
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	ʒ	
[-voiced]		f	θ	s	ʃ	h
Affricates:						
[+voiced]					ʤ	
[-voiced]					ʧ	
*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., /ɫ/ and /ɾ/ (denoted by a small line diacritic underneath the grapheme). Note how token examples (*teacher*) /tičɾ/, (*little*) /lɪt ɫ/, (*table*) /teɪb ɫ/ (vision) /vɪʒŋ/, 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 /] [/ čɾ /] and

[[/ ɪ /] [/ t̩ /]], each showing a [CVCC^v] with final consonant [C^v] denoting a vocalic /ɪ/ and /ɹ/ (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
	ɪ	ə	oy
	e	^	au
		ε	*]
low:		æ	
		a	

13.1c Examples of IPA: Consonants

- | | | |
|---|--|--|
| / b / <u>b</u> all, r <u>o</u> b, r <u>ab</u> bit | / d / <u>d</u> ig, s <u>a</u> d, s <u>u</u> dden | / g / g <u>o</u> t, j <u>o</u> gger |
| / p / <u>p</u> an, t <u>i</u> p, r <u>ap</u> per | / t / <u>t</u> ip, f <u>i</u> t, p <u>u</u> nter | / k / <u>c</u> an, <u>k</u> ee <u>p</u> |
| / v / <u>v</u> ase, l <u>o</u> ve | / z / <u>z</u> ip, b <u>u</u> zz, c <u>a</u> rs | / ʒ / m <u>e</u> as <u>u</u> re, ple <u>a</u> s <u>u</u> re |
| / f / <u>f</u> un, l <u>e</u> af | / s / <u>s</u> ip, <u>c</u> ent, b <u>o</u> ok <u>s</u> | / ʃ / <u>sh</u> oe, <u>o</u> ce <u>a</u> n, p <u>re</u> ss <u>u</u> re |
| / ð / <u>th</u> e, f <u>ur</u> th <u>er</u> | / l / <u>l</u> ip, t <u>a</u> bl <u>e</u> , d <u>o</u> ll <u>a</u> r | / ʧ / <u>ch</u> air, <u>c</u> ello |
| / θ / w <u>it</u> h, <u>th</u> eor <u>y</u> | / r / <u>r</u> ed, f <u>e</u> ar | / ʤ / j <u>o</u> ke, lod <u>g</u> e |
| / w / <u>w</u> ith, <u>w</u> ater | / y / <u>y</u> ou, <u>y</u> ear | / h / <u>h</u> ouse |
| / m / <u>m</u> ake, h <u>a</u> m | / n / <u>n</u> ear, f <u>a</u> n | / ŋ / s <u>ing</u> , p <u>ink</u> |

**Note:* Many varieties of American English cannot distinguish between the ‘open-‘O’ vowel /ɪ/ e.g., as is sounded in caught /k]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 :

/ i / see

/ I / indian

/ e / say

/ ε / head

/ æ / cat

/ u / you

/ U / book

/ o / go

*/]/ caught

/a/ pot cot

Diphthongs:

/ ay / eye

/ oy / toy

/ au / couch

Schwa: / ə / sofa / ^ / cup

IPA Examples (Broad Transcription):

(1) / ay θɪŋk ðə kæt wɪθ ðə hæʔ wɪç ɪlvz ən ðə mæt ɪz maɪ frɛnd fɔr laɪf /
 (I think the cat with the hat which lives on the mat is my friend for life)

(2) / wi ɪŋgwɪs wɪʃ tu spɪk əbaʊt weɪ stʊdɪnz meɪ grəmətɪkəl mɪsteɪks /
 (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 no where 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

<u>Front shift</u>	<u>Back shift</u>	
→ ay	au ←	ay
(i) i	(i) u	
↑	↑	au
(ii) e	(ii) o	
↑		
(iii) ε		
↑		
(iv) a		

Some Pronunciation shifts: Middle Pre-Elizabethan to Modern English

(4)	<u>Front</u>	<u>Back</u>
	(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: /clen/ → /clen/ → /clin/	(iii) name: /namə/ → /nem/ → /nem/
	break: /bræken/ → /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 *adjacency 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*, *fiths*)

(b) /s/ → /z/ (when adjacent to /b, d, g, ð, m, n, ŋ, l, r, y/ [+voiced consonants]: *tom's*, *bids*, *bugs*, *teeths*)

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/ (ca r 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* /təmz/, *Bill's* /bɪlz/, etc. Often, entire words without bound morpheme segmentation likewise undergo assimilation. Consider some token examples below:

of /ʌv/, *is* /ɪz/, *these* /ðiz/, *teethe* /tið/ (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 ^ n/ → (8) (b) /k a r \$ s ^ 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.... → (9) (b) The # teacher # sits....

