Clear speech modification of labial and lingual articulation

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In a noisy environment, speakers adapt their speech in a number of ways (Arons 1992). A speaker may unconsciously or consciously enhance aspects of their speech, aiming to benefit a (potential) listener, by drawing on cognitive, linguistic and social resources to sound phonetically "clear". Typically individual parameters of changes are quantified using acoustic analysis (e.g. Nicolaidis and Rispoli, 2005), while perceptual intelligibility tests can reveal more global factors affecting clarity. Direct study of how clear speech is planned / implemented in articulation itself using articulatory phonetic techniques is however relatively rare (e.g. Nicolaidis 2012) and so little is known about possible trading relations between jaw, tongue and lips, for example, or segmental timing and gestural dynamics, or the silent phrases of speech preparation. Take the well-known acoustic augmentation in noise is the expansion of the vowel space: presumably, speakers alter their supralaryngeal articulations to achieve this expansion via wider jaw opening and modified tongue and lip gestures, but making vowels more distinct from each other in articulatory space is a complex problem, the nature of which is little understood.

Our focus is the clear speech that is produced in conversation with a listener whose hearing is impaired. Experimentally, speech babble noise over headphones was used.

In a Scottish English single speaker pilot, the materials were isolated /b/+V+/p/ CVC words. They thus varied only in the vowel, which was one of six monophthongs. A randomized wordlist of six repetitions of each was elicited, and data from mid-sagittal Ultrasound Tongue Imaging, lip-jaw profile camera, and synchronised acoustics were used to analyse the expansion of the vowel space in articulation and acoustics.

Articulations were indeed altered in the noisy condition. Low/back vowels were lowered. The higher front vowels /i/ and /e/ remained high and the tongue front was slightly retracted. The vowel /ʉ/ hardly changed at all. The labial distinction between rounded and unrounded was enhanced in all vowels. Though the initial /b/ and final /p/ were a fixed frame for every target word, in the noisy condition the initial /b/ consonant was clearly hyper-articulated with increased labial compression (cf. Nicolaidis 2012 on similar lingual compression) but the final /p/ was not. F1 raising and an increase in the (Bark) area of the acoustic vowel space were observed, along with increased intensity and duration.

The full paper will report a full experimental study of six speakers and present additional findings. The implications for syllabic models of speech production will be discussed.

References

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