Representing consonant synchronicity

Phonotactics Workshop

University of Potsdam

March 14th, 2024

Geoff Schwartz - UAM Poznań (geoff@amu.edu.pl)

Why am I here?

- To promote the perspective on phonotactics offered by the Onset Prominence (OP) representational framework (Schwartz, many references)
- OP offers a deeper understanding of phonotactic issues than
  - Theories based on a linear segmental string (or skeleton)
    - The 'same' sequence of phonetic symbols may show different phonetic and phonological properties in different languages
  - Theories based on traditional representations of the syllable
    - There are plenty of issues for which syllable theory requires ad-hoc fixes…
- The OP perspective makes explicit and testable predictions for experimental phonetic study
  - New channels of communication between phonologists and phoneticians

Outline

- Motivating the OP approach to the phonetics of consonant clusters
  - When the 'same' cluster is not the same
- Cluster phonotactics within the Onset Prominence framework
  - Basic structures and mechanisms
  - Phonetic predictions
- Choose your own adventure
  - empirical evidence, or additional applications of the theory?

Motivation

- Phonological tradition has been focused on two primary goals in dealing with phonotactics
  - Empirical: data on the occurrence of consonant clusters, their acquisition, their behavior in loanwords, etc.
  - Theoretical: hypotheses about syllable structure, and claims generalizations about the 'markedness' of clusters
    - The most widely used theoretical tool is of course sonority

- But this tradition doesn't offer much insight when the 'same' cluster behaves differently across languages
  - Such differences can be both phonological and phonetic…

When the same is not the same

- Compare Polish and English /gr/: *gra* 'game' vs *grow*
- This seems like a relatively uninteresting comparison
  - They are both stop+liquid sequences
  - They both show a rise in sonority – 'branching' onsets in traditional syllable theory
  - They both are relatively common in the two languages – they might be described as 'unmarked' or 'preferred'
- Most phonological approaches to phonotactics would have little to say about /gr/ in Polish as opposed to English . . . .
  - Differences in phonetic realization of the two consonants (e.g. pre-voicing, approximant vs. tapped rhotic) might be mentioned…
  - …but most would assume these are irrelevant for the structural representation of the cluster
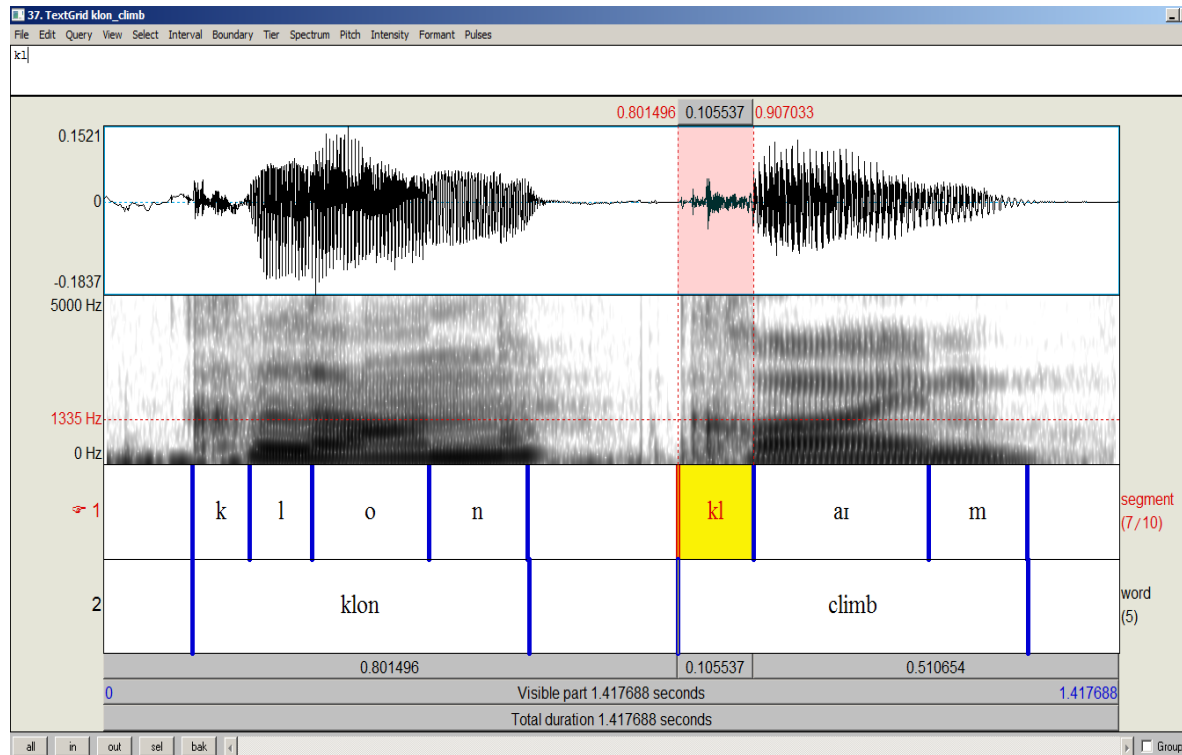
When the same is not the same

- Compare Polish and English /gr/: *gra* 'game' vs *grow*
- Polish onset clusters contribute to prosodic minimality for inflectional morphology
  - So *gra* inflects normally: *gry, grze, gier*, etc.
  - CV shaped words do not inflect, and are often pronounced as enclitics, or are often produced in isolation as CV?
    - CCV, CVC, or VC can be minimal, but not CV
  - This means that C1 in clusters must be contained in a separate prosodic unit from C2 (they aren't really 'complex' or 'branching' onsets)
- English onsets play (nearly) no role in prosodic minimality
  - *ate*, *rate*, and *great* are all perfectly well-formed prosodic words
  - whether there's an onset or an onset cluster makes no difference

When the same is not the same

- Stop-sonorant clusters in English and Polish
  - Timing differences
- Synchronous articulation in English, and allophonic processes associated with truly complex onsets
  - Approximant devoicing in *clear* and *quite*
  - Affrication in *tree* and *drive*
  - Coalescence in *tune* and *due*
  - Difficulties for acoustic segmentation
- Asynchronous articulation in Polish
  - Vowel intrusion is frequent
  - None of the allophonic processes associated with English
  - Easier segmentation . . .

When the same is not the same

- Stop-approximant clusters in English and Polish
  - Synchronous in English, asynchronous in Polish
  - Acoustic segmentation, compare /kl/ in *climb* vs. *klon* 'maple'
    - /l/ not devoiced in Polish, so /kl/ boundary much easier to spot

When the same is not the same

- English and Polish show clear differences in behavior in the 'same' stop-initial rising sonority onsets (TR)
- The differences are both phonological and phonetic
  - prosodic behavior
  - articulatory synchronicity
- The phonological differences predict the phonetic differences
  - Since C1 is part of a separate prosodic entity from C2 in Polish clusters, then we should expect relatively asynchronous articulation
  - This is exactly what we get
- So where do the phonological differences come from?
  - For a possible story, check out the OP model . . .

The Onset Prominence framework

- Non-arbitrary explanation of phonotactic patterns
  - Encodes (some) sonority effects, and easily derives exceptions to the SSG
  - Predicts behavior of the 'same' clusters across languages
  - Explains prosodic behavior of codas – whether or not they bear weight (not in this talk though ;)
- Predictions about the relative phonetic synchronicity of consonant sequences
- A single system encompassing the phonetics-phonology interface, segmental representation, phonotactics, and larger prosodic structures (see bibliography slide)

OP – basic structures

- Abstracted away from stop-vowel CV sequence (left)
  - Each layer derived from explicitly defined phonetic events, which form acoustic 'landmarks' (Stevens 2002)

