Survival and neutralization of a rare cross-linguistic contrast: the case of Romanian palatalized postalveolars

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In brief

The contrast	plain and secondarily palatalized postalveolar fricative
The language	This occurs in Romanian, but is very restricted cross-linguistically
The findings	Distinction between the plain and palatalized form maintained in production, despite low perceptual salience
Example	[koʃ] 'basket' [koʃʲ] 'you sew'

Goals

1. Provide descriptive account of secondary palatalization (SP) in fricatives at this, and other, places of articulation
2. Add to typology of SP
3. Discuss potential reasons for observed discrepancy between perception and production

SP overview

Production of a secondary palatal gesture in addition to a consonant's primary place gesture.

- Found in about 27% of a random sample of 117 languages (Bateman 2007)
- Present in Polish, Russian, Irish, Isthmus Mixe, etc.
- **Phonological status:**

  Distinctive: Russian: consonants with secondary palatal articulations are part of the phonemic inventory, in contrast with plain ones, e.g. [glup] 'stupid' vs. [glup^{j}] 'depth'

  Non-distinctive: Japanese: surface realization of underlying CV or CG sequences (Vance 1987)

SP overview

- **Phonological behavior:** neutralization of plain-palatalized contrast encountered in final (coda) position, in pre-consonantal position, more often with labials than coronals
- **Articulatory properties:** fronting and raising of the tongue body towards the hard palate, timed with respect to the primary articulation (timing varies by speaker and syllabic position, Kochetov 1998, 2002)
- **Acoustically:** palatalized Cs longer than plain ones, stops have strident-like release, cause low F1 and high F2 on neighboring vowels
- **Perception:** contrast disfavored (less salient) at labial place as opposed to [+anterior] coronal (Kochetov 2002, Kavitskaya 2006)

SP: Romanian

- Found in Romanian, but not elsewhere in Romance
- ONLY in word-final position
- Commonly associated with (but not restricted to) presence of 2 affixes (plural for nouns/adj and 2nd p. pres. ind. of verbs)

Plural	a.	pom [pom] 'tree'
	b.	pomi [pom^{j}] ''trees'
2nd p.	a.	sar [sar] 'I jump'
	b.	sari [sar^{j}] 'you jump'

- Widespread view: underlying word-final /i/ triggers palatalization on preceding C then deletes (Chitoran 2002) => surface contrast between plain and palatalized Cs word-finally (a-b pairs above)

SP: Romanian

- Perception of palatalized Cs influenced by primary POA
- Romanian departs from previous findings: listeners more sensitive to SP in labials and dorsals than in either [+ant] or [-ant] coronals
  - Spinu 2007: [p] vs. [ʦ] and [ʃ] (manner confound)
  - Spinu 2009: [v] vs. [z] (small sample)
  - Spinu 2012: [f], [v], [x] vs. [z] and [ʃ] (neutral context)

SP in postalveolars

- **Kochetov 2002**: postalveolar segments usually pattern with either plain or palatalized consonants but NOT both
- **Żygis and Hamann 2003**: some loanwords in Polish show palatalization of (retroflex) postalveolar fricatives before the high front vowel /i/ to palatalized laminal postalveolar fricatives which contrast acoustically with alveolo-palatal fricatives
- **Campbell 1974**: Livonian contrasts /ʃ/ and /ʃʲ/; Mordvin contrasts /c/ and /cʲ/
- **Dieterman 2002**: morphological palatalization affects all consonants in Isthmus Mixe, including postalveolar fricative; distinctions found between plain and palatalized forms in duration, spectral peak, and formant transitions (higher F2 and F3 for palatalized).

Romanian: SP contrast in postalveolars

Şuteu 1961:

- Study involving self-described pronunciation, without acoustic analysis
- 94.4% of 309 speakers (all from Bucharest, Romania) reported making a distinction between the singular and the plural form of a word ending in a postalveolar fricative
- Many of the informants reported pronouncing a 'short' or 'weak' i-sound at the end of the plural item

Schane 1971:

- Depalatalization process applies to palatal consonants in Romanian (ʃ, ʒ, ʧ)

Current study

Production Experiment: acoustic properties of Romanian SP

- distance between plain-palatalized segments (within and across different pairs)
- determine status of SP in postalveolars

