Paninian Relations

Alan Prince

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(1)OT works by imposing an order on a candidate set.
- •Each constraint imposes an order (stratified hierarchy, with a greatest element)
- •The definition of “>>” combines these constraint orders into an order imposed by a ranking.

(2) Linguistic systems display substantive universal (ordering) properties on their elements:
e.g. markedness scales like [CV. ≻ CVC. ≻ CVCC.] , [i ≻ ü ≻ ö] etc.
e.g. prominence scales like [a > eo > iu > ə] , [Vː > VG > V] , [#σ > ...σ] , [σ́ > σ̆]

(3) **How do these notions of order fit together**? How can grammar successfully take account of, be guided by, the substantive orders that underly linguistic systems? Two ideas are current:
(1) element-based hierarchies, à la P&S 93. e.g. *ö >> *ü >> *i /// $*VCC]_\sigma$ >> $*VC]_\sigma$
(2) set-inclusion constraint families: *{ö}, *{ö ü} *{ö ü i} /// $*\{VCC]_\sigma\}$, $\{*VCC]_\sigma, *VC]_\sigma\}$

(4) **Logic of Scales, Hierarchies, and Multiplicities**
-*Scales*: if you fall 150 ft, you have fallen 100 ft.
•if you can carry 20 kg, you can carry/have carried 10kg.
•maintain voicing for a 200msec closure,& you have done/can do so for 100msec.
-*Hierarchies:*
•if an event occurs in a subordinate clause, it has also occured in a whole sentence.
•if a Foot contains a stressed high vowel, so does a Prosodic Word.
-*Multiplicities*
•if a word contains 2 *r*’s, it contains an *r*.
In every case we can imagine a nested set of *intervals* anchored at 0: ((((0) 1) 2)....) . (bifurcations of the scale)

(5) Banning such sets generates a stringency hierarchy:
a. *{0,1} is more stringent (*more general — rules out more things*) than *{0}.
b. *{0–m} is more stringent than *{0–k}, for m>k.
c. *In particular*: Violating *{0–k} *entails* violating *{0–m}.
Quantitatively, for any form f
d. $|*\{0\text{–}k\}|_f \le |*\{0\text{–}m\}|_f$ $|C|_f$ = the number of violations in f of C.

(6) Exx.
a. F(voi)/Ons *vs*. F(voi). (Lombardi, Beckman). If you devoice in Ons, you devoice.
b. $*CC]_\sigma$ *vs*. $*C]_\sigma$. If you have a doubly-closed syllable, you have a closed syllable.
c. *í. *vs*. *V′ . If main stress lodges on (Ci), it lodges on a short vowel.

(7) A stringency hierarchy is a special case/ general case situation. (general = more stringent)
Panini says: special always takes precedence over general.
So: “Paninian ranking” S >> G.
But OT says (generically): any constraint may take precedence over any other.
•How does free-ranking fit with stringency-related constraints?

(8) Pursuing the matter, we will discriminate two cases: markedness hierarchies, where free ranking of set-inclusion constraints leads to error; prominence-sensitive hierarchies, where it is necessary (or at least possible!).

(9) Suppose constraints are defined on such intervals, rather than on the points of the scale.

Aim: derive interaction from nature of representation (scalar, multiple, hierarchical)
rather than from from fixing of ranking, retaining free-ranking hypothesis.

[Kiparsky 1993, 1994: ROW-1/TREND hdouts; Green 1993:ROA-8 were first to broach this line of attack.]

Remark: in the usual markedness case, we show that this *will not work*. (i) Many naive expectations about the consequences of this move are simply wrong, qua logic, (ii) Empirical evidence points the other way also.

(10) **Scale notes**.

•Given a linguistic scale a $\succ$ b $\succ$ c $\succ$ ...., there are *many, many ways* to design a constraint+ranking system representing it.

•At one extreme, one could have a single n-ary constraint; at the other, a constraint for each degree of the scale.

•Scale sense: it's not just that the elements a,b,c,... stand in a certain *order*; crucially, the question is how that order may be *interrupted*. The very sense of markedness is that a language may have {a}, or {a,b}, or {a,bc,},.... Ergo, we must recognize each of the degrees of the scale in the constraint system!

