Phonological Typology in Optimality Theory

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Outline of this lecture

a. Introduction to Optimality Theory (OT; Prince & Smolensky 2004)
b. Typology in prosodic phonology: syllable structure (Prince & Smolensky 2004)
c. Typology in segmental phonology: palatalization (extending Kurisu to appear)

1. Basic architecture of OT

(1) a. Generative theory in that input is mapped onto output.
   b. (Basically) parallel computation of output by hierarchical constraints.
   c. Constraints are by hypothesis universal and violable.
   d. The most harmonic candidate wins the competition.
   e. Richness of the base prevents any restrictional impositions on input.
   f. The only source of language differences lies in constraint rankings.

(2)

<table>
<thead>
<tr>
<th>/input/</th>
<th>constraint 1</th>
<th>constraint 2</th>
<th>constraint 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. candidate A</td>
<td>*!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. candidate B</td>
<td></td>
<td>*!</td>
<td></td>
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<tr>
<td>c. candidate C</td>
<td></td>
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<td>*</td>
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</table>

(3)

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</table>

(4) Two types of constraints
   a. Faithfulness constraints: Input-output identity is evaluated.
   b. Markendess constraints: Unmarked structure or representation is favored whereas marked one is punished.

Why OT is conducive to typological research:

a. Earlier generative phonological theories (Chomsky & Halle 1968 et seq.) are essentially rule-based, and each rule does not have to be but may be language-specific.
   b. In OT, all constraints are universal, and language differences arise from constraint reranking.

Consequences:

a. OT is inherently typological (McCarthy 2002: 108).
   b. An analysis of one language gives rise to typological predictions (i.e., factorial typology).
   c. Only the types of grammar yielded by permutation of constraints should exist potentially.

Worry:

There are hundreds of constraints proposed in OT literature. This entails explosion of typological patterns predicted to exist.

Partial answer:

Different rankings often converge on the same pattern. Surface patterns are not as many as possible ranking combinations (see sections 2 & 3).
2. Factorial typology I: syllable structure (Prince & Smolensky 2004)

Issue:
How OT explains possible variation of syllable inventories in human languages. We abstract away from the presence/absence of complex onsets/codas (see Kager 1999 for this aspect).

(5) a. \( \sigma \) C V C b. \( \sigma \) C V c. \( \sigma \) V C d. \( \sigma \) V

Question:
Is language allowed to exploit any combinations of the four structures?

(6) Two markedness constraints
a. Onset: Every syllable begins with a consonant.
   b. NoCoda: Every syllable ends in a vowel.

(7) Two faithfulness constraints
a. Max: Every input material is parsed in the output (i.e., no deletion).
   b. Dep: Every material in output has a correspondent in its input (i.e., no addition).

Logical rankings of four constraints:
4! = 24 different possible rankings

Question:
Does reranking of the four constraints produce 24 different patterns?

Answer:
No, because certain rankings converge on the same result (see below).

2.1 Onset

(8) Two rankings: (i) Onset outranks Faith (ii) Faith outranks Onset.

Ranking (i) (Onset » Faith):

(9) /CV/       Onset   Faith
    a. CV       !      *    1
    b. V        *      *

(10) /V/       Onset   Faith
      a. CV       *      
      b. V        *      

\( \uparrow \) Onset is required in languages with Onset » Faith.

Ranking (ii) (Faith » Onset):

(11) /CV/       Faith   Onset
      a. CV       *      
      b. V        *      

(12) /V/       Faith   Onset
      a. CV       *      
      b. V        *      

\( \uparrow \) Onset is optional in languages with Faith » Onset.
Interaction of faithfulness constraints:

(13) Two rankings: (i) Max outranks Dep (ii) Dep outranks Max

Interaction of (13) with (8i):

(14) \[ \begin{array}{|c|c|c|c|} \hline & \text{/VCV/} & \text{Onset} & \text{Max} & \text{Dep} \\ \hline a. & V.CV & *! & & \\ b. & CV.CV & * & * & \\ c. & CV & *! & & \\ \hline \end{array} \]

In (8i), the two faithfulness rankings diverge into two different results.

Interaction of (13) with (8ii):

(16) \[ \begin{array}{|c|c|c|c|} \hline & \text{/VCV/} & \text{Max} & \text{Dep} & \text{Onset} \\ \hline a. & V.CV & *! & * & \\ b. & CV.CV & *! & * & \\ c. & CV & *! & * & \\ \hline \end{array} \]

In (8ii), the two faithfulness rankings converge on the same result.

Observation:
In Onset » Faith, it does matter how Onset violation incurred by the faithful candidate is avoided. The repair strategy is tangential when onsets are optional since breaching Onset is the cheapest.

