

## **The opposition of /i/ and /u/ in Scottish English children: acoustic and articulatory evidence**

This study addresses acoustic and articulatory properties of high tense vowels in Standard Scottish English (SSE) child and adult speakers. High vowels /i/ and /u/ in adult SSE are closer together in the acoustic and articulatory space than these vowels in Southern British English. In children acquiring Scottish English phonology, realisations of /u/ tend to be at first more front and variable, gradually changing to more back productions ([1]). A recently collected database of SSE child and adult productions ([3]) has provided impressionistic evidence that these two vowels sound very similar to each other in some 6 to 8 year-old children. The present study analyses acoustic and articulatory data from this database. The aim is to find out to what extent children who have generally acquired the phonemic system are different from adults in how they realise the opposition between /i/ and /u/, and whether children maintain the contrast in tongue position between the two vowels. The results will inform theories of speech development and practical descriptions of English phonetics.

The objectives of the study are: 1) to establish whether /i/ and /u/ are significantly different from each other in children, as well as in adults; 2) to identify and explain the nature of any age-related differences, using complementary information from acoustic and articulatory data.

The database consists of synchronised recordings of the acoustic signal and lingual articulations, the latter obtained using ultrasound tongue imaging. Ultrasound provides information about the shape of most of the midsagittal tongue contour, including the root (e.g. [2]). The speakers selected for this study are six female adults and six children aged between 6 and 8 years. Ten repetitions of each target vowel are produced within a /s/-vowel syllable in a carrier phrase.

The data analyses are as follows. In each token, F2 is calculated at the vowel midpoint. Separately for children and adults, F2 values for /i/ and /u/ are compared, using T-tests with Bonferroni adjustment. The tongue surface contour is traced at the vowel midpoint in each token, and defined in terms of x-y coordinates. Distances between tongue curves are used to compare /i/ and /u/ tongue contours. Separate Anovas for children and adults establish whether the tongue position for /i/ is significantly different from the tongue position for /u/. A correlation is performed between acoustic and articulatory results. In addition to the statistical analyses, qualitative examination of individual variation in tongue shapes and spectrograms will be used to explain the nature of any age-related differences in realising the vowel distinction.

### References

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- [2]. Stone, M. (2005). A guide to analyzing tongue motion from ultrasound images. *Clinical Linguistics and Phonetics*, **19**, 455-502.
- [3]. Zharkova, N. (2009). *An ultrasound/acoustic database of lingual articulation in children and adults* [computer file], Colchester, Essex: UK Data Archive, UKDA-store, September 2009. UKDA-store record number 280.