Why (not) weight? The case for Harmonic Grammar – Part II

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5. HG and the contents of Con

The case of Japanese loanword devoicing in section 2 shows that HG can generate attested patterns that fall out of reach when the same constraints are ranked. This allows us to draw two important conclusions. First, weighted constraint interaction can in principle permit a smaller set of more general constraints than that used in OT analyses of the same data. Second, because HG can account for attested patterns with a constraint set that differs from the one needed in OT, it is likely that any fleshed out theory of some set of linguistic phenomena in HG will be in some ways less restrictive, and in some ways more restrictive, than the comparable OT one. We now turn to concrete examples of both of these points.

5.1 Reduction through weighting: Lango vowel harmony

A key argument for OT’s violable constraints is their ability to reduce complex language-specific patterns to more general, plausibly universal principles. For example, Prince & Smolensky (2004: §4) show that a complex pattern of stress in the dialect of Hindi described by Kelkar (1968) can be reduced to the interaction of three general constraints. This reduction depends on constraint violability: two of the three constraints are violated when they conflict with a higher-ranked constraint. In this section, we see that the same sort of argument can be made for replacing OT’s ranked constraints with weighted ones.

The demonstration takes the form of a case study: ATR harmony in Lango, as described in Bavin, Woock & Noonan (1979), from which all the data below are taken. The analysis is based on generalizations originally uncovered by Bavin Woock & Noonan, and draws heavily on the analyses of Archangeli & Pulleyblank (1994) and Smolensky (2006) (see Potts et al. 2009 fn. 6 on some data issues). Smolensky’s use of local constraint conjunction suggests the possibility of a treatment in terms of weighted constraints.

Although the constraints in this analysis are simple, their interaction is complex; a correct weighting must simultaneously meet a host of conditions. Finding such a weighting involves extensive calculation. This analysis thus illustrates the utility of OT-Help for conducting linguistic analysis in HG.

We’ll also be talking more about vowel harmony when we turn to serial OT and serial HG, so this case study will serve to introduce some of the data and analytic possibilities.
Lango has a ten-vowel system, with five ATR vowels [i e u o a] and five corresponding RTR vowels [i e o a]. The following examples of ATR spreading show that it targets RTR vowels in both suffixes (30a–d) and roots (30e–h), in other words, that ATR spreads left-to-right and right-to-left. I have omitted tone from all transcriptions.

(30) Example (17) from Potts et al. (2009)

<table>
<thead>
<tr>
<th>ATR spreading Example</th>
<th>Transcription</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. /wot+ɛ/</td>
<td>wode</td>
<td>‘son (3 sg)’</td>
</tr>
<tr>
<td>b. /ŋut+ɛ/</td>
<td>ŋute</td>
<td>‘neck (3 sg)’</td>
</tr>
<tr>
<td>c. /wot+a/</td>
<td>woda</td>
<td>‘son (1 sg)’</td>
</tr>
<tr>
<td>d. /buk+na/</td>
<td>bukko</td>
<td>‘book (1 sg)’</td>
</tr>
<tr>
<td>e. /atim+ni/</td>
<td>atinni</td>
<td>‘child (2 sg)’</td>
</tr>
<tr>
<td>f. /dék+ni/</td>
<td>dekki</td>
<td>‘stew (2 sg)’</td>
</tr>
<tr>
<td>g. /lɔt+wu/</td>
<td>lutwu</td>
<td>‘stick (2 pl)’</td>
</tr>
<tr>
<td>h. /lɛ+wu/</td>
<td>lewu</td>
<td>‘axe (2 pl)’</td>
</tr>
</tbody>
</table>

These examples also show that ATR spreads from high vowel triggers (30b, d–h) as well as from mid vowels (30a, c), and from both front (30e, f) and back vowels (30a–d, g, h). The examples also show that it crosses consonant clusters (30d–g) and singletons (30a–c, h). Finally, they show that it targets high vowels (30e, g), mid vowels (30a, b, f, h) and low vowels (30c, d).

For each of these options for trigger, directionality, intervening consonant and target, there is a preference, which is instantiated in the absence of spreading when that preference is not met. The preferences are listed in (31), along with examples of the failure to spread under dispreferred conditions, as well as references to the minimally different examples in (17/30) in which ATR spreading does occur in the preferred environment.

