Readjusting English Irregular Past Tense Morphology

Workshop **O**n **M**orphology at **P**rinceton

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The Punch-Line(s)

English Irregular Past-Passive-Participle (PA) Verb Derivations
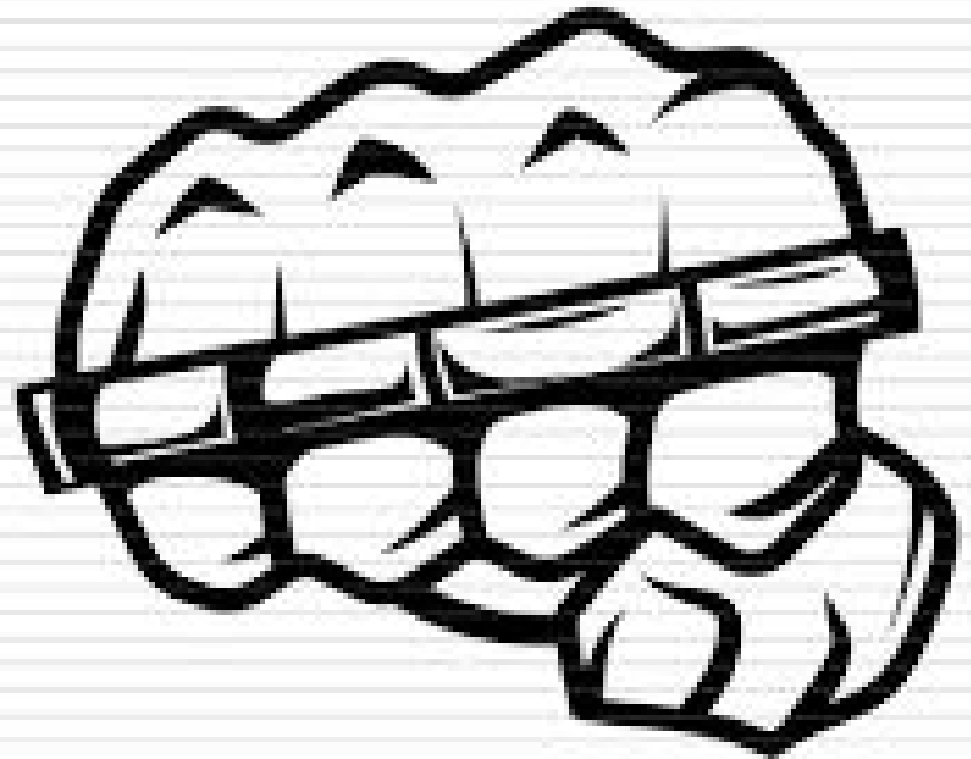
No verb-root allomorphy

(in English, partly in agreement with e.g., Embick & Halle 2005)

English Verb roots and PA morphemes undergo Vocabulary Insertion in separate cycles.

(contra Embick & Halle 2005, Embick 2010)

PA allomorphy is non-local

(see Dolatian & Guekguezian 2023 for a recently discussed example, and references therein)

The Punch-Line(s)

English Irregular PA Surface Forms:

No Readjustment Rules - A Piece-based Analysis

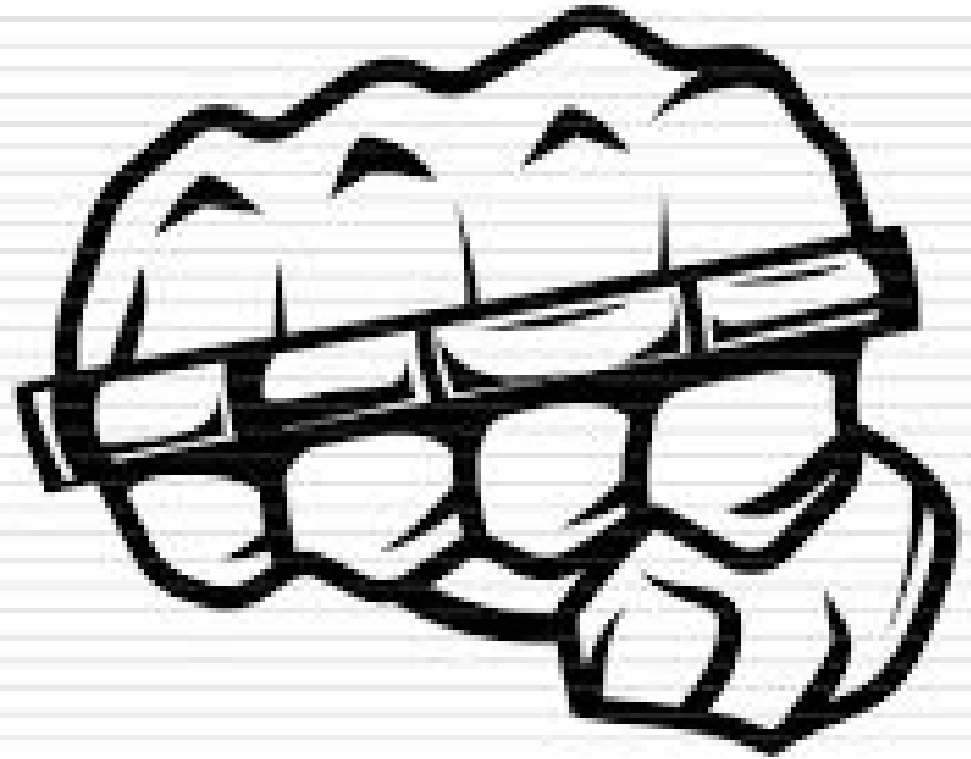There is only Suffix Allomorphy

Weak pattern

1 morpheme, always: -D, -t, -ɔt (no Zero)

Strong pattern

1 morpheme in the Past: ablaut

2 morphemes in the Participle,

Also always: ablaut AND –n

The regular phonology of English predicts when the ablaut vowel and -n will be realized phonetically, and when they will not.

3

Piece assumption

- All other things being equal, a piece-based analysis is preferred to a Readjustment Rule analysis when the morpho-syntactic decomposition justifies a piece-based treatment.

(Embick and Halle 2005:60)

Outline

1. The tools we need.

2. The English PA system is pretty regular.
   - A CVCV/autosegmental analysis

3. Conclusions.

+ Appendices

1. A distributional table of English Strong Irregular Verbs.

    Including the 5 weird ones that don't fit nicely.

2. The sub-types of Class 1.

3. The -ɔt forms

4. The Real Irregulars.

    Be, do, go, make, have : They are not that irregular and also demonstrate bi-phasal derivations.

5. On non-local allomorphy.

    There are chains of relations that percolate the root features.
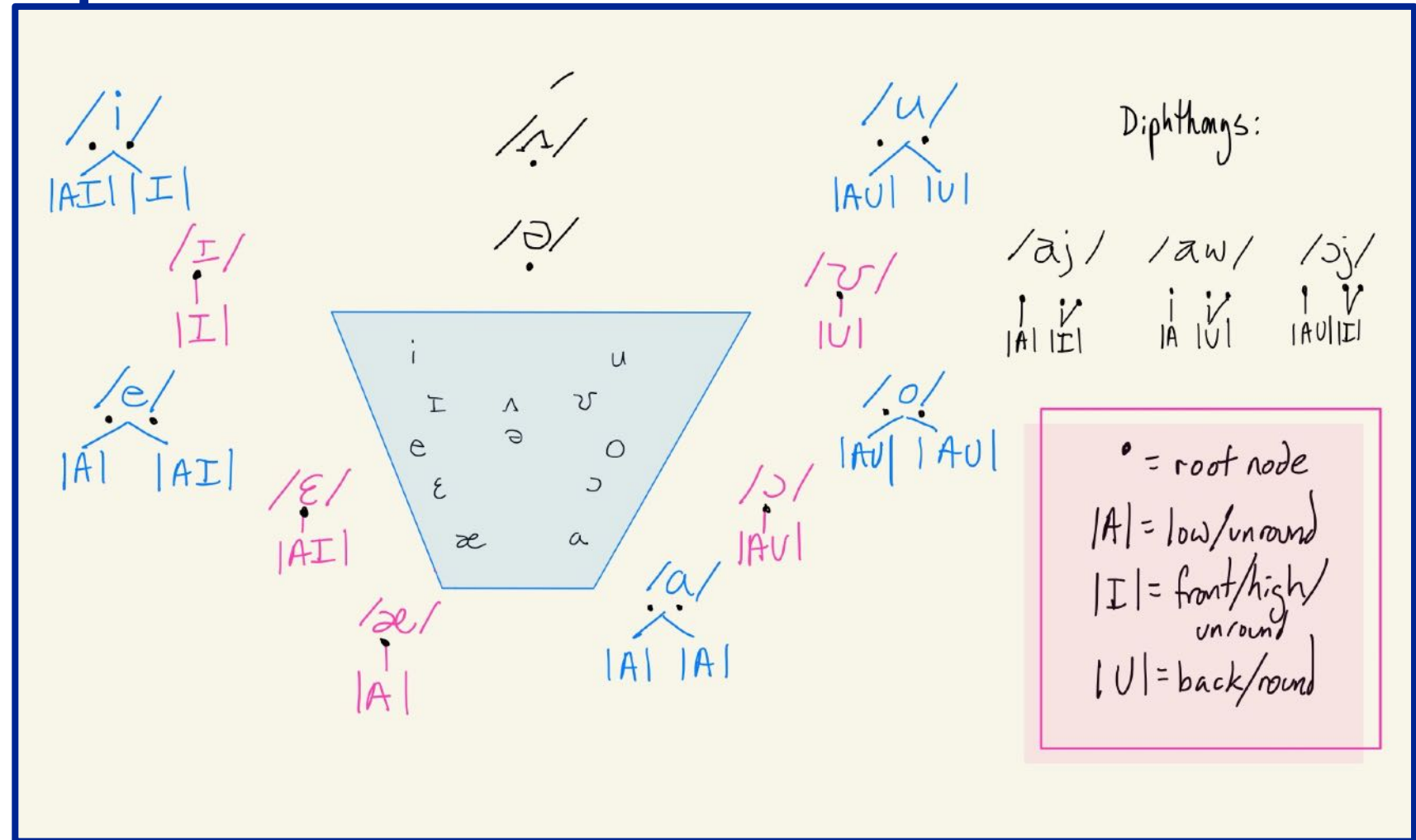
1. The tools we need

Vocalic Structure

CVCV / Autosegmental Phonology
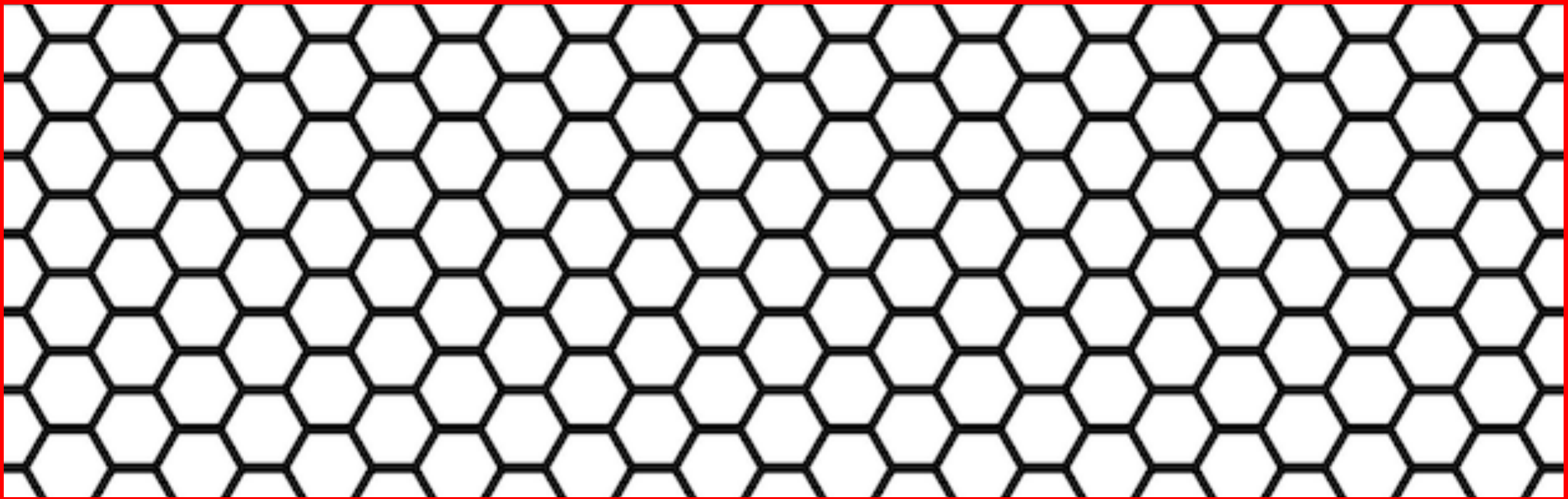
Phases

Vocalic Structure

- Element/Particle Theory
  - (Schane 2001, Szigetvári 2016, Pöchtrager 2015, Polgárdi 2015 - inspired)
- The English Tense-Lax distinction is also Long-Short.
  - Long vowels also have more internal structure than short vowels.
  - Shortening of a long vowel reduces its structure, changing its quality.
  - All dependants of long vowels contain |A| and this entails that lowering will result from shortening.
  - If the head of a diphthong vocalizes, the resulting hiatus will be resolved by deletion.

