What is stress?

We are interested in finding out how stress is placed within words across languages. We are going to find that there are some very interesting generalizations to be made.

You probably also recognize that there is phrasal stress. We will not talk about that much. It is related, but it is also understood to be different from stress within words.

You may not have ever asked yourself: what is stress? It is surprisingly elusive. It is reflected in the phonetics, but not in a way that is consistent across languages, or even always within the same language. Sometimes stressed syllables are louder; sometimes they are longer; sometimes they are different in pitch; sometimes they are all three. In some languages, like in English and Russian, they can be recognized because they don’t undergo a special reduction process that the language has for unstressed syllables. But if you are skeptical, you might therefore wonder, is there even such a thing as “stress”? Or is it just that sometimes languages have some systematically different pronunciations of different syllables with different intensity; other languages have systematically different pronunciations of syllables with different lengths (and we know that’s true anyway, as languages can have lengthening and shortening rules for vowels); and other languages have different rules for adjusting pitch (and that’s true too, in tone languages)? As it turns out, although the realization of stress differs across languages, there is a general “relative prominence” relation that holds among syllables that shows some strong commonalities across languages.

How might these commonalities be different from the general commonalities that hold across different languages in segmental phonology? After all, segmental phonology does seem to follow some principles, as we will see after Spring Break; for example, there could never be a rule of the segmental phonology that devoices every second consonant, but there could be a rule that deletes a vowel only if it is exactly word-initial (not preceded by any consonants). So here are two hypotheses:

H1: If we look across languages, we see that stress assignment does not follow any special principles that are different from segmental phonology

H2: If we look across languages, we see that stress assignment follows its own principles

Interesting corollary for the issue of whether there is a cross-linguistically coherent device for “stress” that makes up part of the human language faculty:

- If H1 is true, we don’t really learn anything, because if “stress” means “volume” in L1 but “duration” in L2, then we could always rewrite the stress rules of L1 as “volume” rules and we could rewrite the stress rules in L2 as “duration” rules
• However, if H2 is true, and the special cross-linguistic generalizations about how stress works hold regardless of whether stress is realized as pitch/volume/duration etc, then we would probably think that stress exists as something independent of its exact phonetics, because, otherwise, it would be weird if a bunch of duration systems in one type of language conspired to look a lot like a bunch of volume systems in other types of language.

We won’t explore the details of this interesting corollary; almost everyone in the field is convinced that stress exists, in part because H2 seems to be true—but of course there is always more you could investigate and question. Anyway, today we will explore the first hypothesis.

The Sound Pattern of English

This is a simplified version of the Sound Pattern of English (SPE) analysis of English stress. There is much more to get the details right, so there are lots of words that you will think of that don’t work like this. This is because English stress is somewhat complicated. Nevertheless, when just a few more rules than this are stated, it is quite regular, and a big chunk of the language can be stated with a minimum of lexically-specified stress markings. But, because the details were quite different under later analyses—and because we’ve since rejected most of this analysis—it isn’t really worth getting you to learn all of the details of the SPE analysis in this course. After all, this course isn’t about English stress; this course—or at least, this part of the course—is about stress in general.

Preliminaries

As with everything in phonology, we write the segments as a string of symbols. It is not that important to get the exact phonetic symbols right, particularly because the symbols that Chomsky and Halle use are often fairly different from their phonetic realizations. Besides, really, each symbol is just an abbreviation for a set of valued features. You should know that hiding inside each symbol are a bunch of features like [−high], [+ant], etc. But I will just use symbols that are straightforward to understand and give the right distinctions. However, it is important to give the bracketing that would be returned by the syntax.

(1)

\[ æspærægæs \] \_N

In the SPE analysis, stress is marked by a feature [stress]. It has a special value [−], which indicates that the segment does not receive stress, and, in general, means, for a vowel, that it will be reduced to [ə]. It can also take natural number values, 1, 2, …; 1 is interpreted phonetically as primary stress, 2 as secondary stress, and so on (down to some distinctions that perhaps no one actually makes! CH and their sources take distinctions down to 4 to be potentially meaningful).

