Two types of ties (some notes)

Kathryn Pruitt - October 2009

Abstract

Two kinds of ties – convergent and non-convergent – should be distinguished in Harmonic Serialism. Convergent ties are those in which the ultimate output of the derivation is not affected by the choice among tied candidates at an intermediate step. Conversely, non-convergent ties are those in which the choice among tied candidates *does* affect the ultimate output of the derivation. Early on we observed mostly ties of the convergent type, and some discussion centered around whether all ties in HS might have this character. Here I demonstrate that both types of ties are possible, both in theory and in practice. However, it is argued that only ties of the convergent type should be permitted to remain in the theory.

1. What are ties and when do ties occur?

1.1 What is a tie?

A tie among two or more candidates in an Optimality Theory analysis generally diagnoses a problem with the constraint set used in that analysis. OT is a model that assumes a particular structure for the function relating each underlying form to a surface form (that of an optimization problem), but the assumption that a model of grammar should describe a function for this mapping is standard in generative linguistics. When a particular analysis fails to determine a single winning candidate for a given input, the function criterion is not met, and an appropriate response would be to add a tie-breaking constraint or redefine an existing constraint or constraints, so that the candidates are no longer problematically tied.

Aside from the formal argument that grammars are functions, the reason ties are not permitted in OT, even in cases where they could in principle be useful (e.g., to model variation), is that they are unstable. We can't rely on a specific set of outputs being jointly optimal unless we can ensure that no constraint will ever distinguish the tied candidates.[1] And given the diversity of constraints that have been proposed in OT it is quite unlikely for a true tie to persist when other reasonable constraints are included. From a formal standpoint, a tie can be remedied straightforwardly with additional constraints (or constraint redefinitions), but whether a *principled* remedy is available – one that is consistent with one's current motivating hypotheses – is usually the question of interest. It may be the case that a particular hypothesis about CON would be undermined if a principled way to resolve a tie could not easily be posited. Thus, ties do not necessarily signal ultimate indeterminacy, but instead they alert the analyst that the hypothesized constraints under consideration are not themselves sufficient to control the outcome of the phonological process being modeled. For these reasons, ties in OT are A BAD THING.

[1] Recall that this has nothing to do with ranking permutation and factorial typology. A constraint that breaks a tie between two candidates will do so no matter where is it ranked.

Given the fact that ties in OT are to be avoided, we might expect that ties in Harmonic Serialism, a model of grammar which shares its foundations with OT, should be similarly avoided. Indeed if an HS grammar failed at the last step of the derivation to find a single output under some ranking, this would be regarded as a problem.[2] But it has been observed in work within HS that tied candidates at *intermediate* derivational stages are often quite likely, and whether such cases should be automatically be regarded as problematic in HS, as are tied optima in OT, is less clear. The main reason such ties are not obviously problematic is that in many cases of tied optima at intermediate steps, the choice among the candidates has no consequence for the output that is ultimately achieved. That is, no matter which of the intermediately tied candidates were declared to be the winner, we predict the same eventual output of the derivation regardless.

This can be illustrated with a simple example of a language with coda deletion. A language with the ranking NoCoda >> Max will show deletion of all underlying codas both in parallel OT and in HS, assuming that no higher ranking markedness constraints interfere and that Max is the lowest ranked among faithfulness constraints that can be violated to satisfy NoCoda. The simplified parallel OT analysis is shown by the tableau in (1).

(1) Language with coda deletion in pOT

/pat.kap/	NoCoda	Max
a. pat.kap	2 W	L
→b. pa.ka		2

Although our intended output is the same in HS, modeling this language derivationally requires that deletions happen one-at-a-time, per the gradualness assumption which is implemented with a restricted Gen. Because Gen only produces candidates with at most one instance of one operation applied, the winning candidate in (1) is not yet under consideration in the first step of an HS derivation because it has two deletions relative to the input.[3] The tableau in (2) shows the first step in the same hypothetical language with coda deletion as it would be analyzed in HS. As this tableau illustrates, the two candidates with one deletion tie, as they both leave one coda remaining and violate Max once each. Candidate (a) loses because it leaves the codas intact and (d) loses because it deletes the following onset which does not improve on NoCoda.[4]

[2] The very last step of the derivation is the one in which the faithful candidate (the input to that iteration) is the winner, so a genuine "last step" tie would mean that a non-identical candidate shares the (local) faithful candidate's violation profile. This implies that there are operations performed by Gen that incur no additional violations, in either markedness or faithfulness, beyond those incurred by the faithful candidate, which in turn suggests that the Gen of the analysis is too powerful compared to Con.