8

CVCV Phonology

(Lowenstamm 1996, Scheer 2004+, Scheer & Szigetvári 2005, Ulfsjorninn 2014+, Polgárdi 2015)

- Final Empty Nuclei are found at the right edge of cyclic domains.

- Some consonant sequences have 'special' relationships.

- Long vowels need to be licensed
    - = there is a pronounced vowel in a following syllable or a FEN

- A syllabic consonant may interact with a preceding vowel.

Phases

- Phases are small, and small phases are active in the derivation of the English Past Tense.

- PIC1 rather than PIC2
    - Although there is no PIC, at least in the phonology (and probably in the syntax too: (e.g., Bošković 2007, 2014; Newell 2008, 2017; Bobaljik & Wurmbrand 2005, Stepanov 2001).
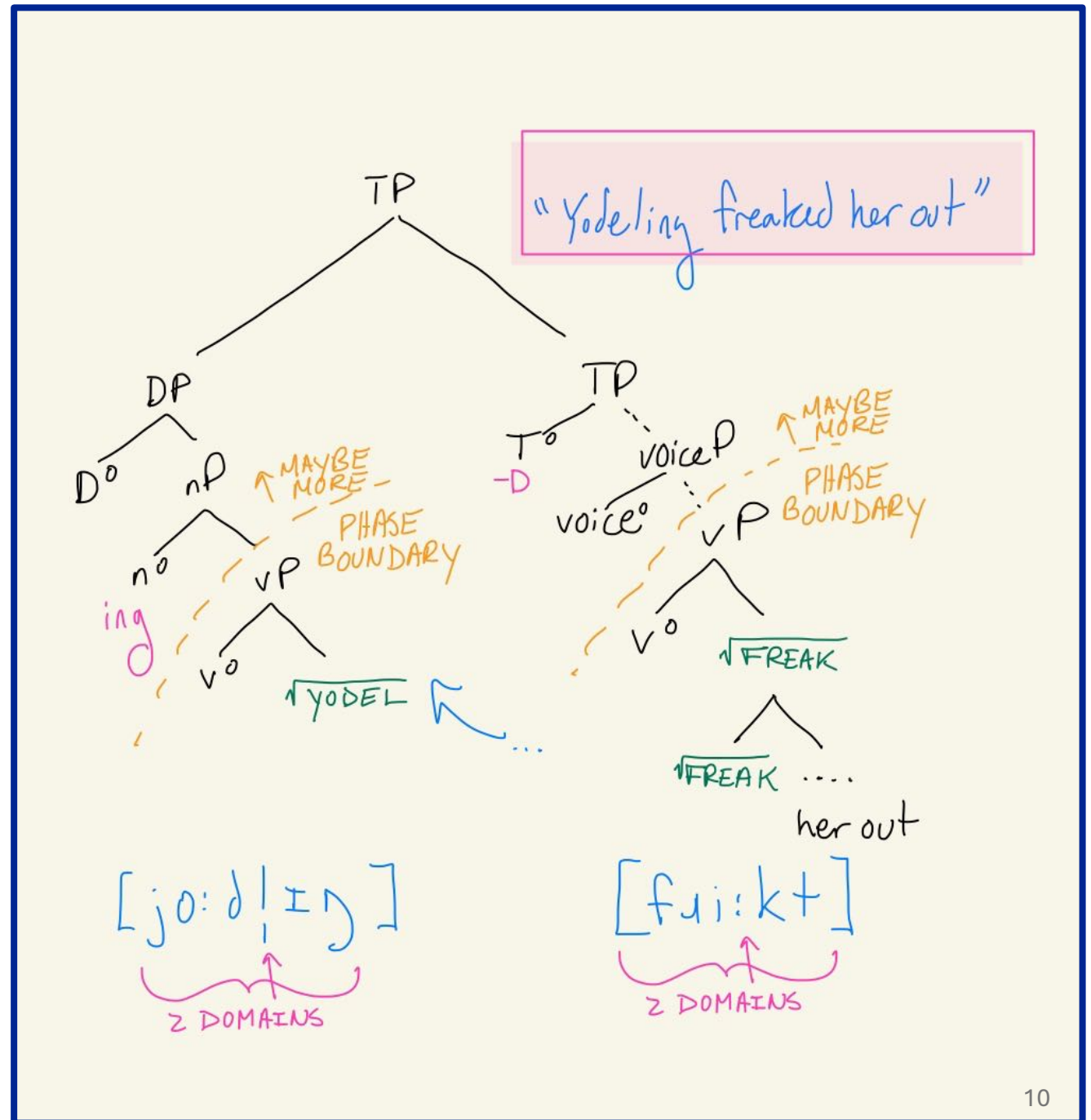
2.   The English PA system is pretty regular.

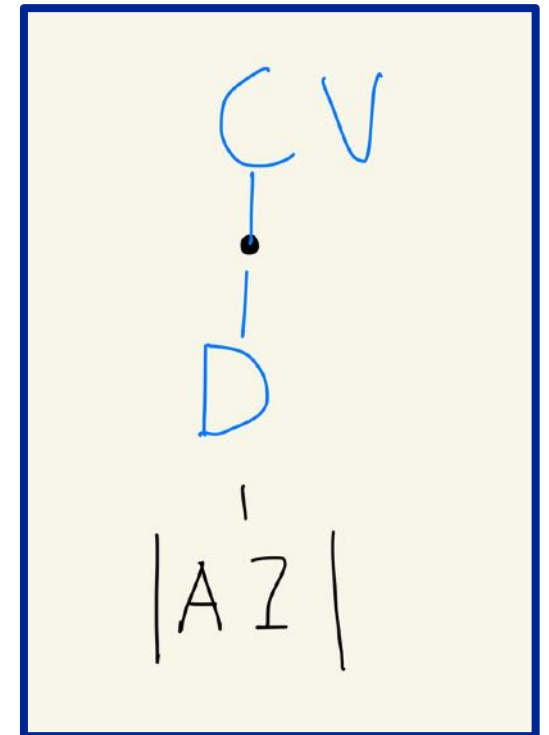Some of this is what people have always done, but autosegmental.

Some is (I think) better (and autosegmental).

Regular and Weak Irregular PA forms

Both derived in 2 phases; -D is not floating, but -t is.
See Appendix 3 for the -ɔt forms

Regular -D forms

- The Regular Pattern in the PA
  - -D : underspecified for voice, syllabified
  - -D forms cause neither shortening nor ablaut.
  - -D forms have no restrictions on the size of the base.
  - -D FORMS MUST BE BI-PHASAL
  - e.g. conjugate, conjugated, imagine-imagined, excavate-excavated, play-played, rain-rained, shout-shouted, glow-glowed, leash-leashed…

FINAL EMPTY NUCLEI may GOVERN and LICENSE.
- FENs are found at the end of each cyclic domain.
- FENs cannot be internal to a cyclic domain.

Phonological derivation → | LEASH — LEASHED |

∴ Regular PA forms are derived in 2 CYCLES.

Lowering cannot happen before VI of the root (contra Embick & Halle 2005).
c.f. *comparable, lightening etc.*

Weak Irregular -t forms

- Verbs in this class: *bereave, bleed, breed, creep, deal, dream, feed, feel, hear, keep, kneel, lead, lean, leap, leave, light, lose, mean, meet, plead, read, sleep, speed, sweep, weep.*

- Verbs that are in this class vacuously because they have an underlying short V that can't undergo shortening/lowering: *bend, bet, build, burn, burst, cast, cost, dwell, hit, hurt, learn, let, put, rid, set, shed, shit, shut, slit, smell, spend, split, spread.*

-t forms

- The weak irregular pattern (nothing incredibly new here, pattern-wise)
  - -t : specified for voicelessness, floating, triggers Phonological Merger
  - -t forms cause shortening but never ablaut.
  - -t forms only affix to monosyllabic verbs (excluding prefixes). (see Lowenstamm 2023 for a templatic account of this pattern, but this is true for all irregular verbs)
  - -t will not be pronounced after another coronal consonant but is there in the phonology (geminate).

- -t WILL HAVE 'LEVEL 1'-TYPE PHONOLOGY EVEN IF INSERTED IN A SEPARATE PHASE FROM ITS BASE.
  - (see Newell 2021 for English, and any other autosegmental analyses of affixation, see Newell & Piggott 2014 for Phonological Merger.)

- Floating structure probes into a previously-computed string;
  - there is only one FINAL EMPTY NUCLEUS in a syllabified string.
- Once probing/search applies at the segmental level,
  repair strategies (epenthesis, syllabification) re-apply.
- These derivations are synchronically active (contra Kaye 1995)
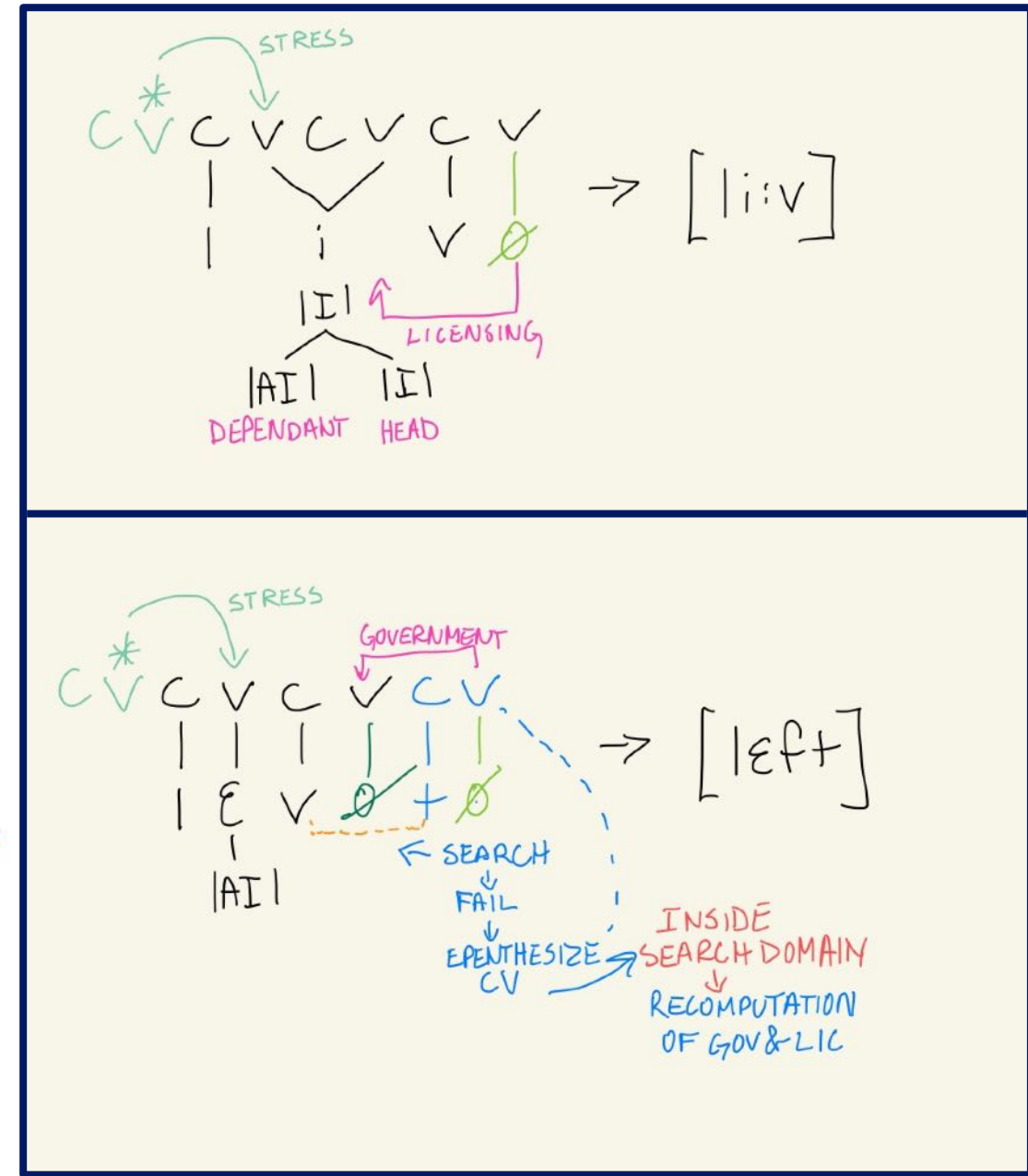
Phonological derivation

LEAVE

LEFT

∴ Weak Irregular PA forms appear to be 'Level 1'/monocyclic but they are also derived in 2 CYCLES.