•There are still many, many ways to do this!

•Element hierarchies and set-inclusion families provide 2 examples using *binary* constraints:

(11) Element hierarchies. a$\succ$b$\succ$c$\succ$d. Construct one constraint for each scale degree.

$$*d \equiv \begin{array}{c} abc \\ | \\ d \end{array} \qquad *c \equiv \begin{array}{c} abd \\ | \\ c \end{array} \qquad *b \equiv \begin{array}{c} acd \\ | \\ b \end{array} \qquad (*a \equiv \begin{array}{c} bcd) \\ | \\ a \end{array}$$

Note that all of the constraints except the first *contradict* the scale! Further they all conflict w/ each other

Therefore, these MUST be ranked. The scale is expressed in exactly one ranking:

*d >> *c >> *b >> *a (*a is actually not needed)

(12) Set-inclusion hierarchy. a$\succ$b$\succ$c$\succ$d Construct every bisection of the scale:

$$abc|d \equiv \begin{array}{c} abc \\ | \\ d \end{array} \qquad ab|cd \equiv \begin{array}{c} ab \\ | \\ cd \end{array} \qquad a|bcd \equiv \begin{array}{c} a \\ | \\ bcd \end{array}$$

(13) Every such constraint C *preserves* the scale S (the scale is a total refinement of each) in that (x$\succ$y;C) $\Rightarrow$ (x$\succ$y, S).

In fact, from the totality of such constraints the scale is entirely reconstructable *without ranking*.

	*{d}	*{c,d}	*{b,c,d}
a			
b			*
c		*	*
d	*	*	*

(14) The set-inclusion hierarchy gives the scale order under any ranking (no *conflict* between members). The element hierarchy under only one. Therefore, the set-inclusion hierarchy allows for an interesting further range of grammars! These require the intervention of other constraints to establish crucial rankings. The study of Paninian relations is the study of the set of grammars obtained by free ranking of a set-inclusion hierarchy with other constraints that allow crucial ranking to be established.

(15) **Element Stringency vs. Form Stringency**.

Constraints are defined on *elements of structure*.

Evaluation takes place over whole forms, which may contain *many* elements.

(16) **Ranking Background**: Agreement, Disagreement, Conflict.

Ranking — A, B *directly rankable* if they conflict on (opt, subopt).

Indirectly rankable by transitivity, though, when ∃ T, A>>**T** and **T**>>B.

(17) Conflict requires this sort of array (where one of a,b is in fact optimal):

/f/ →	A	B
a	*	
b		*

(18) Or, indicating the winners of the comparison in each column (cf. Prince 1998: ROA-288)

/f/ →	A	B
a ~ b	**b**	**a**

In this case, A>>B yields **f**↦**b**, and B>>A yields **f**↦**a**.

(19) Observe that for A, B in a stringency relation, there is no pair over which the constraints conflict.

(a,b) ↦ a, (a,c) ↦ a, (b,c) ↦ b, no matter what the ranking.

(20) **FALSE BELIEF ALERT #1. Form Stringency** does not follow from **Element Stringency!** **Multiplicity** of violation upsets the apple cart. Consider this abstract situation:

/f/ →	S = *{a}	G= *{a,b}
bb		**
a	*	*

(21) Or, showing the winners in each column:

/f/	S = *{a}	G= *{a,b}
bb ~ a	bb	a

(22) Here G & S actually **conflict**! To speak of stringency in evaluation, we must be sure that the constraints stand in the appropriate relation with respect to the actual candidates.

(23) This leads to our first appalling result. Consider *C]σ *vs.* *CC]σ (NOCODA vs. NODOUBLECODA)

maptk →	G = *C]σ	S = *CC]σ
map.tik.	**	
maptk.	*	*

maptk →	G= *C]σ	S= *CC]σ
map.tik. ~ maptk.	maptk.	map.tik.