(31) Conditions favouring ATR-spreading in Lango

a. High vowel trigger
   i. R-L spreading only when the trigger is high
      /nɛn+Co/ [nɛnno] *[nɛnno] ‘to see’ cf. (17e–h)
   ii. L-R spreading across a cluster only when the trigger is high
      /gwɔk+na/ [gwɔkko] *[gwɔkko] ‘dog (1 sg)’ cf. (17c)

b. L-R directionality
   i. Mid vowel triggers spread only L-R
      /lɛm+Co/ [lɛmmo] *[lɛmmo] ‘to visit’ cf. (17a, c)
   ii. Spreading from a back trigger across a cluster to a non-high target only L-R
      /dɛk+wu/ [dɛkwu] *[dɛkwu] ‘stew (2 pl)’ cf. (17d)
c. *Intervening singleton*
   i. L-R spreading from mid vowels occurs only across a singleton
      \[\text{gwok+na} / \text{gwokka} * \text{gwokka} ]’dog (1 sc)’ cf. (17a, c)
   ii. R-L spreading from a back trigger to a non-high target only
      across a singleton
      \[\text{dek+wu} / \text{dekwu} * \text{dekwu} ]’stew (2 pt)’ cf. (17h)

d. *High target*
   R-L spreading from a back trigger across a cluster only to high
   vowels\(^8\)
   \[\text{dek+wu} / \text{dekwu} * \text{dekwu} ]’stew (2 pt)’ cf. (17g)

e. *Front trigger*
   R-L spreading across a cluster to a mid target only from a front
   trigger
   \[\text{dek+wu} / \text{dekwu} * \text{dekwu} ]’stew (2 pt)’ cf. (17f)

I follow Smolensky (2006) in ascribing the Lango trigger and directionality
preferences to constraints on the heads of feature domains, though the
implementation differs somewhat in the details. Headed domain structures for ATR
are illustrated in (32b) and (32d), in which the ATR feature domain spans both
vowels. In (32b) the head is on the rightmost vowel, and in (32d) the head is
leftmost. Unlike Smolensky (2006), I assume that a feature domain is minimally
binary – a relation between a head and at least one dependent. In the disharmonic
sequences in (32a) and (32c), the ATR feature is linked to a single vowel, and there
is no head-dependent relation. The assumption that the ATR vowels in (32a) and
(32c) are not domain heads is crucial to the definition of the constraints on triggers
below. In these representations, a vowel unspecified for ATR is RTR; the use of
underspecification here is purely for convenience.

(32) *Headed domain ATR structures*

\[
\begin{align*}
\text{a. ATR} & \quad \text{b. ATR} & \quad \text{c. ATR} & \quad \text{d. ATR} \\
p & e & t & i \\
& & & e \\
& & t & i
\end{align*}
\]

For spreading to occur, there must be a constraint that disfavors representations
like those in (32a) and (32c) relative to (32b) and (32d) respectively. I adopt a
single constraint that penalizes both (32a) and (32c): Spread[ATR] (see Wilson
2003, Smolensky 2006 and McCarthy 2009 for alternative formulations of a
spreading constraint).
(33) Spread[ATR]
For any prosodic domain $x$ containing a vowel specified as ATR, assign a violation mark to each vowel in $x$ that is not linked to an ATR feature.

Spread[ATR] conflicts with a set of constraints that penalize spreading in particular circumstances. The preference for rightwards directionality comes from Head-L:

(34) Directionality
Head-L
Assign a violation mark to every head that is not leftmost in its domain.

Preferences for high and front triggers are encoded by penalizing non-high and non-front heads:

(35) Triggers
Head[high]
Assign a violation mark to every head that is not high.

Head[front]
Assign a violation mark to every head that is not front.

The preference for singleton interveners is due to a locality constraint, following Archangeli and Pulleyblank (1994):

(36) Locality
Local-C
Assign a violation mark to every cluster intervening between a head and a dependent.