Strong Irregulars
Ablaut + -n forms

5 sub-classes, grouped into 3 here.
See Appendix 1 for a table with their distribution/ablaut types.
See Appendix 2 for the details of the 3 sub-classes of class 1.

Class 1
In which the ablaut vowel is blocked in the Participle

- This class includes all ablauting verbs that end in a single non-nasal consonant.

- The subclasses all show *some* unpredictable variation in their vowel alternations.
  - Subtype 1: bases with the underlying diphthong [aj] : *drive-drove-driven, hide-hid-hidden*
  - Subtype 2: bases that end in a vocalic offglide : *blow-blew-blown, see-saw-seen*
  - Subtype 3: bases that show unpredictable variation in ablaut quality and quantity :

    long → short: [te:k] *take* ~ [tʊk] *took*

    short → long: [gɪv] *give* ~ [ge:v] *gave*

- The common patterns in this class:
  - The ablaut only appears in the past, not in the participle.
  - These verbs revert to their base vowel in the participle.
  - The -n affix is pronounced in the participle.

The verbs in these classes

Subtype 1:

bite-bit-bitten,   drive-drove-driven,   hide-hid-hidden,   ride-rode-ridden,   rise-rose-risen, shrive-shrove-shriven,   smite-smote-smitten,   stride-strode-stridden,   strive-strove-striven, write-wrote-written,

Subtype 2:

blow-blew-blown,   draw-drew-drawn,   grow-grew-grown,   know-knew-known,   slay-slew-slain, see-saw-seen, throw-threw-thrown

Subtype 3:

eat-ate-eaten,   fall-fell-fallen,   bid-bade-bidden,   give-gave-given,   forsake-forsook-forsaken, take-took-taken, shake-shook-shaken

# The -n morpheme, and the full-vowel ablaut allomorphs

- The -n Vocabulary Item is a nasal C specified to branch onto a V position : a syllabically underspecified syllabic nasal.
  - It is selected for by certain classes of roots.
    - (and certain roots in the Stative (Embick 2004))
- The ablaut allomorphs in class 1 are selected for by 1 or more roots. These are full vowel suffixes with a root node that dock to a local (rightmost) full V position (c.f. Zdziebko (2017) for Old English).
  - These vowels must replace a vowel or a diphthong and cannot replace a syllabic consonant.
  - These vowels replace the already-syllabified root-vowel and may be underlyingly specified as long or short.
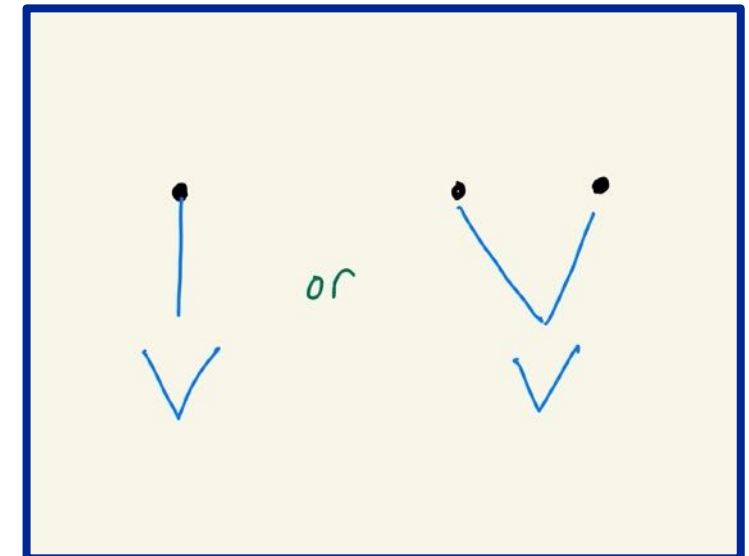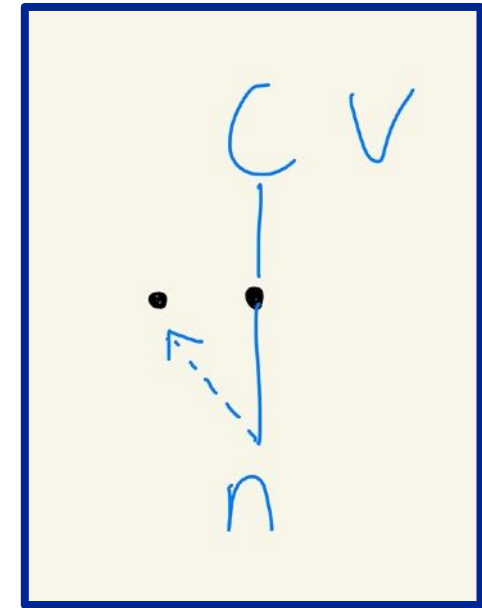
- Here we have 2 separate morphemes deriving the PA.
- Why propose that the ablaut is there even in the passive/ participle? Because it is not always blocked (see Type 2).

Phonological derivation

TAKE

TOOK

TAKEN
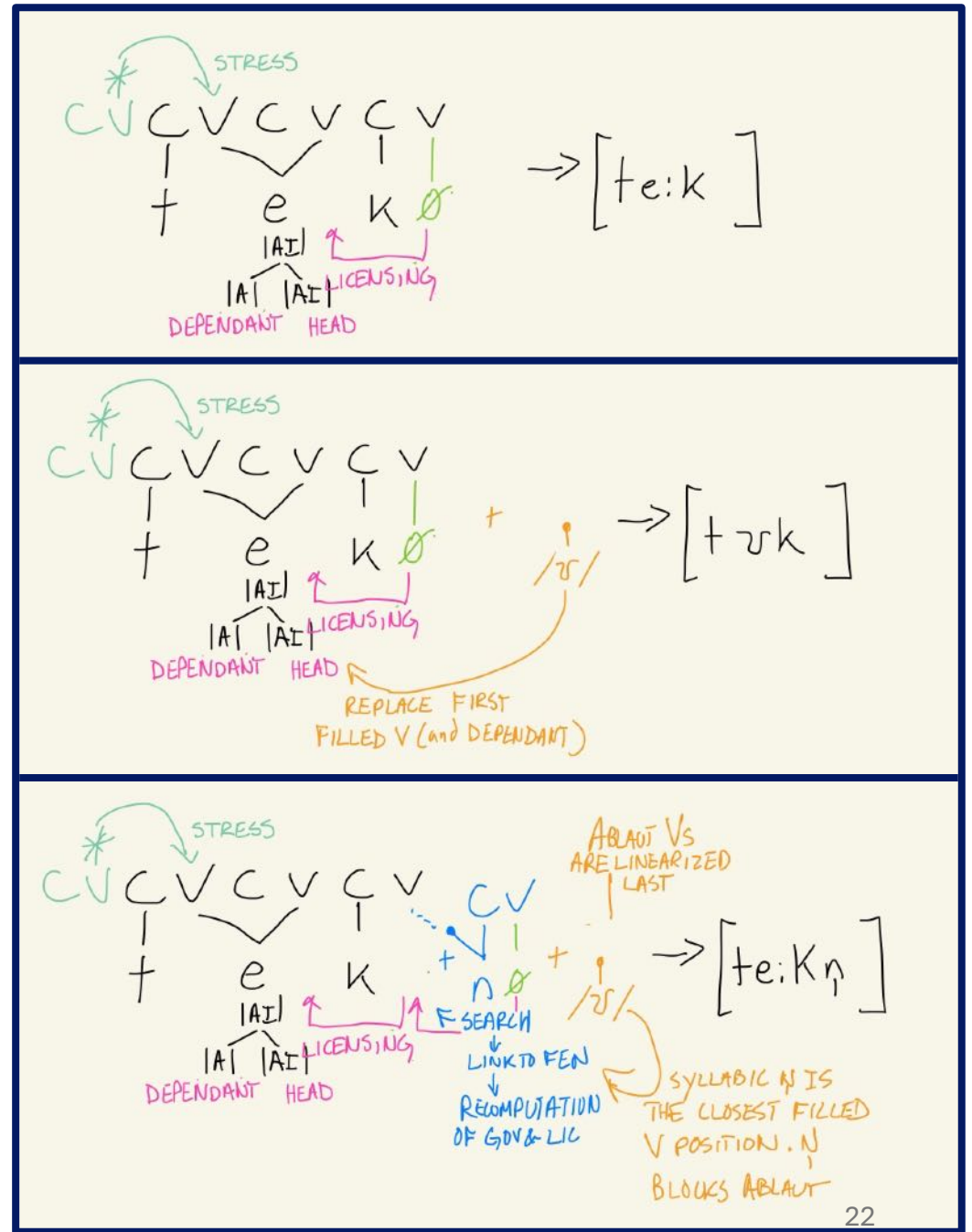
- The derivation occurs in (at least) 2 cycles.
- Both affixes are underspecified, and therefore undergo Phonological Merger (Newell & Piggott 2014) must occur, phonologically masking the cyclic derivation.

Class 2
In which the ablaut is not a vowel, and so is not blocked in the Participle

- The common patterns in this class:
  - The ablaut always results in [o], [ɔ] or [aw].
  - The ablaut never changes the syllabic properties of the underlying vowel of the root.
  - The ablaut appears in both the past and the participle.
  - All roots end in a single non-Nasal C, or in a Coronal NC-sequence
    - Coronal NC coda sequences are the only ones to behave as though they are mono-consonantal in English.
    - They may be preceded by a long vowel or diphthong : fiend vs *fiemp/fienk
  - The -n affix is pronounced in the participle, except after NC (see class 3)

- Verbs in this class: *bear-bore-born, bind-bound-bound, break-broke-broken, choose-chose-chosen, find-found-found, get-got-gotten, grind-ground-ground, freeze-froze-frozen, speak-spoke-spoken, steal-stole-stolen, swear-swore-sworn, tread-trod-trodden, tear-tore-torn, wake-woke-woken, wind-wound-wound, weave-wove-woven*