Rules apply in sequence; each rule applies to the output of the previous rule, except for the first rule, which applies to the output of the syntax. Each rule changes, adds, or deletes some features, but leaves the rest intact. Rules apply to as many segments as possible. Here is the first rule (one that CH allude to, but never give any kind of notation for):

(2) (Initial Stress Assignment)

\[ [] \rightarrow [− \text{stress}] \]

And here is what the rule would do to the previous (I will mark stress above the symbols):
From now on I will mark [−stress] by leaving it out, since, from this point in the derivation on, all symbols have some marking for [stress]:

\[ \text{[æspærægæs]}_N \]

**Primary stress assignment**

Now let’s look at the first rule:

(5) (Main Stress Rule)

\[ V \rightarrow [1 \text{ stress}] / - C_0 \left( \begin{bmatrix} - \text{tense} \\ - \text{stress} \end{bmatrix} C_0^1 \right) / - \left( \begin{bmatrix} - \text{tense} \\ - \text{stress} \end{bmatrix} C_0 \right) \langle N \rangle \]

The notation $C_0^1$ means 0 or 1 consonants; the notation $C_0$ means 0 or more consonants. The round brackets mean “optional”; you always apply the maximal version of the rule that matches the string. The angle brackets mean “optional,” but for a discontinuous part of the rule. Thus the second part of the context of the rule is only matched for nouns. So, this expands to four rules, disjunctively ordered (i.e. ORed):

(6)

\[ V \rightarrow [1 \text{ stress}] / - C_0 \left( \begin{bmatrix} - \text{tense} \\ - \text{stress} \end{bmatrix} C_0^1 \right) / - \left( \begin{bmatrix} - \text{tense} \\ - \text{stress} \end{bmatrix} C_0 \right) \langle N \rangle \]

\[ V \rightarrow [1 \text{ stress}] / - C_0 \left( \begin{bmatrix} - \text{tense} \\ - \text{stress} \end{bmatrix} C_0^1 \right) \langle N \rangle \]

\[ V \rightarrow [1 \text{ stress}] / - C_0 \left( \begin{bmatrix} - \text{tense} \\ - \text{stress} \end{bmatrix} C_0^1 \right) \]

\[ V \rightarrow [1 \text{ stress}] / - C_0 \]

The tense vowels here are the long vowels and diphthongs; there aren’t any tense vowels in this string. They’re all lax. The tense vowels we will deal with are:

(7)

\[ [\text{aeiou}] \]

The lax vowels are:

(8)

\[ [\text{æeiouæ}] \]
This rule gives the following output:

\[(\text{æsparægas})_N\]

Let’s go over why, from the right end of the context: there is an N and a lax –stress vowel in the final syllable, so we include the last part of the context. This is preceded by a lax –stress vowel and a single consonant, so we also include the next part. We mark the preceding vowel as \([1 \text{ stress}]\).

Now we need another rule to give us the reduced vowels characteristic of English. Here’s a version of the rule that operates across the board:

\[(\text{Vowel Reduction})\]

\[
\begin{cases}
- \text{stress} \\
- \text{tense} \\
\text{V}
\end{cases}
\rightarrow [\text{o}]
\]

We obtain:

\[(\text{æsparægas})_N\]

Let’s try some more:

\[
\begin{array}{ccc}
[\text{dævælm}]_N & [\text{hərajzən}]_N & [\text{smapsis}]_N \\
\text{MSR} & [\text{dævælm}]_N & [\text{hərajzən}]_N & [\text{smapsis}]_N \\
\text{VR} & [\text{dævælm}]_N & [\text{hərajzən}]_N & [\text{smapsis}]_N \end{array}
\]

The two optional parts of the MSR tell the grammar to ignore (1) the final syllable; (2) a previous syllable with a lax vowel and only one consonant following. If the previous syllable has a tense vowel or has more than one consonant following, then it will be stressed.

Now, SPE does not have any notion of “syllable,” but we could recast “only one consonant following” in a syllabic way: “there is no consonant following the vowel \text{within the same syllable}.” If we divided these words into syllables, we would have: \([\text{dæ} . \text{væ} . \text{lm}]_N, [\text{hə} . \text{raj} . \text{zən}]_N, [\text{sm} . \text{aps} . \text{sis}]_N\).

As we will see, crosslinguistically, syllables that have a consonant following within the syllable (in the “coda” of the syllable) often pattern for the purposes of stress just like long vowels—meaning, phonetically long vowels. In fact, all of the things we have called “tensed” in English are also phonetically long (with some exceptions that we won’t get to); so we might (and Chomsky and Halle eventually do) reformulate these rules in terms of length, rather than tenseness, so that, underlyingly, all the things we have marked “tense” are actually marked “long.” There is a wrinkle, which is that \text{not} all of the things called “lax” in English are phonetically short, so we might think we have a problem saying that these things are underlyingly “short”; but it is easy to see that these cases of phonetically long surface vowels can be derived by rule—they are allophonic variants of underlying short vowels (we won’t get to these arguments either, though).