- 'Segments' extracted from CV hierarachy (right)
  - Manner/sonority encoded structurally; 'segments' and 'syllables' constructed from same materials (no association lines)
 - Lower is more sonorous: vowels>approximants>fricatives>nasals/stops
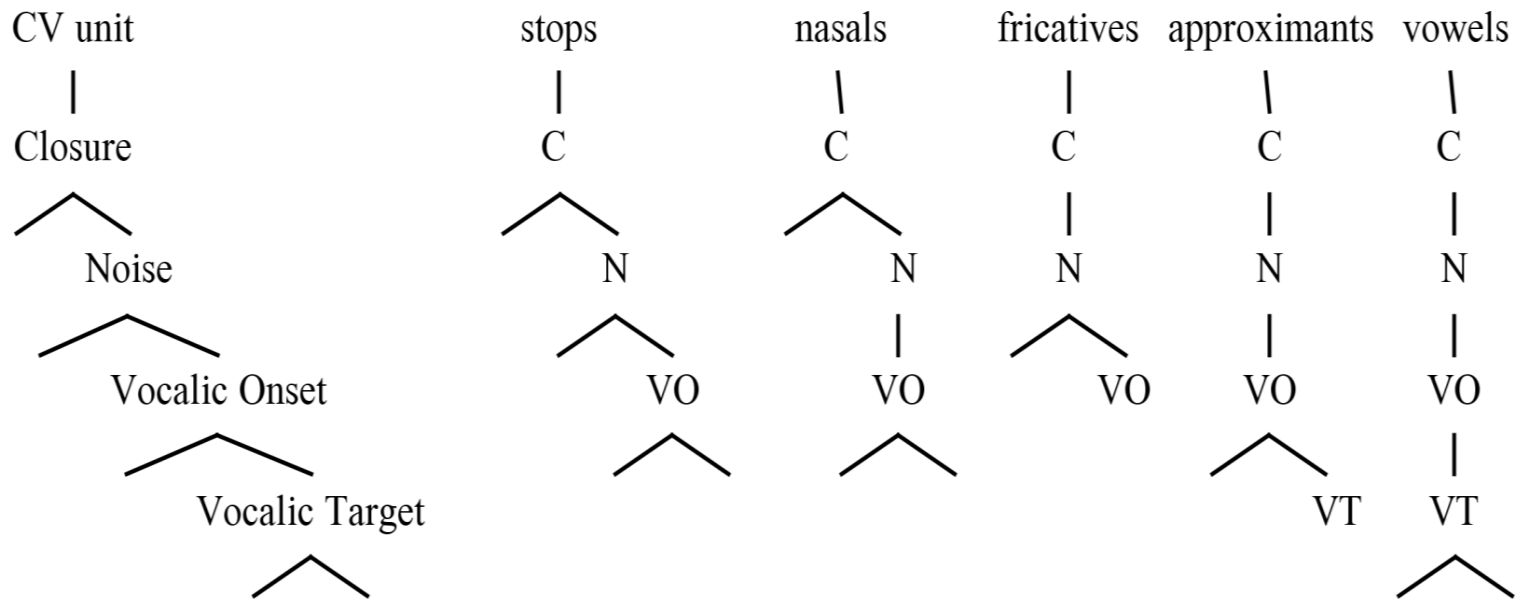
OP – ambiguity in linearization

- Consider an acoustic CVC 'string' alongside the OP hierarchy
  - English *gag* /gæg/: three segments, six structural nodes
- Ambiguities
  - VO: is it part of the vowel or the initial consonant
  - What do we do with the coda?
   - Make one big tree or start a new one?
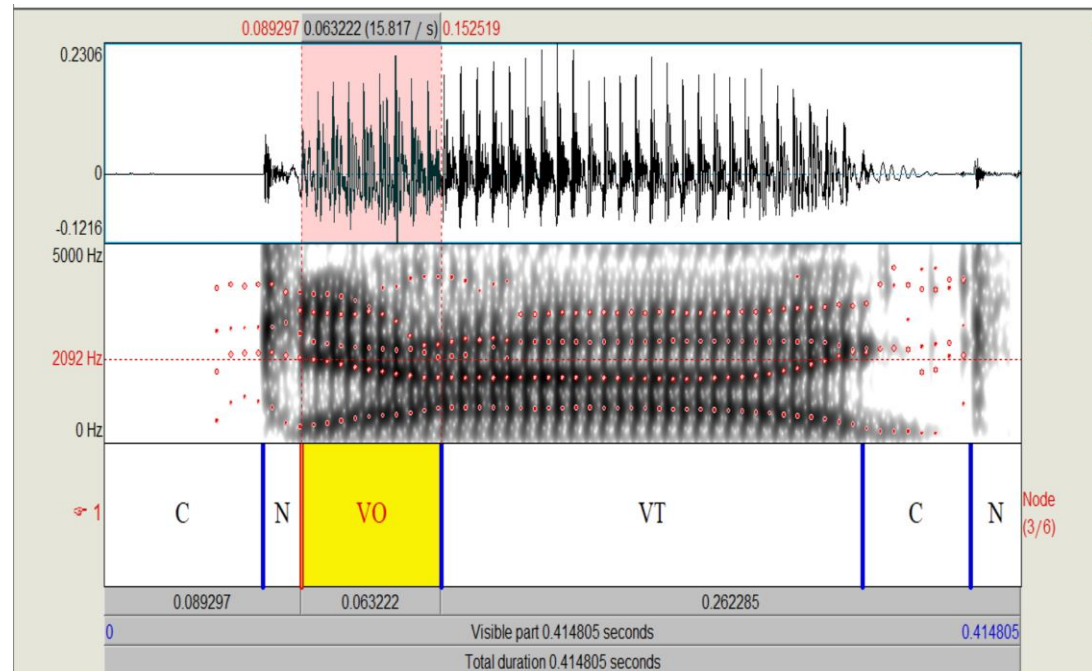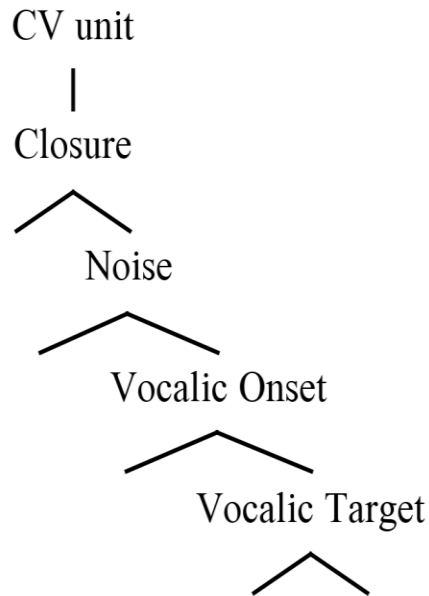
OP phonotactics

- The relations between OP trees are governed by four phonotactic mechanisms:
  - *absorption*, *promotion*, *adjunction* and *submersion*
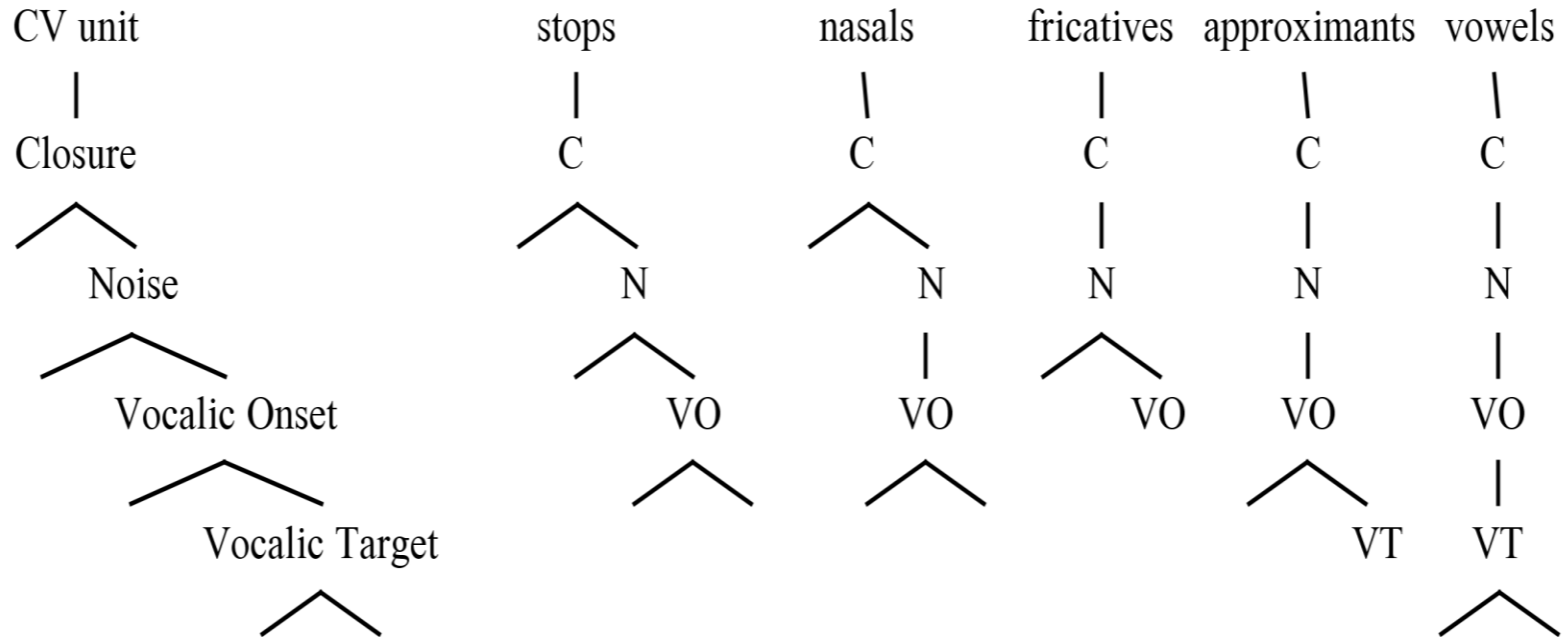
'Absorption'