/ ðə # tič | ɹ | # | z | I ts / / ðə # tič | ɹ | # | s | I ts /

(no assimilation applies)

(See §13.5.4 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' → /ov̥ær/ 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 (preceding 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 /ŋ/, /l/ 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] → fricative [+voiced] / _____ [+voiced](C)

Examples: wife /wayf/ wives /wayvz/

(c) Rule: liquid/nasal [+voiced] → liquid/nasal [-voiced] / [-voiced](C) _____

Examples: now /no: / snow /sno: /
 lace /le: s/ place /ple: 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 uktt/ (cooked)
 */ɪd/ /wantɪd/ (wanted)

*(Note: Regarding child phonology, the /ɪd/ is the **default** choice whereby young children (up until early school age) often say ‘cleaned’ /klineɪd/, ‘cooked’ /kʊkɪd/, ‘played’ /pleɪɪd/, ‘slept’ /sliptɪd/, and even over-generated forms such as ‘seed’ (past tense of see) /siɪd/, ‘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/
			/h/			

Latin → English

- (15) **Examples:** (i) /p/ → /f/: pater → /fɑðər/ (*father*)
(ii) /t/ → /θ/: tres → /θri/ (*three*)
(iii) /k/ → /h/: canis → /haund/ (*hound*)
(iv) /b/ → /p/: labium → /lɪp/ (*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 'Kepe'd' 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 /kept/ 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* (gōs, gōsi ‘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 gōs → /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.

13.2.3 Minimal Pairs Examples

- (19) (a) (dime) / d ay: m / [+Plosive: +Alveolar, +voiced]
- (time) / t ay: m / [+Plosive: +Alveolar, -voiced]

- (b) (game) / g e: m / [+Plosive: +Velar, +voiced]
 - (shame) / ʃ e: m / [-Plosive: -Velar, -voiced]
- / ʃ / [+Fricative] [+ Palatal]

(c) (sip)	/	$\begin{array}{ c } \hline s \\ \hline \end{array}$	ɪ: p /	[$\begin{array}{ c c } \hline +\text{Fricative:} & +\text{Alveolar,} \\ \hline \end{array}$	-voiced]
(chip)	/	$\begin{array}{ c } \hline \check{c} \\ \hline \end{array}$	ɪ: p /	[$\begin{array}{ c c } \hline -\text{Fricative:} & -\text{Alveolar} \\ \hline \end{array}$	-voiced]
					/č/ [+Affricate] [+Palatal]	

(d) (berry)	/	$\begin{array}{ c } \hline b \\ \hline \end{array}$	ɛ: ri /	[$\begin{array}{ c c c } \hline +\text{Plosive:} & +\text{Bi-labial,} & +\text{voiced} \\ \hline \end{array}$	
(very)	/	$\begin{array}{ c } \hline v \\ \hline \end{array}$	ɛ: ri /	[$\begin{array}{ c c c } \hline -\text{Plosive} & -\text{Bi-labial} & +\text{voiced} \\ \hline \end{array}$	
					/v/ [+Fricative] [+Labio-dental]	

Note that in example (19b), all three distinctive features are in contrast as compared to (19a), where only one feature is in contrast. Whether or not all three or just one distinctive features is found to contrast, all examples are nonetheless minimal pairs. But notice how (19e) below is not an example of a minimal pair due to the fact that more than one pair is in opposition:

(e) (pressure)	/p	$\begin{array}{ c } \hline r \\ \hline \end{array}$	ɛ	$\begin{array}{ c } \hline \check{s} \\ \hline \end{array}$	ɹ /
(pleasure)	/p	$\begin{array}{ c } \hline l \\ \hline \end{array}$	ɛ	$\begin{array}{ c } \hline \check{z} \\ \hline \end{array}$	ɹ /

As an exercise, use IPA to create some minimal pairs out of your line two fricative (as shown in your chart above). E.g., (berry vs. very, teeth vs. teethe, assured vs. adjured, etc.)