Perception Experiment: address previous issues

- more subjects
- more speakers
- more places of articulation
- using a mismatch detection task

Targets

Four distinct POAs examined, each represented by a plain and a palatalized form:

Labial	[f, v] - [fʲ, vʲ]
Dental	[z] - [zʲ]
Postalveolar	[ʃ] - [ʃʲ]
Dorsal	[x] / [h] - [ç̟ʲ]

For each C: 4 pairs of words (all minimal pairs; disyllabic; final stress):

- e.g. *[pantof]/[pantofʲ]* shoe/shoes

Total number of targets:

- 5 consonants x 4 words x 2 forms (plain/pal.) = 40

Production Experiment

- Targets embedded in context-neutral carrier sentence:

  Am să aleg cuvântul ***[pantof/pantofʲ]*** *când voi gata.*
  'I will choose the word 'shoe/shoes' when I am ready.'

- 31 subjects (10 M, 21 F, mean age 21.7 yrs)
- InvTool software: sentences read from computer screen
- 40 targets + 80 fillers randomly presented in 3 blocks (=120 targets/subject)
- 6 items discarded due to disfluencies → **3,674 items**

Analysis

- Each segment analyzed acoustically:
  1. **duration**
  2. **average spectral properties** expressed as the first six coefficients of the Bark cepstrum (c0-c5): estimated separately for all 10 ms frames of each segment and then averaged
- Repeated-measures, within-subjects ANOVAs (effect of Consonant and Palatalization on duration and cepstral coefficients)
- Hidden Markov Models (HMMs) were used to divide the fricatives into 3 regions of internally minimized variance; the cepstral coefficients were averaged over each region and a linear discriminant analysis with leave-one-out cross-validation was used to separate the plain and palatalized classes.

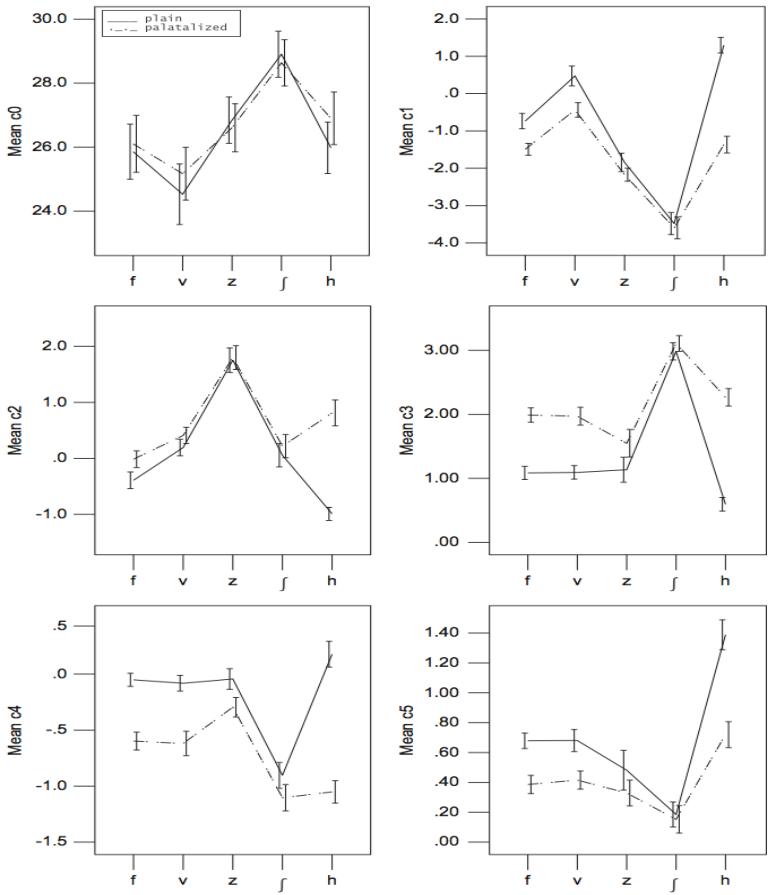
Results: Group

ANOVAs:

- Significant main effects found for Consonant and Palatalization on all the dependent variables.
- Significant interactions between these factors observed in all cases.

Duration: significant differences between plain and palatalized only found for /v/ and /h/ (NOT for /ʃ/).