Summary:

a. 2 patterns from Onset » Faith
b. 1 pattern from Faith » Onset

2.2 Coda

a. NoCoda » Faith inhibits coda consonants.
b. Faith » NoCoda sanctions coda consonants when faithful parsing of input has them.
c. The two faithfulness rankings in (13) meaningfully interact only with NoCoda » Faith.

Summary:

a. 2 patterns from NoCoda » Faith
b. 1 pattern from Faith » NoCoda

2.3 Bringing pieces together

(18) \[ \begin{array}{|c|c|c|} \hline & \text{Onset » Faith (2 patterns)} & \text{Faith » Onset (1 pattern)} \\ \hline \text{NoCoda » Faith (2 patterns)} & CV (2x2=4 patterns) & (C)V (1x2=2 patterns) \\ \text{Faith » NoCoda (1 pattern)} & CV(C) (2x1=2 patterns) & (C)V(C) (1x1=1 pattern) \\ \hline \end{array} \]

Output convergence diminishes the number of surface types.
No language other than the four basic types in (19) is attested.
Languages of the type VC are systematically ruled out as no possible ranking generates them.

3. Factorial typology II: palatalization (extension of Kurisu to appear)
3.1 Japanese mimetic palatalization (Mester & Itô 1989; Hamano 1998)

(20) **Base forms**  | **Gloss**  | **Palatalized forms**  | **Gloss**
---|---|---|---
zabu-zabu | splashing | ʒabu-ʒabu | splashing indiscriminately
noki-noki | stretching | ɲoki-ɲoki | stretching inelgantly
kata-kata | clattering | ɰaʃa-ɰaʃa | clattering a-periodically
kasa-kasa | rustling | ɲaʃa-ɲaʃa | rustling uncomfortably

Coronals take precedence over labials and dorsals.

(21) **Base forms**  | **Gloss**  | **Palatalized forms**  | **Gloss**
dosa-dosa | flowing | doʃa-doʃa | flowing in large amounts
noso-noso | slowly | noʃo-noʃo | slowly but clumsily
neta-neta | sticky | netʃa-netʃa | very sticky
neto-neto | sticky | netʃo-netʃo | very sticky

When the two consonants are both coronals, the right one hosts palatalization.

(22) **Base forms**  | **Gloss**  | **Palatalized forms**  | **Gloss**
poko-poko | up and down | p'oko-p'oko | jumping around imprudently
gobo-gobo | gurgling | g'obo-g'obo | gurgling messily
goho-goho | coughing | g'oho-g'oho | coughing with nausea

The first consonant is palatalized if the root contains no coronal consonant.

(23) **Base forms**  | **Gloss**  | **Palatalized forms**  | **Gloss**
goro-goro | goggled-eyed | g'oro-g'oro | goggled-eyed restlessly
norororo | slow | noro-noro | wriggling around
zara-zara | coarse (texture) | ʒara-ʒara | jingling
horororo | weak | ʃoro-ʃoro | staggering

Liquid /r/ is immune to palatalization, so the coronal priority is not applicable to /r/.

**Facts of interest here:**
a. Coronals are more susceptible to palatalization than non-coronals (coronal dominance effect).
b. The rhotic persistently resists palatalization (rhotic exclusion effect).

(24) **2sg. masculine**  | **2sg. feminine**  | **Gloss**
---|---|---
a. kifæt | kifæt-i | open!
zhimæd | zhimæs-i | drag!
lipvæs | lipvæs-i | dress!
b. xidan | xiʃæn-i | cover!
giʃæl | giʃæy-i | kill!
c. kifæb | kifæb-i | write!
diʃeq | ʒiʃeq-i | be dry!
sifær | šifær-i | break!

In Harari 2nd person feminine subject construction (Leslau 1958; Rose 1997b), palatalizable segments are coronal consonants alone (24a), but /r/ is never palatalized (24c).
The rightmost coronal (other than /r/) undergoes palatalization (24a, b). When the final coronal is a sonorant, a stem-medial coronal is also affected by palatalization (24b).
(25) 2sg. masculine  2sg. feminine  Gloss
a.    libæs  libæʃ  dress!
kift  kiftʃ  open!
zimd  zimʒ  pull!
dirg  dirgʃ  hit!
flæx  flæxʃ  be patient!
b.    nixæβ  nixæβʃ  find!
nigif  nigifʃ  prune!
gimim  gimimʃ  chip the rim of the utensil!


Palatalization occurs stem-finally if the final segment is either a coronal or dorsal (25a).

Otherwise, the rightmost dorsal is palatalized (25b).