And finally, the preference for high targets is represented by the constraint ATR[high]:

(37) Target condition
ATR[high]
Assign a violation mark to every ATR vowel that is not high.

Demo: hg2lp-lango.txt
Discussion point: Weighting conditions from comparative view
5.2 Comparison with alternatives

If the constraints in the previous section were considered either inviolable, as in theories outside of HG and OT, or rankable, as in OT, they would be insufficient for analysis of the Lango paradigm. In this section, we'll consider extant analyses constructed under each of these assumptions about the activity of constraints. We'll see that they suffer in terms of both generality and restrictiveness.

In their parametric rule-based analysis, Archangeli & Pulleyblank (1994) posit five rules of ATR spreading. Each rule specifies directionality and optional trigger, target and locality conditions. These are schematized in (38). Cells left blank indicate that the rule applies with all triggers, targets or intervening consonants.

(38) A&P’s (1994) analysis in terms of parameterized rules

<table>
<thead>
<tr>
<th>direction</th>
<th>trigger</th>
<th>target</th>
<th>locality</th>
</tr>
</thead>
<tbody>
<tr>
<td>L-R</td>
<td>high</td>
<td></td>
<td>VCV</td>
</tr>
<tr>
<td>L-R</td>
<td>high</td>
<td></td>
<td>VCV</td>
</tr>
<tr>
<td>R-L</td>
<td>high</td>
<td>high</td>
<td>VCV</td>
</tr>
<tr>
<td>R-L</td>
<td>high, front</td>
<td>high</td>
<td></td>
</tr>
</tbody>
</table>

The conditions are inviolable constraints on the application of the rules. Because of their inviolability, they must be limited to apply only to particular rules: none of them are true generalizations about ATR spreading in the language as a whole. Even though the directionality, trigger and locality preferences do not state completely true generalizations, they have broad scope in the ATR system of Lango, and must therefore be encoded as constraints on multiple rules. Thus inviolability entails the fragmentation of each generalization across separate formal statements.

Along with this loss of generality, there is a loss of restrictiveness. In Archangeli & Pulleyblank’s parametric rule system, any set of rules with any combination of conditions can coexist in a language. Davis (1995) and McCarthy (1997) discuss this aspect of the theory with respect to disjoint target conditions on two RTR-spreading rules; here we consider the further possibilities introduced by trigger and locality conditions. One notable aspect of the Lango system is that L-R spreading is ‘stronger’ in all respects: there is no environment in which R-L spreading applies more freely with respect to any of the conditions. This ‘uniform strength’ property is predicted by the HG analysis, but not by the one using parametric rules. As Davis and McCarthy show, the latter theory allows one rule to apply more freely with respect to one condition, and another rule to apply more freely with respect to another condition. For example, with the parameter settings in (39), L-R spreading targets only high vowels, while R-L spreading has only high vowels as triggers. The set of triggers is unrestricted for L-R spreading, whereas the set of targets is unrestricted for R-L spreading.
(39) Parameter settings generating an unattested language type

<table>
<thead>
<tr>
<th>direction</th>
<th>trigger</th>
<th>target</th>
</tr>
</thead>
<tbody>
<tr>
<td>L-R</td>
<td>high</td>
<td></td>
</tr>
<tr>
<td>R-L</td>
<td>high</td>
<td></td>
</tr>
</tbody>
</table>

Smolensky's (2006) OT-LC analysis of Lango is similar to the A&P's parametric rule-based one. It can cope with Lango, at the cost of some generality w.r.t. the HG analysis. Here is how OT-LC would work with the constraints we've been using:

(40) OT-LC analysis of Lango

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>eC1</td>
<td>eC1</td>
<td>W</td>
<td>W</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>iC1</td>
<td>iC1</td>
<td>W</td>
<td>W</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>eCC1</td>
<td>eCC1</td>
<td>W</td>
<td>W</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>iCC1</td>
<td>iCC1</td>
<td>W</td>
<td>W</td>
<td>L</td>
<td>L</td>
</tr>
</tbody>
</table>

It also produces the unattested language type, thus suffering in terms of restrictiveness w.r.t. HG.