Featural/Sub-segmental ablaut allomorph

- This allomorph modifies the quality of the vowel of the base, but never interacts with or alters quantity.
  - It consists of the Elements |AU|, but no root-node.
  - Linking these elements occurs internally to the structure of the base vowel as follows:
    - The local vowel is targeted (|AU| is suffixal)
    - |A| is added where possible
    - |U| too, and it replaces |I|
    - (only the head glide of diphthongs is local)
  - This linking is not blocked by consonants, syllabic or otherwise, as it occurs strictly within the melodic tier.
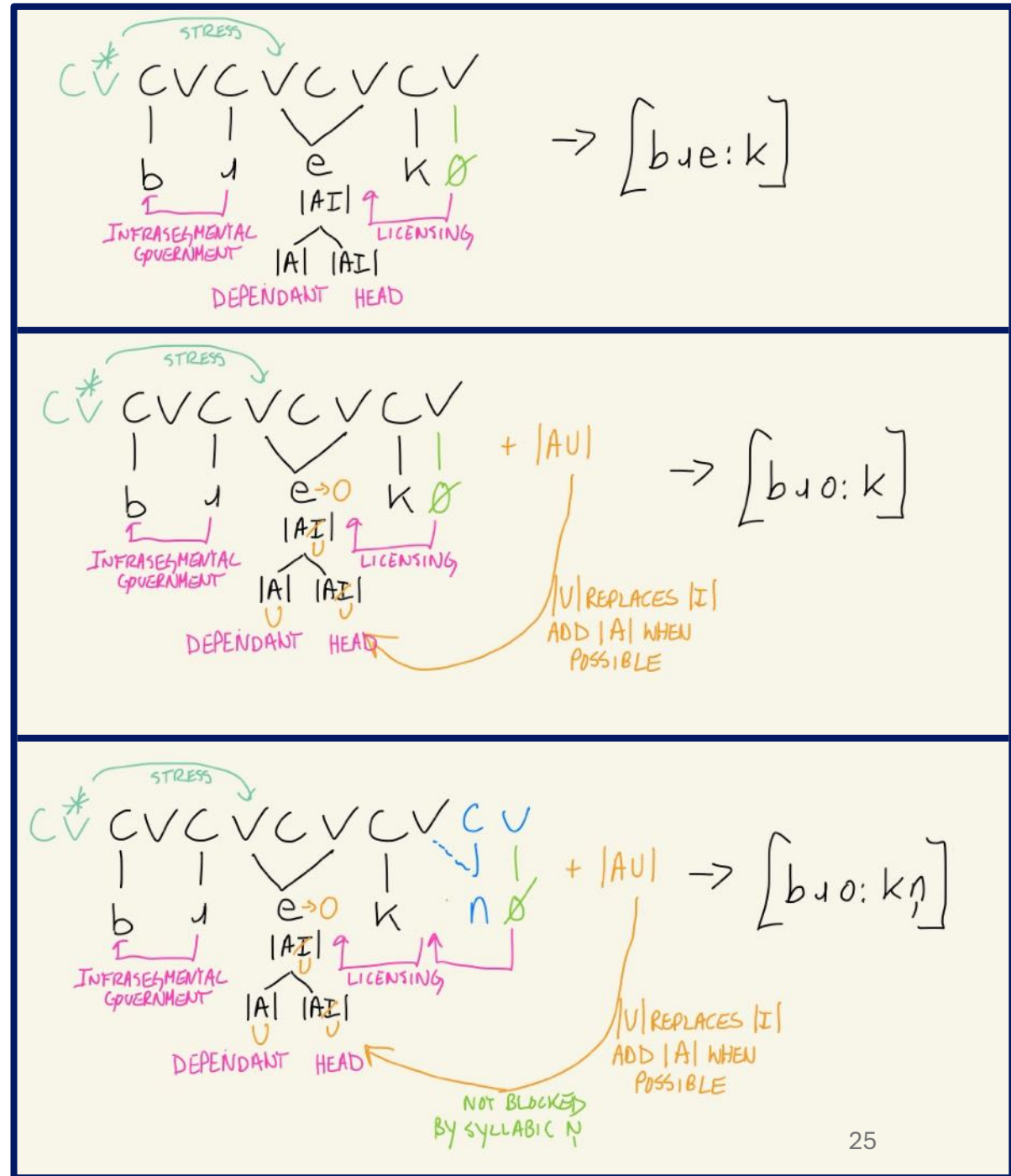
|AU|
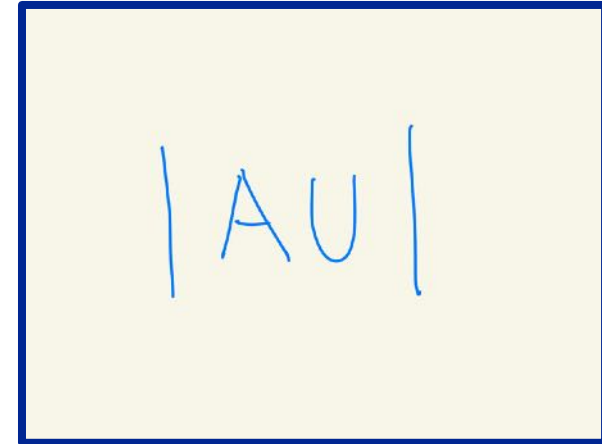
- Here we overtly have 2 separate morphemes deriving the PA.
- These examples give clear evidence that the ablaut morpheme is present in strong verbs in the participle.

Phonological derivation

BREAK

BROKE

BROKEN

- Sub-segmental Ablaut is not blocked by a syllabic nasal, as it is not targeting a segmental Root Node.
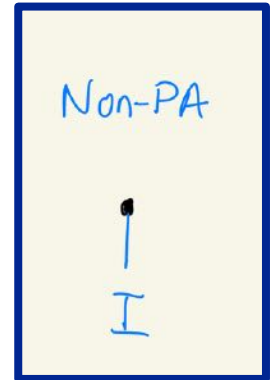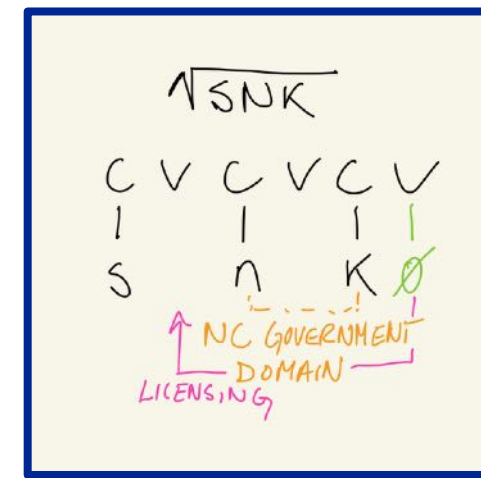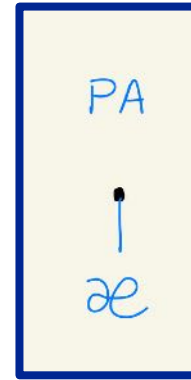
Class 3

In which the 'present' vowel is not part of the root, and there is a stable vowel in the Participle

- The common patterns in this class:
    - All roots that end in a C$_{[nasal]}$ or a non-Coronal NC sequence.
    - All but one of these verbs (come) have either [ʌ] or [æ] ablaut in the Past.
    - All forms, regardless of their UR or ablaut vowels, have [ʌ] in the participle.
        - Note that unlike Class 1 and Class 2 verbs, these verbs do not revert to their UR vowel in the participle, nor do they maintain their Past ablaut vowel
    - The -n suffix is unpronounced - but it is there.
        - Preceding Nasal Cs and Coronal NC-sequences ([nd], [nk] or /ng/→[ŋ]) result in the lack of phonetic-realization of a following -n.

- Verbs in this class: *begin-began-begun, come-came-come, cling-clung-clung, drink-drank-drunk, fling-flung-flung, hang-hung-hung, ring-rang-rung, run-ran-run, shrink-shrank-shrunk, sing-sang-sung, sink-sank-sunk, sling-slung-slung, slink-slunk-slunk, spin-spun-spun, spring-sprang-sprung, sting-stung-stung, stink-stank-stunk, string-strung-strung, swim-swam-swum, swing-swung-swung, win-won-won, wring-wrung-wrung.*

Class 3 roots, and the non-PA vocalic morpheme

- The vowel generally considered to be part of the UR of class 3 roots is not, in fact, specified as part of the root.
  - These roots are not specified for a vowel in their UR.
    - As was proposed in Guerssel and Lowenstamm (1994) for some verbs in Classical Arabic and Ségéral & Scheer (1998) for a couple of verbs in German.
  - This accounts for their special behaviour in the participle: they do not revert to the vowel seen in the Present, unlike Class 1 verbs.
  - V-[ʌ]-[ʌ] verbs have no ablaut vowels in the PA (or they have [ʌ])
    - This pattern is not an 'apophonic path' but 3 separate derivations (contra predictions in Ségéral & Scheer 1998)
      - PA and Part: Ø→ [æ] (PA) , except Ø→ Ø when [æ] cannot link
      - Non-PA (T^0,n^0) :Ø→ [ɪ]

- Here the UR of the verb contains no vowel. The suffix ablaut vowels are full segments. Therefore, the PA ablaut is blocked from docking when the syllabic -n is present, just as in Class 1.

Phonological derivation

SINK

SANK

SUNK

- An empty V position is realized as schwa;

  - /ə/ is realized as [ʌ] when stressed.
  - -n is not phonetically realised after a $C_{[nasal]}$ or a non-Coronal NC sequence.
    - Yes, you can ask me about 'sunken' in the QP

5. General Conclusions.

Phonological Conclusions

- Neither allomorphy nor readjustment analyses of the ablaut patterns in English can explain the phonological regularities we see in the data.
  - Syllabic –n blocks the attachment of ablaut vowels…
  - But does not block the attachment of ablaut *features* due to phonological locality.
  - We can 'see' it blocking even when it is not pronounced.
    - This is nice, as most people agree that Readjustment Rules should be, if not banned, a last resort (e.g., Embick & Halle 2005; Haugen & Siddiqi 2013)
- All Ablaut verbs are also -n verbs
  - The fact that the only ablaut effects that emerge in the participle are those that affect segment-internal structure only would be random in any account that does not appeal to phonological structure.
  - The fact that only the nasal(C)-final roots lack overt -n in the participle would also be random in a non-phonological account.

Computational conclusions

- The regular PA morpheme *must be* computed phonologically in a separate cycle from the root.
  - And therefore, all other affixes that emerge in the same syntactic position are also computed in a separate domain from the root.

- The account proposed here brings English in alignment with other languages where the verb spells out low in the VP (Ojibwe, Chukchansi Yokuts, Turkish, Cupeño, Malagasy, Chichewa….) and Tense morphology is demonstrably in a separate syntactic and phonological domain.

- There is no Phonological PIC
  - Phonological Merger is triggered across cycles.

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Appendices

On the-ɔt forms, the different classes of Strong irregulars that end in a single non-nasal C, the 'real' irregulars, and the allomorphy/syntax.

Appendix 1:
A distributional table of English Irregular Verbs
(Including the weird ones that don't fit nicely)

UR-Ab-UR (phonological blocking)	underlying	surface
eat-ate-eaten (1)	[iː]-[eː]-[eː]	[iː]-[eː]-[iː]
bid-bade-bidden (2(1))	[ɪ]-[eː] (or [æ])-[eː] (or [æ])	[ɪ]-[eː] (or [æ])
hide-hid-hidden (2)	[aj]-[ɪ]-[ɪ]	[aj]-[ɪ]-[ɪ]
take-took-taken (3)	[eː]-[ʊ]-[ʊ]	[eː]-[ʊ]-[eː]
fall-fell-fallen (1)	[ɑː]-[ɛ]-[ɛ]	[ɑː]-[ɛ]-[ɑː]
drive-drove-driven (8)	[ai]-[oː]-[oː]	[ai]-[oː]-[ɪ]
draw-drew-drawn (1)	[ɑː]-[uː]-[uː]	[ɑː]-[uː]-[ɑː]
grow-grew-grown (4)	[oː]-[uː]-[uː]	[oː]-[uː]-[oː]
slay-slew-slain (1)	[eː]-[uː]-[uː]	[eː]-[uː]-[eː]
see-saw-seen (1)	[iː]-[ɑː]-[ɑː]	[iː]-[ɑː]-[iː]

UR-Ab-Ab (no phonological blocking)	underlying	surface
wake-woke-woken (5)	[eː]-[oː]-[oː]	[eː]-[oː]-[oː]
choose-chose-chosen (1)	[uː]-[oː]-[oː]	[uː]-[oː]-[oː]
freeze-froze-frozen (4)	[iː]-[oː]-[oː]	[iː]-[oː]-[oː]
get-got-gotten (2)	[ɛ]-[ɔ]-[ɔ]	[ɛ]-[ɔ]-[ɔ]
find-found-found (4)	[ai]-[aw]-[aw]	[ai]-[aw]-[aw]

UR-Ab-Empty (phonological blocking)	underlying	surface
come-came-come (1)	[ʌ]-[e]-[e]	[ʌ]-[e]-[ʌ]
drink-drank-drunk (9)	[ɪ]-[æ]-[æ]	[ɪ]-[æ]-[ʌ]
run-ran-run (1)	[ʌ]-[æ]-[æ]	[ʌ]-[æ]-[ʌ]
fling-flung-flung (10)	[ɪ]-[ʌ]-[ʌ]	[ɪ]-[ʌ]-[ʌ]
hang-hung-hung (1)	[æ]-[ʌ]-[ʌ]	[æ]-[ʌ]-[ʌ]

Weird	underlying	surface
hold-held-held (non-o remains in participle) (1)		[o]-[ɛ]-[ɛ]
tell-told-told sell-sold-sold (apparently mixed class) (2)		[ɛ]-[o]-[o]
stand-stood-stood (behaves like the UR-Ab-Ab verbs, but loses the N and the vowel is [ʊ]) (1)		[æ]-[ʊ]-[ʊ]
shine-shone-shone (ends in a nasal, but maintains ablaut in the participle, and it's not the expected [aw] of an UR-Ab-Ab verb) (1)		[aj]-[ɔ]-[ɔ]

Irregular verb count:
67 ablaut verbs (counting the 'weird')
54 weak irregular verbs (no ablaut)
5 'real irregulars' (Appendix 4)
NB. that I am not counting prefixed forms unless it is the only one (e.g., bereave)

Appendix 2:
The sub-types of Class 1

Class 1 : Subtype 1
Verbs with a diphthong (always [aj]) and a single final C in their UR (e.g., drive-drove-driven)

- These verbs take an [o] or [ɪ] ablaut in the PA, and then undergo regular shortening of [aj] to [ɪ] in the participle (c.f. Tri-syllabic shortening: *deride-derisive*).