- The primary OP phonotactic mechanism, by which a vowel is joined with a preceding consonant to form a CV unit
  - Motivated by a prosodic minimality constraint – individual consonants and vowels are usually not prosodically well-formed on their own
- Below we see absorption in a CV sequence
 - Absorption can also form rising sonority clusters . . .
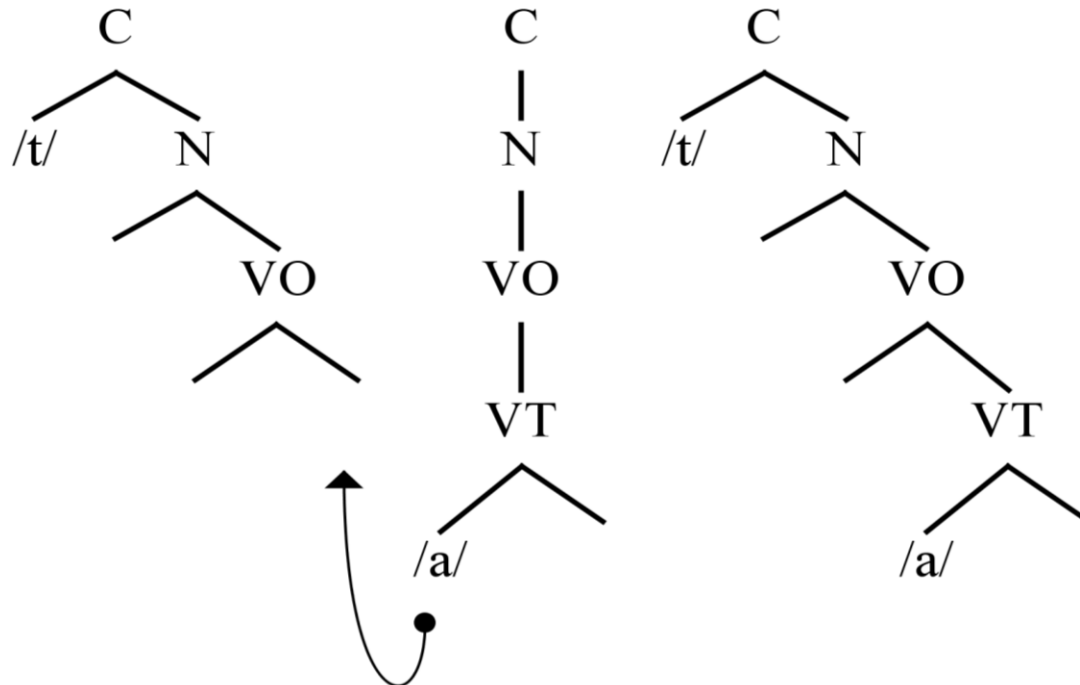
Absorbed clusters – TR type

- Consonants 'absorbed' into single iteration of OP hierarchy – when tree to the left is higher
  - High degree of phonetic synchronicity in the cluster, since both consonants are contained in a single iteration of the OP hierarchy
  - Expectation for allophonic processes indicative of synchronous cluster production (English approximant devoicing, coalescence, affrication)
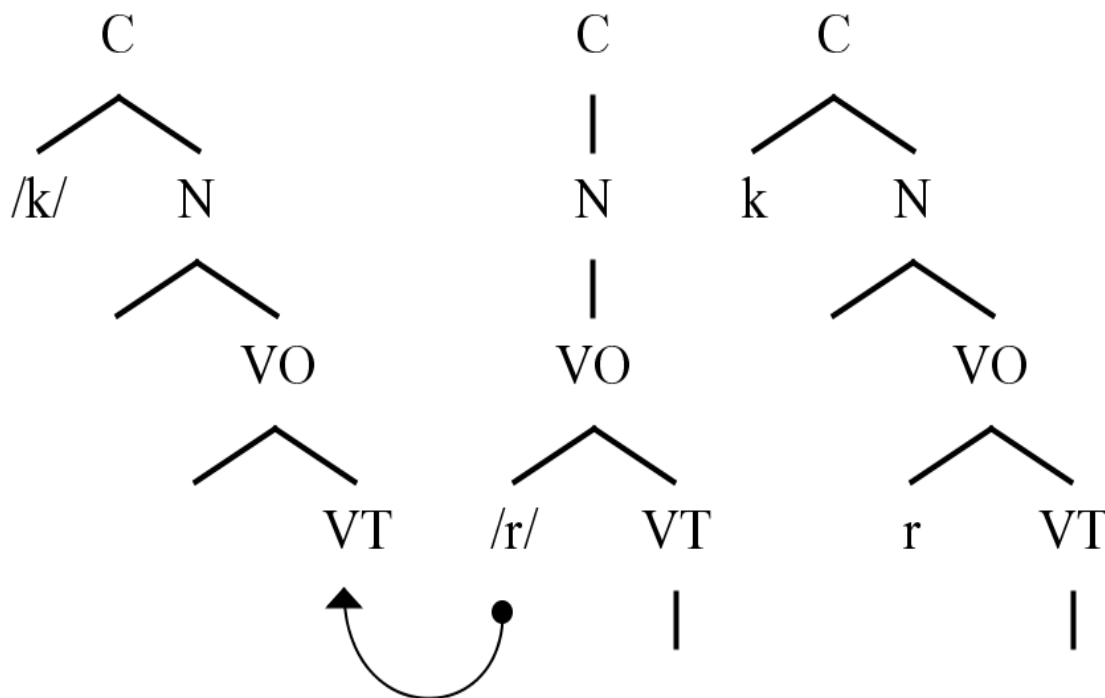
Sonorant 'promotion'

- Approximants by default are made of just a binary VO node
  - Closure and Noise are unary
  - Unary nodes are 'marked' in that they create a mismatch with the basic stop-vowel hierarchy made up of binary nodes
- One way to repair this is to 'promote' the sonorant, by removing the binary nodes
 - A promoted sonorant cannot be absorbed
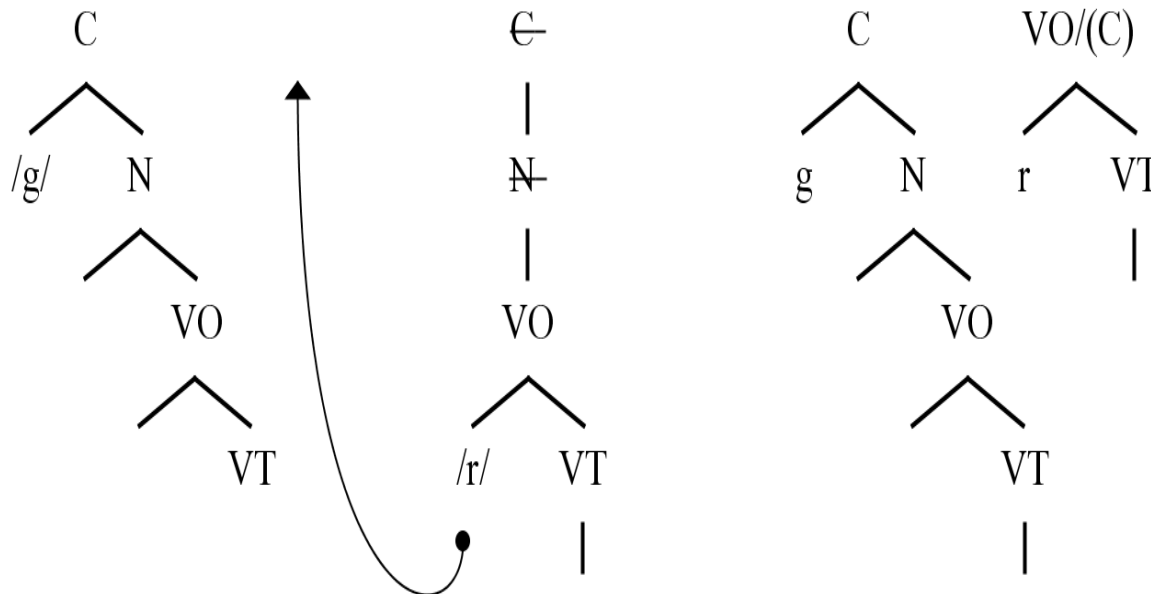
Promoted sonorants and 'adjoined' clusters