13.2.4 Recap of Feature Matrix

Let's return to the IPA charts for a moment. When looking at the consonant chart, an icon representation of the inner mouth emerges. In moving left-to-right, we pass through a series of places of articulation sites, starting with the front (apex) part of the mouth (e.g., bilabial/) and moving toward the back (dorsal) part of the mouth (e.g., velar). This feature of place can be indicated by e.g., [+/-Front]: /b/ [+Front], /g/ [-Front]. An even finer grained

distinction involves the subtle placement of the tongue, referred to as [+/- **Anterior**] where anterior refers to the tongue's approximate place to the front of the mouth, as opposed to the back—e.g.,

- | | | | |
|------|---------|----------|------------------|
| (20) | (steep) | /sti: p/ | /s/ [+Anterior], |
| | (sheep) | /ši:p/ | /š/ [-Anterior] |

Other distinctive features include the following:

(21) **[+/- Plosive]**

- | | | | |
|--|---------|---------|----------------|
| | (bake) | /be: k/ | /b/ [+Plosive] |
| | (shake) | /še: k/ | /š/ [-Plosive] |

(22) **[+/- Fricative]**

- | | | | |
|--|-----------|--------|------------------|
| | (very) | /veri/ | /v/ [+Fricative] |
| | (berry) / | bəri/ | /b/ [-Fricative] |

(23) **[+/- Affricate]**

- | | | | |
|--|--------|--------|------------------|
| | (jam) | /j æm/ | /j/ [+Affricate] |
| | (sham) | /šæm/ | /š/ [-Affricate] |

(24) **[+/- Nasal]**

- | | | | |
|--|----------|--------|--------------|
| | (merry) | /meri/ | /m/ [+Nasal] |
| | (sherry) | /šeri/ | /š/ [-Nasal] |

(25) **[+/- Liquid]**

- | | | | |
|--|--------|-------|----------------|
| | (look) | /lUk/ | /l/ [+ Liquid] |
| | (took) | /tUk/ | /t/ [- Liquid] |

(26) [+/- Glide]

(wake) /we: k/ /w/ [+Glide]

(fake) /fe: k/ /f/ [-Glide]

(27) [+ Sonorant]: vowels, nasals, liquids, glides. [+ Sonorant] by definition are [-Plosive] since they involve no (plosive) explosion of a build-up of air.

(a) [+Sonorant]: m, n, ŋ, l, r, w, y, h

(b) [-Sonorant]: plosives, fricatives....

(28) [+ Continuants]: consonants....

(a) [+Strident]: v, f, z, s, š, ž, ĵ, č

(b) [-Strident]: b, p, d, t, g, k, ð, θ, m, n, ŋ, l, r, w, y,

Matrix features in opposition(29) **Consonant**

vs.

Vowel-like

[+ Consonantal] / [- Sonorant]

[+Sonorant] / [- Consonantal]

(30) [+Obstruent]

vs.

[-Obstruent]

b, p, d, t, g, k,

m, n, ŋ

l, r,

w, y,

(31) [-Continuant]

vs.

[+Continuant]

b, p, d, t, g, k,

v, f, ð, θ, z, s, ž, š,

vowels

In (35), autosegmental assimilation (or consonant harmony/velarization) is found whereby the final consonant [+velar, +voiced/fricative] /k/ is affecting the initial consonant [+alveolar, +voiced/fricative] /d/ and making it +velar. (Hence, if you take /d/ and change its place of articulation from +Alveolar to +Velar—keeping all other distinctive features untouched—the resulting phonemic change is /d/ to /g/). It is this kind of evidence that led some linguists to suppose that early children may not segment on a *phoneme by phoneme level*, but rather may segment and process their ambient sound input based on a *syllable by syllable level*. For instance, if this is indeed the case, a very young child, say at 2 years of age, may not hear and segment *cat* /kæ: t/ as three different segmental phonemes /k/, /æ: / and /t/, but rather may process /k/ as an initial onset and /æ: t/ as a single vowel/consonant coda. (Also see §13.5 for some remarks on phonological/syllabic development).

By **segmenting** at a larger **syllabic level**, as opposed to a finer grained phonemic level, this type of autosegmental assimilation may in fact be adultlike in that there indeed are only two perceived adjacent sounds found in the assimilation process—viz., the initial Consonant and Coda [/C/, /VC/]. (If this is the case, we don't have to add an additional stipulation that the child crosses over the otherwise segmented vowel during assimilation).

