Linguistics 404: Class Lecture Notes No.2
Some token data on Morphophonology
Chapter 10

**Phonological Overview (IPA)**

| Table of English Consonants, DJPD16 p.x | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | bilabial | labio -dental | dental | alveolar | post -alveolar | palatal | velar | glottal |
| plosive | p b | | | t d | | | k g | |
| affricate | | | | | tʃ dʒ | | | |
| fricative | | f v | θ ð | s z | ʃ ʒ | | (x) | h |
| nasal | m | | | n | | | ŋ | |
| lateral approximant | | | | l | | | | |
| approximant | w | | | | r | j | | |

See Ling 417 link to IPA /Phonology
http://www.csun.edu/~galasso/Ling417LectureIExamReviewChapteronPhonology.pdf

**How does Phonology impact Morphology?**

**Automatic alternations:**

1. **Clitics:** Clitics get their own word stress/infrastructure
   (See class lecture notes # 1):

   a) [will] [not] > [won't] /i/ > /o/ (vowel backing)
   b) [do] [not] > [don't] /u/ > /o/ (vowel lowering)
   c) [am] [not] > [ain't] /æ/ > /e/ (vowel raising)

2. **German devoicing** from singular to plural:
   tage /tagə/ (days) [+pl] > tag /tak/ (day) [-pl]

3. **Assimilation** past tense: {-ed}: /d/ (played), /t/ (cooked) , /Id/ (wanted)
/ple: d/ /kúkt/ /wantId/

{s}: /s/ (books) /z/ (cars) /Iz/ (boxes)

Stem change via assimilation:
wife > wives (regressive)
/wayf/ > wayfs/ > /wayfz > /wayvz/

4. **English: Historic 'Regressive Assimilation'**/umlaut-vowel change:
foot > feet (via fúti). goose> geese, tooth > teeth, mouse > mice

5. **German Vowel change**:
German: mutter (mother) [-pl] > mütter [+pl] (back to front vowel)

6. **Vowel Change**:

| | |
|---|---|
| | High to low vowel: |
| Child /ay/ > Children /ɪ/ | /ay/ > /ɪ/ |
| | Mid vowel to front |
| brother /^/ > brethren /ɛ/ | /^/ > /ɛ/ |

7. **Base modification**: Voicing:

| Noun | Verb | |
|---|---|---|
| belief | > believe | /f/ > /v/ |

/f/ and /v/ were *allophones* in Old English depending on position:
E.g., 'ofer' was pronounced 'over' : /f/ [-voice] allophone became [+voice] /v/ when /f/ was placed between vowels. Final position 'Devoicing' like German final consonant /g/ > /k/ /tagə/, (days)) ( /tak/ (day)).

[-Voice] > [+Voice]

| Noun | Verb | |
|---|---|---|
| thief | > thieve | |
| bath | > bathe | Vowel raising/voicing: |
| | | /æ/ > /e/ , /θ/ > /ð/ |
| house | > house | /s/ > /z/ |

| singular | > plural |
|---|---|
| wife | > wives (via assimilation) |
| knife | > knives |
| wolf | > wolves |

8. **Stress** (stress shift) Does stress shift modification: Adj+N, N+Adj?

| Trochaic | Iambic | |
|---|---|---|
| (Noun) | (Verb) | boat-house (a kind of house) (Eng = trochaic) |
| ínsùlt | ìnsúlt | house-boat (a kind of boat) |
| díscoùnt | discount | moulin rouge (French mill red) (Fr = iambic) |

Eng /sófə/ Fr. /sòf^/

[bláckbìrd] vs [bláck] [bírd] : stress marks word boundary
[Tóy [cár-crusher]] vs. [[tóy-càr] crusher]

9. **compounding**: vowel lowering
[V break] [N fast] > [N breakfast] /e/ > ɛ/, /æ/ > /ə/

Loss of word stress w/ schwa [__fəst]

10. **Morphological change** /language change via phonological error:
[a [napron]] > [an [apron]], [a [norange]] > [an [orange]]

11. Trisyllabic shortening (lowering)

| | | |
|---|---|---|
| nation | > national | /e/ > /æ/ |
| extreme | > extremity | /i/ > /ɛ/ |
| divine | > divinity | /ai/ > /ɪ/ |