- Other verbs in this class: bite-bit-bitten, hide-hid-hidden, ride-rode-ridden, rise-rose-risen, shrive-shrove-shriven, smite-smote-smitten, stride-strode-stridden, strive-strove-striven, write-wrote-written

- The suffix is a branching (syllabic) [n] but must search for its syllabic/V position.
- Once probing/search applies at the segmental level, repair strategies (epenthesis, resyllabification) re-apply.

Phonological derivation

DRIVE

DROVE

DRIVEN

- Here we have 2 separate morphemes deriving the PA and PART.
- A syllabic nasal requires that the vowel it licences be vocalic (not a glide).
- The glide delinks from the C position, and then the short V-V hiatus is resolved by deleting the first V. (a-ɪ → ɪ)
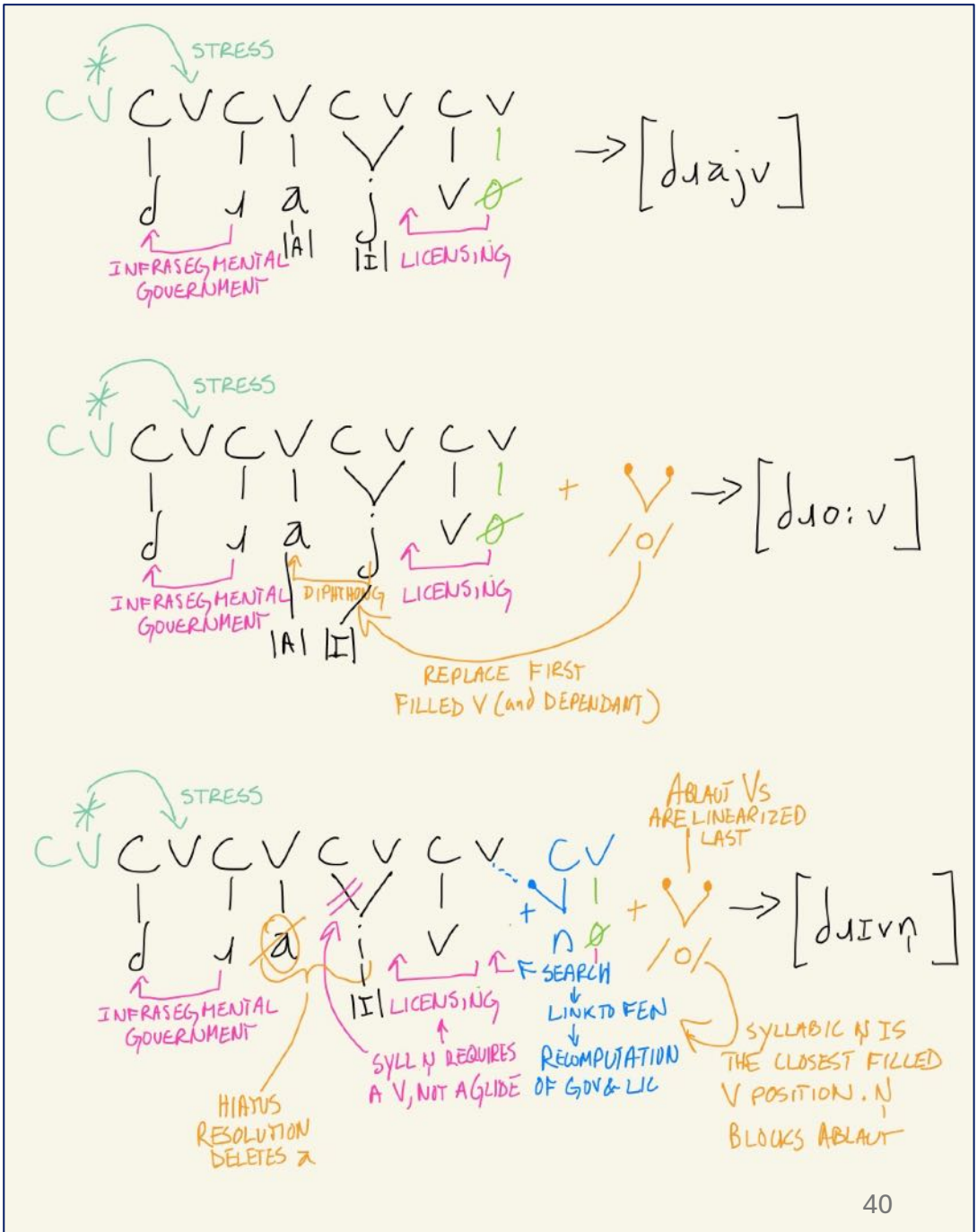
Class 1: Subtype 2

Past-Ablauting verbs ending in a single C that don't have a diphthong in their UR and revert to their UR vowel in the Participle. (e.g., fall-fell-fallen)

- Ablaut in these verbs demonstrates no stability w.r.t. vowel tenseness/length is not stable here. The whole vowel is being replaced, but reverts to the lexical default in the participle:
    - long→short: [te:k] *take* ~ [tʊk] *took*
    - short→long [gɪv] *give* ~ [ge:v] *gave*

- These verbs demonstrate the same blocking of Ablaut in the -n forms as subtype 1.
    - The ablaut patterns here are : [i:]-[e:], [ɪ]-[e:] (or [æ]), [e:]-[ʊ], [ɑ:]-[ɛ].

- Other verbs in this class: beat-beat-beaten, bid-bade-bidden, eat-ate-eaten, give-gave-given, forsake-forsook-forsaken, take-took-taken, shake-shook-shaken

- Here we have 2 separate morphemes deriving the PA and PART.
- Why propose that the ablaut is there even in the passive/ participle? Because it is not always blocked (see Class 2).

Phonological derivation

TAKE

TOOK

TAKEN
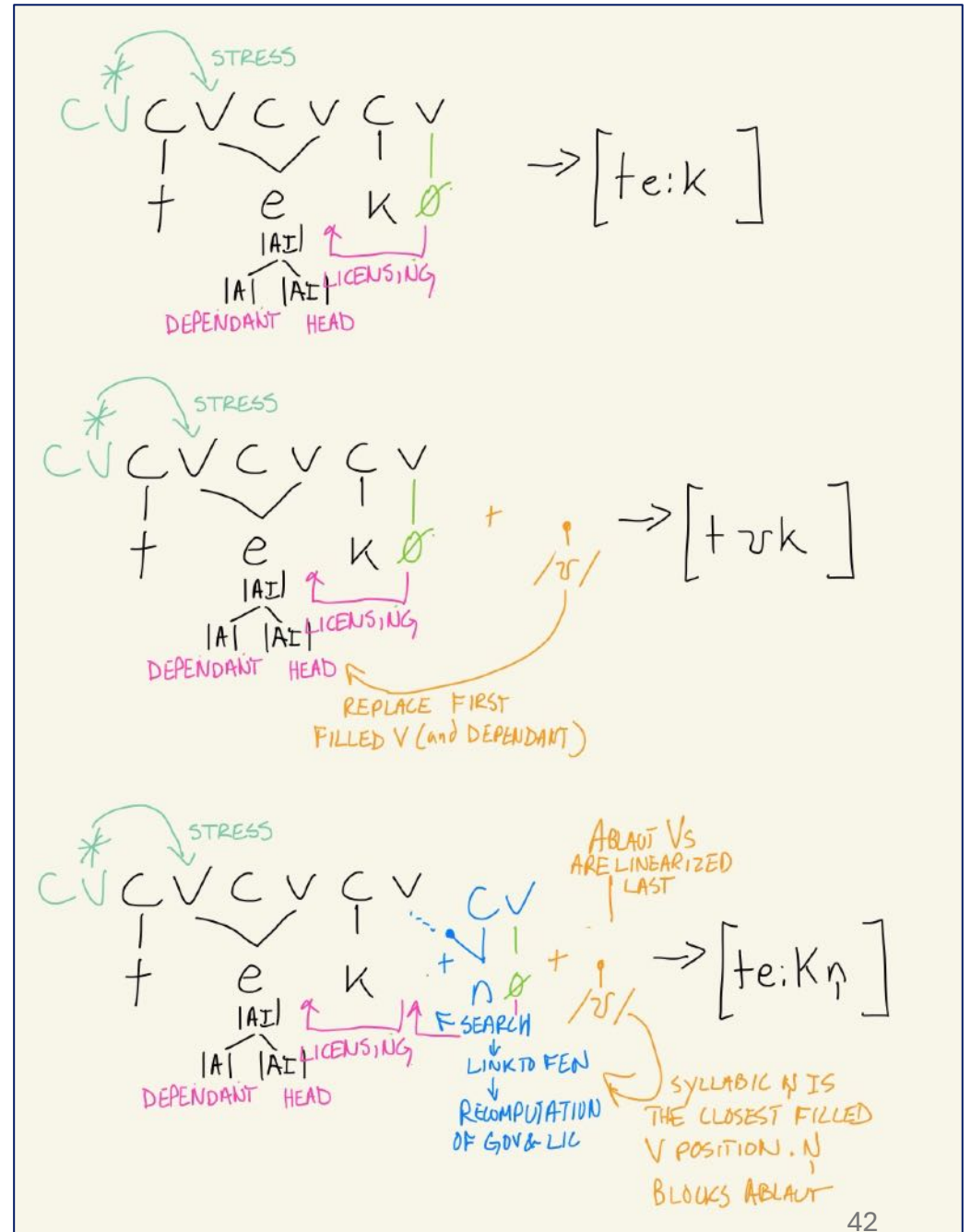
- Syllabic -n blocks attachment of the vowel, as it is the closest filled-vowel position that is targeted by the theme-vowel. The theme vowel cannot displace a consonant.
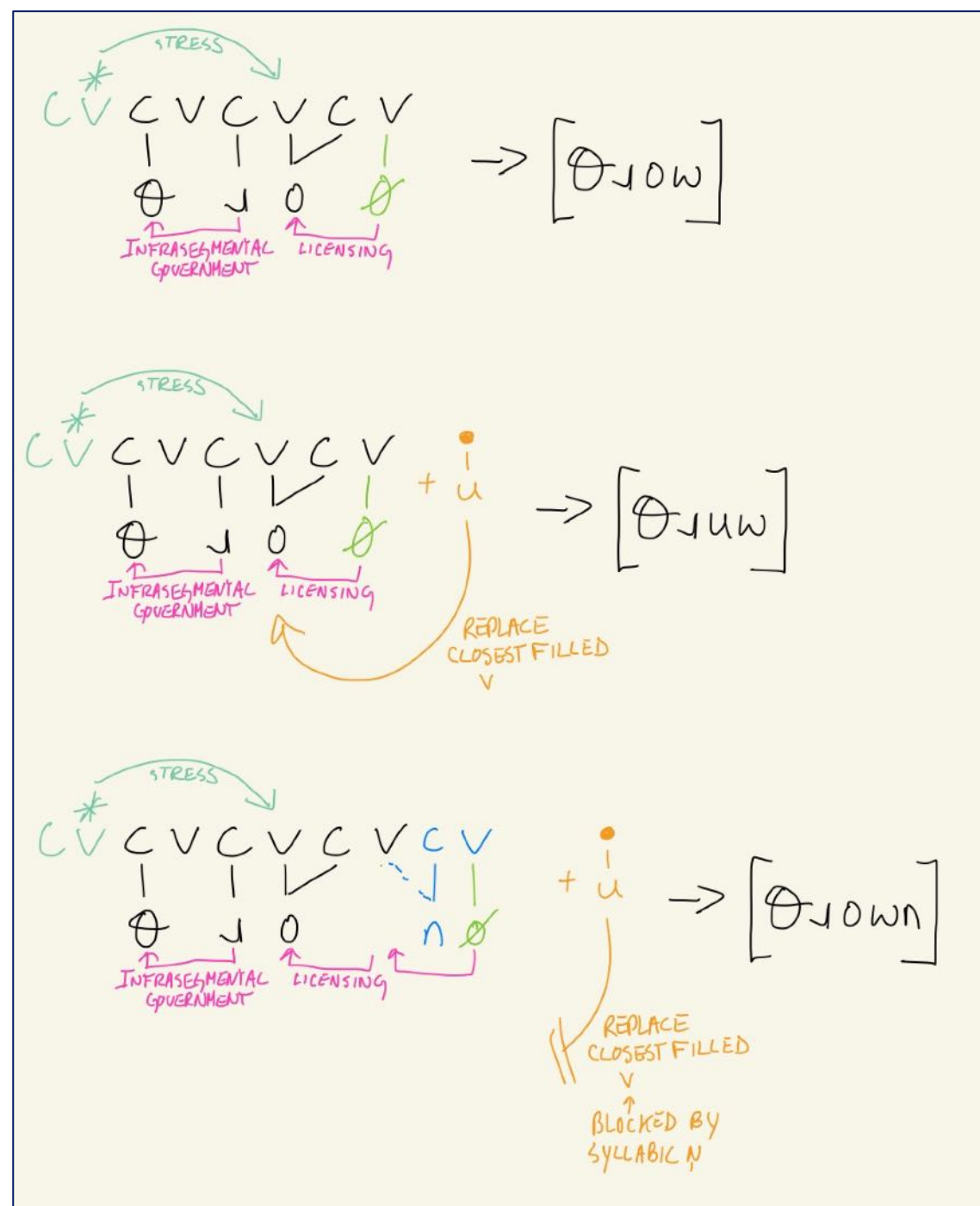
Class 1: Subtype 3
These verbs all end in a vowel and therefore the syllabic -n is not realized as such phonetically (e.g., blow-blew-blown)