Put like this, we see that this core part of the English stress system for nouns is actually almost the same as the Latin stress system (although English has a lot more wrinkles): stress the penultimate syllable if it is \textit{heavy}—has a coda or a long vowel—otherwise (if the penult is \textit{light}) stress the antepenult. There is one difference: if the last vowel is tense, then the last vowel will be stressed, because the last syllable will not be ignored (we will see that in these cases we need some other technology to get the answer right). This difference aside, the basic pattern is the same. That is not how the SPE analysis works, though, because there is no explicit notion of syllable, or of heaviness, or of lightness (together often called \textit{syllable weight}).
Verbs and adjectives

Deriving the stress patterns for verbs is simple: we always omit the part of the MSR that ignores the last syllable. Here are some examples:

\[
\begin{align*}
\text{MSR} & : [\text{æstæn}1\text{I}] & [\text{æp}1\text{I}] & [\text{\textael}1\text{I}] \\
\text{VR} & : [\text{æstænæ}] & [\text{æp}1\text{I}] & [\text{\textael}1\text{I}] \\
\end{align*}
\]

Adjectives work the same, according to this analysis:

\[
\begin{align*}
\text{MSR} & : [\text{fræntæk}1\text{I}] & [\text{men}1\text{I}] & [\text{æbs2rd}1\text{I}] \\
\text{VR} & : [\text{fræntæk}1\text{I}] & [\text{men}1\text{I}] & [\text{æbs2rd}1\text{I}] \\
\end{align*}
\]

Secondary stress

The interesting part of the SPE theory comes when we look at secondary stress (and tertiary, and quaternary). In this theory, secondary stress is, for the most part, not assigned at all. Rather, primary stresses change into secondary stresses whenever a primary stress is marked on a different syllable. To give you a preview, here is how stress is assigned for *anecdote*:

\[
\begin{align*}
\text{MSR} & : [\text{\textael}1\text{I}] \\
\text{VR} & : [\text{\textael}1\text{I}] \\
\end{align*}
\]

The way this stress demotion is implemented is by actually, rather than assigning primary stress, assigning [0 stress], and, for each rule assigning [0 stress], automatically applying this rule afterwards:

\[
[ i \text{ stress } ] \rightarrow [ i + 1 \text{ stress } ]
\]

This may seem weird, but it is like this for a reason: *relative* prominence stays the same. That is, if there were two stresses before, one primary and then one secondary, then adding a primary stress elsewhere preserved the relative prominence between the two. This doesn’t really show up in words, but it was crucial to the SPE analysis of phrasal stress and stress in compounds. Word stress and phrasal stress were part of the same system. How might this work? Rules were assumed (and are often still assumed) to apply *cyclically*: that is, you are given a tree, and you apply the stress rules recursively, bottom up. Here is a simplified version:
BE applies at the end of a cycle. VR isn’t quite correct in the version I’ve given you: when properly specified, it only applies when a word doesn’t have any brackets left inside, and it doesn’t apply at all to words that have had all their internal brackets erased: that is, it only applies once for each word. Of course, stating this relies on there being some marking for word boundaries, which there isn’t in what I’ve given you (but there is in the full analysis).

We are only interested in word stress, so we will put this aside, but now you see the rationale. As you can see, stresses can be demoted by two applications of MSR. On the other hand, as suggested above, the stress in *anecdote* is assigned by a rule we haven’t seen yet:

(12) (Alternating Stress Rule)

\[ V \rightarrow [1 \text{ stress}] / — C_0 V C_0 [1 \text{ stress}] C_0 \]

Let’s look at the derivation again:

Let’s try some more:
Finally, let's try one more:

<table>
<thead>
<tr>
<th>Cycle</th>
<th>MSR</th>
<th>ASR</th>
<th>BE</th>
</tr>
</thead>
<tbody>
<tr>
<td>First cycle</td>
<td>$\overline{[æn\dot{k}d\dot{o}t]\text{æl}}_A$</td>
<td>$\overline{[æn\dot{k}d\dot{0}t]\text{æl}}_A$</td>
<td>$\overline{1[æn\dot{k}d\dot{0}t]\text{æl}}_A$</td>
</tr>
<tr>
<td>Second cycle</td>
<td>$\overline{2[æn\dot{k}d\dot{0}t]\text{æl}}_A$</td>
<td>$\overline{2[æn\dot{k}d\dot{0}t]\text{æl}}_A$</td>
<td>$\overline{2[æn\dot{k}d\dot{0}t]\text{æl}}_A$</td>
</tr>
</tbody>
</table>

**Auxiliary Reduction Rules**

There is a big issue with coverage. The ASR is crucially tied to the presence of a $\dot{c}$. The MSR is as well, and, in any case, each can only apply once per cycle (at least in the version given here; in the full analysis there is a second part to the MSR called the Stressed Syllable Rule which can sometimes apply in addition to the part we’ve seen—but this is still only one more kick at the can). What do we do with words that need several stresses, but are only one morpheme?

