SYLLABLES

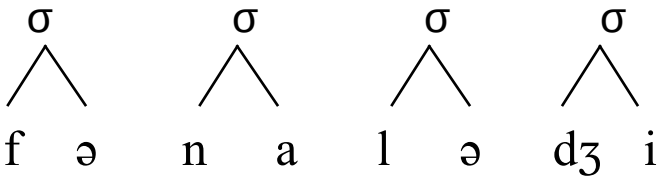
Curiously enough, phonologists in the 1960's and early 1970's paid very little attention to syllables at all. Nevertheless, it turns out that syllables allow us to gain insight on a number of processes that would otherwise seem unrelated if we were not to make reference to syllable structure. Before we get ahead of ourselves however, let's review the approach to syllables that we took in class. Basically, we did the following:

- we motivated the syllable as a unit;
- we argued for a particular representation of the syllable;
- we used the syllable to account for phonological processes of epenthesis and deletion;

Another way to put this is this is that we showed that the concept of the syllable seems valid; we then discussed what syllables themselves might look like internally, and then we used syllables to do some interesting work for us with respect to phenomena such as the inserting and deleting of segments. Now, we'll review each of these areas of class discussion.

Motivating the syllable

What is a syllable? Well, intuitively, we have a sense of how many syllables there are in a word. Just think of the number of syllables as being equal to the number of *beats* that a word has. So, if we say a word like “phonology”, we can probably all agree that *phonology* has four beats, i.e., *pho.no.lo.gy* or, in phonetic transcription, [fə na lə ʤi]. What we refer to when we talk about the number of beats that a word has, then, is really how the segments of a word are grouped or collected into higher level units. In the case of *phonology*, we see a word that phonetically has 8 segments (distinct sounds) that are gathered into four groups (syllables), as in the sketch here, where the symbol σ is used by standard convention to denote a syllable.



Most of the time our intuitions as to how many syllables a word has are straightforward. Of course, this isn’t always the case, as we saw in class when we tried to count the syllables in words such as *fire*, *hour* or *poem*, which show a certain degree of dialectal variation. For some speakers, they have one and for others two syllables. Nevertheless, there does seem to be something to our sense that segments are grouped together into groups, each of which constitutes a beat.

If this were all there were to the matter, however, things wouldn't be very interesting from the point of view of phonology. Rather, it turns out that a number of issues show the syllable to be a relevant unit for understanding or characterizing phenomena such as the rules of various language games or the domains of phonological rules. Such evidence is what motivates the syllable as a phonological unit. Let's review that evidence here:

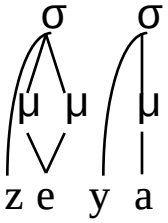
- *the syllable and language games*

Language games are interesting linguistically because they can afford us a means of probing the structure of words. In motivating the syllable, we looked at two language games: 1) the English Pink-Stink game, and 2) the Bakwiri "backward speech" game for disguising speech. Arguably, each of these games provides evidence that support the view that the syllable constitutes a unit of phonological structure, i.e. ***that the syllable is a phonological constituent***.

Why is this the case? Consider first Pink-Stink. When we discussed in class what constitutes a legitimate Pink-Stink vs. Pinky-Stinky vs. Pinkety-Stinkety, we noted that in each case, the pair of words had to have the ***same number of syllables***. Note that the words don't have to have the same number of sounds, as is evidenced right away by a pair like *pinky stinky*. So, in order to characterize the way to play pink-stink, we need to say that the paired words have to be comprised of the same number of syllables and that (ideally though this is harder in pinkety stinkety forms), these syllables should be identical after the *onset* of each of the words. Two things are important here: 1) that we need to match the number of syllables in the pair, and 2) that we need to refer to the distinct onsets of the words, where onset itself is a structure that constitutes a subpart of the syllable.

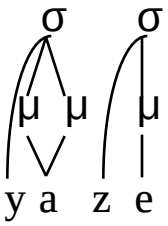
Now consider the relevance of the Bakwiri data. What made these data interesting for the purposes of motivating the syllable is this: speaking backwards doesn't really mean speaking backwards. The way Bakwiri speakers play the game is to reverse the syllables of the word. So, the game form for a Bakwiri word such as [k^{w}eli] turns out to be [lik^{w}e], not *[ilek^{w}], which is what it would be if the game were played by literally producing the words backwards, segment by segment. So, Bakwiri provides striking evidence for viewing syllables as units (a.k.a. constituents) in phonological theory. In order to play the Bakwiri game, we need to know what the segments are that are grouped together to make up each syllable. One more interesting aspect of the Bakwiri game is evidenced by forms such as [zeeya], whose game form is [yaaze]. What's relevant about this form is that vowel length is preserved for each syllable. At the time we first saw the data, we hadn't been introduced to moras. Now, we can see pretty clearly how the game is working. First, we have a representation of the syllabic structure of the regular form, as seen here:

The Regular Form



Then, we simply reverse the segments (known as melodies or segmental melodies) that make up each syllable, but we leave the syllable structure in place, treating it as a template that we map the segments to, as in the picture here:

The Game Form



And we're done! So, to sum up, the Bakwiri data showed us two things. First, we need the notion of the syllable to explain what is meant by "speaking backwards", i.e. we need to refer to the syllable to describe how to play the game. Secondly, the data show that syllable structure itself can be viewed as independent of the segments that make up the syllable.

- *the syllable as the domain of phonological rules*

Another strategy that we used to motivate the syllable was to show that the syllable is relevant to characterizing the domain of phonological rules. One example we considered was the case of aspiration in Sierra Popoluca. We saw that aspiration in Popoluca was predictable in voiceless consonants but that it appeared to occur in two different contexts:

1) at the end of a word: mok^{h} 'corn'
2) before another voiceless consonant: pet^{h}kuy 'broom'

But, if we look at the facts in terms of the syllable, we can see that both of these consonants can be viewed as syllable-final. Using the terminology of syllable theory, the two contexts actually reduce to one: coda position. Of course, the story is a bit more complicated, because not all voiceless consonants in coda position are aspirated. There are two exceptions (note that I use a "." to separate syllables):

1) when the following consonant is the same: pe̤t.ta:p^{h} 'it is being swept'
2) when the following consonant is voiced: ke̤k.gak^{h}.paʔ 'it flies again'

The first problem revolves around the issue of how to represent geminate (long) consonants, and we'll return to this below. The second simply shows that it's not enough to just say that voiceless stops in coda position are aspirated, because we need to also check to make sure that the following onset consonant isn't voiced. Nevertheless, what **is** relevant to us here is that reference to the syllable allows us to simplify the statement of the context in which aspiration occurs. Rather than having to refer to the word edge in one case and to the first of two consonants in a CC sequence in another, we are able to unify the description by reference to syllable structure. In short, aspiration is a property of coda consonants only in Popoluca. If you are an onset, you can't be aspirated. In fact, we don't need to look as far away as Popoluca to find evidence that the syllable is relevant to conditioning the domain of aspiration. English itself provides another nice example. In English, however, we see that

heavy aspiration is a predictable property of voiceless stops when they are in the initial position of a stressed syllable, as in words like [pʰɪn] 'pin' or [rə.pʰɛnt]. Otherwise, voiceless stops are either weakly aspirated or not aspirated. So, again, reference to syllable structure helps us to characterize the domain of a phonological rule.

Data from Sierra Miwok and from Mohawk gave us more motivation for the syllable, allowing us to argue along similar lines for its usefulness to characterizing phonological processes. In Mohawk, which we looked at in class, we saw that vowel length was predictable. Vowels are predictably long under the following conditions:

1) under stress--that is, there are no long vowels that aren't stressed--, and
2) if the vowel is followed by only one consonant and then a vowel.

Note that both of these conditions have to be satisfied. So, in a word like yékreks'ɪ push it', even though the first vowel is stressed, it isn't long.

At this point, we have to ask ourselves: *why does the number of consonants that follow the vowel matter*? The truth is, there's no simple answer to this question, unless we think about the syllable. Here's why. If we view the issue of vowel length in terms of syllable structure, we can argue that vowel lengthening only occurs in open syllables, where by "open" we mean syllables that do not have a coda consonant. This means that in a word such as yék.reks, the [k] is the coda of the first syllable and the following [r] constitutes the onset of the second syllable. However, when only one consonant follows a vowel, we can argue that this consonant forms the onset of the following syllable, as in ra.ké:.tas 'he scrapes'.

This in turn leads us to make an interesting observation: in Mohawk, stressed syllables that don't have a coda undergo vowel lengthening. Why might this be the case? Well, as we have seen, CV: and CVC syllables can both be described as bimoraic (or heavy) syllables--more on this in a bit. Importantly here, reference to syllable structure allows us to understand something deeper about the Mohawk data. Vowels don't simply lengthen when stressed and followed by a single consonant and another vowel, but rather, vowels lengthen in order to guarantee that all stressed syllables in Mohawk are heavy. Here then, we've used syllables to characterize the domain of a rule AND to offer an explanation for WHY the rule itself might apply.