12. /b/ /p/ alternations: (historic language change)

| | | |
|---|---|---|
| lab-ial | tab (bill) | grab |
| lip | tip | grip |

13. /p/ /v/ alternations:

| | |
|---|---|
| april | open |
| avril (French, april) | ovrir |

14. /b/ /v/:
haben (german, old English)
have

/f/ > /v/ [-Pl] > [+Pl]
safe (Noun, adj) wife > wives
save (Verb)

/t/ > /d/ /t/ > /d/ (flap)
Eat fat >
Edible fatter /fædr/

/k/ > /č/ drink > drench, stink > stench

**Notes from syllabus, Case study No. 2**

· Word Stress Compounding: Ch. 2, p. 18

--e.g., Trochaic (English: /sófə/) vs. Iambic (French: /sòf^/) **Case study 2:**

--e.g., [[Tóy] [cár-crùsher]] vs. [[Tóy-càr] [crùsher]] **From stress to Headedness**

--e.g., [v break] [n fast] => [n breakfast] (final-vowel reduction/schwa)

--e.g., English 'house-boat' ((a kind of boat) trochaic = /modification initial)

--e.g., French 'Moulin rouge' (mill red, (= red mill)) iambic = /modification final)

· Phonetic Bootstrapping Hypotheses in Word Segmentation Lecture

· Base modification. Ch.3, p. 35

· Stem allomorphy Ch.10, p. 212

-- e.g., 'wife => wives', 'breathe => breath'

· Vowel lowering e.g., 'national => national' p. 213

· Morphemes & Allomorphs (Tense, Agreement, Genitive inflections). Ch.2, p. 22

· Note on Final 's': morpho {s} vs. phonetic /s/ ;

--e.g., /spiks/ (speaks) vs /fɪks/ (fix).

· Constituency through movement Ch. 1, p. 8

--e.g., [bláck] [biŕd] vs [bláckbird] => (bi-stress = two-words) Ch. 9, p. 192

(bi-stress) vs. (single-stress)

· Clitics as part of phonetic word boundary Ch. 9, p 197

--e.g., #[can't]#he? vs *[can]#[not]#he? => [can]#he#[not]?

# The (American) English Sound System

### 13.1a IPA Chart Consonants: Place & Manner of Articulation

| | bilabial | labio-dental | inter-dental | alveolar | palatal | velar / glottal | |
|---|---|---|---|---|---|---|---|
| **Plosives**: | | | | | | | |
| [+voiced] | b | | | d | | g | |
| [-voiced] | p | | | t | | k | |
| **Fricatives**: | | | | | | | |
| [+voiced] | | v | ð | z | ž | | |
| [-voiced] | | f | θ | s | š | | h |
| **Affricates**: | | | | | | | |
| [+voiced] | | | | | ǰ | | |
| [-voiced] | | | | | č | | |
| ***Nasals**: | | | | | | | |
| [+voiced] | m | | | n | | ŋ | |
| ***Liquids:** | | | | l r | | | |
| ***Glides**: | w | | | | y | | |

***Syllabic Nasals** and **Liquids.** When nasals /m/, /n/ and liquids /l/, /r/ take on **vowel-like properties**, they are said to become **syllabic:** e.g., /ḷ/ and /ṛ/ (denoted by a small line diacritic underneath the grapheme). Note how token examples (*teacher*) /tičṛ/, (*little*) /lIt ḷ/, (*table*) /tebḷ/ (vision) /vIžṇ/, despite their creating syllable structures [CVCC] ([CVCC] = consonant-vowel-consonant-consonant), nonetheless generate a bisyllabic [CVCV] structure whereby we can 'clap-out' by hand two syllables—e.g., [ [/ ti /] [/ čṛ /] ] and [ [/ lI /] [/ tḷ /] ], each showing a [CVCC$^{v}$] with final consonant [C$^{v}$] denoting a vocalic /ṛ/ and /ḷ/ (respectively). For this reason, 'fluid' [-Consonantal] (vowel-like) **nasals, liquids** (as well as **glides**) fall at the bottom half of the IPA chart in opposition to [+Consonantal] **stops**.