(41) OT-LC analysis of unattested language

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>e...i</td>
<td>e...i</td>
<td>W</td>
<td>W</td>
<td>L</td>
<td>L</td>
<td>W</td>
</tr>
<tr>
<td>i...e</td>
<td>i...e</td>
<td>W</td>
<td>W</td>
<td>L</td>
<td>L</td>
<td>W</td>
</tr>
<tr>
<td>e...i</td>
<td>e...i</td>
<td>W</td>
<td>W</td>
<td>L</td>
<td>L</td>
<td>W</td>
</tr>
<tr>
<td>i...e</td>
<td>i...e</td>
<td>W</td>
<td>W</td>
<td>L</td>
<td>L</td>
<td>W</td>
</tr>
</tbody>
</table>

Demo: inconsistent-lango.txt

Discussion point: Why can't HG with these constraints produce this pattern? Why does it in general make the prediction that one direction will be uniformly "stronger" than the other?

The big picture: One might be tempted to favor a less powerful theory of constraint interaction on the grounds that it will offer a more restrictive theory of linguistic typology. However, the predictions of a theory of constraint interaction also depend on the contents of the constraint set. Insofar as a more powerful theory of constraint interaction allows attested patterns to be analyzed with a more restricted constraint set, the resulting typological predictions are likely to be in some ways more
restrictive. This is just as true of comparisons between HG and OT as it is of comparisons between ranked and inviolable constraints.

In comparisons between HG and OT, then, there will often be different constraint sets for each framework. We’ll now look at two typological studies of this sort.

5.2 Typology of positional restrictions

Our first comparison of OT and HG with different constraint sets comes from Jesney (to appear). Positional restrictions are analyzed in OT using two types of constraint: positional markedness (e.g. *Coda-Voice) and positional faithfulness (e.g. Ident-Voice-Onset). It turns out that for at least some phenomena, HG can use just positional markedness, when OT needs both. We’ll see this, and then turn to the typological consequences.

Jesney points out that HG, but not OT, allows for analyses of cases of disjunctive licensing using markedness constraints. A simple hypothetical example from Potts et al. (2009) – voicing is allowed in an onset or in an initial syllable (in this comparative tableau, \( W = +1, L = -1 \)):

(42) HG analysis of disjunctive licensing

a. \( \text{VoiceOnset} \)  
   Assign a violation mark to every voiced obstruent that is not in onset position.

b. \( \text{Voice}-\sigma_1 \)  
   Assign a violation mark to every voiced obstruent that is not in the word-initial syllable.

<table>
<thead>
<tr>
<th></th>
<th>2</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>W ~ L</td>
<td>VOICE</td>
<td>VOICE</td>
<td>IDENT</td>
</tr>
<tr>
<td>[bad.na.bat] ~ [bad.na.pat]</td>
<td>L</td>
<td>L</td>
<td>W</td>
</tr>
<tr>
<td>[bad.na.bat] ~ [bat.na.bat]</td>
<td>W</td>
<td>W</td>
<td>W</td>
</tr>
<tr>
<td>[bad.na.bat] ~ [bad.na.bad]</td>
<td>W</td>
<td>W</td>
<td>L</td>
</tr>
</tbody>
</table>

Discussion point: Failure of OT analysis with these constraints.

An OT analysis is available with positional faithfulness constraints:

(43) OT analysis of disjunctive licensing

a. \( \text{Ident}[\text{voice}]-\text{Ons} \)  
   Assign a violation mark to every output segment in onset position whose input correspondent differs in voicing specification.

b. \( \text{Ident}[\text{voice}]-\sigma_1 \)  
   Assign a violation mark to every output segment in the initial syllable whose input correspondent differs in voicing specification.
Jesney also points out that OT with positional faithfulness cannot handle conjunctive licensing – e.g. voicing is permitted in a segment that is an onset and in a word-initial syllable. This sort of pattern requires positional markedness constraints.