Similarly, you did a homework assignment on Sierra Miwok. In working on it, you noticed that stress fell predictably in two environments:

1) on the first long vowel of a word;
2) or on the first vowel of a word followed by two consonants, whichever came first.

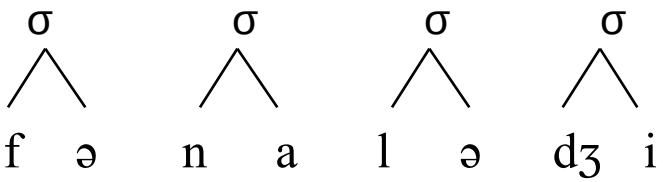
Again, these seem like two distinct contexts. Why should stress care about targeting the first long vowel or the first vowel followed by two consonants? There's no clear reason that it should care about these two contexts and not any number of reasonable or highly ridiculous contexts that we might be able to think of, such as the first long vowel followed by a velar stop or the first high vowel followed by a labial, whichever comes first. I'd be very very surprised to see a language that does this. However, the Miwok case is quite ordinary and

easy to understand, if we use the syllable to characterize the placement of stress. Specifically, if we assume that the fist vowel of a word followed by two consonants really is a vowel in a closed syllable, as in [wít.ta.pï?], the two contexts can be reduced to one simple generalization: ***stress in Sierra Miwok falls on the first heavy syllable of the word.***

A heavy syllable, of course, can come in two flavors, a CVC syllable (i.e. a syllable with a coda consonant) or a CV: syllable (i.e. a syllable with a long vowel). In the next section of this review sheet, we'll look at the issue of how to represent syllable weight in more detail.

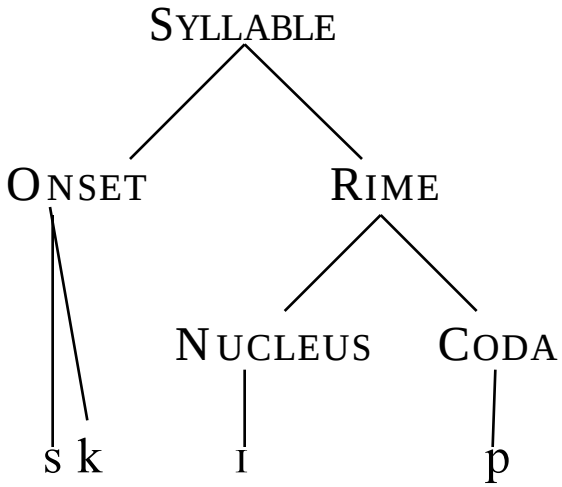
Representing the syllable

I've just argued that CVC and CV: syllables can both be characterized as "heavy", as opposed to CV syllables, which are characterized as "light". One issue that phonologists have investigated is the question of how to represent syllable weight, or to put it more generally, the question of how to represent syllable structure in general. Recall from above that I suggested that the word *phonology* can be fairly uncontroversially divided into four syllables:



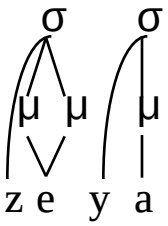
This picture shows the eight segments of the word grouped into four syllables, but it does not offer a view of whether or not there is any internal structure that mediates between the syllable and the segments--structure that would be able, for example, to encode the difference between a light and a heavy syllable. In fact, though linguists are in general agreement that there is some kind of internal structure to the syllable, there continues to be considerable debate over the nature of this structure, and evidence has been brought forth to support apparently conflicting positions. However, there are a few descriptive terms that are helpful in talking about syllable structure. We'll review four of them here: ONSET, NUCLEUS, CODA, and RIME.

If we think of a monosyllabic word like [skɪp], we can think of syllables as having three parts: a consonant (or a string of consonants) that starts the syllable off, a vowel that is the most salient element or the peak of the syllable, and then a consonant (or possible a string of consonants) that closes or finishes the syllable. These are referred to as the ONSET, NUCLEUS, and CODA, respectively. The final two elements together, the nucleus and the coda, are called the RIME, which I've spelled "rime" but which is obviously named for the part of the syllable that we use in rhyming, as in [skɪp] and [tʰɪp]. This traditional terminology gives us a view like this:

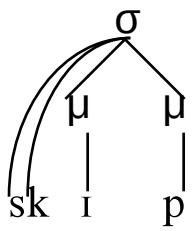


Both onsets and codas are not always necessary in syllables, as can be seen in the English words [it] 'eat' and [ti] 'tea'. The first is onsetless, and the second has an onset but no coda. On the other hand, all syllables have a nucleus, which is usually a vowel. In fact, though there are some languages such as English which allow some consonants to be nuclei, as the final [l] is in the word 'little', there are many languages which only allow vowels to be syllable nuclei.