[3] I'm setting aside, for the purposes of illustration, recent work arguing that segmental deletion is not a sufficiently gradual operation in HS (McCarthy 2008).

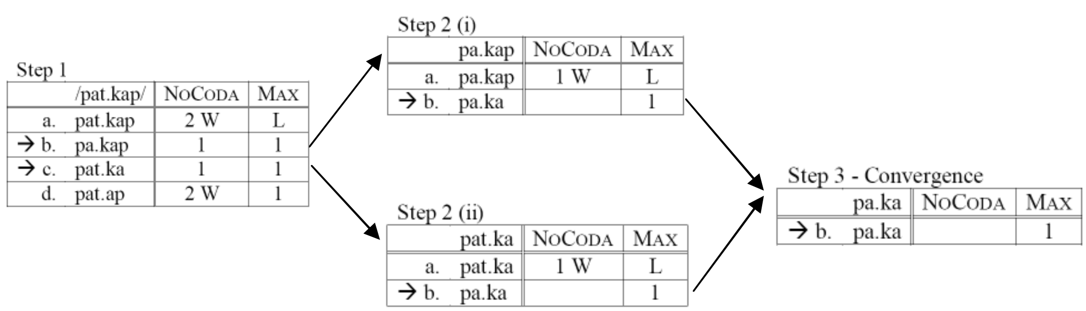
[4] For this illustration I assume that resyllabification is not automatic.

(2) Step 1 in language with coda deletion

	/pat.kap/	NoCoda	Max
a.	pat.kap	2 W	L
→b.	pa.kap	1	1
→c.	pat.ka	1	1
d.	pat.ap	2 W	1

From the perspective of HS, the resulting tie is the best you can do at this step under this ranking, since restricting Gen prevents us from considering the candidate with both codas deleted. Is this kind of tie a *problem* in HS as it would be in OT? The answer is not so obvious from looking just at this example. Although the theory would ideally have something to say about what to do when a tie is encountered, this example shows that what that something is may not actually matter. This is because the choice among the tied candidates in this case does not affect the outcome of the derivation. Either of these candidates could be chosen and the derivation will converge on the desired output [pa.ka]. This is shown in the diagram in (3) below.

(3) Both choices lead to [pa.ka]



It is prudent to ask whether other constraints we haven't considered might break this tie in favor of a particular one of the tied candidates at any step, and indeed it seems likely that *some* relevant constraint or constraints will favor one or the other of these candidates (e.g., place markedness constraints could prefer a particular segment to be deleted). However, the point stands that no matter what order such constraints prefer these deletions to happen, the output is unchanged. Since the choice has no consequence for the ultimate output, the preferences of additional constraints, even ones we think of as being unrelated, will also not be able to effect a change in the ultimate output. For this reason, it's not necessarily the case that we want *a priori* tie-avoidance at intermediate stages in HS. But the situation is, of course, more complicated, as not all ties are created equal. We return to this point in section 2, showing that indeed *some* kinds of ties should be avoided, but that there is a principled distinction between these kinds of ties. But first, the next section illustrates why ties arise in HS at all.

1.2 Why do ties emerge in HS?

To understand the source of the tie in the coda deletion example first note that the tied candidates in the HS analysis in (2) are also among the candidates produced by the unrestricted GEN of parallel OT (though they were not explicitly included in the tableau in (1)). Because we are using the same constraints with the same definitions in both OT and HS, the tied candidates must also have the same shared violation profile in the OT analysis. The candidates are present and are tied in both parallel OT and HS, but the tie is only 'realized' in HS. The reason for this is that the tied candidates in (2) are (collectively) harmonically bounded in parallel OT by the faithful candidate and the candidate with all codas deleted. This can be seen below in (4)A, which adds to the tableau in (1) the tied candidates from the HS analysis. Candidates (b) and (c) cannot win under any ranking of these constraints because for all permutations some other candidate does better, as illustrated in (4)B.