(36) because → /pikʌ/

In (36), the initial /b/ is also devoiced due to the voiceless /k/ (seemingly skipping right over the voiced vowel /i/ in retrograde consonant harmony). The syllabic /CVCVC/ reduces to /CVCV/.

(37) spaghetti → /bʌzgɛdi/

In (37) above, *spaghetti* becomes /bʌzgɛti/ (CVC+CVCv) with /s/ deletion and strategic reinsertion (voiced to /z/) to create the /CVC-CVCv/ structure. Otherwise, (i) if the initial /s/ stays in place, the child is confronted with a /CC/ double consonant onset which might not be available at the given syllabic stage of development, (ii) if the /s/ gets deleted, never again to insert as /z/ for final /C/ of the initial /CVC/ structure, the child then confronts a CVC-*VCV /bʌgɛdi/ thus losing the preferred CVC proto-word template. (/s/, /p/, /t/ become voiced by a **default voicing rule**).

13.4 Phonological Representation and the Dual Mechanism Model: Some ESL/EFL Perspectives

If one were to ever have reason to examine closely some of the more characteristically atypical ESL/EFL phonological behaviors, one might very easily glean from direct observation (in the classroom) that there seems to be plenty of anecdotal evidence pointing to a dual processing of sounds in language—a **Dual Mechanism Model** (DMM) (of sorts) in the processing of sound. The dualism here could potentially be formalized, at least tentatively speaking, (and to be sure with plenty of caveats along the way), as reinforcing a theoretical view which posits that sounds can either take on (i) **rote-style learning** (based on mere frequency of memory, not unlike how one might process environmental sounds), and/or (ii) **rule-based acquisition** (based on perceived phonological rules, etc.). The dual processing model regarding sounds here has spilled-over onto reading strategies for children, as witnessed by the ongoing debates called the **Reading Wars** between ‘Whole Language Approaches’ to reading (which places emphasis on sight word learning from a top-down perspective) vs. ‘Open-Court Methods’ to reading (which refocuses attention to bottom-up phonics based approached to reading). I offer below two case studies in the form of ESL *anecdotes* in order to present the DMM regarding sounds—labeled as follows: *Victor* and *Xuxa*.

13.4.1 The ‘Victor’ anecdote

Victor, a former ESL student of mine, came to me after class on day expressing his desire to be able to say his name (correctly). (Plainly a good place to begin the life-long pursuit of L2 accent reduction). He mentioned to me that whenever he said his name—he pronounced as Bictir /bIktr/, pronouncing the labio-dental voiced fricative /v/ as a voiced bi-labial plosive /b/—people would look somewhat confused. His causal remarks also led me to believe that he was unable himself to confess what the fuss was all about since he was unable to actually hear and thus distinguish the corrected version in any case. In a nutshell, my approach to his problem came in the form of the DMM and can be presented in the following way.

First, I thought to myself how a ‘top-down’ model would be employed, working on the back of a frequency-based memorization model. Such an approach would have Victor simply repeat the phoneme /v/ over and over again, maintaining a frequency-based rote learning procedure (akin to Pavlovian conditioning). Recall, Spanish does have the /v/ sound, as in the

word *voy* (*go*). (The very fact that Victor could say ‘yo voy’ but not his name ‘Victor’ in of itself suggests some processing distinction. We will get back to this). In attempting such a rote-learning procedure, Victor’s best phonemic representation of /v/ continued to sound out as /b/=> /biktr/: he simply could not hear the target (rule-based) phoneme /v/. Attempt after attempt failed.

Turning next to a phonological rule-based ‘bottom-up’ model, one attempting to get victor to say the /v/ sound might have him rather turn to the closest neighboring phoneme as represented on the IPA chart—viz., the labio-dental voiceless fricative /f/. In this way, we would be able to maintain the distinctive features related to Place and Manner of Articulation (labio-dental fricative) with only the voicing feature having to be addressed. Such a rule-based approach to sounds here would have victor produce the /f/ sound in his name (since Spanish does have the /f/ phoneme) and have him then reshape the voicing feature of /f/ [-voice] to being [+voice]. In a sense, tricking Victor into saying his name as Fictor with the additional insertion of the voicing feature overlapped onto the onset consonant /f/. Hence, the rule follows: /f/ + [+voiced] => /v/. When the problem was approach in this manner, Victor did gain some traction on this new phoneme /v/, although he later complained to me that he still could not hear the real distinction. Today, the idea that Victor could not in fact hear, on the one hand, the /v/ /b/ distinction, while on the other hand having access to /v/-initial words such as *vella* (candle) /vɛlə/ (and not */bɛlə/), and *voy* (*go*) /voy/ (and not */boy/) leads me to believe, following current understanding of the DMM, that he might have been processing the two sounds in two fundamentally different ways—namely, (i) a processing of sound based on rote-learning procedures (chunking), and (ii) a processing of sound based on phonological rules.

