First, let’s finish up the Japanese example of constraint-rule interaction.

1. Recap
We saw an alternation between Ø and V at the end of two stems—Ø when a geminate could be created, V elsewhere:

- gak+koo ‘school’
- gaku+sei ‘student’
- gaku+in ‘school, academy’
- dai+gaku ‘university’

Itô attributed this alternation to an epenthesis rule triggered by an unsyllabifiable C.

2. How to account for [gaku+in]?
A constraint requiring alignment of syllable and morpheme boundaries has been proposed to account for phenomena in many languages like

Ø → ? / C + _ V (e.g., German and Dutch prefix-stem boundaries; arguably Keley-i)
Ø → V / [C_i _nas] + [V C_j], where C_i ≠ C_j (the Japanese rule)

- How could an alignment constraint be used to simplify the two rules above?

3. “r” is different

<table>
<thead>
<tr>
<th>Japanese</th>
<th>English</th>
</tr>
</thead>
<tbody>
<tr>
<td>bet+taku</td>
<td>‘detached villa’</td>
</tr>
<tr>
<td>bek+kaku</td>
<td>‘different style’</td>
</tr>
<tr>
<td>bep+puu</td>
<td>‘separate cover’</td>
</tr>
<tr>
<td>be+jitsu</td>
<td>‘separate room’</td>
</tr>
<tr>
<td>bes+satsu</td>
<td>‘separate volume’</td>
</tr>
<tr>
<td>betsu+d3in</td>
<td>‘different person’</td>
</tr>
<tr>
<td>betsu+m’oo</td>
<td>‘alias’</td>
</tr>
<tr>
<td>betsu+bin</td>
<td>‘separate post’</td>
</tr>
</tbody>
</table>

Such constraints are usually expressed in more specific terms, such as “the left edge of a stem must coincide with the beginning of a syllable.” See section 5 of McCarthy, John & Alan Prince (1993). Generalized alignment. *Yearbook of Morphology*: 79–153.
Itô proposes that these final Cs are underlyingly *underspecified*—that is, they lack values for various features (cf. discussion of MSRs in K&K).

- How do you think the stem-final [p] in [bep+puu] gets its features?
- Which features would have to be unspecified in these consonants, and which could be specified?
- How can we explain the consonant quality when a vowel *is* epenthesized? (Note: Japanese has a rule *t* → *Ts / _ u*)
- At least in Sino-Japanese and native words, Japanese has a constraint against voiced geminate obstruents. How might you revise the analysis in light of that fact?

4. **Discussion: Applying Myers’ idea**
- Can we recast any of the constraints we used today as *persistent rules*?
Now, autosegmental representations

We’ve moved a little bit away from representations that are a sequence of matrices, by using a skeletal tier; today we’ll start to go further.

5. Tiers
A “linear representation” (i.e., what we’ve been using till now) of [mājāb] might look like:

\[
\begin{bmatrix}
+\text{nas} \\
+\text{cons} \\
+\text{labial} \\
\ldots
\end{bmatrix}
\begin{bmatrix}
+\text{nas} \\
-\text{cons} \\
+\text{lo} \\
\ldots
\end{bmatrix}
\begin{bmatrix}
+\text{nas} \\
-\text{cons} \\
+\text{hi} \\
\ldots
\end{bmatrix}
\begin{bmatrix}
-\text{nas} \\
-\text{cons} \\
+\text{lo} \\
\ldots
\end{bmatrix}
\]

but we could imagine a reasonable notation system where we write instead:

\[
\begin{bmatrix}
+\text{nas} \\
+\text{cons} \\
+\text{labial} \\
\ldots
\end{bmatrix}
\begin{bmatrix}
-\text{nas} \\
-\text{cons} \\
+\text{lo} \\
\ldots
\end{bmatrix}
\begin{bmatrix}
-\text{nas} \\
-\text{cons} \\
+\text{hi} \\
\ldots
\end{bmatrix}
\begin{bmatrix}
+\text{nas} \\
+\text{cons} \\
+\text{labial} \\
\ldots
\end{bmatrix}
\]

In the skeletal notation we saw last time, this might look like:

\[
\begin{array}{ccc}
\text{C} & \uparrow & \text{V} \\
\text{C} & \uparrow & \text{v} \\
\text{V} & \uparrow & \text{c} \\
\end{array}
\]

[+nas]                             [-nas ]
[+cons ]                             [-cons]
[+labial]                             [-labial]
[+lo ]                             [-lo ]
[+hi ]                             [-hi ]
[+lo ]                             [-lo ]
[+hi ]                             [-hi ]