These traditional terms are convenient descriptive devices, but we actually argued for a different view of syllable structure in class. Specifically, we focused on arguments for the moraic representation of syllable structure. The term *mora* is also taken from traditional grammar, and it refers to a unit of weight. Recall that we have just seen above in our discussion of Sierra Miwok that stress falls on the first heavy syllable of the word, which can be either a CV: or a CVC syllable. In moraic terms, these are both heavy syllables, because they are both ***bimoraic***. In moraic theory, a long vowel is represented as a single vowel segment that is associated to two moras. For its part, a CVC syllable is heavy, because we assume that the coda consonant is associated to a mora. This is shown in the following pictures. For their part, light syllables only have one mora. Consider again the representation of the Bakwiri word *zee.ya* that we saw above. Note that the long vowel does not consist of two [e] segments, but rather, a single [e] that is associated to two moras. For its part, the short vowel [a] of the second syllable is linked to only one mora.



What would a picture of a heavy syllable closed by a coda consonant look like? Like this:



Two things are important to note here:

1) Syllables with a coda share the property of heaviness with syllables that have a long vowel because both have two moras, i.e. they are bimoraic.
2) Onsets don't add weight to the syllable, no matter how many onset consonants there are. So, in the English syllable [skɪp], the onset is a cluster of two consonants, while in the Bakwiri word [zee.ya], each of the two syllables has a single onset consonant. In both cases, however, onsets don't factor into the weight of the syllable.

· *arguments in favor of moraic representations*

Some interesting evidence that has been used in support of the moraic view of syllables comes from the phenomenon known as compensatory lengthening. Besides providing a very simple view of the common syllable weight distinction between light and heavy, moraic representations afford an interesting account of a long noted asymmetry. It has long been known that the loss of certain consonants (normally through historical sound change) has led to the lengthening of vowels, while the loss of others has not. In general, the following asymmetry has been noted: if the consonant that is lost follows right after a vowel, the vowel often lengthens, but if the consonant precedes the vowel, the vowel never lengthens. A classic case is Latin, in which [s] was deleted historically under some circumstances whose details are not crucial here. What is crucial is that the vowel next to [s] only lengthened if the [s] was deleted after the vowel. In the forms in (b), the [s] deletes without affecting the vowel (or the nasal consonant).

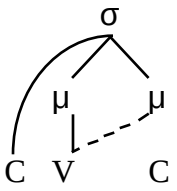
LATIN

a.	*k**as**nus	>	k**a:**nus	'grey'
	*k**os**mis	>	k**o:**mis	'courteous'
	*fid**es**lia	>	fid**e:**lia	'pot'
b.	***s**m**e**reo:	>	m**e**reo:	'deserve'
	***s**n**u**rus	>	n**u**rus	'daughter-in-law'

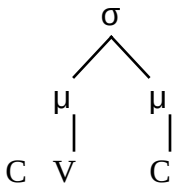
There's a ready explanation of this available in moraic theory. When the [s] follows a vowel in the forms in (a), it's a coda consonant. When it deletes, it vacates a mora that the vowel can spread into, thus resulting in a lengthened (read bimoraic) vowel. When the [s] is an onset, however, it is deleted without freeing a mora, since onsets don't have moras.

Here's a schematic picture of why compensatory lengthening only happens when codas delete, pictured in (a), vs. when onsets delete, pictured in (b).

a) coda deletion leading to compensatory lengthening



b) onset deletion & no compensatory lengthening



Note that only in (a) is a mora freed for the vowel to subsequently fill by spreading. In (b), the onset isn't linked to the syllable, but, from the point of view of syllable weight, the loss of the onset hasn't freed a mora.

In class, we also looked at a couple of famous examples from Old Icelandic, and Ancient Greek in which compensatory lengthening happens when the deletion of a segment happens to the left of the lengthened vowel.