- Final vowels in English spread into a C position (weight-by-position)
  - Other verbs in this class: draw-drew-drawn, grow-grew-grown, know-knew-known, slay-slew-slain, see-saw-seen, throw-threw-thrown

- There is no phonetic syllabic [n] after a sonorant segment on the melodic tier
  - See also *born, sworn, torn* from Class 2.

- This -n is syllabic in the phonological structure : it blocks ablaut.

The truly irregular verbs seem to belong here as well: be-been, do-done, go-gone. See Appendix 4.

The -n in these forms *is* phonologically syllabic and blocks the attachment on the theme vowel.
It is not phonetically syllabic after a sonorant.

Phonological derivation

THROW

THREW

THROWN

Appendix 3:
-ɔt forms
(e.g., *SEEK-SOUGHT*)

Every account needs to say something special about these forms.

- I will assume -ɔt is a templatic allomorph, with the morphosyntactic patterning of -D and -t.
  - The onset of the base is copied into the template.
    - It is possible that the template has only one onset position and that dependents are permitted to 'tag along'.
  - Halle & Mohannan (1985), for example, propose URs that are historically-motivated and opaque.
    - Let's assume that synchronic surface phonological patterns that are easily-derivable are easily-derived.
    - Let us also assume that patterns that are not generalizable outside the PA are not process-driven. (c.f. vowel shortening)

- Verbs in this class: bring-brought, buy-bought, teach-taught, think-thought, catch-caught, seek-sought

Appendix 4:
The *real* Irregulars
(They are not that irregular, and demonstrate bi-phasal derivations)

be, have, make, do, go

(go is the only real problem wrt allomorphy)

These verbs all conform to the revert-to-UR pattern in the participle, and are only irregular in the Past

The distinctions in the present tense between go/do and make/have are consistent with main verbs being computed in two cycles, and auxiliaries in 1.

- **GO**-went-gone
  - real allomorphy in the past, regular participle
  - [ɔ] in UR, lengthened when unaffixed because of word minimality

- N.B. goes [go:z] vs does [dʌz] is an indication that goes is [[go: $_{vP}$]z $_{CP}$] and does is [dʌz $_{CP}$]

- **DO**-did-done
  - ablaut+d in the past, regular participle
  - [ʊ] in UR, lengthened because of minimality in 'do'

- **MAKE**-makes-made-made
  - -d form
  - floating /k/ in the UR of the root. Not really 'irregular'

- N.B. makes [me:ks] vs has [hæz] is an indication that makes is [[me:k $_{vP}$]s $_{CP}$] and has is [hæz $_{CP}$]

- **HAVE**-has-had-had
  - -d form
  - floating /v/ in the UR of the root. Not really 'irregular'

- **BE**-was/were-been
  - real allomorphy in the past, regular participle.
  - [ɪ] in UR, lengthened because of word minimality unaffixed forms.

Appendix 5: On non-local allomorphy.

Features go up, affixes go down

PROPOSAL :

- The Ablaut vowels found in the English PA system are theme vowels.
  - This is a different take on English theme vowels than in Kayne (2016) or Collins (2018).
  - English theme vowels are adjoined to/realized on the highest head in the agreement/feature-percolation chain of the root.

- Feature percolation/agree may cross phase boundaries.

- Many works propose that a chain of agreement or feature percolation may traverse boundaries assumed to be phases (e.g., Bjorkman 2011, the literature on long-distance agreement) or across overt morphemes (e.g., Dolatian & Guekguezian 2023).

- Dolatian & Guekguezian (2023) offers an account of root-conditioned T^0 allomorphy that is anti-local morpho-syntactically (adjacency) and linearly.

- Bjorkman (2011) accounts for auxiliary insertion when agreement between a low root and a high (possibly extra-phasal) head is non-local for AGREE.

- The domains for aux-insertion parallel the domains for PA affixal allomorphy.

Regular verbs : Passive...

- Regular verb roots are specified for a default class (lets call it D).
- Regular verbs do not have overt theme vowels.
- Phases are v^0P, voiceP, and CP, but only the v^0P phase is marked here.
  - Even the lowest PA suffix is outside of the domain of the root.
- There is a single feature that is shared by the PA heads that triggers insertion of -D
  - Let's call it PA.
- The -D morpheme is realized in the closest PA head to the root.
  - We can think of this as Agree/checking of an unvalued Class feature on these heads.
  - This parallels Bjorkman (2011)'s account of Aux insertion patterns. Note that she also proposes that the verb in English remains in its base-position.

Regular verbs :
...Perfect, Past

Weak verbs: Past...

- Weak irregular verb roots are specified for the –t or -ɔt classes.

- Weak irregular verbs do not have overt theme vowels.

- Phases are v⁰P, voiceP, and CP.