- Absorption is impossible with promoted sonorants, clusters may be formed via 'adjunction'
  - Here is absorbed /gr/ in English *grow* vs. 'adjoined' /gr/ in Polish *gra*
  - The contribution of the cluster to prosodic minimality in Polish falls out from the fact that the /g/ and the /r/ are contained in different trees
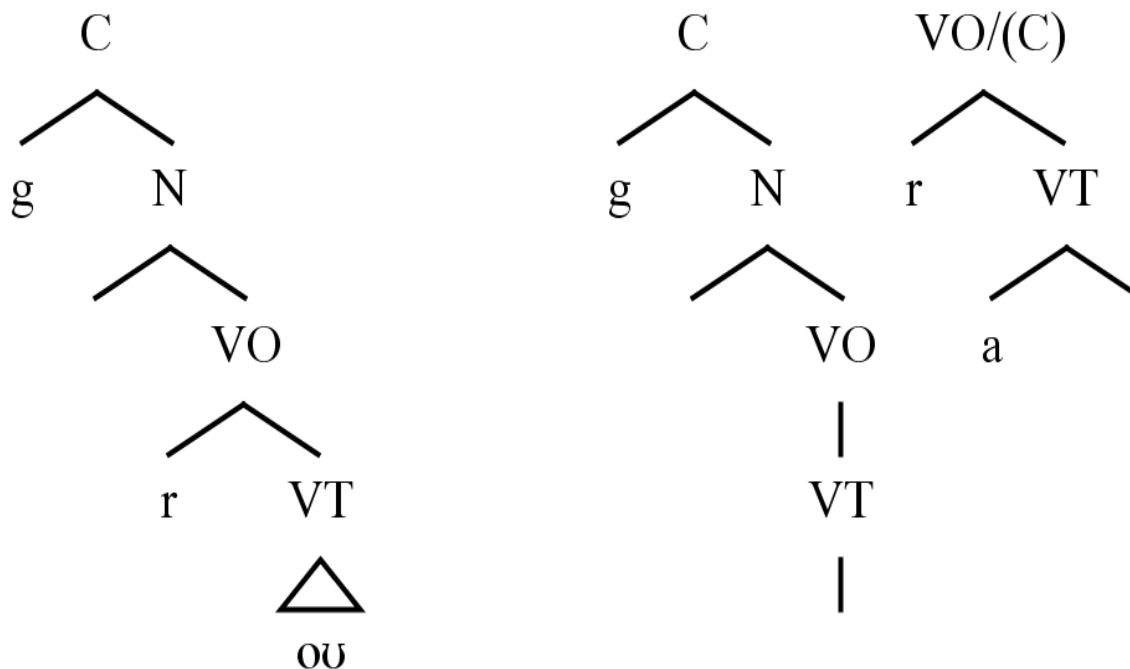
Prosodic minimality in Polish

- For Polish inflectional morphology to work, you need minimally CVC, CCV, VC, but not *CV

- OP unifies this requirement – you need two adjoined trees
  - i.e. the asynchronous cluster articulation is linked with seemingly unrelated aspects of Polish phonology (see Schwartz 2016)
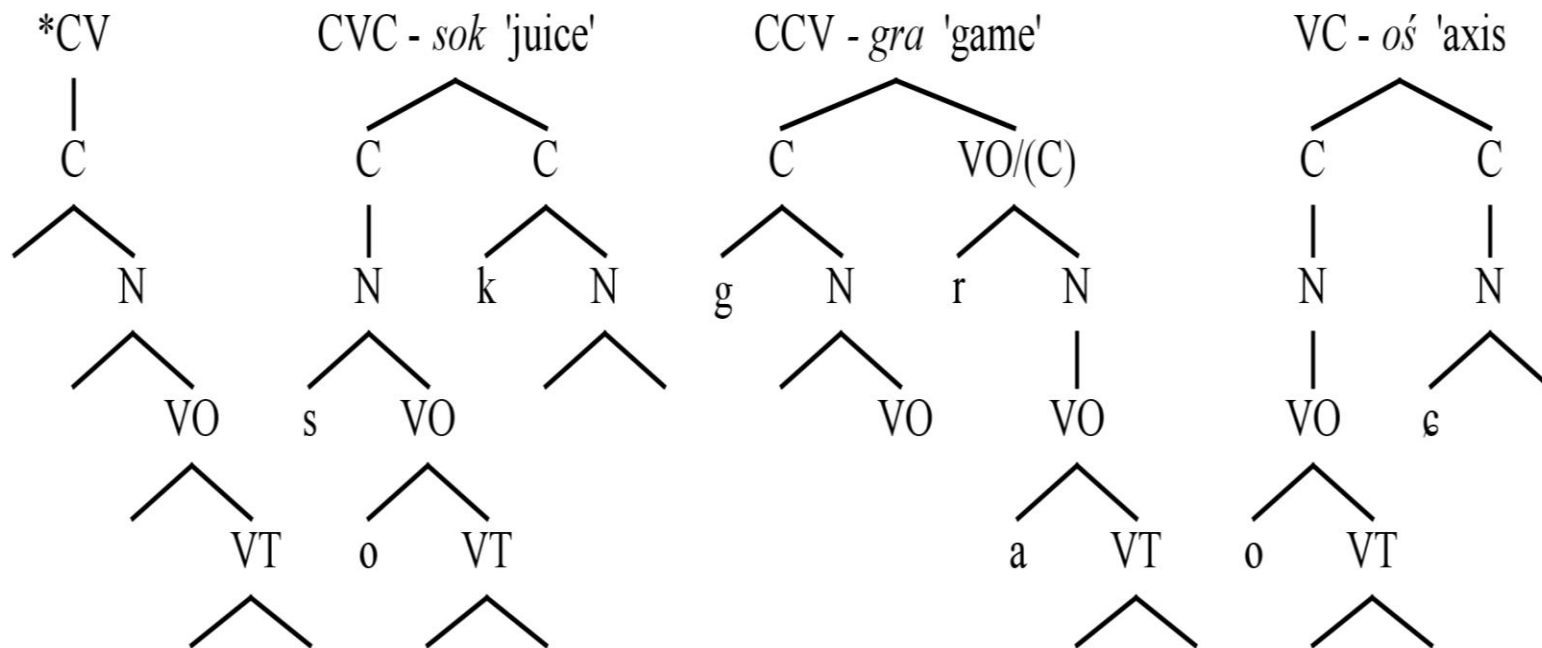
Predictions for phonetics

- In an absorbed cluster we expect tighter phonetic cohesion between the consonants – greater synchronicity
  - English-style allophonic processes (affrication, coalescence, approximant devoicing)
- In an adjoined cluster there is less overlap between the consonants
 - Polish lacks the English-style processes (prevocalically)
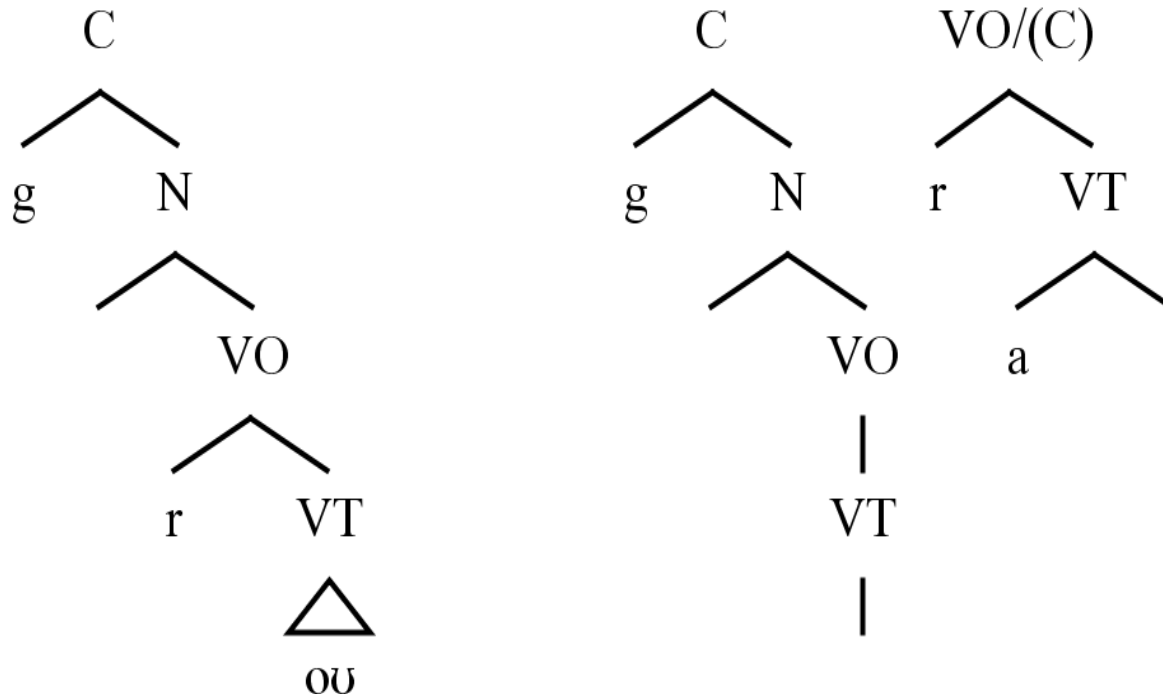
Interim summary

- So far we've seen two types of configuration
- Only TR type clusters can be absorbed
  - i.e. languages that restrict onset clusters to TR
- TR clusters can also be adjoined
  - There are no formal restrictions on adjunction; as we might expect considering Polish cluster phonotactics
    - if you are going to produce large clusters, they better be asynchronous, or the listener's not going to hear them
- There is still one more mechanism to discuss . . .