(24) With G >> S, we actually prefer .CvCCC. to CvC.CvC !! Bruce Hayes notes (p.c.) that it is easily possible to construct an epenthesis system where e.g. *map.tik.* and *maptk.* compete for optimality.

•But it is empirically hopeless to expect that **maptk.** can ever win, by virtue of having only **one** closed syllable where **map.tik.** has **two**.

• And in violation of the guiding idea behind 'the strictness of strict domination' —

If an element α is universally better — less-marked — than β, then when permitted by faithfulness, we are willing to swap bad β for *any number of* α's, no matter what α's deficiencies are. I.e.

*β >> *α so any number of violations of *α are OK if you improve on *β.

(25) Similarly, with stringency relations on Faithfulness, as in Positional Faithfulness (Selkirk,Beckman). Consider Lombardi's F(vd-obstr)/Ons:

/dobmug/ →	S = F(vd)/Ons	G = F(vd)
do*p*mu*k* ~ *t*obmug	do*p*mu*k*	*t*obmug

(26) Such forms are perhaps not likely to be viable competitors for optimality. But the point is clear. Surely we cannot prefer **one** violation in the prominent environment to **two** in its nonprominent complement.

(27) **Possible resolutions**:

a. Abandon freely-ranked interval constraints for fixed-rank element hierarchies.

b. Variant of (a). Impose 'Proper Inclusion Precedence'/ 'Elsewhere Condition' as a meta-condition on ranking.

Reason for rejection: PIP/EC is a formalistic intrusion in a system which already has a precedence-determining mechanism (Prince 1997: ROA 217).

c. Develop a different theory of evaluation of multiple violations, perhaps localistic one-by-one comparisons, in favor of lumping all violations for form.

d. Develop the theory of constraints, so that scalar evaluation, rather than additive lumping, *within* constraints.

$*C]_\sigma$ =NOCODA e.g. would still rate CC. as worse than VC., independent of numerosity. We do this.

(28) **Remark**: total descriptive equivalence of (a) and (b):

Fixed Paninian ranking (special to general) of set-inclusion constraints ≡ Fixed ranking of element constraints.

So with fixed ranking, the difference between the two conceptions is slight.

(Basically, it becomes a matter of how constraints are formulated wrt structural categories— not trivial, but not a matter that changes the basic predictions of the theory.)

(29) An element hierarchy *c >> *b >> *a .... ≡ *c >> *{b,c} >> *{a, b, c} ...., a Paninian interval hierarchy, so long as $x \cap y = \emptyset$ for $x,y \in \{a,b,c,...\}$.

Why? Consider *b>> *a vs. *b >> *{a,b}.

	*b	*a	*{a,b}
1. $a^m b^n$	n	m	n+m
2. $a^p b^k$	k	p	k+p

2 cases:

•If n<k, candidate (1) **wins on *b.** •If n>k, candidate (2) **wins on *b.** *Here, the formulation of *b, *{a,b} is irrelevant.*

‣ If **n=k** then n+**m** > k+**p** is the same as n+**m** > n+**p** and it holds iff m > p (etc.).

I.e. When the decision is passed down the hierarchy by virtue of a tie on *b, the relation of m to p, examined by *a, is the same as the relation of n+m to n+p, since k=n.

Probe Question: why then isn't *{a,b} >> *{a} equivalent to *{a,b} >> *{a,b} ????

(In general, the evaluation-status of *e.g. b* in a constraint ranked below *b is irrelevant.)

(30) **FALSE BELIEF ALERT #2.** "If G is ranked above S, then S can play no role in the grammar." False! The actual characterization must involve the notion of "activity on a constraint set" (P&S 1993).

(31) ★**Satisfaction guaranteed**. Let S, G stand in an Element Stringency relation, so that for any form f, $|S|_f \leq |G|_f$.

Then SAT(G) → SAT(S). (If G is fully satisfied, then so is S, since |G| = 0). A weak property.

NB: From now on, we consider only constraints that stand in a true (Form) Stringency Relation.