As mentioned above, the fact that in Spanish there does exist the sound/phone /v/ raises some interesting questions which just might implicate the DMM—namely, that there may reside two fundamentally different ways in which a speaker has access to speech sounds: (i) rule based and (ii) rote-based (yielding /v/ => /b/ for the former and [v] => [v] for the latter (with // indicating **phonemic awareness** of the sound and [] indicating **idiomatic chunking** of the sound.)

13.4.2 The ‘Xuxa’ anecdote

Perhaps a better anecdote comes from an ESL observation I once had concerning the palatal voiceless fricative [sh] sound /š/, as in the word *shower*, *shoe*, *English*, etc. Recall that the Spanish language does not at all

have the voiceless palatal fricative /š/ (Spanish speakers when speaking English substitute /š/ with /č/). Well, somewhere in the semester of my teaching this class I discovered to my sheer joy a Mexican-gearred Television show named ‘Xuxa’ (so named after the host of the show). Her name was pronounced ‘shusha’ /šušə/. I noticed that all the Spanish speaking participants of the show were indeed able to pronounce the /š/ voiceless palatal fricative. So in recognizing that my Spanish ESL students do have the ability to say /š/ (instead of the affricate substitute /č/), I quickly used the ‘Xuxa’ example in class as a strategy to get them to correctly say *shower*, *show*, *English*, etc. (and not *chower*, *chow*, *Englis* which typically get substituted). Again, to my surprise, I found that while many of the ESL students could produce the fricative [š] sound when the sound chunk was isolated or in the word Xuxa, they still could not extend the sound into speech and produce the /š/ to pronounce the aforementioned English words. In other words, they were unable to extend what might have been an idiomatic sound bite for them and bring themn into a language-based production (as they continued to cling to the /č/ phoneme by rule).

So what is the upshot of these two *anecdotes*? Well, in brief, what I believe we have here is a classic DMM example whereby a speaker might be able to produce a non-segmental and isolative idiomatic sound that is otherwise outside of the speaker’s first language inventory of possible sounds (in this case the palatal fricative [š] sound/phone), but where the speaker cannot extend and generate the very sound when it is processed and mentally perceived as a phonologically segment of rule-based speech. In the former case (i.e, mimicked/parroting isolative sound), what we have here is the sound chunk ‘Xuxa’ simply being memorized/produced as one sound idiom, without the necessary phonological segmentation that normally accompanies speech production. When an attempt is made to process the foreign sound as part of the ‘rule-based inventory’ of the given language (Spanish), the **default phonological rule** is triggered and the /š/ naturally goes to /č/. In the Mexican variety of Spanish spoken about here, the phonological rule is spelled out as follows: [the voiceless, palatal fricative [š] → affricate /č/ (or alveolar /s/)].

In fact, the same processing may be going on for native speakers of English who may be able to pronounce foreign sounding words correctly within the respective accent only because they have memorized by mere sound association the idiomatic phonology of the word, a phonological production otherwise outside of the native speaker’s phoneme repertoire.

A final note on Spanish assimilation might be seen in the example of the word *zapatos* (shoes) where the voiced /z/ becomes unvoiced /s/ due to the following /p/ (a form of retrograde assimilation).

13.4.3 The ‘Paula’ anecdote

Let’s re-examine what it might mean for our Spanish speaking student who was unable to pronounce the name ‘Paula’ with a voiceless /p/, where the voiceless feature took-on voiced qualities—making the phoneme /p/ sound to the American ear as /b/ (Baula). For the Spanish ear, the two sounds are distinct, though not for the American ear). What we can glean from this processing difference of phonemic representation is that the Spanish phonological rule for voicelessness, as it shows up on bi-labial plosives, allows a bit more voicing to enter into the phoneme than for its American counterpart, and as a result the Spanish phoneme /p/ allows for less aspiration (or [-Asp]). It is this rule difference between the two languages that explains how two people can hear the same sound differently.