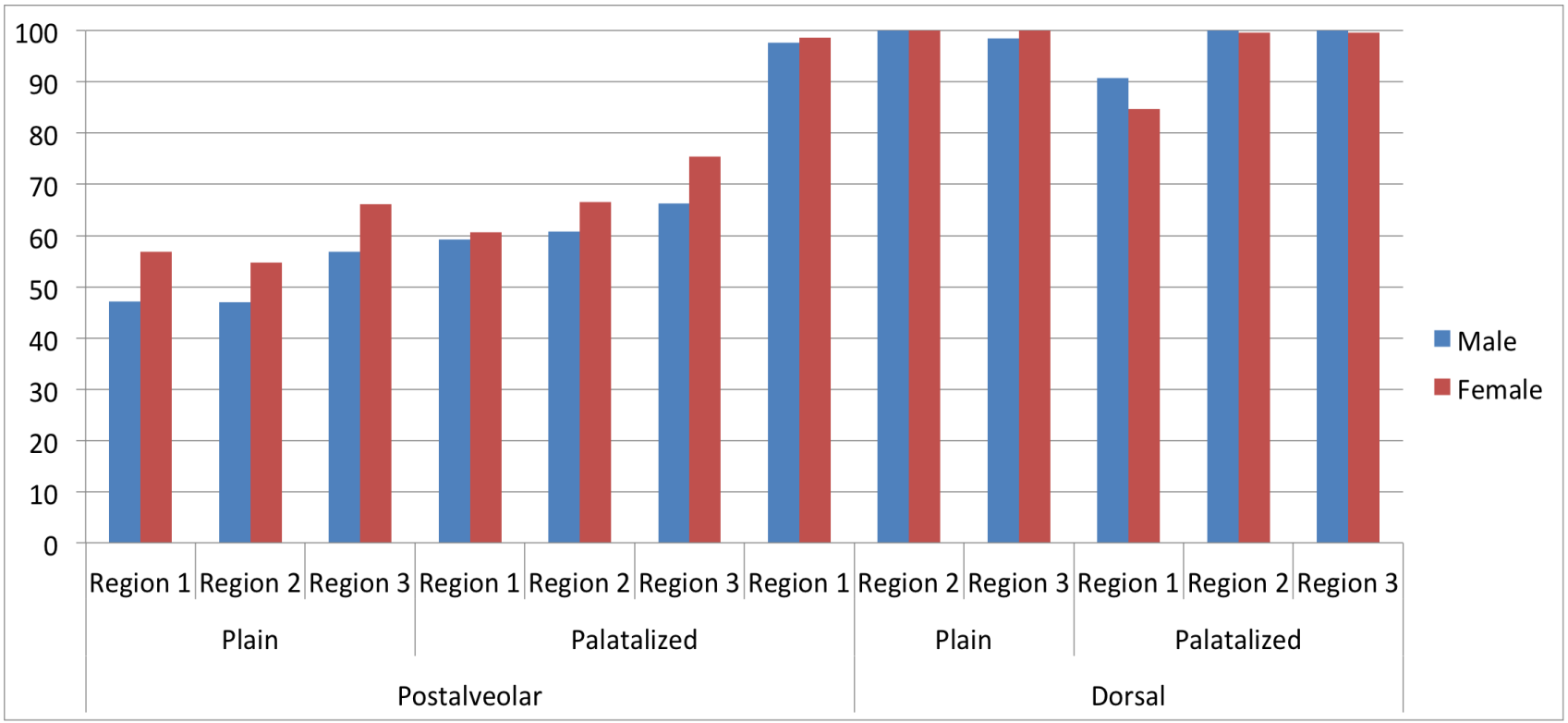
Cepstral coefficients



Results: Individual

- Graphs show number of subjects who produced significant differences between plain and palatalized forms.
- Near significant values ($p < 0.1$) also considered (fewer items included).
- **Postalveolar:** even though no significance found at group level, **only 4 of 31 speakers did not produce a significant difference between plain and palatalized**; more differences found in c2 for postalveolar than for dental.