**13.1b IPA American Vowels** **Diphthongs**

| | front: | | back: | |
|---|---|---|---|---|
| high: | i | | u | ay |
| | I | ə | U | oy |
| | e | ^ | o | au |
| | ε | | * ] | |
| low: | | æ | | |
| | | | a | |

**13.1c Examples of IPA: Consonants**

| | | |
|---|---|---|
| / b / ball, rob, rabbit | / d / dig, sad, sudden | / g / got, jogger |
| / p / pan, tip, rapper | / t / tip, fit, punter | / k / can, keep |
| / v / vase, love | / z / zip, buzz, cars | / ž / measure, pleasure |
| / f / fun, leaf | / s / sip, cent, books | / š / shoe, ocean, pressure |
| / ð / the, further | / l / lip, table, dollar | / č / chair, cello |
| / θ / with, theory | / r / red, fear | / ǰ / joke, lodge |
| / w / with, water | / y / you, year | / h / house |
| / m / make, ham | / n / near, fan | / ŋ / sing, pink |

**Note*: Many varieties of American English cannot distinguish between the '*open-'O'* vowel /Ɔ / e.g., as is sounded in caught /kƆ t/ vs. /a/ as in cot /ka: t/. For this reason, I overlap the /a/ vowel for both low back vowels and extend it to words sounding like *pot, cot, father*, etc.

| **Vowels :** | | **Diphthongs:** |
|---|---|---|
| / i / see | / u / you | / ay / eye |
| / I / indian | / U / book | / oy / toy |
| / e / say | / o / go | / au / couch |
| / ε / head | */ ]/ caught | |
| / æ / cat | /a/ pot cot | **Schwa:** / ə / sofa / ^ / cup |

**IPA Examples (Broad Transcription):**

(1) / ay θIŋk ðə kæt wIθ ðə hæt wIč lIvz an ðə mæt Iz may frɛnd for layf /
( I think the cat with the hat which lives on the mat is my friend for life )

(2) / wi lIŋgwIs wIš tu spik əbaut way studIns mek grəmætIkl̩ mIsteks/
(We linguists wish to speak about why students make grammatical mistakes)

**13.1d The Great Vowel Shift in English**

As part of our general discussion into language variation and change, we turn here to briefly comment on the nature and extent of how the English sound system has undergone a systematic change, as witnessed by shifts in English pronunciation of vowels over time. The greatest example of how phonology has changed in English—and an example consistent with notions of how adjustments of internal representation affect parametric phonological rules (the Principles & Parameters Theory)—is the classic (Pre-)Elizabethan 'Great Vowel Shift'. We say the change was 'systematic' here because it was not simply one vowel that changed over time, but rather, it was one singular change that brought about a 'domino effect' whereby the entire vowel paradigm shifted—as understood by the vowel chart presented in (13.1b) (restated below). There is still at best only speculation as to why the shift came about in the first place: though exactly what started the shift is unknown, as linguists, it is always safe to say as a general rule that since language is a living organism, like all other biological systems, language is prone to change, sometimes abrupt change. However, what is of interest to us here is that the shift was not random, but rather systematic when understood via the IPA vowel chart. As a general descriptive rule (and not without some nontrivial exceptions, e.g., potential 'lowering' and not 'raising' from /u/ to schwa /ə/, (e.g., *cup*) etc.) the shift can be expressed by stating that all phoneme representations moved upward: both front and back vowels became displaced by skipping up one or sometimes two vowel slots in the paradigm. As one vowel then acquired a new mental (parameter) representation, this in turn caused the upper next neighboring vowel to likewise shift (whereby the overall maintenance of the paradigmatic relation was preserved). Regarding this upward shift, note how the upper most (or high) front and back vowels have nowhere to move, (as there is no remaining upper slot)—hence, the upper vowels resort to 'diphthongization'.

Consider the vowel shifts as understood by the IPA charts:

(3) **IPA Shift of Vowels**

**Diphthongs**

| Front shift | Back shift | |
|---|---|---|
| → ay | au ← | ay |
| (i) i | (i) u | au |
| ↑ | ↑ | |
| (ii) e | (ii) o | |
| ↑ | | |
| (iii) ɛ | | |
| ↑ | | |
| (iv) a | | |
| | | |

**Some Pronunciation shifts: Middle Pre-Elizabethan to Modern English**

(4)

| Front | Back |
|---|---|
| (i) wine: /win/ → /wayn/ | (i) house: /hus/ → /haus/ |
| mice: /mis/ → /mays/ | mouse: /mus/ → /maus/ |
| (ii) meed : /med/ → /mid/ | (ii) root: /rot/ → / rut/ |
| geese: /ges/ → / gis/ | goose: /gos/ → /gus/ |
| (iii) clean: /clɛn/ → /clen/ → /clin/ | (iii) name: /namə/ → /nɛm/ → /nem/ |
| break: /brɛken/ → /brek/ | |