'Submersion'

- Absorption joins consonants into single iteration of OP hierarchy; adjunction keeps consonants separate
- The *submersion* mechanism yields a recursive iteration of OP hierarchy; one C embedded within another
  - Intermediate degree of synchronicity
  - In English submersion produces both codas and S-stop onsets
  - Submersion also produces syllabic consonants
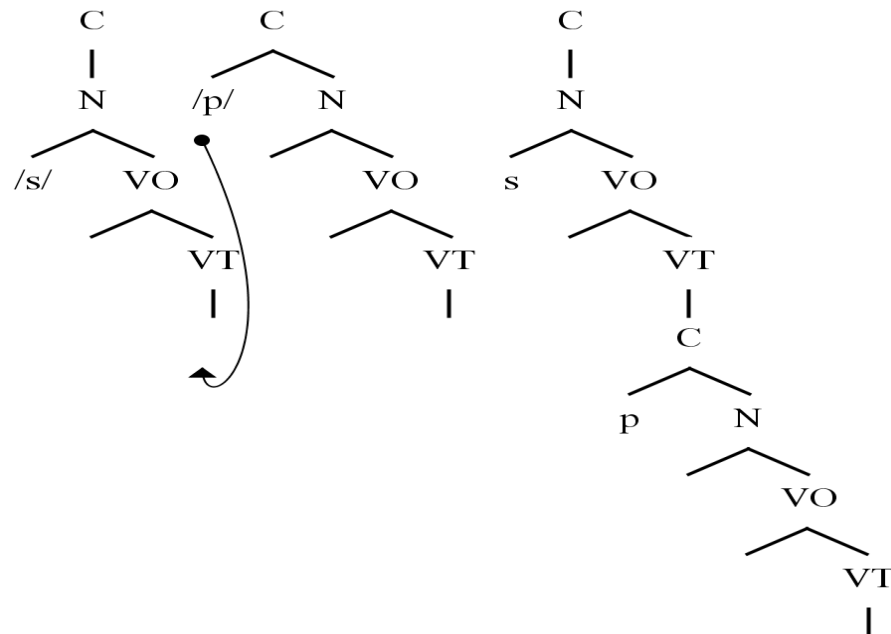
OP cluster typology

- Three degrees of cluster synchronicity
 - absorbed > submerged > adjoined
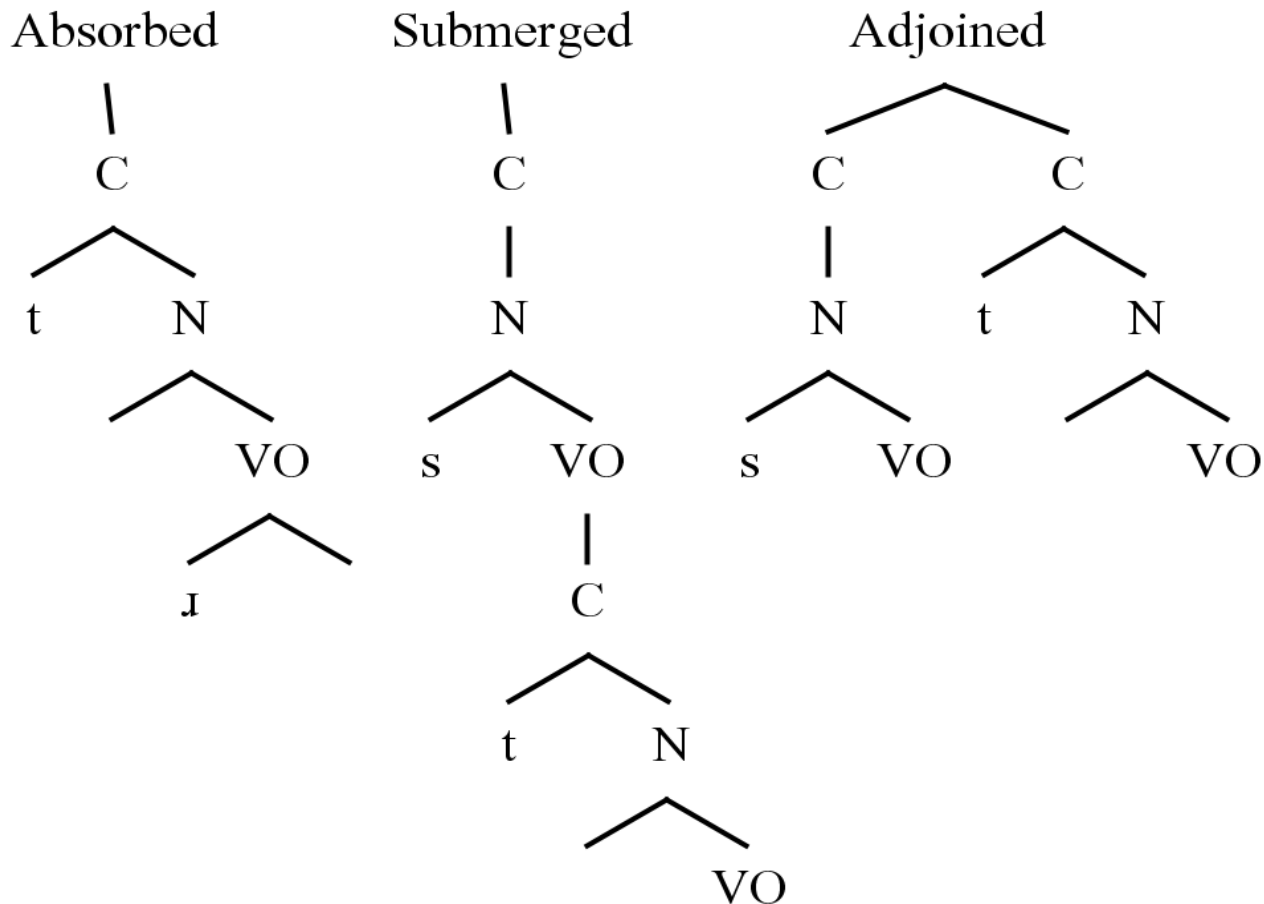
OP cluster typology

- Predictions for phonetics

Structure	Cluster types	Predicted phonetic realization
Absorbed	Only (but not all) TR clusters	Synchronous
Adjoined	No formal restrictions	Asynchronous
Submerged	No formal restrictions	Intermediate synchronicity

- Since there are no restrictions on either adjunction or submersion, we make additional typological predictions
  - Unusual phonotactics can arise from both mechanisms, with submersion showing greater interconsonantal cohesion
  - Hermes et al. (2017): EMA study of Polish and Tashlhiyt Berber

Hermes et al. 2017

- EMA study of clusters in Polish and Tashlhiyt Berber
  - Greater lags between consonants in Polish
  - Submersion in Tashlhiyt (Schwartz 2015) vs. adjunction in Polish
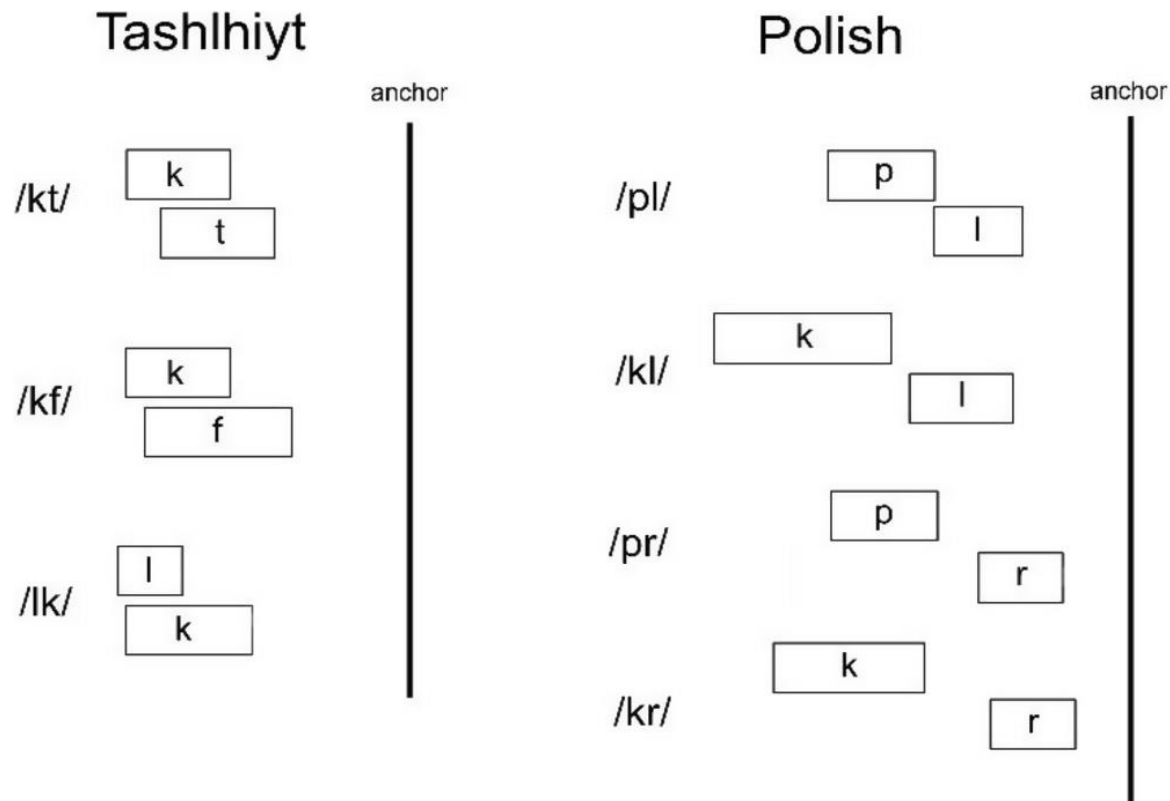
Interim summary

- Table summarizes the three languages discussed so far
- The OP configurations are compatible with both phonetic and phonological evidence in these languages

| Language	Cluster configurations
English	TR absorbed; ST submerged; codas submerged
Polish	Everything adjoined (except 'trapped' sonorants), including codas
Tashlhiyt Berber	All clusters submerged (consonants are syllabic)

Choose your own adventure!