Results: classification of palatalization by region (split by gender)



Perception Experiment

- Previous experiments: perception of plain-palatalized contrast without any additional morphological cues signaling the presence of palatalization (e.g. *'I will choose the word X when I'm ready.'*)
- BUT is this causing the subjects to pay less attention to palatalization? (if the difference is subtle, may not see an effect)
- Current experiment: include additional cues to the absence/presence of palatalization to see if they can detect mismatch
- 31 subjects (11 M, 20 F, mean age 24.2 yrs)
- E-Prime software: sentence heard over headphones, decide whether acceptable/not (keys counterbalanced)
- ANALYSES
  - Accuracy rates
  - Reaction times
  - Sensitivity (d prime)

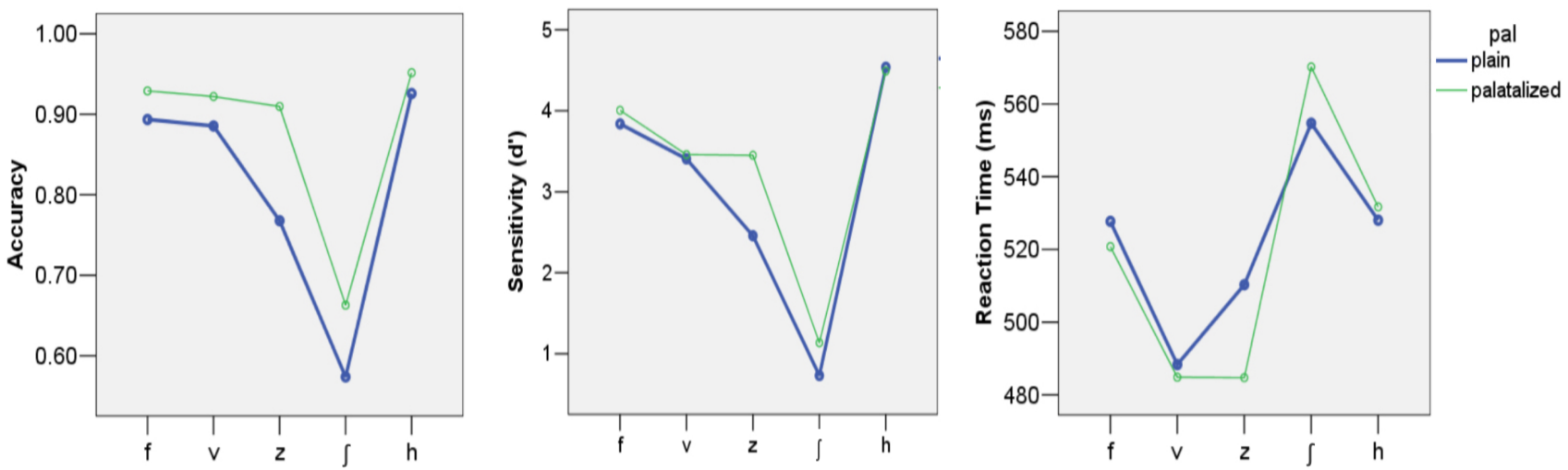
Perception Experiment: additional cue present

- Same targets recorded especially for this experiment by 15 different speakers
- Each target word in 4 different conditions:

  plain matched (target word: sg., cue: sg.)
  e.g. un panto[f] one shoe
  plain mismatched (target word: sg., cue: pl.)
  e.g. patru panto[f] *four shoe
  palatalized matched (target word: pl., cue: pl.)
  e.g. patru panto[fʲ] four shoes
  palatalized mismatched (target word: pl., cue: sg.)
  e.g. un panto[fʲ] *one shoes

- Only matched sentences recorded directly; actual target sentences involved cross-splicing of the target words in both matched and mismatched conditions.

Results: accuracy, sensitivity, reaction time



Predictions for sound change

Licensing by Cue (Steriade 1997, Kochetov 1999, 2002): distribution of a phonological contrast sensitive to amount of acoustic information available in a given environment

- If environment A provides more acoustic information to a contrast between two segments /x/ and /y/, the identification of the contrast by listeners is likely to be high, and, as a result, the contrast would be *preserved*.
- If environment B provides less acoustic information to the contrast, the identification rate of /x/ vs. /y/ would tend to be lower and the contrast is more likely to be *neutralized*.

Phonetic knowledge hypothesis (Hayes and Steriade 2004): perceptually fragile contrasts tend to undergo one of two changes – enhancement or neutralization.

SP contrast in postalveolars

- Realized articulatorily by most speakers
- Low perceptual salience → fragile contrast
- This situation has presumably been going on for at least 50 years (Șuteu 1961)
- Questions:
  - Why hasn't it been neutralized or enhanced?
  - How is it acquired?