Generalization:
Coronals are the most preferable docking sites of palatalization, and labials are the worst hosts of palatalization. Dorsals are in-between.

(26)  *Labʃ *Dorʃ *Corʃ

Palatalized coronals are more harmonic than palatalized labials or dorsals.

This hierarchy accounts for the coronal dominance effect.

(27) 

<table>
<thead>
<tr>
<th>/zabu-zabu,[-ant]/</th>
<th>Max[−ant]</th>
<th>*−[Cor]/</th>
<th>*Corʃ</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.    zabu-zabu</td>
<td>*!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b.    ʒabu-ʒabu</td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>c.    zab’u-ʒab’u</td>
<td></td>
<td>*!</td>
<td></td>
</tr>
</tbody>
</table>

Candidate (27a), which does not realize the [−ant] feature, is eliminated by Max[−ant]. This is a faithfulness constraint that calls for surface exponence of [−ant], the phonological feature that is responsible for palatalization.

The coronal dominance effect follows from *−[Cor]/ *Corʃ.

Hall (2000):

a. Language exhibits an asymmetry with respect to inventories of palatalized consonants. There are many languages with palatalized non-rhotics without any palatalized apical rhotics, but not vice versa. The existence of a palatalized apical rhotic implies that of a palatalized non-rhotic.

b. Historical facts reveal high markedness of palatalized apical rhotics. Phonemic /r/ was lost in Czech and Polish (Carlton 1991). Many Romance languages still have traces of palatalized /n/ and /l/, but the remnant of /r/ is not extant at all (Hock 1991: 134). In Serbo-Croatian, /r/ was depalatalized although other palatalized sonorants remained intact (Hock 1991: 134).

(28)  *[r]/ *Corʃ

(29)  *[r] Max[−ant] *−[Cor]/ *Corʃ

*[r] outranks *−[Cor]/ because palatalized non-coronals appear occasionally.

This constraint hierarchy elucidates the rhotic exclusion effect.

(30) 

<table>
<thead>
<tr>
<th>/goro-goro,−[ant]/</th>
<th>*r/</th>
<th>Max[−ant]</th>
<th>*−[Cor]/</th>
<th>*Corʃ</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.    goro-goro</td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b.    ʒoro-ʒoro</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c.    gor’o-gor’o</td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

High ranked *[r] blocks the coronal dominance effect.

No surface realization of [−ant] is again ruled out by Max[−ant].

As a consequence, the initial non-coronal consonant attracts palatalization.
3.2 Typology of consonant palatalizability

(31) a. $^{*}{\text{Lab}}^y \gg ^{*}{\text{Dor}}^y \gg ^{*}{\text{Cor}}^y$
   b. $[^{r'}] \gg ^{*}{\text{Cor}}^y$
   c. Max[–ant]

The hierarchical rankings in (31a) and (31b) are universally fixed, respectively.
(31a), (31b), and (31c) are independent of each other, allowing rerankability.

Combinability of (31a) and (31b):

(32)

\[
\begin{array}{c}
\begin{array}{ccc}
^*{\text{Lab}}^y & \gg & ^*{\text{Dor}}^y \\
[^{r'}] & \gg & ^*{\text{Cor}}^y \\
\end{array}
\end{array}
\]

(31b) dictates that palatalized rhotics are more marked than palatalized coronals in general.
But $[^{r'}]$ is not intrinsically ranked with respect to $^*{\text{Lab}}^y$ and $^*{\text{Dor}}^y$.

Combinability of (31c) and (32):

(33)

\[
\begin{array}{c}
\begin{array}{cccc}
^*[^{r'}] & \gg & ^*{\text{Lab}}^y & \gg & ^*{\text{Dor}}^y & \gg & ^*{\text{Cor}}^y \\
1\text{Max} & \gg & 2\text{Max} & \gg & 3\text{Max} & \gg & 4\text{Max} & \gg & 5\text{Max}
\end{array}
\end{array}
\]

(34)

\[
\begin{array}{c}
\begin{array}{cccc}
^*{\text{Lab}}^y & \gg & ^*[^{r'}] & \gg & ^*{\text{Dor}}^y & \gg & ^*{\text{Cor}}^y \\
1\text{Max} & \gg & 2\text{Max} & \gg & 3\text{Max} & \gg & 4\text{Max} & \gg & 5\text{Max}
\end{array}
\end{array}
\]

(35)

\[
\begin{array}{c}
\begin{array}{cccc}
^*{\text{Lab}}^y & \gg & ^*{\text{Dor}}^y & \gg & ^*[^{r'}] & \gg & ^*{\text{Cor}}^y \\
1\text{Max} & \gg & 2\text{Max} & \gg & 3\text{Max} & \gg & 4\text{Max} & \gg & 5\text{Max}
\end{array}
\end{array}
\]

No intrinsic ranking relation is established between Max[–ant] and palatalization markedness constraints. As a result, the former can occupy all potential slots available.
This consideration submits 15 possible rankings.

