Acquisition of consonant clusters by Greek-speaking children: Word-initial /s/-stop and stop-/s/ sequences

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INTRODUCTION

The production of consonant clusters is challenging for young children, with clusters typically emerging after correct production of singleton consonants has stabilized (e.g. Smit et al. 1990). While numerous studies have investigated children's acquisition of consonant clusters, the majority of such studies have focused on English (e.g. Gierut 1999; McLeod et al. 2001; Smit 1993). There has been limited research on the acquisition of consonant clusters in other languages (e.g. Barlow 2003; Jongstra 2003; Tzakosta 2001). Cluster acquisition is particularly interesting in Greek, which has an exceptionally rich system of consonant clusters. It is also one of relatively few languages that allows word-initial clusters of /s/ with /p/ and /k/ where the sibilant is inside of the stop (and Greek also has the affricate /ts/), as well as clusters of /s/ with /p/, /t/, and /k/ where the sibilant is outside of the stop. This study reports on acquisition of consonant clusters in Greek.

RESEARCH QUESTIONS

1. What is the time course of acquisition of word-initial /s/ + stop and stop + /s/ clusters in Greek-speaking children?
2. How does this relate to acquisition of the singleton members of these clusters?
3. What are the typical error patterns for these clusters?
4. How is cluster acquisition in Greek similar to and different from cluster acquisition in English?

CONSONANT CLUSTERS ELICITED

/s/ + stop sequences	Example	Stop + /s/ sequences	Example
/sp/	['spiti] 'house'	/ps/	['psaɾi] 'fish'
/st/	['stasi] 'bus stop'	/ts/*	['tsada] 'bag'
/sk/	['skilos] 'dog'	/ks/	['ksilo] 'stick'

*Usually analyzed as an affricate.

PARTICIPANTS

Age Groups	N	Age in Months (Mean)	Age Range in months	Non-verbal IQ
2-year-olds	10	30.1	24.3-35.3	N/A
3-year-olds	10	42.9	38.6-47.5	119**
4-year-olds	10	55.3	48.8-59.6	109.6
5-year-olds	10	66.2	61.0-71.8	107.5

** Calculated only using the 5 children over age 3;6.

STIMULI

- The target sequences were /s, p, t, k, sp, st, sk, ps, ts, ks/.
- The target consonant or consonant cluster was placed in word-initial position in familiar real words that were:
  - Two or three-syllables in length
  - Pictureable
- Each target consonant or consonant cluster was paired with all possible vowel combinations of /i, e, a, o, u/.

EXAMPLES OF STIMULI

/'skala/ /'skevos/ /'skilos/ /'skorðo / /'skupa /

PROCEDURE

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

ANALYSIS

- Native-speaker transcription using Praat waveform editor
- Initial consonant and cluster were labeled:
  - Correct
  - Incorrect
- If incorrect, phonetic transcription of perceived error
  - Substitution of sound from phonemic inventory
  - Substitution of sound from outside phonemic inventory
  - Distortion
  - Deletion
- Phoneme-by-phoneme inter-rater reliability with a second native Greek transcriber for 5% of the data was 88%.
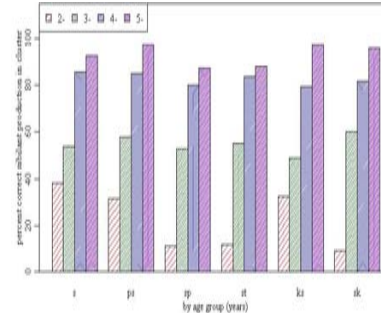
FIGURE 1. ACCURACY OF SINGLETON OR CLUSTER
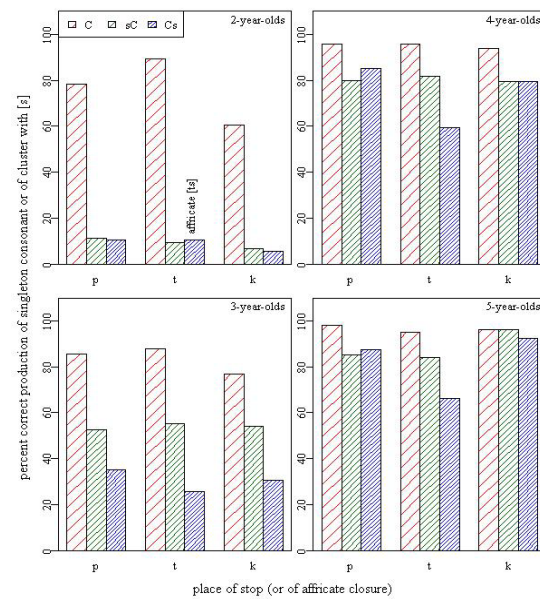
RESULTS: ACCURACY ANALYSIS I

- Accuracy increases with age.
- Single consonants > /s/-stop clusters > stop-/s/ clusters > affricate /ts/.
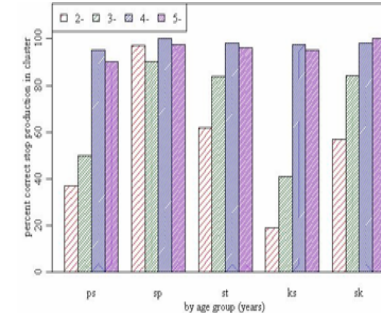- /ts/ is less than 80% accurate, even at age 5.

