INTRODUCTION

- Children do not always progress ably from incorrect, unaided productions to readily perceivable and transcribable phonological categories.
- Children may go through a stage of 'covert contrast'.

Covert contrast: A phonological difference between two sounds that is not perceptible to adults (e.g., Mack & Barton, 1960).

- Covert contrast for stops and fricatives has been reported in the literature, but there is little work on affricates and consonant clusters.
- Furthermore, there is limited work on covert contrast for languages other than English.

PURPOSE OF THE STUDY

- To look for covert contrast in word-initial stop-/s/ clusters and the affricate /ts/, both of which are late-acquired in Greek (Panhellenic Association of Linguologists, 1995).

METHODOLOGY

Participants:
- 19 monolingual Greek-speaking children (six 2-year-olds, seven 3-year-olds, three 4-year-olds, and three 5-year-olds).
- Typically-developing.
- Selected from a larger sample of 60 2-to-5-year-olds.

- Selected because they produced correct /s/ in singleton targets, but reduced stop-/s/ clusters and the affricate /ts/ to [s].
- Cluster reduction to [s] in stop-/s/ sequences was a common error pattern (Sykas et al., 2007).
- 14 young native Greek-speaking adults from the same dialect region were also recorded in the same task.

Task and Procedure:
- Word-repetition task.
- A picture and a digitized recording of the stimulus were presented simultaneously.
- The children were instructed to repeat the word that they heard.
- Children's repetitions were digitally recorded.

Stimuli:
- 2- or 3-syllable real words with word-initial /s/, /ps/, /ts/, and /ks/ before each of the vowels /a/, /e/, /i/, /o/.
- All words were stressed on the first syllable.

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[Analyses]
- Children's productions were transcribed by a Greek native speaker/phonetician (the first author) using the Praat waveform editor (Boersma & Weenik, 2001).
- For the productions of the 19 children analyzed, we paired productions of [s] in cluster reductions to correct /s/ targets in the same vocalic context.
- For example, /as/ in target /pas/ (atak) was paired with the same-child's correct production of /as/ in target /parer/ (lizard).
- We examined the duration of the fricative [s] for both cluster reductions and correct productions of singleton /s/.
- We performed a spectral moments analysis to compare the fricative internal dynamics of productions of reduced [s] in stop-/s/ sequences to productions of correct singleton /s/.
- We measured spectral amplitude to compare the degree of sibilance of the fricative at different points in time.
- We applied the same analyses to the correct productions of singleton /s/ and stop-/s/ sequences produced by adults.

RESULTS: DURATION ANALYSIS ADULTS (For correct singleton production of /s/ and stop-/s/ sequences)

- There is a significant effect of sibilable structure on fricative duration.
- Fricative duration in singleton /s/ is longer than in /ps/ or /ts/.
- Fricative duration in /ps/ is similar to that in /ts/.
- Since duration in /ts/ is considerably shorter than that in /ps/ and /ts/.

RESULTS: DURATION ANALYSIS CHILDREN (For correct singleton /s/ and reduced [s] for stop-/s/ sequences)

- There is a significant interaction between underlying syllable structure and age group for reduced [s] duration.
- Reduced [s] for underlying clusters is longer than correct singleton /s/ in 2- and 3-year-olds, but tends to be shorter in 4- and 5-year-olds.
- Reduced [s] is more variable than correct singleton /s/.
- Underlying place of articulation of the ‘deleted’ stop does not have a consistent effect on the duration of reduced [s].

RESULTS: SPECTRAL MEAN FREQUENCY (CENTROID) ADULTS (LEFT) AND CHILDREN (RIGHT)

- Target /ps/ and /ks/ have a higher spectral amplitude both at onset of frication and overall compared to that of singleton /s/ and /ts/.
- The affricate /ts/ has a clearly distinct contour shape as compared to both singleton /s/ and stop-/s/ sequences /ps/ and /ks/.

- This suggests that children are attempting to produce an initial stop before the fricative in an underlying stop-/s/ cluster, by making a less narrow constriction at onset, as compared to their productions of target singleton /s/.

CONCLUSION AND DISCUSSION

- Covert contrast was observed for Greek-speaking children who were perceived to neutralize stop-/s/ sequences to [s], suggesting the need to supplement transcription with acoustic analysis to better describe children's phonological knowledge.
- Future research will focus on a fine-grained analysis of the acoustic data, including an examination of individual subject data, as well as the perception of reduced stop-/s/ sequences and singleton /s/ by Greek adult naïve listeners.

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