Articulatory kinematics in long and short consonants

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This presentation examines articulatory kinematics and interarticulator programming in long and short consonants with particular emphasis on Japanese. The purpose is to analyze the articulatory implementation of length contrasts. Articulatory movements were recorded using a magnetometer in native speakers of Japanese. The linguistic material consisted of Japanese words containing a sequence of vowel-consonant-vowel that only differed in the length of the consonant, such as /sama, samma/, /kami, kammi/, /hata, hatta/, /saka, sakka/. These words allowed analysis of both lip and tongue movements, and also of different manners of articulation. Acoustic analysis of consonant duration showed very robust differences with the long consonants having about twice the duration of the short ones. The results for lower lip closing movements in labial consonants showed the characteristic bell-shaped velocity profile for the short consonants. In contrast, for the long ones, the velocity profile was not symmetric. Here, the acceleration signal of the lower lip closing movement showed that the deceleration of the lip was momentarily reduced in order to maintain the contact between the lips for a longer period of time. For consonants produced with the tongue, the most salient difference between the long and short consonants was the average speed of the tongue movements during the consonant: the speed was lower for the long than for the short consonants. This difference was most likely due to the necessity of maintaining the contact between the tongue and the palate for an extended period of time. These results thus show that speakers of Japanese systematically modulate the speed of tongue movements in producing long and short consonants, making it slower during a long consonant. In no case did these modulations result in the tongue coming to a complete stop, most likely due to a general principle of cost minimization in movement control. They thus add another dimension to control of movement velocity in speech, which has mostly been studied in the context of speaking rate, stress, shape of velocity profiles, and the relationship between movement amplitude and peak velocity. [Work supported by NIH.]