Question:
Do we find 15 different patterns of palatalization inventories?

Answer:
No. Again, the number of predicted surface patterns is diminished by surface convergence.

(36)

<table>
<thead>
<tr>
<th>Types</th>
<th>Constraint rankings</th>
<th>Cor $^y$</th>
<th>Dor $^y$</th>
<th>Lab $^y$</th>
<th>[$^{r'}$]</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>(33①) (34③) (35①)</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>II</td>
<td>(34②) (35②)</td>
<td>✔</td>
<td>✔</td>
<td>×</td>
<td>✔</td>
</tr>
<tr>
<td>III</td>
<td>(35③)</td>
<td>✔</td>
<td>×</td>
<td>×</td>
<td>✔</td>
</tr>
<tr>
<td>IV</td>
<td>(33②)</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>×</td>
</tr>
<tr>
<td>V</td>
<td>(33③) (34③)</td>
<td>✔</td>
<td>✔</td>
<td>×</td>
<td>✔</td>
</tr>
<tr>
<td>VI</td>
<td>(33④) (34④) (35⑥)</td>
<td>✔</td>
<td>×</td>
<td>×</td>
<td>✔</td>
</tr>
<tr>
<td>VII</td>
<td>(33⑤) (34⑤) (35⑥)</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
</tr>
</tbody>
</table>

Again, convergence is found here. Only 7 types arise out of 15 rankings.

Claim:
The typological variation in (36) is confirmed by crosslinguistic facts.
(37) **Types** | **Languages** | **References**
--- | --- | ---
I | Old Church Slavonic | Huntley (1993) |
| Bulgarian | Scatton (1993) |
| Sorbian | Stone (1993b) |
| Slovene | Priestly (1993) |
| Polabian | Polański (1993) |
| Lithuanian | Senn (1966) |
| Scottish Gaelic | Gillies (1993) |
| Nenets | Décsy (1966), Salminen (1998) |
| Mordva | Zaicz (1998) |
| Terr Lapp | Korhonen (1984) |
| North Veps | Vitso (1987) |
| Pæez | Gerdel (1973) |
| Gude | Hoskinson (1974) |
| Butthaa Dagur | Svantesson et al. (2005) |
| Khalkha Mongolian | Svantesson et al. (2005) |
| Chahar | Svantesson et al. (2005) |
| Buriad | Svantesson et al. (2005) |
| Romanian | Chitoran (2002) |
| Karaim | Hansson (2007) |
| Konkani | Miranda (2003) |
II | Ukranian | Shevelov (1993) |
| Latvian | Schmalstieg (1993) |
| Manx | Jackson (1955), Broderick (1993) |
| Tibirí Hausa | Wolff (1993) |
| Chah | Leslau (1950), Rose (1994a, b, 1997a, b), Banksira (2000) |
III | Muinane | Walton & Walton (1967) |
| Toda | Emeneau (1984), Spajić et al. (1996) |

*Most languages with a palatalized rhotic rules in all types of palatalized consonants.
This suggests salient markedness of palatalized rhotic consonants.

(38) General predictions regarding consonant palatalizability

**Prediction 1:** Languages with palatalized labials have palatalized dorsals and coronals.
**Prediction 2:** Languages with palatalized dorsals have palatalized coronals.
**Prediction 3:** Languages lacking palatalized coronals have no palatalized consonant.

*Note:* Most languages are classified into Type VI. There are too many languages to list here (e.g., Korean), so they are omitted below. Over 260 languages of this type are provided by Maddieson (1984).

(39) **Type IV languages**

<table>
<thead>
<tr>
<th>Languages</th>
<th>References</th>
</tr>
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<tbody>
<tr>
<td>Nambakaengo</td>
<td>Maddieson (1984: 367)</td>
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<td>Mono</td>
<td>Olson (2005)</td>
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<tr>
<td>Belorussian</td>
<td>Mayo (1993)</td>
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(40) Type V languages