Let's try some:

<table>
<thead>
<tr>
<th>Cycle</th>
<th>MSR</th>
<th>ASR</th>
<th>BE</th>
</tr>
</thead>
<tbody>
<tr>
<td>First cycle</td>
<td>$[\text{rododendron}]_N$</td>
<td>$[\text{oklahoma}]_N$</td>
<td>$[\text{monangahila}]_N$</td>
</tr>
<tr>
<td>ASR</td>
<td>$\overline{[\text{rododendron}]_N}$</td>
<td>$\overline{[\text{oklahoma}]_N}$</td>
<td>$\overline{[\text{monangahila}]_N}$</td>
</tr>
<tr>
<td>VR</td>
<td>$\overline{[\text{rododendron}]_N}$</td>
<td>$\overline{[\text{oklahoma}]_N}$</td>
<td>$\overline{[\text{monangahila}]_N}$</td>
</tr>
<tr>
<td>BE</td>
<td>$\text{rododendron}$</td>
<td>$\text{oklahoma}$</td>
<td>$\text{monangahila}$</td>
</tr>
</tbody>
</table>

Eek. We need to fix this. CH “fix” this problem by adding one more rule, the Auxiliary Reduction Rule. Despite the name, this rule doesn’t do any reduction; rather, it prevents reduction by adding secondary stresses at the beginning of a word.

**(13)** (Auxiliary Reduction Rule)

$$\left[\begin{array}{c} \text{stress} \\ V \end{array}\right] \rightarrow [2 \text{ stress}] / \#[- \text{ stress}]_0 \rightarrow \left\{ \begin{array}{c} C_0 \left[ \begin{array}{c} \text{tense} \\ V \end{array} \right] \bigg] C_0^1 \ \left[ \begin{array}{c} \alpha \text{ stress} \\ V \end{array} \right] C_0 \left[1 \text{ stress}\right], \ \alpha \text{ weaker than 2} \end{array}\right\}$$

This solves our problem:
This, Chomsky and Halle professed, is rather unfortunate. It works, but it looks suspiciously like the ASR (after all, it gives us alternating stress!) and it is not too far off MSR either. There is something wrong with the theory, they admit. And empirically there is something wrong, too—for we can still only apply ARR once. What about flocinaucinihilipilification? Admittedly, you can imagine that people might break this down mentally into a lot of morphemes, but even if you could break it down correctly, this would predict that people keep reducing and reducing the stress with each cycle, which also seems wrong.

Finally, there is a nice result that this whole system can give us which is tantalizingly out of reach. There are some pairs of words that have exactly the same segmental structure, but they differ in one crucial way: they contrast in that one has and one does not have tertiary stress. Tertiary stressed vowels are mostly only noticeable because they are not primary or secondary stressed, but they still fail to reduce. At the moment, however, if we try and walk through the derivation of one of these words, we will get almost, but not quite, the right stress pattern. So let’s first state the rule that will let us see the facts:

(14) (Pretonic Weakening)

$$[2 \text{ stress}] \rightarrow [3 \text{ stress}] / - C_0 [1 \text{ stress}]$$

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<tbody>
<tr>
<td>First cycle</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASR</td>
<td>[örkéstret] V</td>
<td>[örkéstret] V + jόn N</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Spir.</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>PTW</td>
<td>-</td>
<td>-</td>
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<tr>
<td>ARR</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>BE</td>
<td>(see below)</td>
<td>(see below)</td>
<td>[ınfest] V + etjόn N</td>
<td></td>
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</tbody>
</table>

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<tbody>
<tr>
<td>Second cycle</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSR</td>
<td>-</td>
<td>[örkéstret] V + jόn N</td>
<td>-</td>
<td>[ınfest] V + etjόn N</td>
</tr>
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<td>-</td>
<td>[ınfest] V + etjόn N</td>
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</tbody>
</table>

|---------|---------------|------------------------|------------|----------------------|
Some generalizations

Although you can probably think of some words that don’t work for the system given above, there more than likely fit some mini-generalization covered by one or another rule in the full SPE analysis. However, even where the coverage is good, there are some generalizations that are just not captured:

- The Alternating Stress Rule does essentially the same thing as the Auxiliary Reduction Rule, namely, set a primary stress two syllables before another primary stress.
- The Main Stress Rule is similar to the ASR in that it sets a primary stress two syllables before the last syllable.
- The Stressed Syllable Rule (a rule not mentioned here) does almost the same thing as the ASR, placing a primary stress two syllables before another primary stress (actually, it can also place a primary stress *immediately* before another primary stress if the preceding syllable is heavy; we have not seen this, but it is necessary for words like *ellipsoid* and for deriving *tórrment* from *tormént*).

References