## 13.2 Sounds and Rules: Matrix Distinctive Features and Assimilation

One major consequence that has come out of the Chomskyan revolution in linguistics has to do with the acknowledgement that sounds in a given language are essentially built-up out of a matrix of smaller phonological features, and that such features, much like how the chemist understands the periodic table of elements, can combine to create a phoneme. The very notion of breaking-up features and combining them to making speech sounds widely differs from a potential Skinnerian approach that would hold that speech is simply rote-learned by-products of environmental sounds and is essentially non-rule-based. Returning to the Chomsky vs. Skinner debate just for a moment, perhaps one of the more important aspects of how one is to define language and its function, as based out of the Chomskyan revolution, is the understanding that language is essentially built-up out of rules. This rule-base analogy can be uncovered at each of the sub-

levels of language, as presented in this text, from (sound-based) phonology, to (word-based) morphology, all the way up the chain to (sentence-based) syntax. In phonology—and this is by no means an exhaustive list—the matrix comes to include distinctions based on the entire gamut of **phonological distinctive features**—e.g., (C)onsonants include: *place/manner of articulation, voicing, lateral, coronal, nasal,* etc. The main features that have been presented in this text center around traditional notions of place/manner and voicing, but as you can see, there are many more such features involved with producing sound. For example, the lateral feature refers to the sound made when the air is pushed to flow alongside both sides of the tongue (as in the voiced, palatal liquid phoneme /l/, which distinguishes it from the voiced, palatal liquid phoneme /r/ in forming potential minimal pairs). This essential handyman's toolbox of matrix sounds allows us to deconstruct sounds in a language and divulge their inner workings. One can see this important bi-product of the matrix when examining a phonological process termed **Assimilation**.

***Assimilation.*** Assimilation is defined as a rule-based phonological process that changes feature values of segmented sounds in order to make neighboring phonemes sound more alike. In other words, it is a matrix-based phonological rule that pushes a sound to resemble its neighboring sound: the notion of *neighboring* suggests there to be an *adjaceny condition*. For all intents and purposes, there is such an adjacency condition (though see constraints on assimilation below). The best way to describe the inner trappings of assimilation is to demonstrate what happens when, for example, a voiced consonant /r/ sits alongside a voiceless consonant /s/ as in the word *cars*, an [ /r/ + /s/ ] adjacency:

(5) e.g., [/C/ [+voice]] + [/C/ [-voice]] as in /r/, /s/… (e.g., *cars*)….
...the plural marker /s/ becomes a voiced /z/: e.g., (cars) /s/ → /z/ (karz/.

Consider the distribution following such assimilation below:

(6) (a) /s/ → /s/ (when adjacent to /p, t, k, f, θ/ [-voiced consonants]: *spay, stay, kicks, fifths*
(b) /s/ → /z/ (when adjacent to /b, d, g, ð, m, n, ŋ, l, r, y/ [+voiced consonants]: *tom's, bids, bugs, teethes*

Applying the above adjacency rules of assimilation, consider the resulting effects of the words below:

(c) [Nouns] *Cars, Boys, Dimes, Cans,* [Possessives] *Tom's, Dan's,* [Verbs] *Sings, Buys, Wears,* [Preposition] *of,* etc.

What one finds in their production is that there is a systematic voicing of the /s/ phoneme in all the examples above: e.g., *cars* => /karz/, *boys* => /boyz/, *dimes* => /daymz/, etc. The voicing rule applies as follows: [[-voiced], C] => [[+voiced], C] when preceded by a [+voiced], (C)onsonant]. Hence, /s/ becomes /z/ when preceded by /r/, /m/, /n/, etc. Of course, since the (V)owel is inherently [+voiced] by definition (as in the word *boys*), the same assimilation rule applies.

Consider briefly the mechanics of assimilation (*cars*) whereby /s/ → /z/ :

(7) /ka [r s ]/ → /ka [r z ]/

Rule: [-voiced (C)] → [+voiced (C)] / [+voiced (C)] ___
/s/ /z/ (car s)

The rule in (7) states that a minus voiced segment becomes plus voiced ( / in the environment of) when the preceding segment is voiced. (This rule of assimilation applies to plural, tense and case morphemes).