(32) ★★**Adjacency in Hierarchy.** $H_1\mathbf{GS}H_2 \equiv H_1\mathbf{SG}H_2$

Pf. G and S do not conflict, so when adjacent, their mutual ranking is not crucial

Note! G and S may still be crucially ranked, by transitivity: G>>T>>S *or* S>>T>>G.

(33) **Activity.** Say that a constraint is *active* on a candidate set if it rejects some candidate.

Observe that one or the other or both may be active on different candidate sets. E.g let G=*{b,c}, S=*{c}.

Consider these candidate sets:

{a,b} - only G active **f↦a**

{b,c} - only S active **f↦b**

{a,b,c} - if S>>G, then both. **f↦a,** S eliminates c, G eliminates b.

(34) **Activity Inhibition** (Analog of "Panini's Theorem" P&S 1993.)

If G>>S, then $G^+ \Rightarrow S^-$. Equivalently $S^+ \Rightarrow G^-$ in the same situation (G>>S).

(35) Observations about activity:

1. If G>>S , S can still be active!! Namely, on some candidate set where G is not active.
2. If S>>G, both can be active. Though when S⁀G, S's activity is inessential, by Properties I and II above, since S⁀G ≡ G⁀S and $G^+ \Rightarrow S^-$. So $S^+ ⁀ G^+ \equiv$ G. But when S>>T>>G, both can be active and essential.

(36) **Total Deactivation.** A different condition on the relation between constraints A and B is needed to assure that A>>B guarantees that B plays no role in the grammar. This holds if *no violation class of A* is split by the violation classes of B, for any candidate set. Specific exx. Repetition of a constraint: the lower-ranked copy is futile. If two constraints have the *same* violation classes, then the subordinate of the pair is never active. See also (47) below.

(37) **Utility of the Paninian Ranking Scheme**. (Paninian intervention).

a. **F**/E >> **M** >> **F** : In E, preserve more structure. Simplify, resolving M by *F, in U−E.

Ex. F(vd)/Ons >> *vd >> F(vd). {ba, pa, ap} b→p in NONonset (cf. Lombardi on voicing).

b. **M**/E >> **F** >> **M** : In E, eliminate complexity, resolving M/E. But retain M-violating complexity in U−E.

Ex. *CC]_σ >> MAX >> *C]_σ CVCC. → CVC■ but CVC. → CVC.

Markedness: implications.

F/E, M, F: if L has α in U−E, then L has α generally. (If a language has voiced codas, it has vd onsets.)

M/E, F, M: if L has α in E, then L has α generally. (If a language has CVCC, it has CVC)

(38) **AntiPaninian Ranking**. Say that a ranking is **crucially Anti-Paninian** (AntiPaninian for short), if G crucially dominates S. This can only happen, by the *Adjacency Property* (★★), in ....G>>**T**>>S .

(39) Suppose G sits atop the hierarchy. Surely, Gen is such that for every candidate set, there is something in it that completely satisfies G.

Then, by the *Satisfaction Guaranteed* (★) property, S is also satisfied on every candidate set!

S, then, cannot be crucially subordinated.

So, S and G cannot be crucially ranked, even by an intervening T, and this can only be a Paninian situation.

(40) For AP ranking, then, there must be a dominating D above G. The simplest AP ranking is this:

D >> G >> T >> S

(41) To rank **T** and **S**, we must have that S is potentially active on some input /f/ (at the level of the hierarchy where T,S are encountered). But if G were active, S could not be. (*Activity Inhibition* Property). So G is **not active** on /f/.
•G cannot be satisfied either!, by the Satisfaction Guaranteed property. So we have the AP scheme—

/f/ →	D	G	T	S
☞ a		*		*
b		*	* !	
a ~ b			a	b

(42) **AP in syllable structure.** (NB: the multiple violation problem (23) does not arise in this example!)

a. Markedness.

i. * C] - "NoCoda"

ii. *CC] - "No Double Coda"

iii. FtBin - "Feet are bimoraic"

b. Faithfulness

F(C ↛ Ø) : Max: don't delete a C in the IO map.

