimuli from the beginning of the word till the end without the burst
5. Stimuli from the beginning of the word till the transition

Figure 1 shows the waveform of various stimuli. Totally 20 synthetic stimuli were generated. The stimuli for each word were randomized & iterated five

times to make 100 stimuli. Using the Playbatch programme (VSS, Bangalore), these stimuli were audio-recorded on to a metallic cassette with an inter-stimulus interval of 1 sec and inter iteration interval of 5 seconds. These formed the material.



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Subjects: Ten female Kannada speaking subjects in the age range of 18-43 years served as the listeners for this study.

Method :

The subjects were seated comfortably & were audio-presented with the synthetic material one at a time through the headphones. They were instructed to listen to the synthetic words carefully & respond to a forced choice binary response sheet provided. The responses of the subjects were tabulated & the percent response for each token was calculated.

Results

The results indicated that the response decreased from token 1 to token 5 indicating that the coarticulatory perception of the vowel would be poor when only the burst was present. Also the responses were poor when the vowel was preceded by the retroflex *iy.* Best responses were obtained when te preceding stop was the bilabial /p/. Figure 2 shows the percent response for the four different stimuli.

Further, transition seemed to be a better cue than burst alone & duplex cues :- transition & Burst together :- were better than single cue for the perception of the vowel. Among the subjects, S3 &S6 responded better than S1, S4, S7, S8 & S10. The individual responses of all the subjects are depicted in figures 3-12. Also, it was observed that some subjects perceived the vowel better in the presence of burst than in the presence of transition. <S1, S3 (for the stimulus pa:ka)S7, S8 (for the stimulus pa:pa)> indicating that some subjects use temporal cues & some spectral.

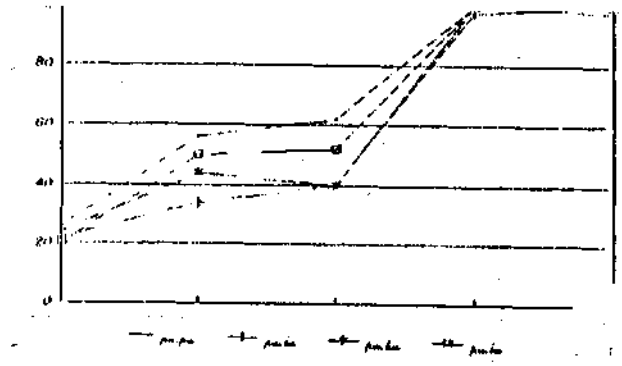

Fig. 2 : Percent response for four different stimuli

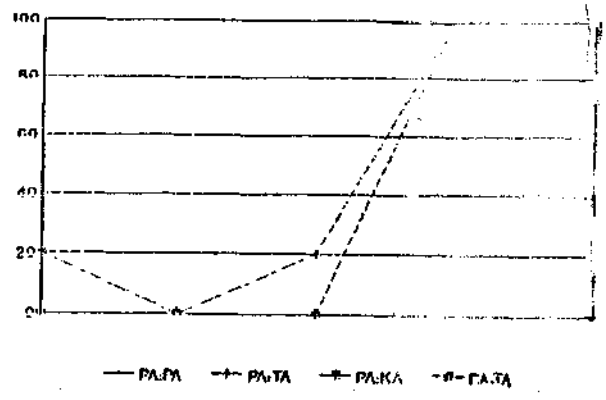

Fig. 3 : Percent response of subject 1.

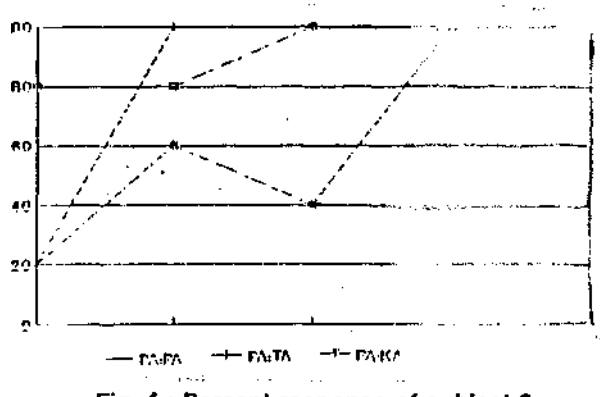

Fig. 4 : Percent response of subject 2.