Note how the preceding [+voiced /r/] above influences the otherwise unvoiced [-voiced] /s/ and changes it to [+voiced] /z/. The same mechanics equally apply to the **plural** nouns *boys* /boyz/, *dimes* /daymz/, and *wives* /wayvz/, as well as to the **tensed** verbs *drives* /drayvz/, *plays* /ple:z/ and *wears* /wɛrz/, as well as to possessive **case** nouns *Tom's* /tamz/, *Bill's* /bIlz/, etc. Often, entire words without bound morpheme segmentation likewise undergo assimilation. Consider some token examples below:

*of* /ʌv/, *is* /Iz/, *these* /δiz/, *teethe* /tiδ/ (as compared to *teeth* /tiθ/).

This analogy now opens up a new way of uncovering why and how certain irregular verbs changed their phonological representations over time (as seen in examples such as *keep* > *kept*, *sleep* > *slept*, *weep* > *wept*, etc.) (See **Allophony and Phonological Change** below for an account of *keep* to *kept*).

**Constraints on Assimilation**

I would like to offer here two basic phonological constraints on assimilation. Firstly, assimilation never seems to cut across **syllable boundaries**. Secondly, assimilation never seems to cut across **word boundaries**. Let's take each respective constraint in turn.

***Syllable Boundary Constraint.*** The IPA symbol that is used to indicate a syllable boundary is /$/. Picking up where we left off regarding the adjacent assimilation from /r s/ to /r z/ as in *cars* /karz/, note how adjacent assimilation does not cross over the syllable boundary and effect the /r s/ within the word *Carson* /kars^n/ (/CVC-$-CVC/)

(8) (a) / k a r $ z ʌ n / →(8) (b) / k a r $ s ʌ n /

(no assimilation applies)

Note how the word *cars* /karz/ (/CVCC/) constitutes a single syllabic boundary (with a single vowel insulated between two consonants) and therefore permits adjacent assimilation of the final consonant cluster. *Carson* on the other hand is bi-syllabic and thus breaks down any adjacency of assimilation. In this instance, assimilation doesn't seem to cut across syllable boundaries.

***Word Boundary Constraint.*** The IPA symbol that is used to indicate a word boundary is /#/. Keeping to our '**/r/-influenced /s/-to-/z/'** example above, consider the complete sentence below and note how assimilation is apparently blocked from crossing word /#/ boundaries:

(9) (a) The teacher zits…. →
/ ðə # tič ṛ # z I ts /
/r/ /z/

(no assimilation applies)

(9) (b) The # teacher # sits….
/ ðə # tič ṛ # sIts /

(See endnote regarding how such knowledge forms the core of the **phonological bootstrapping hypothesis** which allows infants to eventually segment words from their ambient speech stream).

**13.2.1 Allophony and Phonological Change**.

Other examples of assimilation can be found in what is termed allophony. **Allophony** is defined as a variant of a phoneme. An allophone doesn't have the capacity to form **Minimal Pairs** in a language, as they are simply a variant (i.e., a slightly different nuance of the target sound) based on the actual phoneme. (See Minimal Pairs in this section below). Keeping to our historical treatment of phonology, consider below how allophony initiated an eventual phonological and consequent orthographical change as represented in the OE word *ofer* /ofer/ meaning 'over'. In Old English (OE) (499-1066 c.e.), there was only one phoneme /f/, with an allophonic variant of /v/ [+voiced] when /f/ occurred between vowels. As was discussed above, this is a process of assimilation: viz., since all vowels by definition are voiced, the adjacent consonant becomes voiced.

(10) 'ofer' → /ovər/ in pronunciation.

Other examples can be dug up from OE with similar results. For example, consider why the stem *wife* /wayf/ might have changed to *wives* (particularly given the case that the final /e/ would have been pronounced as it preceded the plural {s} /z/)

(11) /f/ → /v/ (in the environment of [+voiced]).

What we have here above is the spelling out of *phonological rules* whereby a phoneme changes due to its environment (e.g., as a result of assimilation). The

rules can be spelled out as involving a target phoneme (proceeding the arrow__→ as the phoneme prior to change), the resulting new phoneme (following the arrow →___) representing the change, and a forward slash / and line ___ indicating the type of environment and position (respectively) in which the change takes place.