(43) The systems:

a. Faithful. {**F** >> NoDoubleCoda, NoCoda} || FtBin

b. Paninian Intervention. {NoDoubleCoda >> **F** >> NoCoda } || FtBin . CVC**C** ↦ CVC■; CVC ↦ CVC.

c. Totally Simplifying. {NoCoda >> **F**, FtBin} || NoDouble Coda. CV(C)(C) ↦ CV(■)(■).

d. Monosyllable Paninian, CV otherwise. {FtBin>>NoCoda>>**F**}, and {NoDoubleCoda >> **F** }

#CVCC# → #CVC■ #, #CVC# → #CVC#. Else CVX. → CV.

e. **AntiPaninian**. FtBin>>NoCoda>>**F** >> NoDoubleCoda.

In	Out	FtBin	*C]	Max-C	*CC]	**Ranking (e)**
i) #CVCC# →	CVCC ~ CVC■			1	2	FtBin | *C] (General) | Max-C | *CC] (Special)
ii)	CVCC ~ CV■■	1	2	1	2	
iii) #CVC# →	CVC~ CV■	1	2	1		
iv) CVCCta →	CV■■ ta ~ CVCCta		1	2	1	**Maps:** #CVCC# ↦ CVCC #CVC# ↦ CVC (cf.43a) Otherwise — CV**CC** ↦ CV■■ CV**C** ↦ CV■ (cf. 43c)
v)	CV■■ ta ~ CVC■ ta		1	2		
vi) CVCta →	CV■ ta ~ CVCta		1	2		

(44) D = FtBin defines a class of forms in which a more marked system prevails, because of F>>M_S, blocking resolution of M_S in (i), where D blocks resolution of M_G (ii, iii). Harmonic completeness is observed, but a rather gamy walk-on-the-wild side takes place.

(45) By contrast, DF_GMF_S defines a class of forms where a *less-marked system* prevails because of $M>>F_S$.
Example: From Lombardi's 1996:NLLT (to appear) voicing typology.
Agree(voi) >> Ident(voi) >> *voi >> Ident/Ons(voi).
Onsets: both voiced & voiceless obstruents.
Clusters: bt, pd → pt, bd → bd. So we have b→p, d→t in clusters to achieve AGREE, not elsewhere.

(46) **Is this the real thing?**
Cf. Tamil (Beckman 1998:ROA-234). Much richer system in initial syllable than elsewhere.
CVVCC- vs. $CVVC_i$ maximum
Note, however, that system (43)d , which is Paninian, has the same general property (CVC in E, CV generally).
•For Tamil to be Antipaninian, we need a constraint analogous to FTBIN, which specifically disallows only $CVVC_i$ and smaller, thereby preventing the 'hyper'-reduction of CVVCC. Does it exist? If it exists, can it be effectively inserted into a Paninian version of the anti-complex syllable hierarchy?

(47) **Proposal**. To eliminate the possiblity of AP ranking, we must eliminate the possibility of a tie on G.
Suppose, given a scale $\langle a_i,>\rangle$ on a set of elements a_i, we construct *every possible compound constraint* joining any of the $*a_i$'s by >>. such that the resulting compound constraint *respects the scale relations.*

t ≻ k ≻ p ≻ q

[*q]	tkp ≻ q	Least Stringent	'Special'
[*q>>*p]	tk ≻ p ≻ q	↓	↓
[*q>>*p>>*k]	t ≻ k ≻ p ≻ q	Most Stringent	'General'

These compounds are then the constraints in CON embodying the scale. *Let them be freely ranked.*
NB: Given this scale, [*p] in isolation is not a possible constraint, because it says q≻p.

(48) **Multiple violation.** If scalar constraints are as in (47), the multiple violation problem (23) disappears, by virtue of the properties of strict domination (exactly as in the familiar fixed-ranking hierarchy treatment). Since the 'general' constraint is now [*CC. >> *C.], any occurrence of CVCC will be fatal if the alternative only incudes CVC.

(49) **Paninian and AP interactions with Peak Prominence Scales.** We now turn to another domain: scales involving the concordance of intrinsic syllabic prominence with main stress.