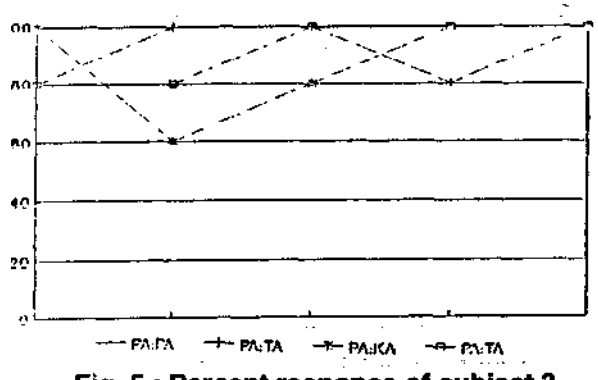

Fig. 5 : Percent response of subject 3.

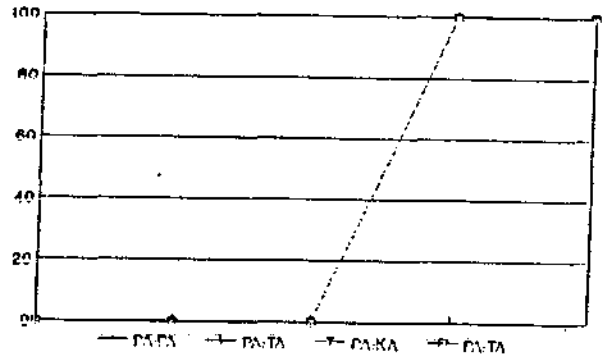

Fig. 6 : Percent response of subject 4.

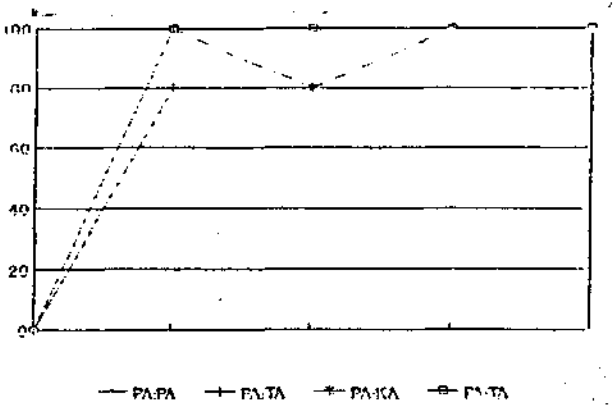

Fig. 7 : Percent response of subject 5.

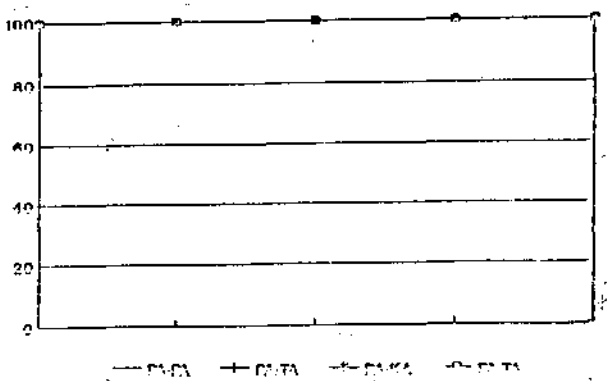

Fig. 8 : Percent response of subject 6.

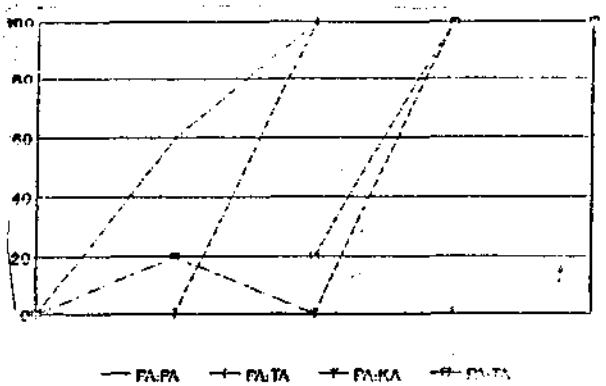

Fig. 9 : Percent response of subject 7.