For example, consider the rules below with (12a) showing the change of an {in-} prefix (with the meaning 'lack of' or 'not') to {im-} due to phonological conditions and (12b) showing change of voicing of /f/ to /v/. Nasals which are voiced by definition may take on voiceless allophonic qualities /n̥/, /l̥/ due to the preceding adjacent consonant (12c):

(12) (a) Rule: alveolar nasal → bilabial nasal / _____bilabial
Examples: Inhospitable /ɪn/ Impossible /ɪm/
Infrequent Impure

(b) Rule: fricative [-voiced] → ficative [+ voiced] /_____[+voiced](C)
Examples: wife /wayf/ wives /wayvz/

(c) Rule: liquid/nasal [+voiced] → liquid/nasal [-voiced] /[-voiced](C)___
Examples: now /no: / snow /sn̥o: /
lace /le: s/ place /pl̥e: s/

Finally, a fine example of where assimilation of phonology affects the morphological level (allomorphy) can be found in the English Past Tense system. Notice how the /d/ of the {ed} morpheme takes three variant sounds.

(13) Assimilation affecting Past Tense {ed}:

| | | |
|---|---|---|
| | /d/ | /ple: d/ (played) |
| {ed} | /t/ | /k ʊkt/ (cooked) |
| | */Id/ | /wantId/ (wanted) |

*(*Note:* Regarding child phonology, the /Id/ is the **default** choice whereby young children (up until early school age) often say 'cleaned' /klinId/, 'cooked' /kUkId/, 'played' /ple: Id/, 'slept' /slipId/, and even over-generated forms such as 'seed' (past tense of see) /siId/, 'goed', 'wented', etc.).

### 13.2.2 Grimm's Law and Phonological Change

Picking up on the above theme (12b) regarding /f/ >/v/ early allophony, a similar process is found in what has been called Grimm's Law (so named after the (authors) Grimm brothers who first discovered morpho-phonetic correlations between Old English (Germanic) and other Indo-European Languages (IE(L)). The law seeks to ascertain how the (Germanic-based) OE sound system was first derived from IEL. The English phoneme /f/ is a good place to start. The IE /p/ as found in the word /pater/ (*father*) underwent an evolutionary sound change (as based on Grimm's Law) whereby /p/ became /f/. In fact, there is an entire

systematic paradigm shift having to do with consonants that is on a par with what happened to the vowels during the Great Vowel Shift.

Consider below some of the more familiar regular shifts as represented by Grimm's Law:

(14) Some examples of Grimm's Law.

| | | | | | | |
|---|---|---|---|---|---|---|
| **Proto-Indo-European:** | /p/ | /t/ | /k/ | /b/ | /d/ | /g/ |
| **Germanic/English:** | /f/ | /θ/ | /x/ | /p/ | /t/ | /k/ |

| | **Latin** | → | **English** | | | |
|---|---|---|---|---|---|---|
| (15) **Examples:** | (i) /p/ | → | /f/: | pater | → /faðər/ | (*father*) |
| | (ii) /t/ | → | /θ/ : | tres | → /θri/ | (*three*) |
| | (iii) /k/ | → | /h/: | canis | → /haund/ | (*hound*) |
| | (iv) /b/ | → | /p/: | labium | → /lIp/ | (*lip*) |
| | (v) /d/ | → | /t/: | duo | → / tu/ | (*two*) |
| | (vi) /g/ | → | /k/: | ager | → /ekər/ | (*acre*) |

## Phonological Change

Let's now turn to the irregular verb class of *kept*, *slept*, *left*, etc. This verb class, which, keeping to historical continuity, should have also partaken in the past tense /d/ formation, began to take on other phonological representations based on assimilation. Using the same phonological processing mechanisms as discussed above, what we can say about the above words is that the final [-voiced, (C)] (/p/, /f/ respectively) which would have preceded the [+voiced] {d} for past tense forces an assimilation thus changing the /d/ into a voiceless /t/. In effect, the verbs should rightly be spelled-out as *keep-ed* /kipd/, *sleep-ed* /slipd/, etc., but as we can see, assimilation has run its course.

***From 'Keeped' to 'kept'.***As a quick study, it's instructive to look at one verb in particular and trace its development and change throughout the aforementioned Great Vowel Shift and other morph-phonological processes. In many ways, the example of the Modern English (ModE) (1500-present) verb 'keep' is instructive and may provide some interesting insights into possible accounts of language change.

Beginning in Old English (OE) (449-1066c.e.) and leading into early Middle English's (ME) (1066-1500c.e.) *'Pre-Great Vowel Shift*', long vowels in certain environments (due to vowel/consonant sequences and stress) were shortened (a process called **vowel shortening**). The verb 'keep' (OE infinitive ('cepan' /kepan/) falls under this account of vowel shortening—e.g., /e: / > /ɛ/ as in 'kept' /ke: pt/ > 'kept' /kɛptə/ potentially due to the final consonant past tense marker. (Typically, in ME, long vowels were shortened when they were followed by two or more consonants).