We could even put every feature on its own tier:

\[
\begin{bmatrix}
+\text{nas} \\
+\text{cons} \\
+\text{labial} \\
\ldots
\end{bmatrix}
\begin{bmatrix}
+\text{nas} \\
-\text{cons} \\
+\text{lo} \\
\ldots
\end{bmatrix}
\begin{bmatrix}
+\text{nas} \\
-\text{cons} \\
+\text{hi} \\
\ldots
\end{bmatrix}
\begin{bmatrix}
-\text{nas} \\
-\text{cons} \\
-\text{lo} \\
\ldots
\end{bmatrix}
\]

6. How can we decide?
Changing the theory in this way is a good idea only if the new theory does a better job than the old at correctly distinguishing highly valued from lowly valued grammars (or grammar fragments).

---

2 As before, the evidence as to what is actually highly valued comes, in practice, mainly from typology—even though we have seen before that typological evidence can be problematic.
As before, the claim is that rules that can be expressed in a simple form (though we will not spend time spelling out how rule simplicity is to be calculated) are highly valued. So, we are interested in

- rules that look relatively complicated (relative to other rules, that is) in the old theory but relatively simple in the new one—new theory predicts they are highly valued
- rules that look relatively simple in the old theory but relatively complicated in the new one—new theory predicts they are lowly valued

7. Tonal association

Kikuyu (Niger-Congo language from Kenya with about 5.3 million speakers; discussed here based on Goldsmith 1990, whose data come from Clements & Ford)

<table>
<thead>
<tr>
<th>Kikuyu Words</th>
<th>Tone Suffix</th>
</tr>
</thead>
<tbody>
<tr>
<td>tô rɔ̀r ìré</td>
<td>‘we looked at’</td>
</tr>
<tr>
<td>tô mò rɔ̀r ìré</td>
<td>‘we looked at him’</td>
</tr>
<tr>
<td>tô mà rɔ̀r ìré</td>
<td>‘we looked at them’</td>
</tr>
<tr>
<td>tô tôm ìré</td>
<td>‘we sent’</td>
</tr>
<tr>
<td>tô mò tôm ìré</td>
<td>‘we sent him’</td>
</tr>
<tr>
<td>tô mà tôm ìré</td>
<td>‘we sent them’</td>
</tr>
<tr>
<td>má rɔ̀r ìré</td>
<td>‘they looked at’</td>
</tr>
<tr>
<td>má mò rɔ̀r ìré</td>
<td>‘they looked at him’</td>
</tr>
<tr>
<td>má mà rɔ̀r ìré</td>
<td>‘they looked at them’</td>
</tr>
<tr>
<td>má tôm ìré</td>
<td>‘they sent’</td>
</tr>
<tr>
<td>má mò tôm ìré</td>
<td>‘they sent him’</td>
</tr>
<tr>
<td>má mà tôm ìré</td>
<td>‘they sent them’</td>
</tr>
</tbody>
</table>

- Take a minute to ascertain the basic facts—on what does the tone of the tense suffix ìré/ìré depend? On what do the tones of the two verb roots (in bold) depend? On what do the tones of the object suffixes (underlined) depend? 

- Ideas for how we can account for this with linear representations and rules (assume a feature [hi tone])?

In the “autosegmental” notation proposed by Goldsmith, we can write a rule thus (Goldsmith’s (9)—“T” stands for any tone, such as H or L in this language):

\[
\begin{bmatrix}
C_0 & V & C_0 & V \\
\end{bmatrix}
\]

\[ \text{peninitial association} \]

Yes, this is a rule! Its structural description is

\[
\begin{bmatrix}
C_0 & V & C_0 & V \\
T & & & \\
\end{bmatrix}
\]
(i.e., everything except the dashed line) and the structural change it requires is insertion of the association line.

We need two more rules for the rest of the tones:

\[
\begin{array}{c}
V \quad C_0 \quad V \\
| \\
T \quad T
\end{array}
\]

\textit{association convention}³

\[
\begin{array}{c}
C_0 \quad V \\
T
\end{array}
\]

\textit{initial association}

The circle is part of the structural description, and means “not associated to anything on the other tier”.

- Let’s apply this grammar fragment to derive ‘we looked at them’—what must we assume about the association of tones in underlying forms?

All three rules are typical of the kind of thing you see in tone languages, and all three rules are some of the simplest that could be written in this notation.

- Compare this to the linear analysis we developed above: do the linear rules look simple compared to other, less plausible linear tone rules we could write?

³ For Goldsmith, association conventions actually derive from universal principles, and don’t need to be specified on a language-particular basis.