Neutralization

Examples:

- voiced vs. voiceless distinction neutralized in Russian obstruents
- plain-palatalized contrast with labials in coda position cross-linguistically

Romanian: neutralization with some speakers (12% compared to 6% in 1961 study, but very speculative since those findings not supported by acoustic measurements).

Enhancement

Examples (in general):

- plain consonants became velarized in languages with SP
- The fricative [s] contrasts with [ʃʲ] in Romanian
- Also Romanian: SP contrast in dorsal fricatives implemented as a velar for plain forms and palatal for palatalized ones.

Possible enhancement strategies for postalveolar fricatives:

- strengthening to an affricate (Catalan)
- sibilants become affricates word-initially and after a consonant (ʃ→ ʧ, ʒ→ ʤ, Lavoie, 2014)
- fortition to full-fledged stop (Lavoie, 2001)

How is it acquired?

- If adults cannot perceive it, presumably children cannot either (similar perceptual system after the age of 1, Werker and Tees 1984).
- Is the distinction absent before learning the correct spelling?
- Longitudinal study could establish if it is acquired before (based on morphological pattern) or after becoming literate (external pressure).
- Visual cues may also play a part.

Grammatical restructuring

- Kochetov 2002: deviations from general cross-linguistic patterns may be due to properties of the lexicon and grammar of these languages – a particular contrast might be maintained in a less favorable environment if the pressure from additional factors is sufficiently strong
- Strength of this pressure depends on productivity and relative salience of these morphological categories (Pierrehumbert 2001)
- Highly productive, morphologically-transparent alternations: stronger effects

Grammatical restructuring

This appears to be the case in

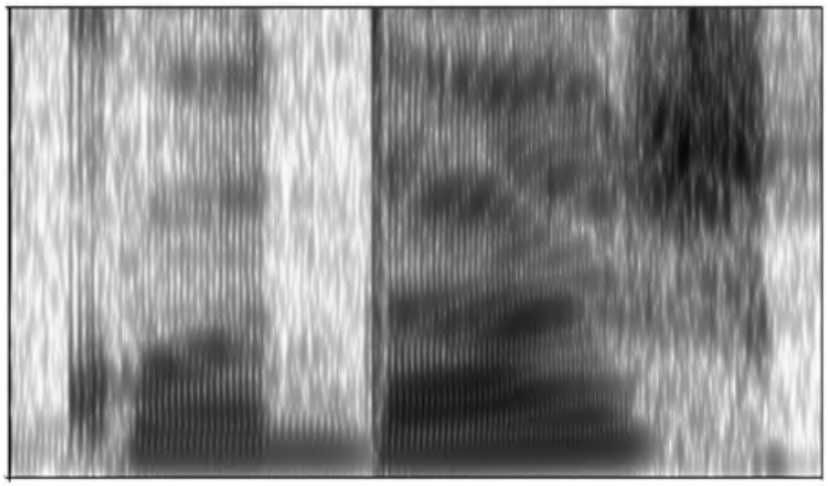
Russian	some palatalized Cs allowed in medial clusters (most unfavorable environment) but morphologically conditioned
Nova Nadezhda	dialect of Bulgarian: all palatalized stops allowed in word-medial clusters but these result from addition of highly productive inflectional or derivational affixes
Isthmus Mixe	plain-palatalized postalveolars, morphologically conditioned
Romanian	same as Isthmus Mixe

Conclusions

- Rare cross-linguistic contrast conforms to typological predictions – acoustically and perceptually weak
- No strong evidence of either neutralization or enhancement (perhaps incipient male-driven sociolinguistic tendency to neutralize?)
- Lack of 1-to-1 correspondence between phonetic factors triggering neutralization and actual neutralization patterns attested in individual languages

Thank you!