- In the remaining time, you can choose from
  1. Studies a in project on the phonetic realization of clusters in Polish and English, and the production of L2 English by Polish learners
  2. Trapped sonorants in Polish – where do they come from?
  3. More about Tashlhiyt Berber syllabification

The choice is yours ☺

Consonant synchronicity in Polish and English

- Case 1: Production of s-stop onsets in Polish and English
- Phonological differences
  - English – No laryngeal contrast after /s/, shortened VOT in C2
  - Polish – C2 determines voicing profile of the cluster, no apparent weakening of C2
- Submerged cluster in English
  - C2 weakened, but not necessarily lenis?
- Adjoined in Polish
 - C2 is prosodically strong
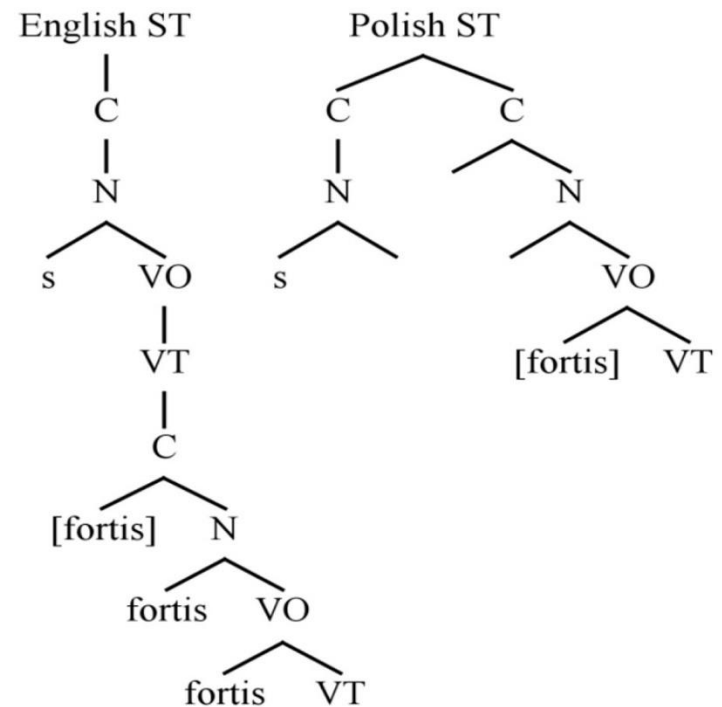
Consonant synchronicity in Polish and English

- Case 1: Production of s-stop onsets in Polish and English
  - Published here: https://journals.sagepub.com/doi/10.1177/02676583221122425
- Acoustic study: Does Polish shorten VOT after /s/, like English?
    - Polish singletons: mid-range VOTs (20-50 ms), room for shortening
    - 38 monolingual speakers, sentence reading task
  - Some shortening of VOT in /p/, but not /t/
    - Effect for /p/: lesser coarticulation resistance of labials (Pastätter & Poupler 2017)
    - Results are compatible with adjoined configuration in OP
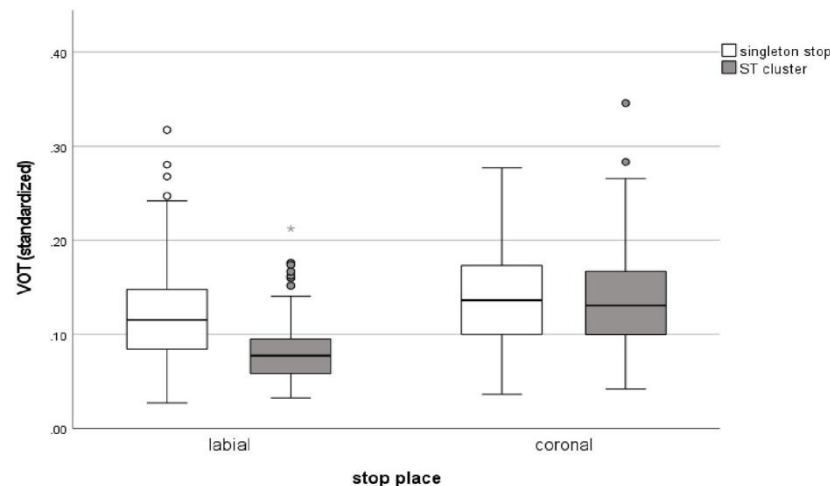
Consonant synchronicity in Polish and English

- Case 2: Production of TR onsets in Polish and English
- EMA study (with Anne Hermes and Radek Święciński): do Polish-English produce longer articulatory lags in Polish than in English?
  - 5 L1 Polish teachers of English phonetics
  - Pairs of words with similar phonological shape (e.g. PL *blok* vs. Eng *block*)
  - Longer lags (left), and longer C2 acoustic durations in Polish
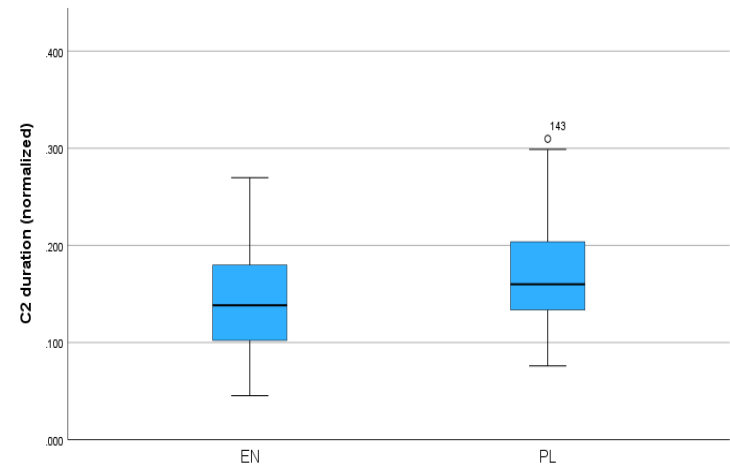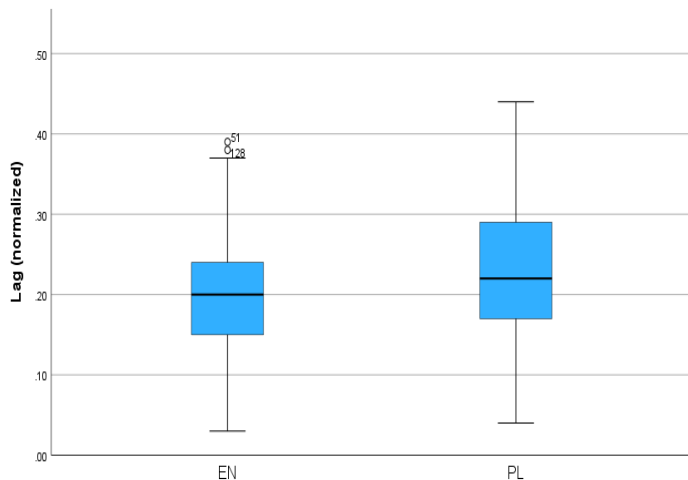
Consonant synchronicity in Polish and English

- The studies of Polish and English test the phonetic realization of hypothesized structural distinctions in the two languages
  - Adjoined vs. absorbed TR clusters
  - Adjoined vs. submerged s-stop clusters
  - We've also done some perceptual experiments looking at TR affrication in English, and intrusive vocoids in Polish
- I do not see how these hypotheses can be formulated in traditional segment-syllable-sonority approaches
  - but for OP, the phonetic synchronicity of a cluster may in fact have phonological origins

Polish trapped sonorants

- Polish has an interesting set of large onset clusters corresponding to syllabic consonants or vowel-liquid sequences in other Slavic languages
  - The Common Slavic word for 'larynx' = grŭ.ta.ɲĭ
  - The short (yer) vowels were lost . . .
  - In Czech, the /r/ became syllabic, *hr.tan*, Russian *gar.taɲ*
  - In Polish, we get *krtań*, a one-syllable word with an onset /krt/ (the /r/ is non-syllabic)

Evolution of the trapped sonorant

- The /r/ from the CS form had been absorbed into the stop
- Then the yer vowels dropped
- Later, sonorants were promoted in Polish
- In words like *krtań* the /r/ was trapped inside the /k/, and couldn't be promoted