OLD ICELANDIC (North Germanic)

*l**iu**gan	>	l**ju:**ga	'lie'
*k**eo**san	>	k**jo:**sa	'choose'

(5) ANCIENT GREEK

a. *Apparent* compensatory lengthening after an onset is deleted

*odwos	>	o:dos	'house' (East Ionic)
*wiswos	>	(w)i:sos	'alike' (Asiatic Ionic)

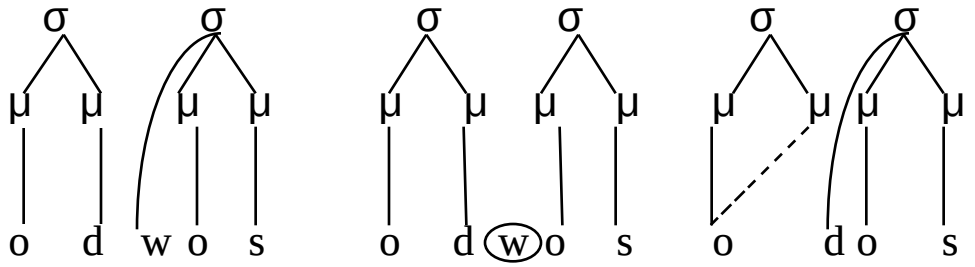
b. But...no lengthening in these clear cases of onset deletion

*dweyos	>	deos	'fear' (all dialects)
*klewos	>	kleos	'renown'
*woikos	>	oikos	'house'

In fact, both of these cases can be shown to arise from freeing up a mora. In Old Icelandic, the deleted segment is one of two vowels in a diphthong. So, even though it is to the left of the lengthened vowel, its loss frees a mora for the next vowel to spread into. We simply need to spread towards the beginning of the word. In Ancient Greek, things are trickier. In the forms meaning 'house' and 'alike', can you remember how the analysis goes? I'll spell it out, but you should make sure you can draw it and explain why lengthening happens in the forms in (a) but not the forms in (b). In (a), the [w] deletes in [od.wos] leaving the following syllable without an onset thus: od.os. Next, under the assumption that syllables want onsets (The Onset Principle), the coda of the first syllable resyllabifies as the onset of the second.

Once it does this, it frees up its mora for the preceding vowel to spread into, resulting in the output form [o:.dos]. Here's a picture:

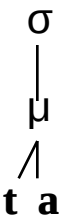
1) Original form **2) [w] is deleted** **3) [d] resyllabifies as an onset & [o] lengthens**



Having seen this, you should also be able to show why there is no lengthening when [w] is lost in the forms in (b). (Hint: in the (b) examples, there is no coda consonant that can resyllabify as the onset of the next syllable.)

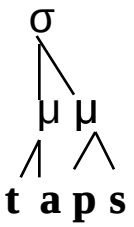
In short, moras allow us to represent weight very simply. At the same time, they offer a nice explanation for the long-standing question of why compensatory lengthening only seems to be triggered by coda deletion. The answer is because the loss of onsets does not result in a free mora for an adjacent vowel to spread into.

One final question we looked at regarding moraic representations regarded just where onsets attach to the syllable. In this handout, I've been attaching onsets directly to the syllable node (i.e. the σ). The jury is still out on this issue, but I did give you some data from Japanese that was suggestive. In particular, we looked at data from a language game called *Shiritori*. We saw that the easiest way to characterize how to play the game was to say that speakers begin a new word with the sounds that comprise the final mora of the word that the other player gives them. There was one catch though, this required us to assume that onsets are attached (or docked) to the first mora of the word in Japanese, and not directly to the syllable, as in this picture of the syllable [ta].



Note, however, that whether we attach onsets directly to the syllable or to the leftmost (first) mora of a syllable, they still do not contribute to the weight of the syllable. That is, they still don't contribute a mora of their own:

As a final note about weight, there are languages that have complex codas (like English), and even long vowels that are followed by one or more coda consonants. Yet, there is very little evidence that languages actually make distinctions that go beyond the heavy vs. light, i.e. monomoraic vs. bimoraic level. For the most part and for the purposes of this class, then, we'll simply assume that syllables can have no more than two moras and that multiple coda consonants, when they are allowed by a language, all share the final mora of the syllable, as in the picture here:



Epenthesis, deletion and the syllable

After we looked at syllable structure in terms of moraic representations, we addressed a final issue in our discussion of syllables: the relationship between syllabification, constraints on syllable shapes in particular languages, and the apparently very distinct processes of epenthesis and deletion. At first blush, epenthesis and deletion would appear to have little to do with one another, since the former involves the insertion of a segment, while the latter involves segmental deletion. What we saw in class, however, was that many cases of epenthesis and deletion can be insightfully analyzed as syllable-driven.