After this vowel shortening took hold, the contrasting phonologies of the two stems in Middle English would have become ‘kep’ /ke: pə/ (present tense) > ‘kepte’ /kɛptə/ (past tense) whereby the shortening only affected the second word of the ModE pair ‘keep’ vs. ‘kept’. After this shortening took hold, leading up to the ME period, the Great Vowel Shift readjusted the unaffected vowel in the first word of the pair (‘keep’ /ke: p/) and raised the vowel /e/ to /i/, rendering OE/ME /ke: p/ to ModE /ki: p/.
(But note how the word *freak* /fri: k/ doesn’t change into past tense *freaked* /frɛkt/ as does *keep* into *kept*. Other factors might be at play here questioning e.g., at which period the word entered into the language, etc. It may very well be that *keep* is an older word which has gone through the various periods of language change, as opposed to the word *freak* which is a relative newcomer.)

There are two possible accounts for why the ModE second word (marked for past tense) equally did not raise as part of the vowel shift. It is in this context that we can explore how regular vs. irregular morpho-phonological processes might affect potential change, as determined by how each are independently stored in different parts of the brain (The Dual Mechanism Model as advanced herein).
Let’s trace the vowel from OE below:

(16) ***Old English ‘Keep’*** Ic cep-e (/ke: p- ə/, infinitive (cepan) = ‘I keep’
(with ‘cep’ acting as the stem, with the final particle /e/ reduced as an unstressed schwa).

Having /ke: p/ as the original infinitive stem, the past tense formation of {d}—referred to as the weak verb class tense marker and already quite pervasive in OE, becoming the default past tense marker by ME—took the stem and added the {d} marker resulting in the base form /ke: pd/ (OE cepte). Though of course, as shown in OE ‘cepte’, what we now know about assimilation with the adjacent /p/ and /d/ undergoing assimilation, eventually the final /d/ became voiceless, becoming /t/. What is interesting to us here is the idea that it was the irregular verb pronunciation (the second word of the pair that came about via vowel shortening) that seems to have been unaffected by the subsequent Great Vowel Shift, leaving untouched the irregular /kɛpt/ but getting a hold of what would have been the regular stem’s phonology /ke: p/: viz., raising the low vowel /e: / to the high vowel /i/.

What we might argue for here is that this is an instance of an irregular stem being **phonologically frozen** in time due to the fact that it became part and parcel of an idiomatic, rote-learned item, and hence stored as an associative sound-memory chunk (that part of the brain not open to rule-based formation, such as the vowel shift). Given that idiomatic irregulars are not prone to the same kinds of pressures regarding rule-based formations and processing, they escaped any influence of historical paradigmatic shift otherwise open to ‘rule-based’ items. In other words, as opposed to idiomatic/sound-memory irregular stems, rule-based regular stems were not protected from change and as a result were vulnerable to the vowel shift of the later ME period. Though many of the subtle details regarding OE/ME phonology and phonological change are still unclear to us, this

sort of argument, if correct, would provide one more piece of evidence in favor of the Dual Mechanism Model as advance herein.

***Autosegmental Phonology***. Auto-segmental Phonology is a phonological theory that states that phoneme adjacency is not entirely based on approximation (or strict adjacency), but rather that phonological adjacency is determined by hierarchical class—for instance, *vowel adjacency* make work on a level whereby consonants are skipped over (V_ [C] _V), and likewise, consonant adjacency may work on a level whereby vowels are skipped over (C_ [V] _C): such class adjacency (and not strict approximate adjacency) is what is behind the term **Vowel** or **Consonant Harmony**. It is said that this new phoneme-class adjacency, as proposed by auto-segmental phonology, works on a *tier* relationship: the idea being that only vowels interact with other vowels, and consonants with other consonants. To understand this better, it is instructive to ask how phonetics and phonology were earlier considered, particularly in the context of assimilation which is said to be a phonological rule sensitive to phoneme adjacency—viz., the fact that two neighboring sounds may influence each others distinctive feature composition). Some examples of autosegmental phonology are captured in the following sections, specifically having to do with *Umlaut*, and Child Language *Consonant Harmony* (§13.3).

***Umlaut.*** Considered as a form of assimilation, umlaut processes have shaped English morphology over time. In earlier treatments of the word *goose* (g*ō*s, g*ōs*i '*geese*'), the plural marker {/i/} undergoes **retrograde assimilation** by affecting the initial vowel of the /CVC/ stem. The fact that the final vowel /i/ seems to affect the initial vowel, skipping over the medial consonant /t/, could be argued as an example of **autosegmental assimilation** as presented above.