Representing *krtań*

- 'Sonority sequencing' observed within individual C constituents
- Polish has no formal restrictions on the number of consecutive C constituents containing consonants
- Gaps in cluster inventories are merely the result of the evolution of the Polish lexicon
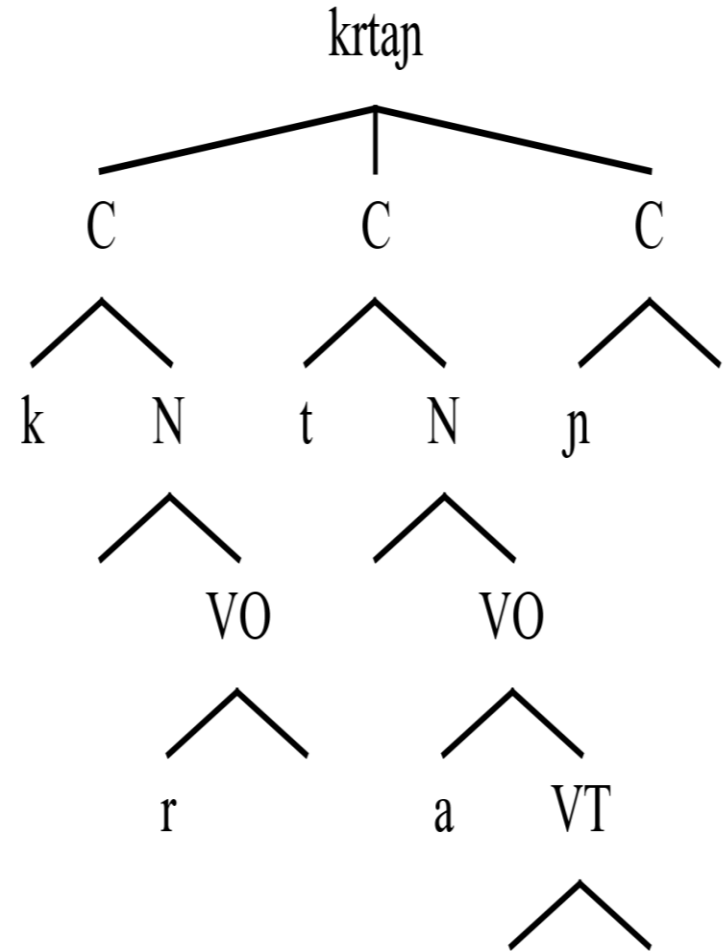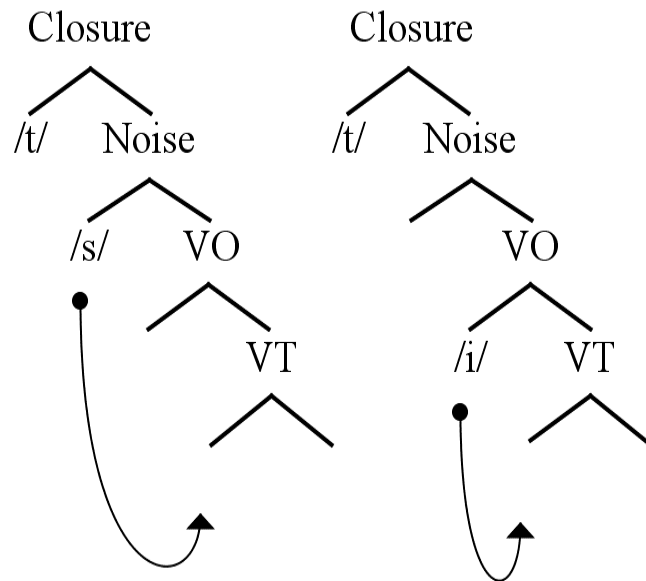
Why is Tashlhiyt Berber unusual?

- A classic case: anything can be syllabic, but sonority has a role
- Individual segmental representations extracted from entire CV hierarchy, including the VT level
- Left, a stop structure in most languages; Right: a stop structure in Tashlhiyt, which can be a light syllable on its own
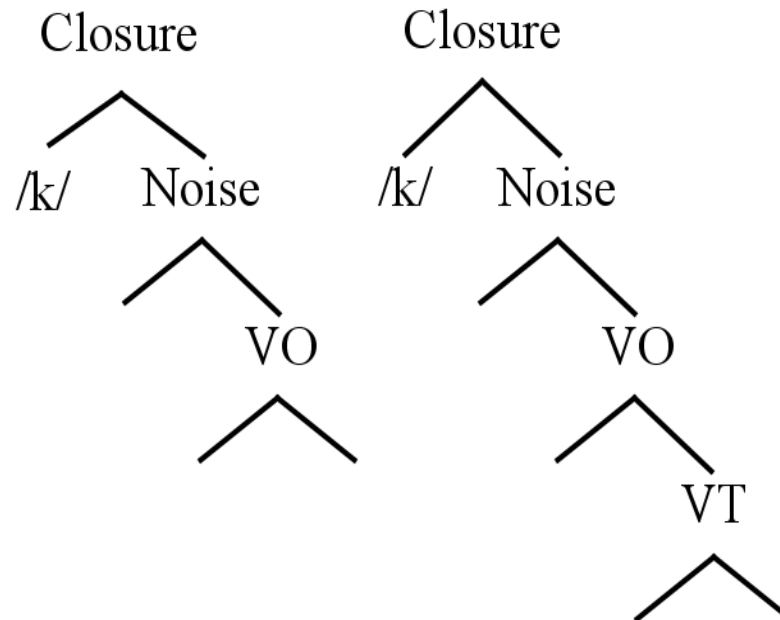
Why is Tashlhiyt Berber unusual?

- Two types of syllabic consonants that show different behavior (e.g. in morphology, versification)
  - Sometimes the peak is more 'sonorous' than the onset
  - Absorption creates 'complex' onsets which are banned, so the more 'sonorous' segment is submerged; onset-peak
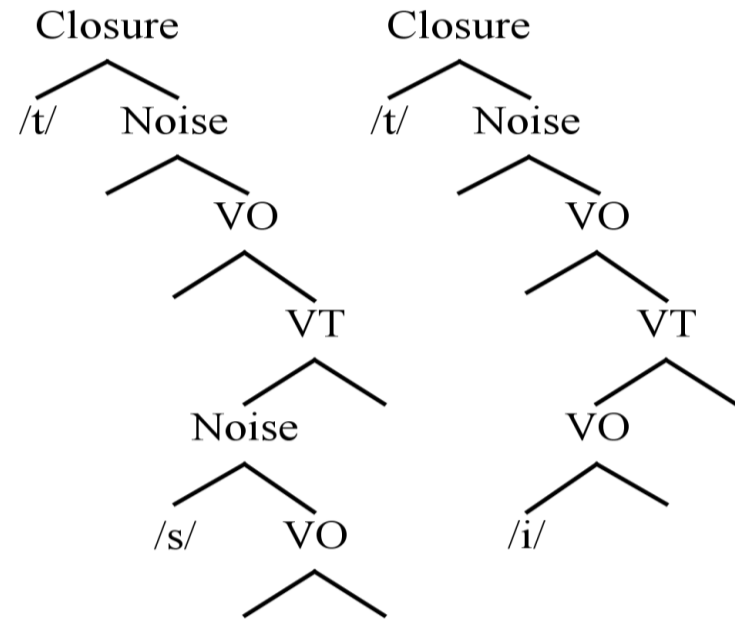
Why is Tashlhiyt Berber unusual?

- Two types of syllabic consonants that show different behavior (e.g. in morphology, versification)
  - Sometimes the peak is less 'sonorous' than the onset
  - Here submersion produces 'onset-coda' type syllables
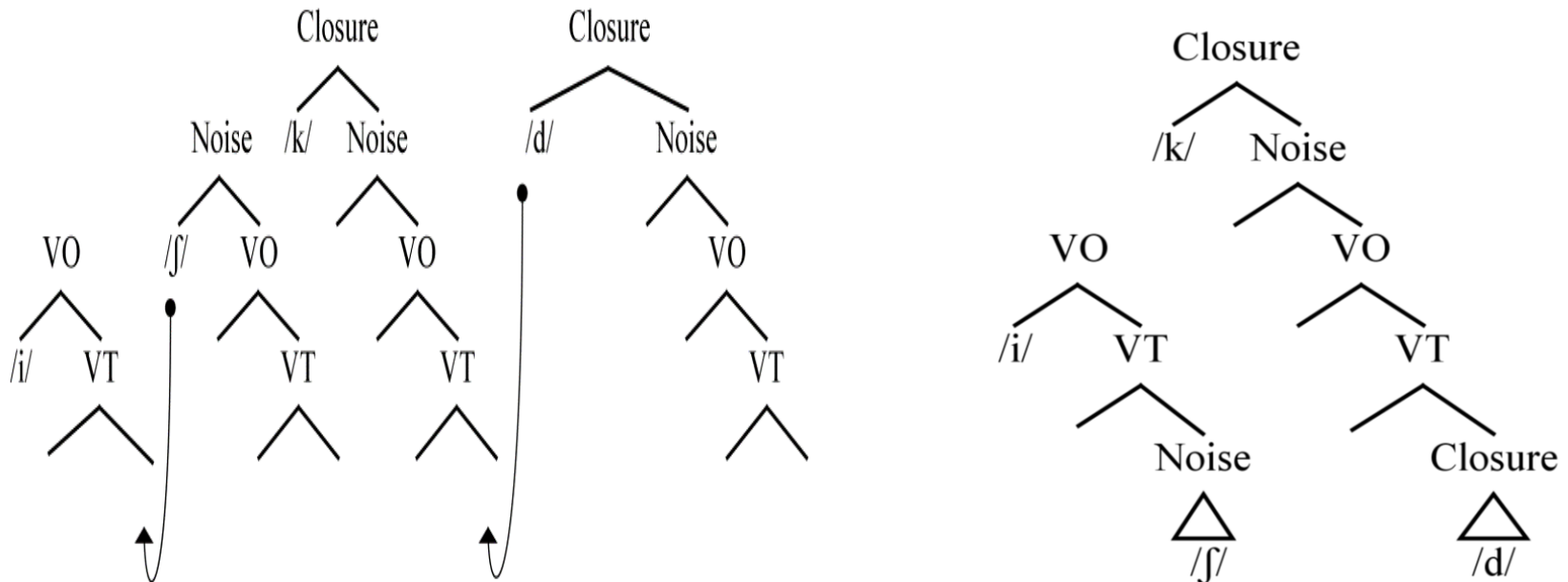
Tashlhiyt Berber in OP - summary