Recall, for example, the Karok data from the homework you did earlier in the semester. For this problem, you noted that two rules were necessary:

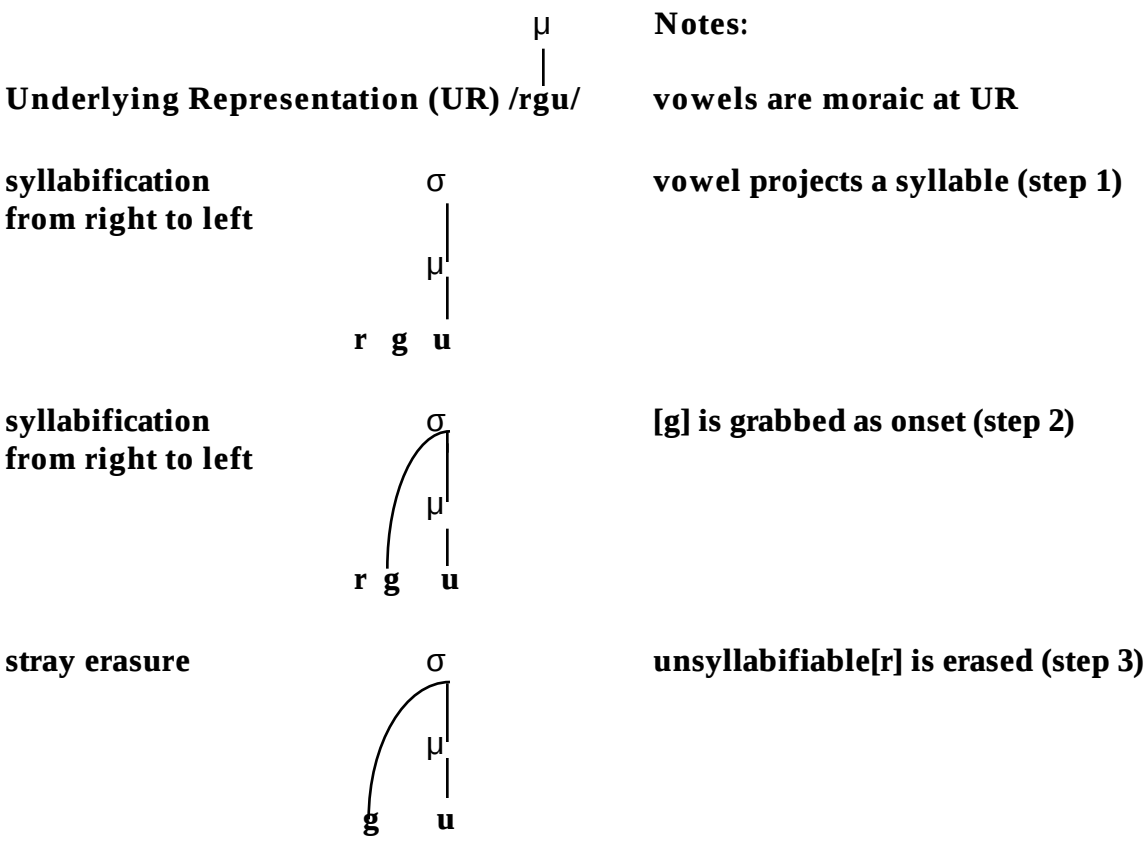
1) a rule inserting a glottal stop word-initially if and only if a word began with a vowel;
2) a rule deleting the second of two consecutive vowels within a word.

If you go back to that homework now, you can see that both rules are aimed at guaranteeing that no syllables in the language begin with a vowel. So, it turns out that Karok is a language that absolutely requires syllables to begin with an onset; that is, it is a language that adheres to the Strict Onset Principle.

What's the ONSET PRINCIPLE. Basically, the onset principle is this: if you have a VCV string, it will syllabify as V.CV and *NOT* VC.V, because syllables like to have onsets. Some languages, like Karok, take this generalization to the limit by forcing all syllables to have

onsets, even if this means adding glottal stop in some cases and deleting vowels in others. So, Karok adheres very strictly to the onset principle.

One of your homework assignments was geared specifically at showing you a case of syllable-driven deletion. This was the Tibetan numerals problem. For the exam, you should be prepared to show how syllabification allows us to account in a maximally simple way for the Tibetan data. Specifically, the problem revolves around the need to have UR's in Tibetan such as /rgu/, while at the same time recognizing constraints on Tibetan syllable structure that prohibit complex onsets in syllables. If we assume that Tibetan syllabifies from right-to-left, we can see that the [u] nucleus will grab [g] as its onset consonant. Of course, the ban on complex onsets means that we can't fit the [r] into the syllable, so [r] is deleted by *stray erasure*. STRAY ERASURE simply means that segments that are not attached to syllable structure are deleted automatically at the end of the phonological derivation. Here's a picture of a derivation:



However, there are cases in which /rgu/ and other similar number morphemes appear as the second element of one of the Tibetan numerals. Here, the [r] isn't lost, as in [dʒurgu] 'nineteen' because it can syllabify as the coda of first syllable. You must be able to show how this works.

