Vowels in Turkish consonant clusters: Mind or matter?

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Question: Are vowels added in Turkish consonant clusters by the mind (phonology), or only by matter (gestural coordination)?

Phonology and vowel insertion

- Every language has rules about what sounds can go together & how:
  - Gwimp sounds like it could be English
  - Pmiwg doesn't!
- These rules are a language's **phonology**. Speakers know them implicitly.
- Speakers of a language will change the shape/sounds of a word to make it match the rules stored in their minds (their phonology)
  - Japanese [pokki] → English [poki]
  - Russian [ʧar] → English [zar]
  - English "Merry Christmas" → Hawaiian "Mele Kalikimaka" → Japanese "Merii Kurisumasu"


- Vowels are added to fit loanword into the borrowing lg's phonology:
  - /kr/ of Christmas is okay in English phonology, but needs to be broken up into /k+vowel+r/ for Japanese or Hawaiian phonology

Speech sounds: Mind or matter?

Type 1: Sounds that the speaker intends to produce.
- The speaker has a mental representation of them.
- Part of the phonology → result of processes in the **mind**
- Ex.: Sounds you think of as part of the word
- Ex.: Vowels added in *Mele Kalikimaka* to make it fit the phonology

Type 2: Sounds that the speaker produces unintentionally.
- The speaker doesn't have a mental representation of them
- "Intrusive" sounds → result of physical processes (**matter**)
- Ex: *prince* sounds the same as *prints*
  - The speaker has [t] in mind when saying *prints*
  - … but not when saying *prince*
  - Intrusive [t] in *prince* is a side-effect of [n] → [s] transition
- Ex: pronouncing *please* as *puh-lease*
  - *ea* is really part of the word, but *uh* isn't
  - *Uh* = side-effect of slowing down [p] & [l] gestures = intrusive vowel

How can we tell Types 1 & 2 apart?

Vowel insertion in Turkish

Phenomenon
- French prince is borrowed into Turkish as [pirens]: inserted [i]
- Is the inserted vowel Type 1 (mind-driven) or Type 2 (matter-driven)?
- How can we tell?

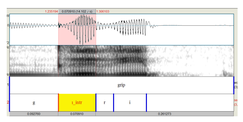
Diagnosing intrusive vowels
- Shorter than real vowels
- More affected by surrounding sounds and speech style / rate
- Don't count as syllables for poetry or music

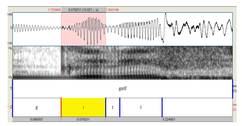
Experiments
1) Acoustic study → Inserted vowels sound different
2) Gestural study → Inserted vowels have a different tongue position
3) Corpus study → Inserted vowels are affected by context

Experiment 1: Acoustics

Method
- 6 Turkish speakers
- Recorded in a sound attentuated booth
- 5 repetitions of 54 words: real vowels as in *pirinç* 'rice' vs. inserted vowels as in *prens* 'prince'

Results
- Vowel sounds occur in 74% prens-type words
- Inserted vowels are shorter (6ms)
- Acoustics of *prens* vowels are more affected by the following vowel than acoustics of *pirinç* vowels



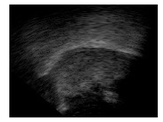


Discussion
- Insertion is variable, which is unusual for mind-driven epenthesis but typical for matter-driven intrusion
- Insertion produces a vowel that is "less" than a real vowel

Upshot: Acoustic evidence suggests these inserted vowels reflect gestural timing.

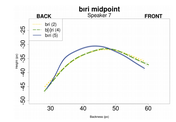
Experiment 2: Articulation

Method
- Same as Expt. 1
- Ultrasound of tongue movements also recorded
- Compare tongue position in *pirinç* vs. *prens*



Results
- Variation between subjects and conditions
- In general, tongue position in *prens* words is
  - Different from position in *pirinç* words
  - Fronter when the following vowel is front /i/

Discussion
- Tongue position in *prens* words is more affected by the following vowel & preceding consonant than in *pirinç* words
- When tongue position differs across the three conditions, *prens* and *p[i]rens* pattern together, and *pirinç* patterns separately



Upshot: Ultrasound evidence shows these inserted vowels are articulated differently from real vowels.

Work in progress

Experiment 3: Corpus study
- Method: Model transcribed vowel insertion in a corpus of 30k tokens
- Results: Insertion is affected by the consonant context and other factors that affect gestures but don't affect type 1 vowel insertion.
- Discussion: Corpus results also suggest insertion is gesturally-driven

Experiment 4: Inserted vowels in Turkish music
- Method: Do musicians treat *p[i]rens* and *pirinç* vowels the same?
- Results: Variability even within the same song/singer. Sometimes inserted vowels get a beat; sometimes they don't
- Discussion: *P[i]rens* vowels are optionally treated like real vowels in text-setting. It remains an open question how singers think of them.

Takeaway: Vowel insertion in Turkish onset clusters seems to be driven by matter, not mind. But it takes work to disentangle these factors.

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