- Syllabification in TB easily described in OP
  - Consonant syllabicity is the result of submersion, but it comes in two varieties (different behavior in morphology, versification)
  - Phonetic findings of Hermes et al. (2017) are explained; CC in which C2 is syllabic (TB) shows greater synchronicity that CC with non-syllabic C2

- See Schwartz (2015) for the syllabification story

Final remarks

- An adequate theory of phonotactics should be able to explain how the 'same' cluster can be structurally different in different languages
  - OP does this, without stipulation; its phonotactic mechanisms have independent motivation in the model
- An adequate theory of phonotactics should facilitate the formulation of new hypotheses for phonetic study
  - Sonority and the 'segment' don't really help us here
- OP needs more exposure, and empirical testing
  - I need help with this . . . ☺

OP – selected bibliography

- Schwartz, G. 2013. A representational parameter for onsetless syllables. *Journal of Linguistics* 49, 613-646. DOI:10.1017/S0022226712000436
- Schwartz, G. 2015. Who needs a nucleus? Tashlhiyt Berber syllabification in the Onset Prominence representational environment. *Poznań Studies in Contemporary Linguistics* 51, 247-290. DOI:10.1515/psicl-2015-0011
- Schwartz, G. 2016. On the evolution of prosodic boundaries – parameter settings for Polish and English. *Lingua* 171, 37-73. DOI:10.1016/j.lingua.2015.11.005
- Schwartz, G. 2016. Word boundaries in L2 speech – evidence from Polish learners of English. *Second Language Research* 32, 397-426. DOI:10.1177/0267658316634423
- Schwartz, G. 2017. Formalizing modulation and the emergence of phonological heads. *Glossa – a Journal of General Linguistics* 2 (1), 1-20. DOI:10.5334/gjgl.465
- Schwartz. G. 2017. The perception of sandhi-blocking in Polish vowel initial words. *Folia Linguistica* 51, 671-693. DOI:10.1515/flin-2017-0025
- Schwartz, G., Arndt, D. 2018. Laryngeal Realism vs. Modulation Theory – evidence from VOT discrimination in Polish. *Language Sciences* 69, 98-112. DOI:10.1016/j.langsci.2018.07.001
- Schwartz, G. 2020. Refining representations for L2 phonology. *Second Language Research* 36(4), 691-707. DOI:10.1177/0267658319852383
- Schwartz, G., Kaźmierski, K. 2020. Vowel dynamics in the acquisition of L2 English – an acoustic study of L1 Polish learners. *Language Acqui*sition 27(3), 227-254. DOI:10.1177/0267658319852383
- Schwartz, G. 2021. The phonology of vowel VISC-osity – acoustic evidence and representational implications. *Glossa – a Journal of General Linguistics* 6(1). DOI:10.5334/gjgl.1182
- Schwartz, G., Kaźmierski, K., Wojtkowiak, E. 2021. Perspectives on final laryngeal neutralization – new evidence from Polish. *Phonology* 38 (4), 693-727. DOI:10.1017/s0952675721000373
- Schwartz, G. 2022. Asymmetrical cross-language phonetic interaction – phonological implications. *Linguistic Approaches to Bilingualism* 12(2), 103-132. DOI:10.1075/lab.19092.sch
- Wojtkowiak, E., Schwartz, G. 2022. The acoustics of plosives and the formation of prosodic structure in Polish. *Folia Linguistica* 56(2), 273-324. DOI:10.1515/flin-2022-2020
- Schwartz, G. 2023. The phonetic underpinnings of phonological specifications – all gradience is not created equal. In: *Primitives of Phonological Structure* / Breit Florian *[et al.]* (*eds.*), Oxford Studies in Phonology and Phonetics, Oxford University Press, pp.225-250, Article number:9, ISBN 9780198791126
- Schwartz, G. 2023. Searching for common phonological space – /s/-stop clusters in L1 Polish and L2 English. *Second Language Research* 39(4), 1049-1076. DOI:10.1177/02676583221122425
- Schwartz. G. 2023. All TRs are not created equal – L1 and L2 perception of English cluster affrication. *Journal of Linguistics* 59(3), 623-654. DOI:10.1017/S0022226722000275
- Schwartz, G., Wojtkowiak, E. 2023. Asymmetrical equivalence classification – cluster affrication vs. lenis stops in the speech of Polish learners of English. *Research in Language* 21(4), 421-442. DOI:10.18778/1731-7533.21.4.05

Phonotactics papers highlighted

- Schwartz, G. 2013. A representational parameter for onsetless syllables. *Journal of Linguistics* 49, 613-646. DOI:10.1017/S0022226712000436

- Schwartz, G. 2015. Who needs a nucleus? Tashlhiyt Berber syllabification in the Onset Prominence representational environment. *Poznań Studies in Contemporary Linguistics* 51, 247-290. DOI:10.1515/psicl-2015-0011

- Schwartz, G. 2016. On the evolution of prosodic boundaries – parameter settings for Polish and English. *Lingua* 171, 37-73. DOI:10.1016/j.lingua.2015.11.005

- Schwartz, G. 2016. Word boundaries in L2 speech – evidence from Polish learners of English. *Second Language Research* 32, 397-426. DOI:10.1177/0267658316634423

- Schwartz, G. 2017. Formalizing modulation and the emergence of phonological heads. *Glossa – a Journal of General Linguistics* 2 (1), 1-20. DOI:10.5334/gjgl.465

- Schwartz. G. 2017. The perception of sandhi-blocking in Polish vowel initial words. *Folia Linguistica* 51, 671-693. DOI:10.1515/flin-2017-0025

- Schwartz, G., Arndt, D. 2018. Laryngeal Realism vs. Modulation Theory – evidence from VOT discrimination in Polish. *Language Sciences* 69, 98-112. DOI:10.1016/j.langsci.2018.07.001

- Schwartz, G. 2020. Refining representations for L2 phonology. *Second Language Research* 36(4), 691-707. DOI:10.1177/0267658319852383

- Schwartz, G., Kaźmierski, K. 2020. Vowel dynamics in the acquisition of L2 English – an acoustic study of L1 Polish learners. *Language Acqui*sition 27(3), 227-254. DOI:10.1177/0267658319852383

- Schwartz, G. 2021. The phonology of vowel VISC-osity – acoustic evidence and representational implications. *Glossa – a Journal of General Linguistics* 6(1). DOI:10.5334/gjgl.1182

- Schwartz, G., Kaźmierski, K., Wojtkowiak, E. 2021. Perspectives on final laryngeal neutralization – new evidence from Polish. *Phonology* 38 (4), 693-727. DOI:10.1017/s0952675721000373

- Schwartz, G. 2022. Asymmetrical cross-language phonetic interaction – phonological implications. *Linguistic Approaches to Bilingualism* 12(2), 103-132. DOI:10.1075/lab.19092.sch

- Wojtkowiak, E., Schwartz, G. 2022. The acoustics of plosives and the formation of prosodic structure in Polish. *Folia Linguistica* 56(2), 273-324. DOI:10.1515/flin-2022-2020

- Schwartz, G. 2023. The phonetic underpinnings of phonological specifications – all gradience is not created equal. In: *Primitives of Phonological Structure* / Breit Florian *[et al.]* (*eds.*), Oxford Studies in Phonology and Phonetics, Oxford University Press, pp.225-250, Article number:9, ISBN 9780198791126

- Schwartz, G. 2023. Searching for common phonological space – /s/-stop clusters in L1 Polish and L2 English. *Second Language Research* 39(4), 1049-1076. DOI:10.1177/02676583221122425

- Schwartz. G. 2023. All TRs are not created equal – L1 and L2 perception of English cluster affrication. *Journal of Linguistics* 59(3), 623-654. DOI:10.1017/S0022226722000275

- Schwartz, G., Wojtkowiak, E. 2023. Asymmetrical equivalence classification – cluster affrication vs. lenis stops in the speech of Polish learners of English. *Research in Language* 21(4), 421-442. DOI:10.18778/1731-7533.21.4.05

Thanks for listening ☺