Spanish /p/ [+Voiced, -Asp] vs. English /p/ [-Voiced, +Asp].

13.5 A Final Note on Phonological Development

‘U-shape learning’ provides a very good window into the processing of child language phonology regarding a pre-linguistic **pre-representational stage** (@12-18m) whereby idiomatic and formulaic speech occurs vs. a linguistic/**representational stage** (@18m/24m...+ w/benchmarks) whereby true phonemic awareness comes on line (a result of rule-based phonology where assimilation, default voicing, and syllabic developmental considerations take place).

13.5.1 Steps to U-shape learning in Phonology

Let’s follow how a target word such as ‘*Pretty*’ might project ‘u-shape’ learning from 18 months through to 36 months (+/-20%)

→ (i) Phrase-1 (18m): /prIti/ pristine pronunciation based on idiomatic/memorized speech (no phonology rules, no phonemic awareness,

Other Evidence for unconscious knowledge of phonetics.

For example, early MLU utterances of /CVC/ structures (e.g., *cat* /kæt/) often reduce for children to /CV/ structures e.g., *cat* = /kæ:/. This is not because the children cannot hear the final voiceless stop /t/, but rather because they have not yet established the larger /CVC/ syllabic template (and the final /C/ must drop)—i.e., it is rather a production (based on syllabic development) and not a comprehension shortcoming. Other developmental examples include *banana* /nænæ/ (with initial weak /CV/ deletion, followed by a more prosaic /CV/ germination). The syllabic development in very young children (18 months to 6 years of age) seems to follow the sequence presented below:

13.5.2 Syllabic Development:**(40) Syllabic Phases:**

Phase-1: 10-18m Idiomatic speech (parroting)

CV: /ba/, /ga/, /kæ:/

Pre-representational CV: CV (germination of CV): /baba/, /kaka/,

Representational

Phase-2: 18-24m CVC (= proto-word template) /kæ: t/, /kul/ (= *school*)

Phase-3: 2-3years CVCV /bIdi/ (as in u-shape learning, ex. ‘*pretty*’) or

/nænæ/ for *banana* whereby the weak initial CV /ba/ structure is deleted in favor of the stressed CVCV structure—this process is called ‘weak syllable deletion’ and again proves that child phonological processes are rule-based early on.

Phase-4: 4⁺ years (C)CCVCCC(C) /splIntərz/ (*splinters*)

One very nice finding that has come out of recent fMRI studies has shown that there is indeed a processing distinction to be made, as indicated by activity in certain areas of the brain, which suggests that (i) idiomatic Pre-Representational speech in very young children, prior to 18 months, is in fact not rule-based and triggers only the associative temporal lobe area of the

brain, while (ii) true representational speech, as uttered by children beginning in phase-2, triggers frontal lobe activity.

One theory that has come out of such recent fMRI findings is a theory called **Speech is Special**. This theory basically suggests that speech, unlike environmental or idiomatic sound, is processed much in the manner of syntax and is thus computed in Broca's area of the brain. It is also this frontal lobe rule-based processing of speech which calls for a distinction to be made between animal cries, chants (as in animal communication) and human speech (language).

13.5.3 Phonotactics

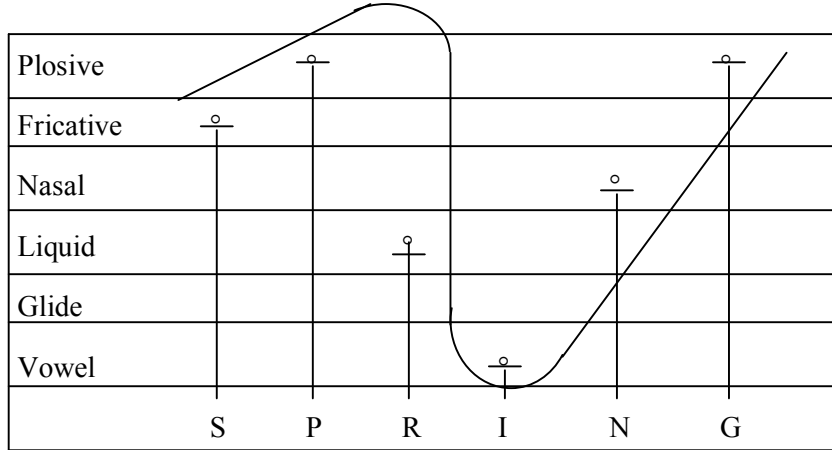
As a final note, let us consider how children might use the rules of their phonological system, as determined by **stress** and **prosody**, in order to shape the acquisition of word. Phonotactics is largely those rules inherent in a phonological system which are used by a child to gain additional tacit knowledge in order to know how words are to be built-up. In other words, phonotactics is used as a scaffolding in constructing the progression from phoneme to morpheme to word.