**Demo:** positional-faith.txt, positional-mark.txt

For these types of data, OT requires positional markedness and positional faithfulness, while HG needs only positional markedness. While more work needs to be done to determine whether HG can successfully deal with all of the phenomena attributed to positional faithfulness, a potential consequence is that HG can function without that constraint type. This would be a welcome result, because positional faithfulness constraints are known to make bad predictions. Zoll (1998) points out that they predict that a floating feature would dock on the weak licensor, rather than the strong one. Abstractly:

(44) Attested (W) and unattested (L) outcomes for /katnakat/ + floating [voice]

<table>
<thead>
<tr>
<th>W ∼ L</th>
<th>IDENT[voice]</th>
<th>IDENT[voice]</th>
<th>*VOICE</th>
<th>IDENT[voice]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-ONS -σ₁</td>
<td>-ONS -σ₁</td>
<td></td>
<td>-ONS -σ₁</td>
</tr>
<tr>
<td>[gat.na.kat] ∼ [kat.na.kad]</td>
<td>L</td>
<td>L</td>
<td>W</td>
<td>W</td>
</tr>
</tbody>
</table>

Our comparison of the typological consequences of HG and OT treatments of positional restrictions therefore uses different constraint sets: positional markedness for HG, and positional markedness and positional faithfulness for OT.

**Demo:** positional-HG.txt, positional-OT.txt, positional-OT/HG-output.xlsx

The graphic version of “positional-OT/HG-output.xlsx” from Potts et al. (2009):

(45) HG with pos. mark. vs. OT with pos. mark. and pos. faith

<table>
<thead>
<tr>
<th>[gat.na.kat]</th>
<th>[kad.na.kat]</th>
<th>[kat.na.gat]</th>
<th>[kat.na.kad]</th>
</tr>
</thead>
<tbody>
<tr>
<td>[bad.na.bad]</td>
<td>HG &amp; OT</td>
<td>OT</td>
<td>OT</td>
</tr>
<tr>
<td>[bad.na.bat]</td>
<td>HG</td>
<td>OT</td>
<td>OT</td>
</tr>
<tr>
<td>[bad.na.pat]</td>
<td>HG &amp; OT</td>
<td>OT</td>
<td>OT</td>
</tr>
<tr>
<td>[kat.na.bat]</td>
<td>HG &amp; OT</td>
<td>OT</td>
<td>OT</td>
</tr>
<tr>
<td>[bat.na.pat]</td>
<td>HG &amp; OT</td>
<td>OT</td>
<td>OT</td>
</tr>
<tr>
<td>[pat.na.pat]</td>
<td>HG &amp; OT</td>
<td>OT</td>
<td>OT</td>
</tr>
</tbody>
</table>
5.2 Typology of scalar interactions

Recall from section 2 that scalar constraints are viable in HG because weights allow for “cut-offs”:

(46) “English” – only sonorants as consonantal nuclei

<table>
<thead>
<tr>
<th></th>
<th>/tn/</th>
<th>Dep 1.5</th>
<th>*C-Nuc</th>
<th>/ts/</th>
<th>Dep 1.5</th>
<th>*C-Nuc</th>
</tr>
</thead>
<tbody>
<tr>
<td>tN</td>
<td>1</td>
<td>-1</td>
<td>1</td>
<td>tS</td>
<td>1</td>
<td>-2</td>
</tr>
<tr>
<td>tVn</td>
<td>1</td>
<td>-1.5</td>
<td></td>
<td>tVs</td>
<td>1</td>
<td>-1.5</td>
</tr>
</tbody>
</table>

Scalar constraints that assign violations in a linear fashion cannot handle what de Lacy (2004) calls “conflation”. An example from his paper:

(47) An example of conflation from de Lacy (2004)

(12) Ngamasan antepenult stress in words with three light (i.e. CV, CVC) syllables

a. **Stress antepenult** [c o] *if the penult is short* [i y u ə i]

   - [jɛmbir̥i] ‘dressing’
   - [cɛtu] ‘very much’
   - [cɛtɔmtɪ] ‘fourth’
   - [nɔnjĩr̥a] ‘going out’
   - [kɔntu] ‘carry’
   - [sɔlɔtu] ‘glass’

b. **Stress antepenult** [a] *if the penult is short* [i y u ə i]

   - [anĩr̥a] ‘large’
   - [bãrũfi] ‘devil’
   - [kãnɔmtu] ‘which (in order)’
   - [hãsĩr̥a] ‘fishing rod’