(50) **The Issue.** In a number of systems (cf. Everett & Everett, 1984:*LI 15*;Davis 1988:*Phonology 5*, 1989:*ESCOL 6*; Prince & Smolensky 1991:UAz/UCol TR, 1993:RuCCS-TR-2; Kenstowicz 1994:ROA-33, Hayes 1995:book, de Lacy 1997:ROA-236, Walker 1996:ROA-172), the main stress is located by a condition on syllable 'heaviness' or suitability for peak-status, involving such facts as nucleus sonority, vowel length, weight, closure, and even onset status (coronality: Davis; voicing: Everett & Everett). The question is: how can a scale like vocalic sonority vary in its effects from language to language, esp. with all constraints present in all languages?

(51)Ex. **Asheninca Campa** main-stress. (J. Payne 1990:*Amazonian Lgstcs*, B. Hayes 1995)
Fundamentally, LR iambic, Heavy = VV, last syllable never stressed.
Main stress falls on the head of one of the last two feet. When last foot is iambic, we have:
a. Nothing special going on: rightmost

sà: **sá:** ti	'type of partridge'
not**ò**N ka**méN** to	'my gun'
nawì saw**è** ta**ná** ka	'I went in vain'
iŋkìŋ kis^{j}i retà ko**tà** wa**ké** ri	'he thought about it for a while'

b. Stress avoids .Ci. in favor of CiN., Ca, Ce, Co.
n^{j}à: w^{j}à: ta**wá** ka**rì** ri 'what he saw in a vision'
c. VV-head beats short V-head:

má: ki**rì** ti	'type of bee'

(52) **Analysis:** *í. , *V̄ >> Rightmost

(53) Observe that Ca., Ce., Co, CaN, CeN, CoN, CiN. is just the complement class of Ci. within the set of short-vowelled syllables. Ergo utility of domination hierarchy in defining.

(54) Observe further that when the last foot is not bisyllabic-iambic, stress avoids the final foot — unless this leads to í.

nokò **wawé** <u>ta</u>ka	(*...wawetáka)
pà: **tiká** <u>ke</u>ri	(* ...tikakéri)

a. *í. causes stress to appear to the right:

opi náta	(* opí nata)
ipi **tsó**ka	(ipí tsoka is also possible)

b. When there's a tie on *í., stress may avoid the rightmost position:

kawí niri	(but kawi níri is also possible).

So *í. >> NonFin(F′) >> Rightmost. (putting aside the noted variants).

(55) **Question: how do you get rid of *í. once you have it in grammar**?

(56) Consider the interaction between Align-Peak-L (main stress on first syllable) and a peak prominence hierarchy: **1**′ ≺ ***2**′ ≺ ***3**′≺ ... where 1, 2, 3,... name degrees of intrinsic prominence of syllables from **weakest (1)** to **stronger...**, as e.g. $|\sigma_{\mu}| < |\sigma_{\mu\mu}| < |\sigma_{\mu\mu\mu}| <$ .... (Cf. also Baković 1996:ROA-168, 1997:ROA-244, and other refs in (50) for discussion)

(57) The conflict is between initial stress (Pk-L) and stressing the weightiest syllable, which need not be initial. (Isomorphic to K. Carlson's 1997:ESCOL discussion of Nakanai reduplication, where the conflict is between copying the first vowel and copying the most prominent vowel.)

(58) The crucial cases: those with weight contrast, with heavier element in noninitial position.
Limiting ourselves to bisyllables, and a 3-way scale:

12 ↦ **1**′ 2 *or* 1 **2**′
23 ↦ **2**′ 3 *or* 2 **3**′
23 ↦ **2**′ 3 *or* 2 **3**′

(59) **The Paninian Rankings**

(60) Pk-L >> *{1′} , *{1′, 2′} . Clearly Stress is always initial.

(61) *{1′} >> Pk-L >> *{1′, 2′}. Stress flees from initial 1 to heavier σ if such there is, else initial.

	*{1′}	Pk-L	*{1′, 2′}
1 **2**′ ~ **1**′ 2	A	B	
1 **3**′ ~ **1**′ 3	A	B	A
2′ 3 ~ 2 **3**′		A	B

(62) *{1′}, *{1′, 2′} >> Pk-L. Both 1 and 2 yield stress to stronger σ, else initial.