(4) Coda deletion in pOT with more candidates

A. NOCODA >> MAX (codas deleted)

/pat.kap/	NOCODA	MAX
a. pat.kap	2	
b. pa.kap	1	1
c. pat.ka	1	1
→d. pa.ka		2

B. MAX >> NOCODA (codas remain)

/pat.kap/	MAX	NOCODA
→a. pat.kap		2
b. pa.kap	1	1
c. pat.ka	1	1
d. pa.ka	2	

The situation is different in HS because restricted GEN does not permit (d) as a candidate at the first step. This crucial member of (b) and (c)'s bounding set in OT is not under consideration at the same time as (b) and (c) in HS, and as a result, these candidates are no longer harmonically bounded at all. Instead, they emerge as jointly optimal under the ranking that favored the missing bounding candidate in parallel OT (i.e., NOCODA >> MAX).

What is the relationship between harmonic bounding and ties in OT? The only problematic ties in parallel OT are among two candidates that share the *optimal* violation profile under some ranking. When a violation profile can never be optimal, the number of candidates sharing this profile is irrelevant, as there is no reason to posit constraints to break ties among candidates that could never win. Thus, in an ideal situation in which the constraint set in OT predicts a single optimum under each ranking, ties among harmonically bounded candidates may persist with no detriment to the theory.

With two assumptions we can generalize from this example to *any* set of tied optima in a HS derivation. The first assumption is that the candidates produced by HS-GEN form a subset of those produced by OT-GEN, reflecting the fact that, by hypothesis, HS-GEN is able to perform a subset of the mutations OT-GEN is able to perform. The second assumption is that the CON of OT does not differ systematically from that of HS.[5]

[5] This is not to say that using HS wouldn't sometimes lead an analyst to a different hypothesis about constraints and their definitions, but no *systematic* differences in the structure or content of CON have been proposed to accompany the change from parallel OT to HS, at this point; GEN and EVAL are the loci of

The first of these assumptions is currently standard in HS, as this difference in GEN accounts for one of the main distinctions between the models. The second assumption is a kind of null hypothesis, but as far as I know it hasn't be explicitly argued for (or against).

It is not the case that all harmonically bounded tied candidates in OT result in tied intermediate optima in HS. The tie will emerge only if a crucial bounding candidate in OT is more than two gradual changes away from the input while the harmonically bounded candidates are just one. Tied harmonically bounded candidates in OT stay tied and harmonically bounded in HS when that set loses under every ranking to some other candidate produced by GEN at the same step. The main point is that when a set of constraints that did not produce problematically tied optima in parallel OT *does* produce an intermediate tie in HS, it's because the tied optima were harmonically bounded candidates in the parallel OT analysis and in HS at least one of the members of its bounding set is not produced by restricted GEN at the same iteration.[6]

2. Convergent vs. Non-convergent ties

The discussion in the previous section showed that the emergence of ties in HS may be regarded as somewhat natural, since the set of constraints imported from OT was not necessarily intended to distinguish among such candidates. And as was demonstrated in Section 1.1, at least some ties essentially resolve themselves (when possible paths lead to the same conclusion), which raises the question: should we ever care about intermediate ties in HS? The answer provided in this section is "yes." As I show next, some intermediate ties are different from the one illustrated in the previous section in that the choice among the tied candidates at an intermediate stage *does* affect the ultimate output predicted under a given ranking. I'll call such ties "non-convergent" to highlight the fact that the tied candidates lead to different ultimate outputs and to distinguish them from "convergent" ties, such as the one in the coda deletion example above, which find the same ultimate output in the end.[7]

An example of a non-convergent tie in HS can be found with a set of constraints that have been proposed to model stress in parallel OT by restricting the locations of rhythmic lapses (and clashes). Here I'll adopt a simplified version of this kind of approach to stress to illustrate the basic problem. (Note: I'm not arguing here that this approach to stress is wrong; I'm just showing that non-convergent ties are possible. The theory might be made to work under different assumptions or additional constraints, but this illustration still stands to show that such ties can arise, at least in practice.)

---

systematic differences between the two models. (EVAL is augmented with a looping mechanism; but is otherwise the same.)

[6] In practice we may not know (or care) whether or not a given set of constraints predict tied optima in parallel OT. But this section is just meant to demonstrate the theoretical relationship between OT and HS on this point.