ACCURACY OF /s/

RESULTS: ACCURACY ANALYSIS II

- /s/ not mastered until 4 years of age.
- /s/ in clusters more accurate in stop-/s/ than in /s/-stop clusters (2-year-olds only).
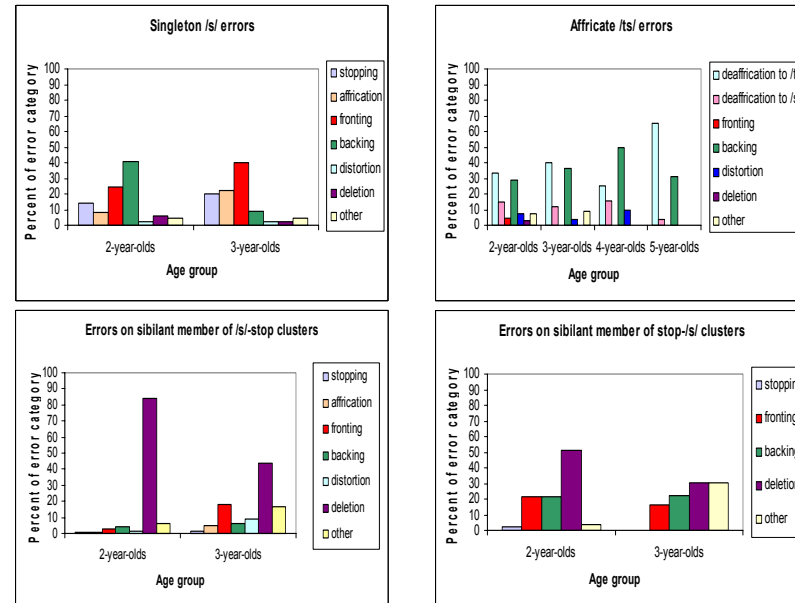
ACCURACY OF STOP IN CLUSTER

RESULTS: ACCURACY ANALYSIS III

- Stop more accurate in /s/-stop than stop-/s/ clusters for 2- and 3-year-olds.

ERROR ANALYSIS

Singleton /s/ errors

Affricate /ts/ errors

Errors on sibilant member of /s/-stop clusters

Errors on sibilant member of stop-/s/ clusters

RESULTS: ERROR ANALYSIS

Errors on /s/ member of /s/-stop clusters
- Predominantly deletion

Errors on singleton /s/
- Backing and fronting
- Deletion is rare

General Summary of error patterns
- Children tend to delete the first member of the cluster.
- Children delete the /s/ more often when it precedes a stop.
- Children delete the stop more often when it precedes an /s/.
- More variability in error patterns for stop-/s/ than /s/-stop clusters.

Errors on /s/ member of stop-/s/ clusters
- Deletion (but much less than in /s/-stop clusters)
- Backing and fronting

Errors on affricate /ts/
- Deaffrication to /t/
- Backing (usually to alveolo-palatal or velar)
- Deaffrication to /s/

DISCUSSION AND CONCLUSIONS

- Greek children show both universal (e.g. cluster reduction to stop in /s/-stop clusters) and language specific errors (e.g. backing errors of /s/) in their acquisition of /s/-stop and stop-/s/ sequences.
- Contrary to the predictions of sonority hierarchy and markedness, /s/-stop clusters are not mastered later than stop-/s/ clusters.
- Contrary to Jacobson's implicational laws, clusters do not imply affricates, which are mastered later than age 5 in Greek.
- The time course of acquisition of /s/-stop and stop-/s/ sequences in Greek may be explained, in part, by differences in phoneme sequence frequency in the Greek language.
- The difference in the error patterns (e.g. /s/ being more accurate when it follows a stop) may be related to differences in perceptual saliency of the stop in /s/-stop and stop-/s/ sequences.
- These results show the importance of studying acquisition in languages other than English.
  - The deletion of /s/ in /s/-stop clusters in English had been interpreted as children deleting the later-acquired member of the cluster. However, this interpretation does not explain the deletion of the stop in stop-/s/ clusters in Greek.
- Future research will address these issues and examine their effect on children's consonant cluster acquisition.

REFERENCES

Barlow, J. (2003) Asymmetries in the acquisition of consonant clusters in Spanish. *Canadian Journal of Linguistics/Revue canadienne de linguistique* **48** (3/4), 179-210.

Jongstra, W. (2003) Variation in reduction strategies of Dutch word-initial consonant clusters. Doctoral dissertation, University of Toronto.

Gierut, J. A. (1999) Syllable onsets: Clusters and adjuncts in acquisition. *Journal of Speech, Language and Hearing Research* **42**, 708-726.

McLeod, S., van Doorn, J. & V. A. Reed (2001) Normal Acquisition of consonant clusters. *American Journal of Speech-Language Pathology* **10**, 99-110.

Smit, A. B. , Hand, L., Freilinger, J. J., Bernthal, J. E. & A. Bird (1990) The Iowa Articulation Norms Project and its Nebraska replication. *Journal of Speech and Hearing Disorders* **55**, 779-798.

Smit, A. B. (1993) Phonologic error distributions in the Iowa-Nebraska articulation norms project: Word-initial consonant clusters. *Journal of Speech and Hearing Research* **36**, 931-947.

Tzakosta, M. (2001) The realization of consonant clusters in child speech [in Greek]. *Studies in Greek Linguistics* **21**, 736-746.

ACKNOWLEDGMENTS

the παιδολογος project
cross-language investigation of phonological development

http://www.ling.ohio-state.edu/~edwards/