Acquisition patterns and acoustic cues of voiceless plosives in Greek

Timothy Arbisi-Kelm, Eunjong Kong,
Mary E. Beckman, Jan Edwards

4th Annual MLK Day Symposium on Linguistics

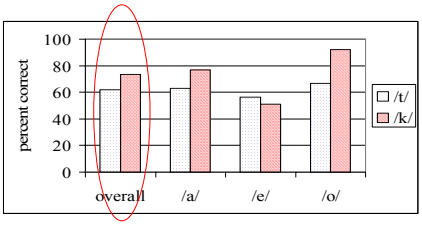
Are all tokens of "/k/" the same sound?

- Is "/k/" in κύμα the same as "/k/" in κουνέλι ?
  - Many linguistic analyses (e.g., Setatos 1974) argue no:

    /k/→[c] *or* [kʲ] / __ V +front
- Is Greek "/k/" the same sound as English "/k/"?
  - The traditional choice of the same IPA symbol for the first consonants in κουνέλι and *cougar* suggests yes, but…

Setatos, Ì. (1974). Phonology of Modern Greek. Papazissis Press.

. . . where English-acquiring children typically are more accurate in producing /t/, Greek-acquiring children are more accurate in their productions of /k/ (Nicolaidis, et al. 2003):



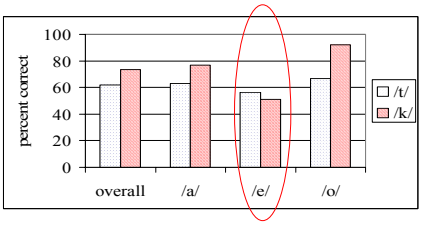
Nicolaidis, K., Edwards, J., Beckman, M., & Tserdanelis, G. (2003). Acquisition of lingual obstruents in Greek. Paper presented at the 6th International Conference of Greek Linguistics, Rethymno, Crete, September 18-21, 2003.

Is this a frequency effect?

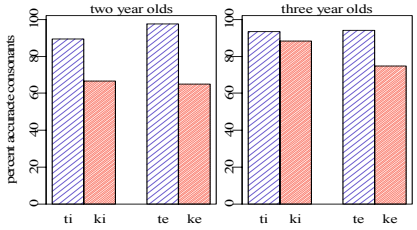
- In an early pilot study (Nicolaidis, et al. 2003), we explored whether acquisition of Greek lingual obstruents was affected by phoneme frequency:

Whereas in English /t/ is slightly more frequent than /k/, in Greek /k/ is significantly more frequent:

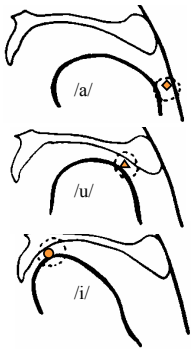
	/i/	/e/	/a/	/o/	/u/	total
/t/	132	160	98	101	49	540
/k/	308	106	731	180	34	1356



On the other hand, in the environment of /e/, /t/ was more accurate than /k/. Is this because /ke/ is less frequent than /te/? Or is it because front /k/ ([c]) is harder to produce than back /k/?

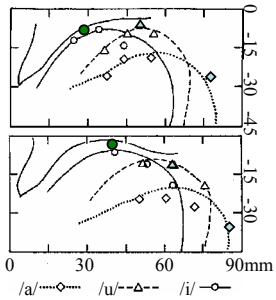


- In later data, this effect was also found for the high front vowel, despite the fact that /ki/ is more frequent than /ti/.
- This suggests that we can't look at acquisition without taking vowel environments into account, and…
- that we can't compare consonants **across** languages without taking vowel environment into account.



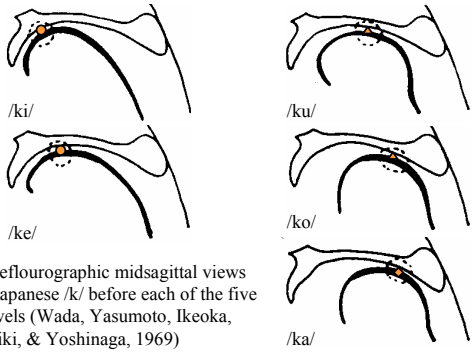
Japanese point vowels, from Wada, et al. (1969)

Both speakers have a less front /i/ than the Japanese speaker's /i/.