Besides the Tibetan numerals, you should study the examples of syllable-driven epenthesis and deletion that we went over in class. These included a data set from Turkish, data from Ponapean and Spanish, and data from Iraqui and Cairene Arabic, showing how the

direction of syllabification makes a difference in the location of epenthesis. If you are confused about these data, make sure you come to see me at some point this week or that you email your questions to me.

Note that I may give you a hypothetical language with a number of constraints on syllable structure and then ask you to put some morphemes together and syllabify the whole string. What you'll have to show me is, for example, what segments (if any) will delete or where epenthesis will occur, given the information about the syllabification of the language that I give you. Here's an example:

Language X has the following constraints on syllable structure:

1) Complex onsets are never allowed: *$_{\sigma}$[CC

2) Complex codas are never allowed, except word finally: *CC]$_{\sigma}$ except at the end of a word

3) Vowel-initial syllables are only allowed word initially: *$_{\sigma}$[V except at the beginning of a word

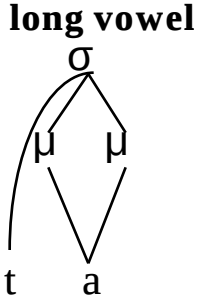
Additionally, language X never deletes a vowel. Instead, it adds [ʔ] as an epenthetic consonant. It will, however, delete consonants that can't be syllabified. So, given the following UR's, and assuming via the onset principle that VCV syllabifies as V.CV, what would the PR for each look like after syllabification?

Example UR's: /ta + rgu/, /nat +rdu/, /na + iburd/, /a + o +po/

Finally, does the direction of syllabification matter for any of the three examples above? Explain why. (hint: look at the second case to answer this question.)

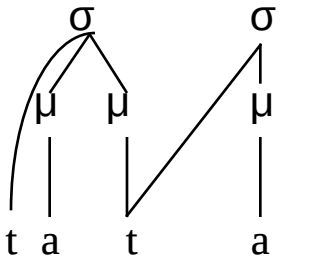
- *a final note on long vowels and geminate consonants*

One final area that touches on both the notions of how syllables are represented and on the process of syllabification regards the treatment of long vowels and geminate consonants. Both of these issues can be thought of as issues of *length*, which is why both long vowels and geminate consonants are often transcribed as VV or CC, as in, for example, [taa] or [tatti]. Transcriptions can be misleading, though, if we assume that because we use two orthographic (letter) symbols, that must mean that we have two sounds in a row. In moraic theory, a long vowel is actually represented as a single segment, as in this picture, where there is only one [a] vowel and its length is expressed through its association to two moras:



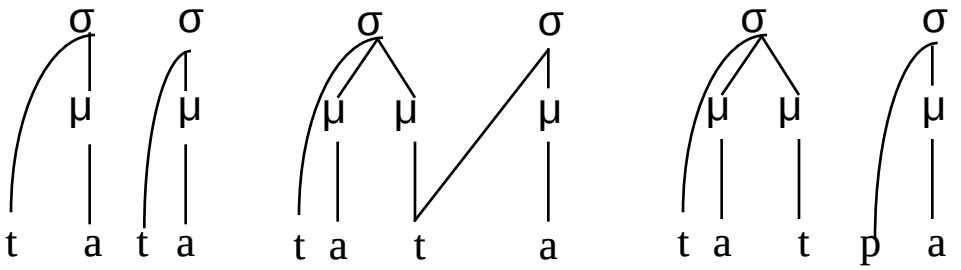
Similarly, moraic theory represents geminate consonants not as two consonant segments, but rather, through the relationship between a consonant and its affiliation to syllable structure. In particular, a geminate consonant is a consonant that is both the coda of one syllable and the onset of a following syllable. So, we would represent the geminate [tt] in a hypothetical word such as [tatta], as in this picture:

geminate consonant



This makes for a nice three-way contrast between a consonant that is simply an onset, as in [ta.ta], a geminate, as in [tat.ta], and just a simple non-geminate coda as in [tat.pa]:

onset: [ta.ta] **geminate: [tat.ta]** **coda: [tat.pa]**

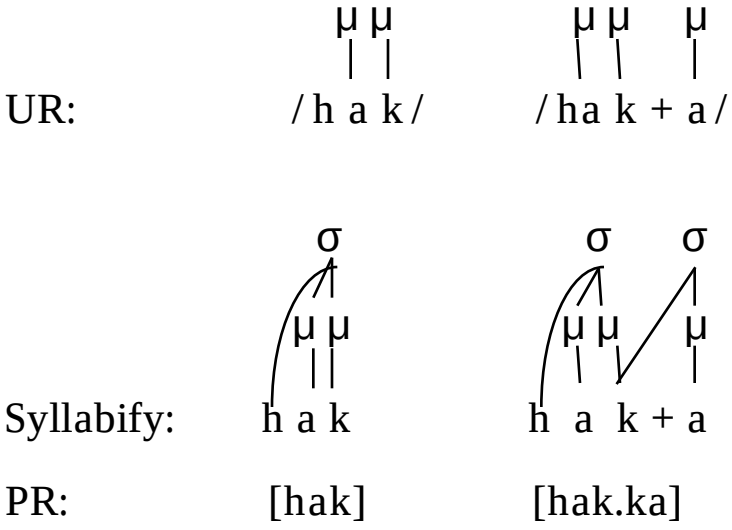


We've seen a couple of very interesting examples of why these representations of long vowels and geminates are particularly insightful ways of viewing vowel and consonant length. In the case of vowels, for example, recall from you Karok homework that the second data set motivated a rule deleting the second of two consecutive vowels. However, in part 1 of the problem, there is an apparent counter-example in the form [siitva] 'steal'. Why, we are led to ask, don't we delete one of the two [i] vowels? Under a moraic analysis, this turns out to be a non-question. We don't delete one of the two vowels because there aren't two vowels. There is one underlying vowel segment that is associated to two moras, as in the representation for long vowels above. Here's a case where transcription is confusing, while moraic representations give us a clear picture of what is going on.

Regarding geminate consonants, a very interesting case arises in the Turkish problem that we looked at in class. In the Turkish data, we see that there are some roots that exhibit an alternation between a final long and short consonant, as in this example, which I've broken up morphologically using dashes.

	nominative	***dative (-a)***	***plural (-lar)***
'justice'	hak	hakk-a	hak-lar

What's interesting here is that this looks like a case of deletion in the nominative and plural forms, because complex codas are not allowed in Turkish. But, if we think about geminate consonants in terms of our moraic representations, we see that the problem isn't really one of segmental deletion. Rather, the apparent deletion happens in the nominative and the plural forms because attaching the underlying geminate as the onset of the following syllable would create a complex onset, which is disallowed for Turkish. Here's a picture of how we get the geminate to surface in the dative but not the simple nominative form. Recall from class discussion that underlying geminate consonants are represented as having a mora, as opposed to non-geminate consonants, which don't have a mora at UR.



What this derivation shows us is that in the first case, the underlying moraic [k] (the would-be geminate, so to speak), can't surface as a geminate, because there's no following syllable for it to attach to as an onset. So, as a result, it simply surfaces as a single coda consonant in [hak]. However, in the dative form, the [k] does surface as a geminate. Why? For two reasons. First, since it is underlyingly moraic, it is syllabified as the coda of the first syllable. Secondly, because of the onset principle, the second syllable does not want to begin with a vowel. So, the coda [k] of the first syllable also attaches to the second syllable to supply an onset. You should be able to do a derivation of a form such as [haklar], showing why the [k] does not surface here as a geminate. Finally, note that there are other forms in the data that look like [hak] in their nominative forms but that don't surface with a geminate consonant in the dative. Here's an example:

	nominative	***dative (-a)***	***plural (-lar)***
'horse'	at	at-a	at-lar

Why is there no gemination here? Well, is we assume that the underlying difference between a geminate consonant and a non-geminate consonant is that the geminate has a mora while the other doesn't, then for roots like [at], we can assume that the final [t] is not underlyingly moraic. As a consequence, when we derive the dative, there's no pressure to syllabify it as a coda. Rather, it simply provides the onset for the second syllable: [a.ta]. You should be able to draw a derivation showing this clearly.

- *terms to be in control of*

Here's a list of some important terms/concepts to make sure you are in control of.

- **syllable**
- **mora**
- **onset**
- **nucleus**
- **coda**
- **consonant cluster**
- **complex onset**
- **complex coda**
- **compensatory lengthening**
- **epenthesis**
- **deletion**
- **onset principle**
- **direction of syllabification**
- **the moraic representation of geminate consonants**
- **the moraic representation of long vs. short vowels**