(13) a. **No stress retraction from mid to low vowels**

   - [bacėbsa] ‘breathing’
   - [nacɛju] ‘hang down, stick out’

b. **No stress retraction from central to high vowels**

   - [cintáji] ‘stoke’
   - [cuhɔnu] ‘during’
   - [hɔtsɔn] ‘torso’

We can get a view of the problem by seeing how the following constraints interact:

(48) Stress-to-sonority (linear)

Assign a violation to the head of a foot for each degree of sonority separating it from [a] (low vowel = 0, mid vowel = −1, high vowel = −2)
Penult
Assign a violation for antepenultimate stress

**Demo:** simple-stress-son-lin.txt.

We can get conflation if the violation scale is non-linear:

(49) Stress-to-sonority (non-linear)
Assign a violation to the head of a foot for each degree of sonority separating it from [a] (low vowel = 0, mid vowel = –1, **high vowel = –3**)

**Demo:** simple-stress-son-nonlin.txt

What about OT? De Lacy (2004) points out that some patterns of conflation are a problem for fixed rankings of constraints in OT, and argues that constraints in a stringency relation can get the full range of patterns. Here are the constraints corresponding to these in (48) and (49):

(50) **Stringency constraints**
  a. *Stress-[i]
     Assign a violation to a stressed high vowel
  
  b. *Stress-[i,e]
     Assign a violation to a stressed high or mid vowel

Factorial typology with the Penult constraint produces four patterns:

(51) **OT Factorial typology**
  a. Penult >> *Stress-[i], *Stress-[i,e]
      Fixed penult stress

  b. *Stress-[i] >> Penult >> *Stress-[i,e]
      Penult stress unless penult is high, and antepenult is mid or low

  c. *Stress-[i,e] >> Penult >> *Stress-[i]
      Penult stress unless penult is high or mid, and antepenult is low

  d. *Stress-[i], *Stress-[i,e] >> Penult
      Pure sonority based stress, default penult

**Discussion point:** Which patterns do fixed rankings get? Which patterns does the scalar constraint in (49) get?

The generalization:
(52) Non-linear scalar constraints get conflation, but restrict the parts of the scale that can be conflated. Thus, HG with scalar constraints is in this respect more restrictive than OT with constraints in a stringency relation.

Which best fits the data? For the stress case, it looks like mid vowels can in fact be conflated with high or with low vowels (see de Lacy 2002/2006 on Gujarati). But for others, I'm suspicious that scales contain natural "break points" that could be captured by non-linear scales, and not by constraints in a stringency relation.

**Discussion point:** What might be some natural break points for sonority?

Let us suppose that the HG scalar constraint set allows mid vowels to be grouped with either high vowels ([low] feature) or low vowels ([high] feature). That is, we have the two non-linear constraints:

(53) Stress-to-sonority-13
   Assign a violation to the head of a foot for each degree of sonority separating it from [a] (low vowel = 0, mid vowel = -1, high vowel = -3 )

(54) Stress-to-sonority-23
   Assign a violation to the head of a foot for each degree of sonority separating it from [a] (low vowel = 0, mid vowel = -2, high vowel = -3)

The predictions of this theory, and OT with the stringent constraints in (50), are largely overlapping. The language produced by HG only is parallel to the one discussed in section 3 above.

**Demo:** simple-stress-son-nonlin-2.txt, simple-stress-son-string.txt

To get a sense of the bigger picture, we can pit two scalar constraint types against one another. To the HG+scalar constraint theory, we add the following constraint (why did I pick this violation profile?):

(55) Weight-to-Stress
   Assign a violation to an unstressed heavy syllable (-2 if heavy, -3 if superheavy)

And to OT with constraints in a stringency relation:

(56) Stress-Heavy: Assign a violation to an unstressed heavy or superheavy syllable.
    Stress-Superheavy: Assign a violation to an unstressed superheavy syllable.

**OT-Help Demo:** scalars-nonlin-ss13-ss23.txt, stringent-rev.txt
**Excel Demo:** scales-HG-output, scales-OT-output, scales-HG/OT-output
**R Demo:** comparison.R
Further references