- PA heads trigger insertion of –t/-ɔt (in concert with the class feature that percolates/is agreed with) in the highest/last head that the root feature agrees with.
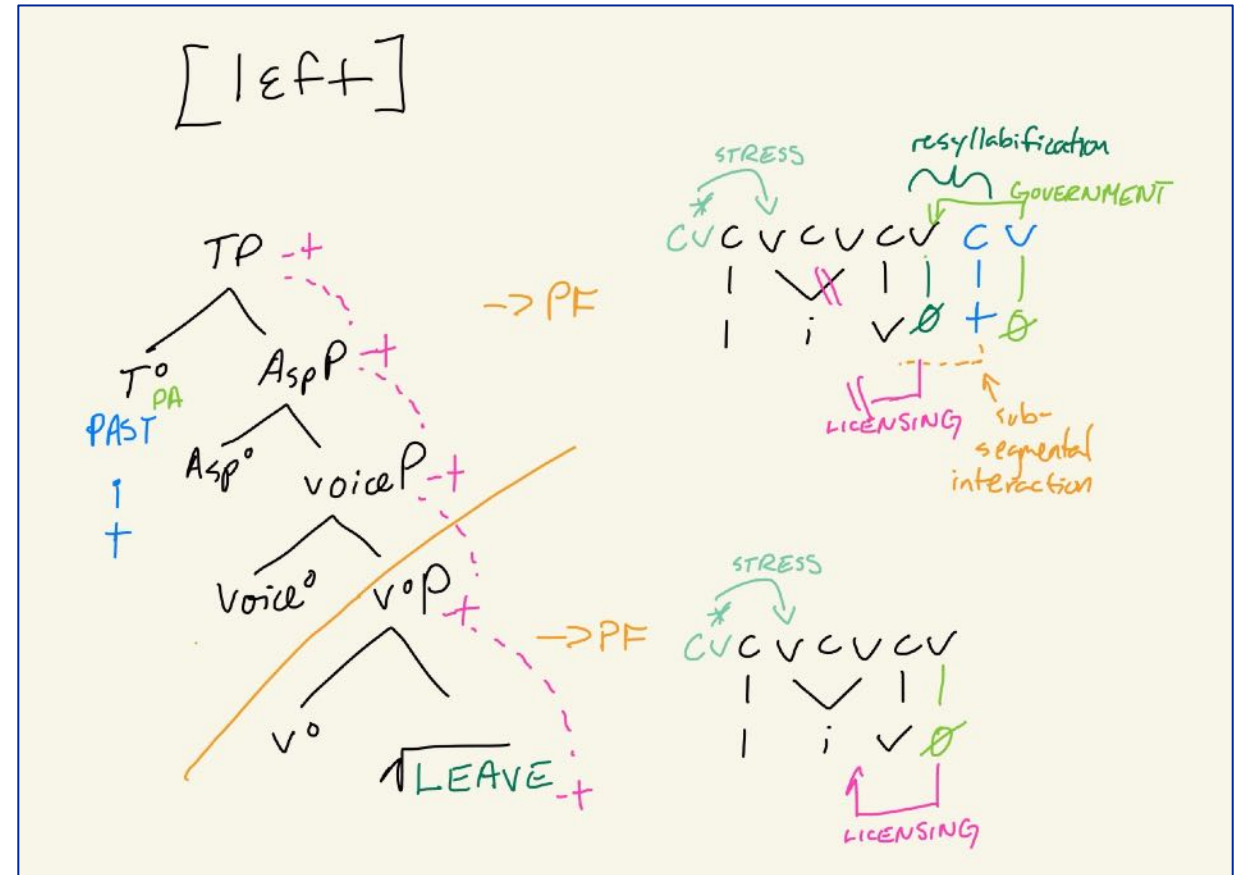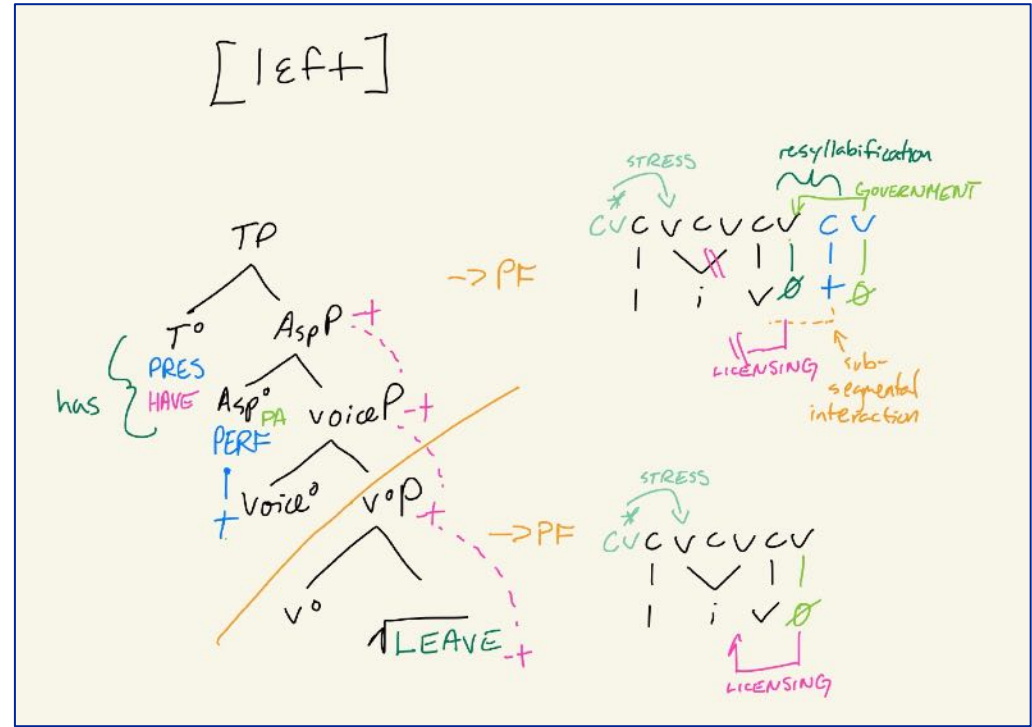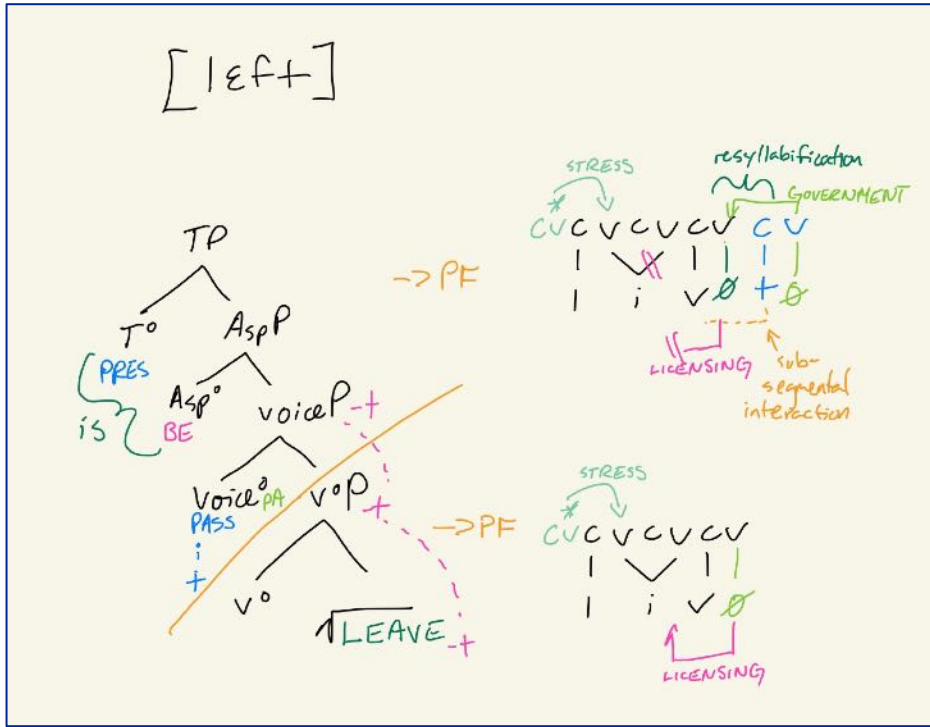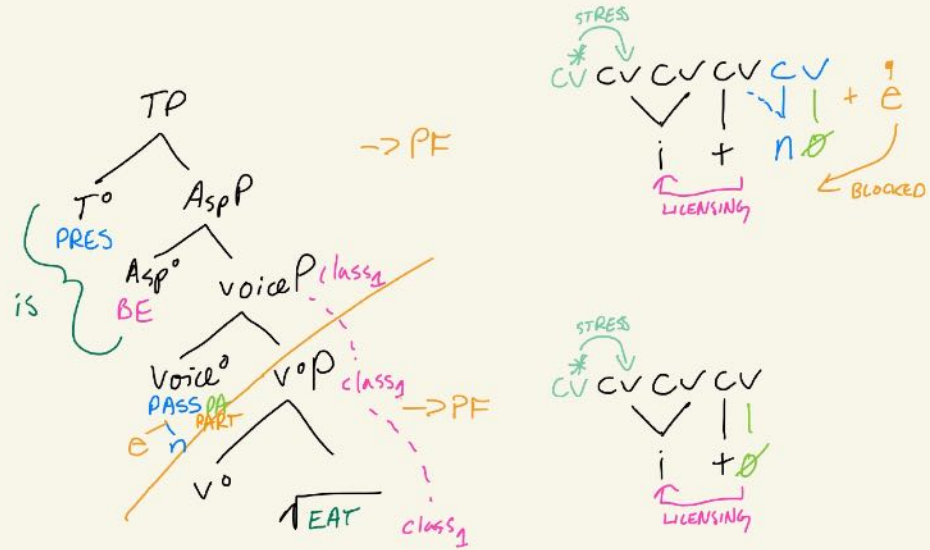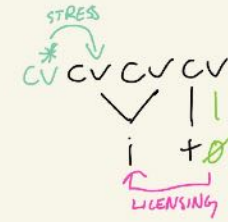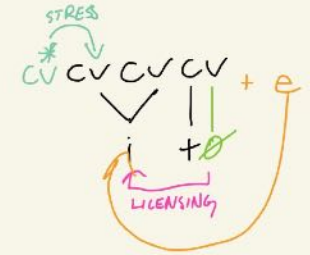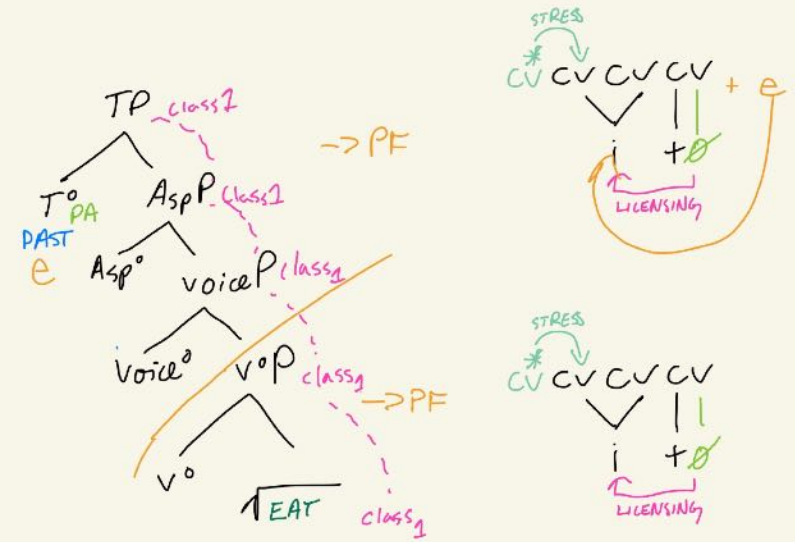
Weak verbs:
...Passive, Perfect,

Strong verbs: Class 1: Perfect...

- Strong Class 1 verb roots are specified for the –n suffix in the Perfect and Passive.

- There is a separate feature that is shared by the Passive and Perfect heads that triggers insertion of the –n suffix.
  - Let's call it PART (Bjorkman 2011:78, Embick 2003, 2004 ASP, Cowper 2005 PREC (for past & perf)). I have not indicated it in the trees either.

- Strong Class 1 verbs also have various segmental theme vowels tied to their Class marker.
  - These theme vowels are adjoined to the highest head that the verb root percolates its class feature to that contains the PA feature. This is $T^0_{[Past]}$ or the head where –n is realized.

- Phases are v^0P, voiceP, and CP.
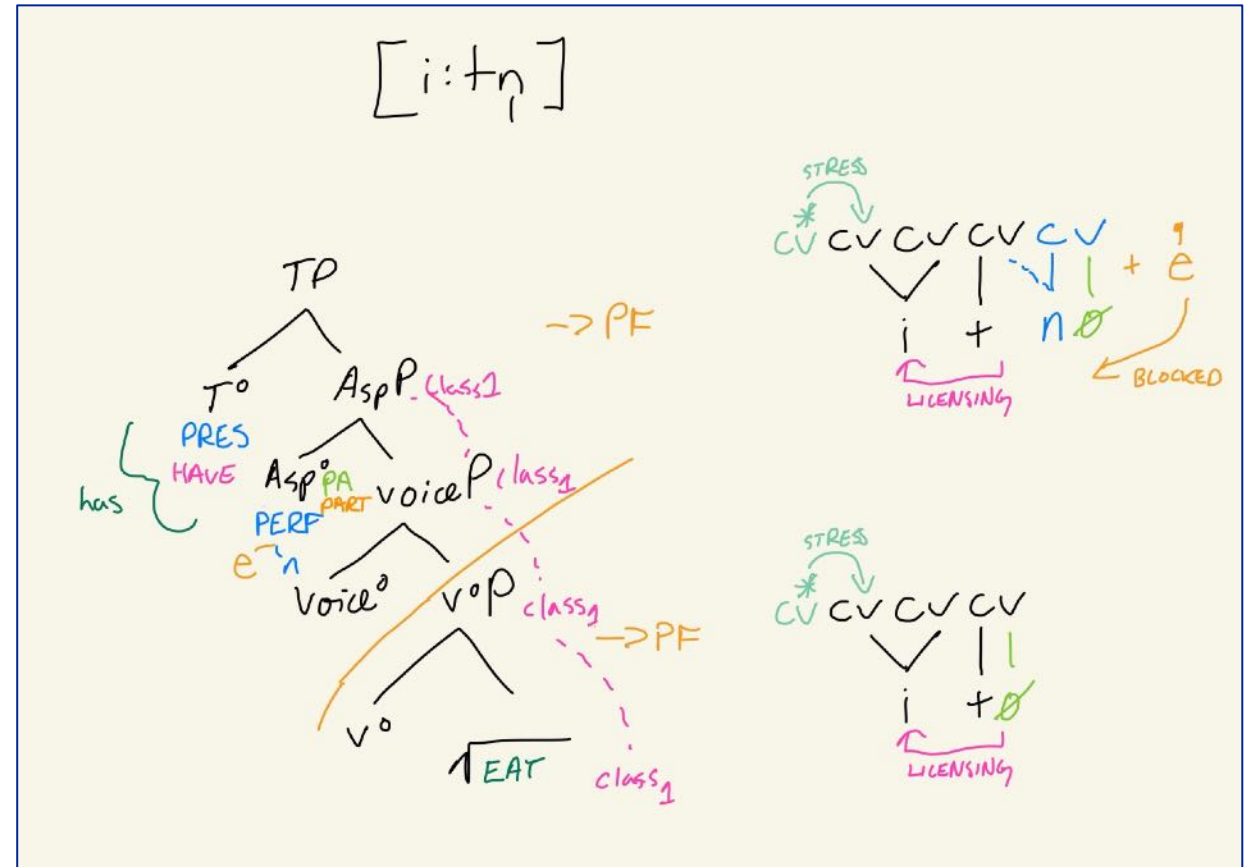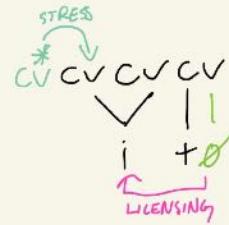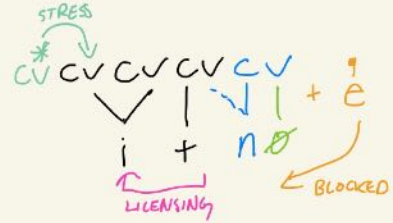
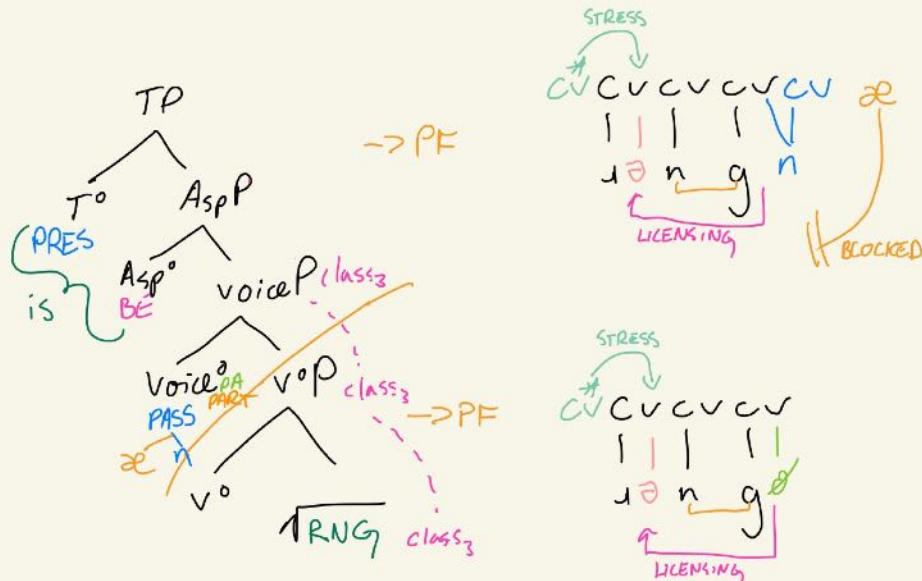Strong verbs: Class 1:
...Passive, Past

Strong verbs: Class 2: Past...