<table>
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</tr>
</thead>
<tbody>
<tr>
<td>Lakkia</td>
<td>Maddieson (1984: 334)</td>
</tr>
<tr>
<td>Siriono</td>
<td>Maddieson (1984: 407)</td>
</tr>
<tr>
<td>Spanish</td>
<td>Cressy (1978)</td>
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<tr>
<td>Rize Turkish</td>
<td>Brendemøen (1998)</td>
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<tr>
<td>Greek</td>
<td>Holton et al. (1997)</td>
</tr>
<tr>
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<td>Watson (2002)</td>
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<td>San’ani Arabic</td>
<td>Watson (2002)</td>
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<tr>
<td>Macedonian</td>
<td>Friedman (1993)</td>
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<tr>
<td>Serbo-Croatian</td>
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<td>Czech</td>
<td>Short (1993a)</td>
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<td>Slovak</td>
<td>Short (1993b)</td>
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<td>Cassubian</td>
<td>Stone (1993a)</td>
</tr>
<tr>
<td>Muher</td>
<td>Rose (1997b)</td>
</tr>
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<td>CiBemba</td>
<td>Hyman (1994), Hyman &amp; Moxley (1996)</td>
</tr>
<tr>
<td>Late Latin</td>
<td>Lloyd (1987), Vincent (1988b)</td>
</tr>
<tr>
<td>Kimatumbi</td>
<td>Odden (1996)</td>
</tr>
<tr>
<td>Sunwari</td>
<td>Genetti (1992)</td>
</tr>
<tr>
<td>Italian</td>
<td>Vincent (1988a)</td>
</tr>
<tr>
<td>Kinyarwanda</td>
<td>Kimenyi (1978, 1979)</td>
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<tr>
<td>Campidanese Sardian</td>
<td>Jones (1988)</td>
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<tr>
<td>Romance Creoles</td>
<td>Green (1988)</td>
</tr>
</tbody>
</table>

(41) Type VII languages

<table>
<thead>
<tr>
<th>Languages</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maori</td>
<td>Maddieson (1984: 345)</td>
</tr>
<tr>
<td>Hawaiian</td>
<td>Elbert &amp; Pukui (1979)</td>
</tr>
<tr>
<td>Samoan</td>
<td>Mosel &amp; Hovdaugen (1992)</td>
</tr>
</tbody>
</table>

UPSID (Maddieson 1984) supplies 20 languages of this type.

Scrutiny reveals that many languages are to be grouped into other types.

Such languages include Tsou, Wantoat, Koiari, Wichita, Hakka, and Fuzhou.

Observation:

a. Only those patterns predicted to exist do exist.
b. In my survey, no language deviates from the seven patterns in (36).
c. The typological predictions in (38) are borne out.

Theoretical implications:

a. Constraints are not dispersed evenly.

The significant paucity of Types II and III languages suggests that palatalized rhotics tend to be viewed far more marked than we might imagine from Japanese.

(42) a. Lab\(^y\) .......... Dor\(^y\) ........................ Cor\(^y\)
   b. \([r']\) .................................................. Cor\(^y\)

Marked \(\leftarrow\) \(\rightarrow\) Unmarked

Among those languages with a palatalized rhotic (34 languages), 26 are affiliated with Type I.

This amounts to approximately 76.5%.

b. Explaining robust crosslinguistic frequency effects of linguistic patterns is not enabled with the theory of partial ordering advocated by Anttila (1997a, b) and Anttila & Cho (1998).
Partial ordering theory predicts that a candidate is predicted to exist by the grammar if it wins in some tableau and that the candidate’s probability of occurrence is nl/t in general form, where n and t represent the number of tableaux in which the candidate wins and the total number of possible tableaux, respectively.

\[
\begin{array}{|c|c|c|}
\hline
\text{Pattern} & \text{Number of tableaux} & \text{Probability of occurrence} \\
\hline
\text{Pattern A} & 4 & \frac{4}{10}=40\% \\
\text{Pattern B} & 3 & \frac{3}{10}=30\% \\
\text{Pattern C} & 2 & \frac{2}{10}=20\% \\
\text{Pattern D} & 1 & \frac{1}{10}=10\% \\
\text{Pattern E} & 0 & 0/10\%=0\% \text{ (non-existent)} \\
\hline
\text{Total} & 10 & 100\% \\
\hline
\end{array}
\]

**Problems:**

a. Partial ordering theory predicts that only 20% (3/15) of languages are grouped in Type VI.
b. The total number of Types II and III languages (2/15+1/15=3/15) is erroneously expected to be the same as that of Type I languages (3/15). There are 8 Types II and III languages, which is far outnumbered by 26 Type I languages.

4. **Conclusion**

a. Richness of the base and universality of constraints attribute the source of language variability to different constraint rankings. OT is by nature conducive to typological research.
b. OT and typology are intimate and benefit from each other for bidirectional reasons: (i) OT is suitable for typological analyses, and (ii) typological facts feed OT analyses excellent tests.

**References**