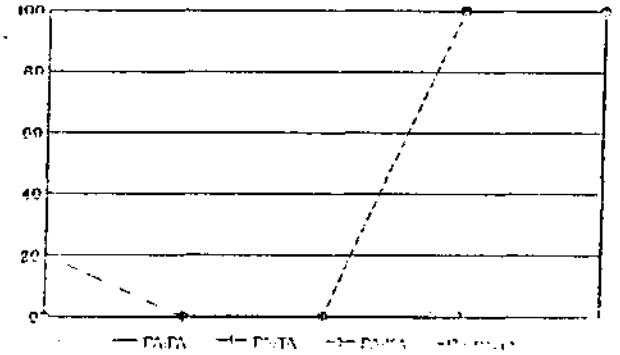

Fig. 10 : Percent response of subject 8.

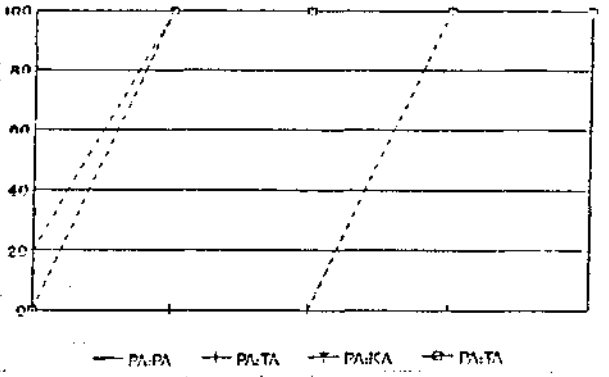

Fig. 11 : Percent response of subject 9.

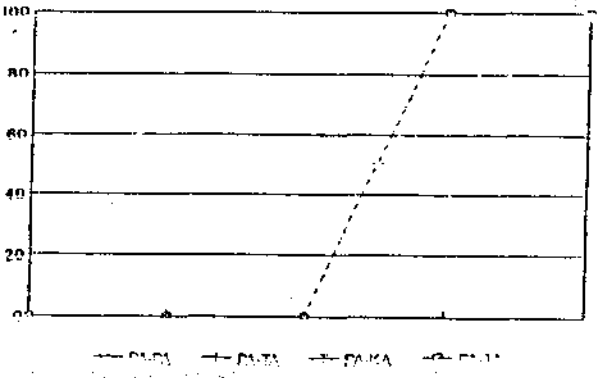

Fig. 12 : Percent response of subject 10.

Discussion

The results reveal that the vowel was better perceived when transition was present rather than when burst was presented. This indicates that the presence of transitions are helpful in perceiving the vowel. Though the subjects seem to perceive the vowel when the burst of the preceding stop consonant is presented it was not above chance level. Thus, it appears that the phonemes overlap on each other & the movement of a phoneme takes place much before that of the phoneme.

When the data was compared with that of the children's data, it was noticed that the responses were

better in adults when compared with that of children in the age range of 4-5 years. However, the responses of 5-6 & 6-7 year old children appeared to be better than adults. Table I shows the responses of children & adults.

	4-5	5-6	6-7	Adults
1	100	100	100	99.5
2	100	100	100	99.5
3	50	100	100	46.0
4	25	75	100	48.5
5	0	25	50	23

Table 1 : Percent response of children & Adults for various tokens.

Thus, it appears that the children by the age of 5-6 years acquire adult like patterns or the coarticulatory perception seems to be complete by 5-6 years of age. Also, it seems that some of the subjects are tuned to temporal cues & some to spectral cues though it is not very distinct & consistent. Most of the subjects appear to be using the temporal cue. However, in the present experiment, the transition part may be considered to belong to either the vowel or the stop consonant. The duration of the transition being shorter cues the listener, that the articulator is traversing from the completely closed state to the completely open state (vowel). Further experimentation could be conducted to investigate the duration of transition required to perceive the vowels.

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