(17) (*goose)* /gos i / (plural) > geese /gi: s/ whereby,
=> /o/ in g*ō*s → /i/ (as a result of retrograde assimilation),

(*mouse)* /mus i / (plural) > mice /may:si/, > /mays/ whereby,
=> /u/ in /mus/ → /ay/ (as a result of retrograde assimilation),

As shown in (17) above, the back high vowel /i/, which historically was a plural marker, assimilates (retrograde) with the front vowel replacing /o/, /u/ with /i/, /ay/ respectively. Other examples include (*lice*) /lusi/ → /lays/ whereby both umblaut as well as vowel shift affected the sound change: (i) Umblaut: /u/→ /i/, and (ii) Great Vowel Shift: /i/ → / ay/ (diphthong).

***Ablaut.*** Historically, the notion of vowel change was part of what was called **Strong Verb Class** in that there were certain classes of verbs which behaved as a unit, sometimes based on vowel/consonant sequences, stress, etc.

For instance, consider the class of verbs which undergo the vowel change /i/ >/e/ > /ʌ/:

(18) (i) sing>sang>sung
(ii) ring>rang> rung
(iii) swim>swam>swum

and sometimes by over-analogy of the '*ing>ang>ung*' sound pattern,

*(iv) bring>brang>brung.

The fact that children (and even young adults) might over-generate the *ing>ang>ung* sound pattern and say *bring>brang>brung* suggests that irregular word formations are indeed associative rote-learned.

**A Note on assimilation**

(19) **On wife > wives**: Note that a case marker suffix could have triggered regressive assimilation, such as an accusative inflection:

| (20) | NOM | | ACC | NOM to ACC in IPA: |
|---|---|---|---|---|
| | I | → | m e | /m/ + /ay/→ /mi/ |
| | (vowel change) | | | |
| | He | → | hi m | /hi/ + /m/ → /hIm/ |
| | (vowel change) | | | |
| | They | → | the m | /ðe/ + /m/ → /ðεm/ |
| | (vowel change) | | | |
| | Who | → | who *m* | /wu/ + /m/ →/wum/ |

wife > {m} > /wayfm/ > /wayvm/ since /f/ becomes [+ voiced] /v/ when between vowels:

/wayvəm/ > 'wives' /wayvz/ (wives)

**A Note on phonological bootstrapping.**

Well, such phonotactic knowledge of constraints might in fact lead a young child as early as 18months into forming the correct hypothesis about where a word ends and where a new word begins. Using similar phonological constraints on assimilation, consider how phonological **prosody** and/or **stress** might lead the child in gaining access to word formations.

(21) The teacher sits.
/ δ # tí čər # sɪ́ ts/

Note above the stress diacritics showing a reduced stress value for the functional word *the* (unstressed schwa /ə/) and an initial stress value for the two remaining lexical words *teacher* (stress initial) and *sits* (stress initial). Children seem to take such prosodic stress information and calculate (via tacit processing) where a previous word ends and where a new word begins, as it would be indicated by our word boundary (generated via syllable boundary).

This notion that children utilize phonology (via prosody and stress) to determine word has been termed the **Phonological** or **Prosodic bootstrapping Hypotheses.** Under these assumptions, a child would not entertain the incorrect hypothesis that the ambient speech input of ‘the teacher sits’ could be segmented as *‘thet eachers its’:

(22) *[The-t] [eacher-s] [its]
/ δ t # i ́čərs # I ́ ts/

This incorrect assumption about these two word boundaries doesn’t enter into the child’s bootstrapping due to two facts:

(i) The functional word ‘the’ is by definition unstressed. This removes the possibility that a CVC could be extended since there first must be a CV with vowel stress as part of a primary onset/rime structure.

(ii) This point above then secures for the child that whatever consonant that follows in the speech stream must be part of the next word since CVC (unstressed) has been eliminated from the equation. This in turn ensures that the /t/ of the next word ‘teachers’ correctly remains as the onset of the following word.

(iii) The ‘s’ could in theory attach to the end of [[teacher]s]( as with plural formations) but then *assimilation* would have to ensure. It doesn’t, forcing the child to assume correctly that the /s/ comes as the onset of the following word, as opposed to it making-up a complex coda of the previous word.