	*{1′}	*{1′, 2′}	Pk-L
1 **2′** ~ **1′** 2	A		B
1 **3′** ~ **1′** 3	A	A	B
2 **3′** ~ **2′** 3		A	B

(63) **Anti-Paninian Ranking.** 3 beats 1 and 2. Else initial.

	*{1′, 2′}	Pk-L	*{1′}
1′ 2 ~ 1 **2′**		A	B
1 **3′** ~ **1′** 3	A	B	A
2 **3′** ~ **2′** 3	A	B	

(64) **Paninian**:

```
1 2 3      3   2        3
            \ /         |
             1          2
                        |
                        1
```

(65) **Anti-Paninian**:

```
   3
  / \
 2   1
```

(66) Extended to 4-scale.

a. **Paninian**: *(i)* 1 2 3 4 *(ii)* *(iii)* *(iv)*

```
(i) 1 2 3 4   (ii) 2 3  4    (iii) 3  4    (iv)  4
                    \ | /           \ /          |
                      1              2           3
                                     |           |
                                     1           2
                                                 |
                                                 1
```

b. **Anti-P** *(i)* *(ii)* *(iii)* *(iv)*

```
(i)    4        (ii)  4       (iii) 4        (iv)  4   3
      /|\            / \            |               \ /
     2 3 1          2   3           3               / \
                     \ /           / \             2   1
                      1           2   1
```

AP rankings

(i). *{1′-**3′**} >> LEFTMOST >>*{1′}, *{1′- 2′}

(ii). *{**1′**}, *{1′- **3′**} >> LEFTMOST >> *{1′- 2′}

(iii). *{1′- **2′**}, *{1′- **3′**}>> LEFTMOST >> *{1′}

(iv). *{1′- **2′**} >> LEFTMOST >>*{1′}, *{1′- 3′}

(67) Non-pathology of AP rankings. All rankings **respect the basic > scale**. Recall (13) on scale representation.

if m *beats* k, then (n > m) ⇒ n *beats* k. E.g **2** ▹1 → **3**▹1, **4**▹1 *cf.* AP (ii)

if m *beats* k , then (k > j) ⇒ m *beats* j. E.g 3▹**2** → 3▹**1** *cf.* AP (iii), (iv)

(68) Observe that the collapsed scale structure is obtainable by putting a boundary after the strongest element mentioned in any above- “Leftmost” constraint. (Those ranked below Leftmost have no force in making distinctions.)

AP	(i)	4 | 3 2 1	**P**	(i)	**4 3 2 1**	NB: *good* peak →... → *bad* peak
	(ii)	4 | **3 2** | 1		(ii)	**4 3 2** | 1	
	(iii)	4 | 3 | **2 1**		(iii)	**4 3** | 2 | 1	
	(iv)	4 3 | **2 1**		(iv)	**4** | 3 | 2 | 1	

(69) Free ranking of interval-inclusion constraints with LEFTMOST (or something similar) allows for every possible fusing of adjacent scale degrees.

Paninian Fusion: from the top, while preserving all distinctions below the point of fusion.
AntiPaninian Fusion: all the rest.

(70) **What exists?** Some cases involving simple weight, then influence of vowel sonority.

(71) In simplest case, standard weight scale: CVV > CVC > CV.

Paninian collapse: CVV, CVC > CV.
AntiPaninian Collapse: CVV> CVC, CV (common: Southeastern Tepehuan, Selkup, Khalkha, etc....)

•Along same lines: uncollapsed SupHv > Hv > Lt (Kelkar’s Hindi: P&S 1993). But do we see SupHv > Hv, Lt ?