English point vowels, from Kent & Moll (1972)

Place of constriction in Japanese /k/ shows a gradient dependency:



Cineflourographic midsagittal views of Japanese /k/ before each of the five vowels (Wada, Yasumoto, Ikeoka, Fujiki, & Yoshinaga, 1969)

Gradient variability

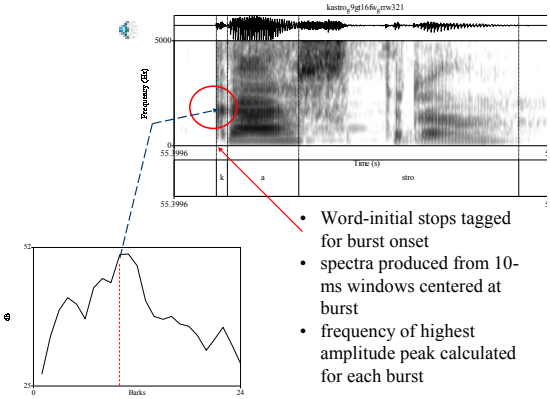
- The Japanese evidence suggests that dorsal stop variation is not simply [c] before front vowels and [k] before back vowels, but rather a continuous variation that is gradiently related to the exact degree of frontness of the following vowel
- Finer-grained acoustic evidence comparing burst centroids between Greek and English further suggests that the gradient relationship is language-specific
  - Greek /k/ more palatalized than English /k/ before front vowels (Tserdanelis, et al. 2005)

Prediction

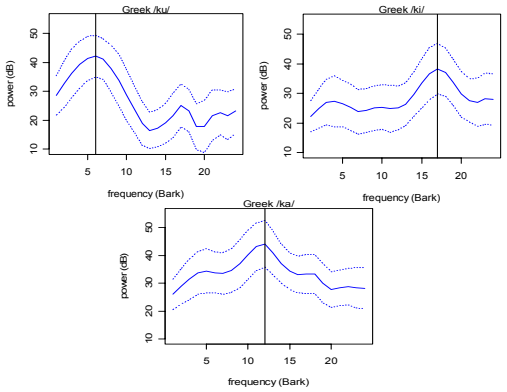
- It is hypothesized that the place of articulation for /k/ within a language will vary continuously with the following vowel
- These place of articulation differences will differ across languages because vowel quality differs:
  - Greek /i/ is fronter than English /i/
  - Greek /u/ is more back than English /u/

Procedure

- Recorded 20 adult speakers of Greek of whom 12 have been analyzed
- Single word repetition task
- Three words tested for each of the five vowel environments
- Comparable data for 20 adult speakers of English of whom 6 have been analyzed



- Word-initial stops tagged for burst onset
- spectra produced from 10-ms windows centered at burst
- frequency of highest amplitude peak calculated for each burst



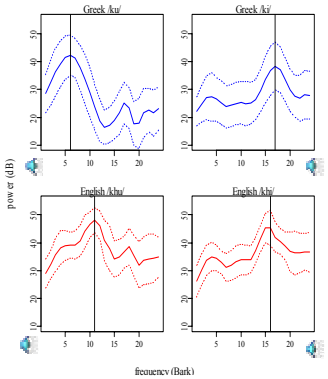
Results

- Frequency of the highest amplitude peak directly correlated with place of articulation of following vowel

  /ku/ < /ka/ < /ki/

- Suggests that realization of dorsal stops is constrained in a gradient way by the degree of backness or frontness of vowel in Greek

- When compared with English velar stops, Greek dorsals are realized at more extreme points of constriction:
  - Greek /ki/ more front than English /khi/, /khI/
  - Greek /ku/ more back than English /khu/



Summary of Results

- In Greek, not only is /k/ preceding /u/ different from /k/ preceding /i/, it is also different from /k/ preceding /a/
- Moreover, when we compare Greek and English, there are differences between English /ku/ and Greek /ku/, and English /ki/ and Greek /ki/

Conclusion

- "Velar fronting" is gradient:
  - An allophonic account of velar fronting in Greek does not capture the full generalization: place of articulation of velar obstruents is directly dependent on the frontness/backness of the following vowel
- In short, every /k/ is different!
- In order to understand acquisition of /k/, it is important to look at the phonetics for both the specific language and the specific vowel context

Acknowledgements

- Asimina Syrika
- Sarah Schellinger
- Hyunju Chung
- Georgios Tserdanelis
- Part of a larger NIH-funded grant (PI Jan Edwards) looking at phonetic acquisition in six languages

References

Setatos, Ì. (1974). *Phonology of Modern Greek*. Papazissis Press.

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