- Strong Class 2 verb roots are specified for the –n suffix in heads specified for PART.

- Strong Class 2 verbs also have a theme "vowel". It is a feature bundle with no root node.
  - This theme "vowel" is adjoined to the highest head that the verb root percolates its class feature to that contains the PA feature. This is $T^0_{[Past]}$ or the head where –n is realized.
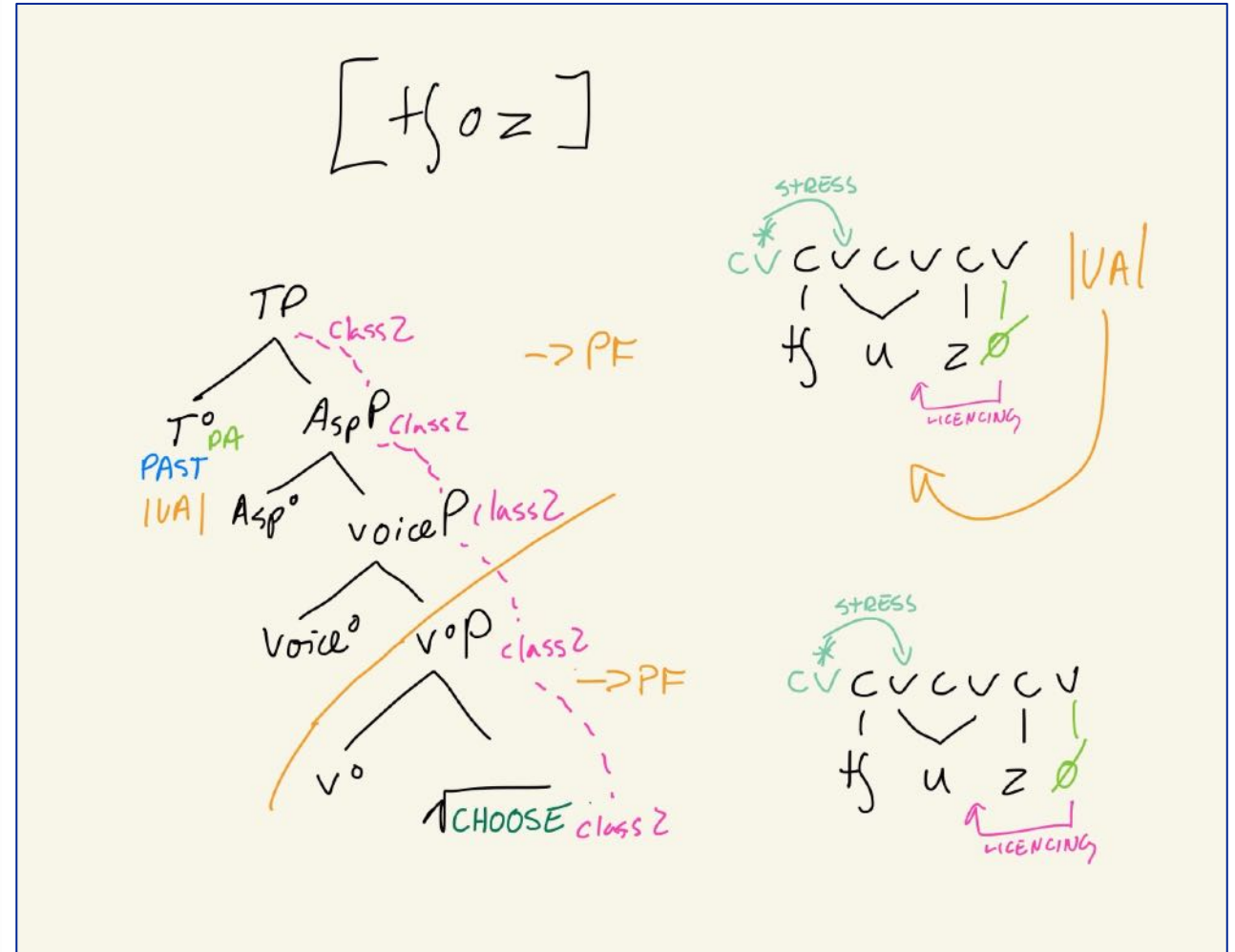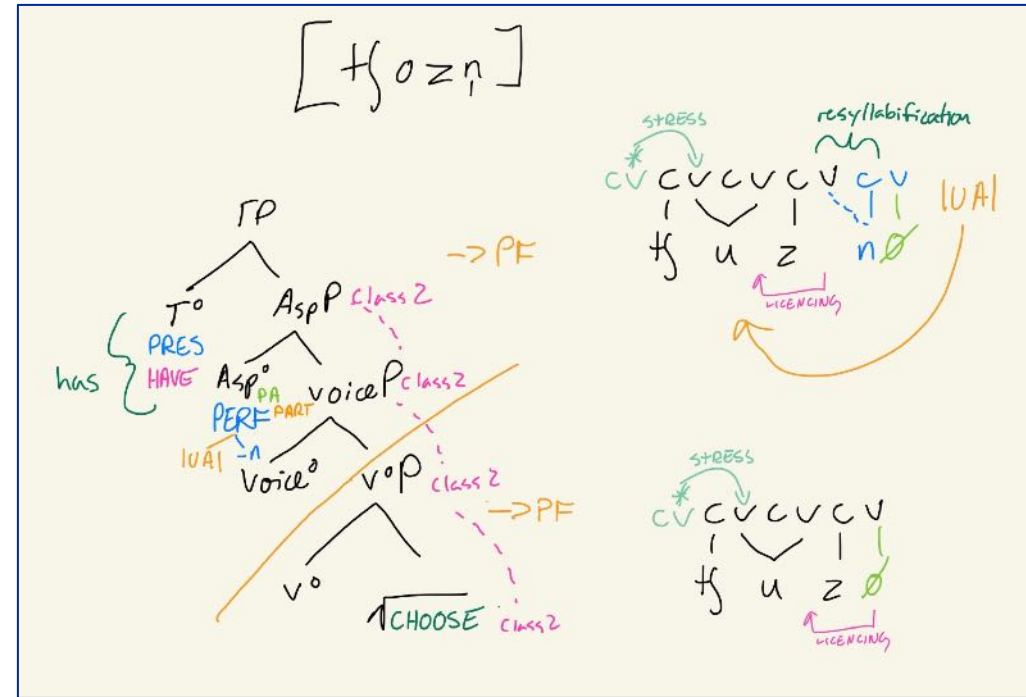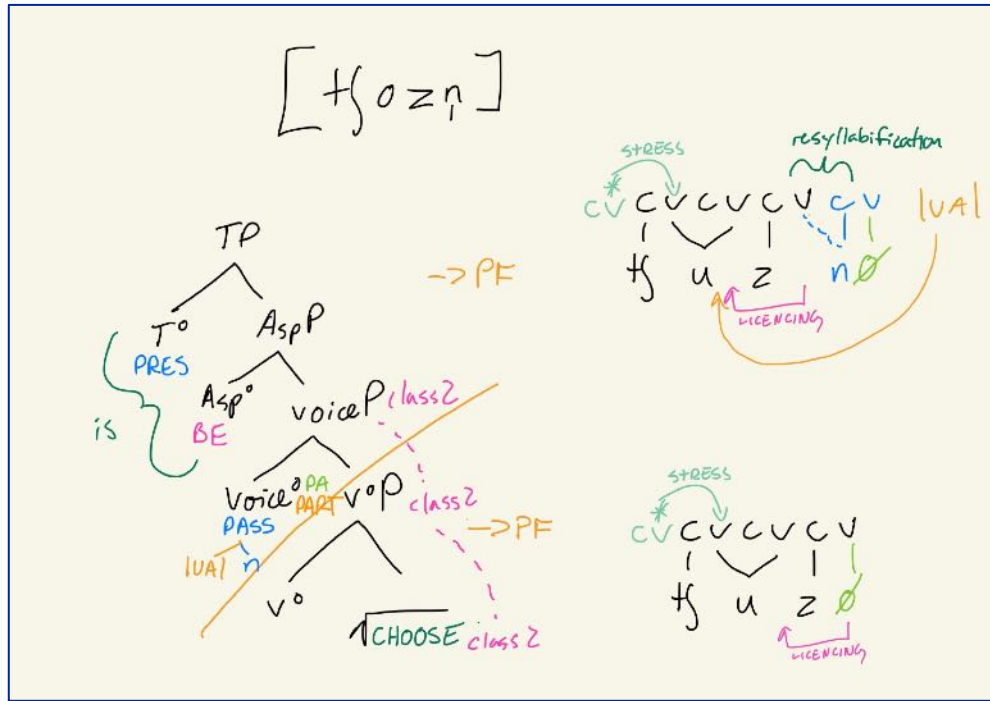
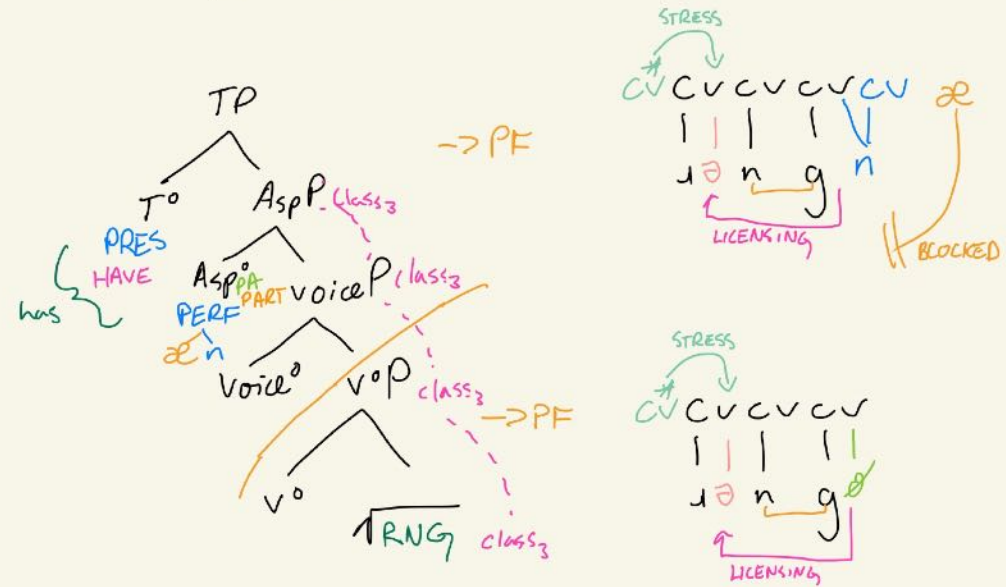# Strong verbs: Class 2:
...Passive, Perfect,

Strong verbs: Class 3: Passive, Perfect, …

- Strong Class 3 verb roots are specified for the –n suffix in the PA.
- Strong Class 3 verbs (may) also have a theme vowel conditioned by their Class marker.
  - This theme vowel is adjoined to the highest head that the verb root percolates its feature to, which may also be the head where –n is realized.
  - V-[ʌ]-[ʌ] verbs may have no theme vowel in the past (e.g. hang-hung-hung)

Strong verbs: Class 3: Present, Past ...

- In the -n forms, linking of the theme vowel is blocked.
- In the present, the theme vowel is inserted in the highest head that the root percolates its feature to : T^0 (e.g., *I ring doorbells*.)

Conclusions to Appendix 5

- Most English inflectional morphemes contain (or consist entirely of) floating phonological structure.
  - Note that in this account there is no -∅ Past Tense allomorph in the weak verb paradigm. All non-pronunciation of -t, -n, or ablaut is derived phonologically.
  - Many derivational affixes in English are also underspecified for syllabic structure (Newell 2021)

- As there is no PIC in the phonology, these underspecified morphemes will merge within the phonological structure of a previously computed phase.

- Feature percolation/agree is also proposed to cross phase/local boundaries.

- The 'double exponence' in the PA system is cross-linguistically 'normal' if ablaut the realization of Thematic vowels.

- We do not need 'pruning' (Embick 2010) to capture allomorphy across null morphemes.