Postalveolar spectrograms



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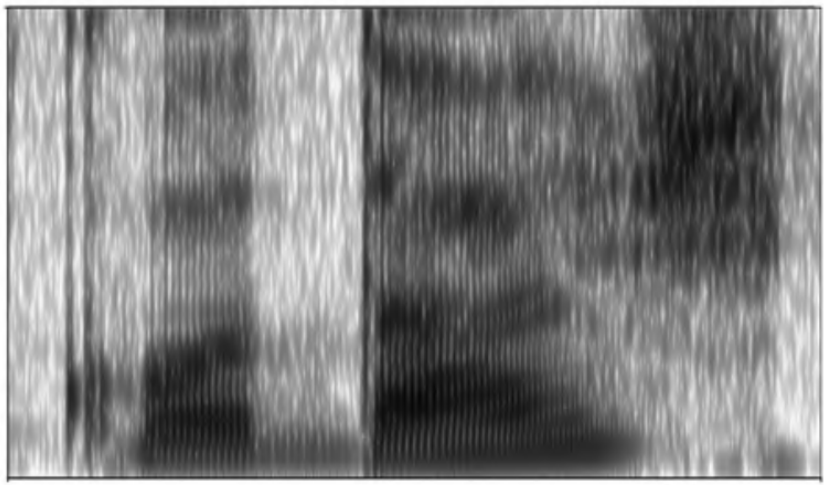

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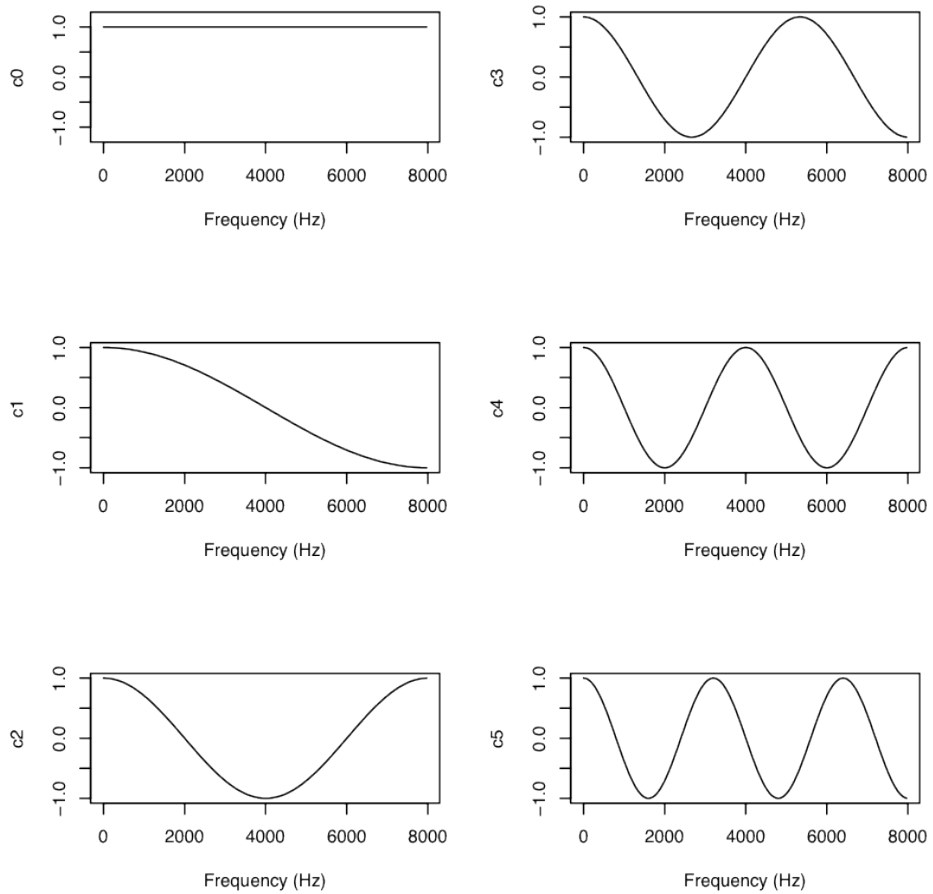
Bark Cepstrum

Bark-scaling: compress the spectrum at higher frequencies and expand it at lower frequencies (corresponding to human auditory system)

Bark Cepstrum: describe amplitude and shape of the speech spectrum using a set of Cepstral coefficients (= sum of product of cepstral feature vector and the speech spectrum)

Cepstral feature vectors



Perception Experiment: sample mismatched stimuli

1. *S-a împiedicat din cauza acelui pantofi, cum bine știi.
   S/he tripped because of that shoes, as you well know.
2. *Ar cam trebui să cumpăr niște pantof, cum bine știi.
   I have to buy some (more than one) shoe, as you well know.