(72) **Sonority interactions.** (K = Kenstowicz 1994:ROA-33, dL = de Lacy 1997:ROA-236

Symbology: L= low (4), M=mid (3), H = high (2), R = ‘reduced/central’ (1)

Language	**Scale**	***Remark***
Mokshan Mordwin [K]		
eoäa > iuə	LM > HR	AP(iv)
Peak: leftmost heaviest.		
(nb crucial exx. of iu ≡ ə missing!! Kenstowicz notes.)		
(if H>R, then Piii, same as Chukchee)		
Mari (‘Literary’ = Cheremis) [K]		
eoäaiu (or whatever vowels it has!!) > ə	LMH> R	P(ii)
Peak: nonfinality, rightmost full V, else leftmost.		
Kobon [K]		
a > eo > u i > ö ɨ	L>M>H>R	P(iv)
Peak: in final 2-σ window, most sonorous; else initial (?) in window.		
Chukchee [K]		
aeo > iu > ə	LM>H>R	P(iii)
Peak: In base-final words, penult unless antepenult is stronger.		
Kara [dL]		
aː > aX. > a. > VX. > V.	L> MHR	AP(i)

Peak: righmost heaviest in words with a non-lightest syllable; else leftmost.
With dL, note scale sorts first by a/non-a, then by µµ/µ. So *{ R'−M'} >> *µ' >> Rtmost.
¿¿Assume non-*a* (CV) is lexically unstressable, *{R'}>>∃Hd(PrWd), but stressed by phrasal default??

(73) **A counter-ploy**. We assume a Peak-Prominence hierarchy, in which the desirability of the peak tracks the intrinsic prominence of the vowel that realizes it. Suppose we *also* introduce a Trough-Obscurity counterhierarchy running the opposite way (cf Prince & Smolensky 1993:ch 8, Kenstowicz 1994).

$*\breve{L} \prec *\breve{M} \prec \breve{H} \prec \breve{R}$ *bad* → *good*

yielding the following family of set-inclusion constraints by the usual scale-bifurcation method:

$*\{\breve{L}\}, *\{\breve{L}, *\breve{M}\}, *\{\breve{L}, *\breve{M}, \breve{H}\}$

(74) Now Paninian fusion yields these patterns:

(i) $\breve{R} \mid \breve{H} \mid \breve{M} \mid \breve{L}$ (ii) $\breve{R}\ \breve{H} \mid \breve{M} \mid \breve{L}$ (iii) $\breve{R}\ \breve{H}\ \breve{M} \mid \breve{L}$

(75) But, because there is only one peak, each of these is equivalent to a structure on the *peak* scale !

(76) Pattern (iii) is $*\{\breve{L}\}$ >> LEFTMOST >> the rest. This says: avoid ă at all costs: i.e. seek á whenever possible. So this is equivalent to the constraint *{R', H', M'}: so L' | M' H' R' = 4|321 = AP(i) in ex. (68) above.

(77) Pattern (ii) is $*\{\breve{L}\}, *\{\breve{L}, *\breve{M}\}$ >> LEFTMOST >> the rest. ‘Seek to stress *a*; lacking that, *eo*; else leftmost.’
So this is equivalent to 4|3| 21 = AP(iii).

(78) So this simply treats (some) AP-fusion as P-fusion from the other end of the scale!

(79) Factual Observation: Mokshan Mordwin (72) does not fit this type! (*but for the missing crucial datum!!*)

(80) **Local Conclusion**. AP ranking in peak-prominence scales allows for fusion of adjacent categories, with possible simplification of allowed constraints types (no Trough-Obscurity hierarchy). In this way, universal distinctions at the bottom end of scales can be hidden in particular grammars, without entailing that higher-end distinctions must also be collapsed, even as the full universality of constraints is maintained.

(81) **Global Conclusion.**
In our exploration of the logic of set-inclusion constraint systems under free-ranking, we have found that—

(i) Certain markedness distinctions (e.g. among syllable types) cannot be successfully represented as set-inclusion hierarchies in a free-ranking grammar, without risking pathological interaction with multiple violation and the generation of incorrect (implausible? impossible?) types. We propose a method of generating compound constraints which *maintains* the scale distinctions appropriately, even under free ranking.

(ii) Set-inclusion hierarchies are more promising in the area of prominence-to-prominence scales, where free ranking allows for observed patterns of *loss* of distinction that do not fit the Paninian S>>G model.