One of the leading problems a child faces in acquiring word is to discover what kind of shape a word can take. Given that in the ambient speech stream there are no pauses in spoken speech, the child somehow has to work out what a possible word might look like (i.e., where does a word end and new one begin). (This problem is examined in Chapter 9 under the labels phonological and syntactic bootstrapping hypotheses). Let's keep our discussion here plain and see whether or not tacit knowledge of the IPA chart as discussed above might avail itself to potential word shaping knowledge. (The term 'word shaping' refers to that knowledge children have in determining whether or not a phonological string is a viable word or not).

Let's revisit our IPA chart and see if and how the child might entertain tacit assumptions about how English words might be shaped. If we take a top-down plosive-to-vowel configuration as in showing (top) *most point of articulation* (plosive/stop) and contrasting that with (bottom) *least point of contact* (vowel), we can begin to sketch out one possible phonotactic tool a child might use in determining a feasible word shape.

Consider below the phonotactics for the word *spring*:

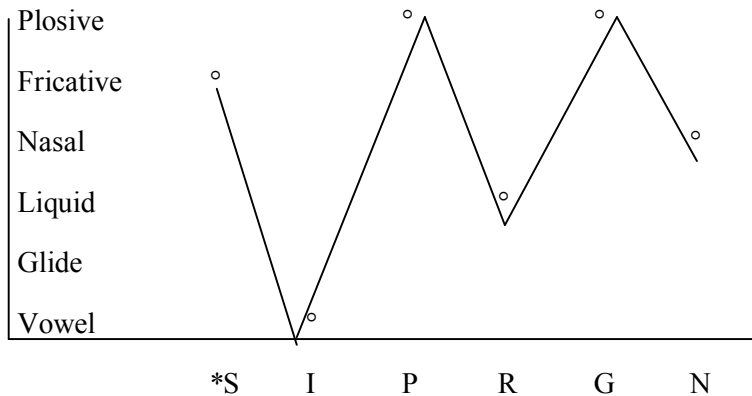
(41)



As can be seen by each of the phoneme placements on the chart, a nice curve surfaces between consonant and vowel placements. This curve represents the syllable make-up of the word. A natural phonotactic syllable/word template is created showing a high (consonant) to low (vowel) ‘rounded’ phonotactic curve.

Conversely, now consider below the ‘spiked’ phonotactics for the non-word **siprgn*:

(42)

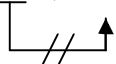


Children, very early-on in their linguistic development might be using such tacit knowledge in order to generate hypotheses about what might constitute a word.

13.5.4 How do children segment words?

Similarly, children seem to know, for example, that English words tend not to allow adjacent plosives within a word internally. Given this tacit knowledge, words such as *tiptoe* **and** *hotdog* cannot be processed as an unsegmented single word. If ‘tiptoe’ won’t be segmented as a single word, then the syllable boundary [[CVC]\$[CVC]] kicks-in, allowing the child to discover that indeed the word is a compound [[tip]\$[toe]] (\$ marks syllable boundary). This [CVC] structure splitting the compound into two segments would then block the possibility of otherwise potential strings *[[tipt][oe]] (with /pt/ adjacency within the first syllable) or *[[ti][ptoe]] (with /pt/ within the final syllable). Again, since adjacent plosives are not allowed within the word, (a matter of phonotactics), children come to realize the compound directly from the CVC structure.

Recall our discussion above regarding the syllable boundary constraint. As compared to the word *cars* /kɑrz/, we noted how assimilation did not cut across the syllable boundary in the word *Carson* /kɑrsən/ (/CVC-\$-CVC/)

(43) / k a r \$ s ə n /


Well, such phonotactic knowledge of constraints might in fact lead a young child as early as 18 months 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.

(44) The teacher sits.
 / ðə # tɪ tʃər # sɪ 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’:

(45) *[The-t] [eacher-s] [its]
 / ðə̀t # ɪ́ çərs # ɪ́ 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.

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