[7] To avoid confusion: each path in a non-convergent tie still 'converges' in the technical sense of having the derivation stop at some point. But since the paths stop on different outputs they are non-convergent in the sense that the derivations stop and leave us without a single winner when taken together.

For this illustration we will assume a *LAPSE constraint, penalizing adjacent unstressed syllables, and two constraints, ALIGNWDL and ALIGNWDR, that penalize a word that does not have a foot aligned with its left/right edge, respectively. We will also assume that other constraints which will not be discussed are ranked high enough to favor iterative disyllabic trochees in all of the cases considered below. This illustration first demonstrates the typology achieved with this small constraint set in parallel OT and then illustrates that the same constraints result in problematic (non-convergent) ties in HS.

As the tableau in (5) shows, right-to-left trochaic stress can be achieved with the ranking *LAPSE >> ALIGNWDL in parallel OT (again, assuming iterativity and trochaic constraints are high ranked). Since right-to-left trochees produce a perfect grid in terms of rhythm, *LAPSE favors this configuration; as a result ALIGNWDR is not necessary to force right alignment.

(5) Right to left stress: *LAPSE >> ALIGNWDL

/σσσσσ/	ALIGNWDR	*LAPSE	ALIGNWDL
a. (ˈσσ)(ˈσσ)σ	1 W	1 W	L
b. → σ(ˈσσ)(ˈσσ)			1
c. (ˈσσ)σ(ˈσσ)		1 W	L

Reversing this ranking to ALIGNWDL >> *LAPSE results in a bidirectional stress system, as shown in the tableau in (6). Because ALIGNWDL necessarily attracts a foot to the left edge of the word – and because feet in this language are trochaic and the word has an odd number of syllables – a lapse is inevitable, so *LAPSE doesn't distinguish between the remaining candidates. ALIGNWDR decides in favor of the candidate in (c), no matter where this constraint is ranked.

(6) Bidirectional stress: ALIGNWDL >> *LAPSE

/σσσσσ/	ALIGNWDL	ALIGNWDR	*LAPSE
a. (ˈσσ)(ˈσσ)σ		1 W	1
b. σ(ˈσσ)(ˈσσ)	1 W		L
c. → (ˈσσ)σ(ˈσσ)			1

Finally, to achieve a left-to-right trochaic stress system we must include a constraint that ranks over ALIGNWDR to favor a non-bidirectional stress pattern. A constraint that has been proposed for this purpose is LAPSEATEND, which penalizes all lapses which are not at the end of the word, as shown in (7).

(7) Left to right stress: ALIGNWDL, LAPSEATEND >> ALIGNWDR; ALIGNWDL >> *LAPSE

/σσσσσ/	ALIGNWDL	LAPSEATEND	ALIGNWDR	*LAPSE
→ (ˈσσ)(ˈσσ)σ			1	1
σ(ˈσσ)(ˈσσ)	1 W		L	L
(ˈσσ)σ(ˈσσ)		1 W	L	1

With these four constraints (and constraints enforcing foot-building and disyllabic trochees, etc.) in parallel OT, we get the more-or-less expected directional typology – right-to-left, left-to-right, and bidirectional (which, while rare, is nonetheless attested).

But in HS the situation is different. Assuming iterative foot-building, the tableau in (8) shows how the candidates with disyllabic trochees at the first step of stress assignment are assigned violations by these constraints.

(8) Step 1 violation marks (constraints unranked)

/σσσσσ/	ALIGNWDL	ALIGNWDR	*LAPSE	LAPSEATEND
a. (ˈσσ)σσσ		1	3	2
b. σ(ˈσσ)σσ	1	1	2	1
c. σσ(ˈσσ)σ	1	1	2	1
d. σσσ(ˈσσ)	1		2	2

As this tableau confirms, these constraints can determine a unique winner at this step if ALIGNWDL is top-ranked (favoring a.) or if ALIGNWDR is top-ranked (favoring b.). However, when either *LAPSE or LAPSEATEND is ranked over ALIGNWDL and LAPSEATEND outranks ALIGNWDR, the two middle candidates tie on these constraints. This is shown in (9) below.[8]

(9) Step 1 tie in HS

/σσσσσ/	LAPSEATEND	*LAPSE	ALIGNWDL	ALIGNWDR
a. (ˈσσ)σσσ	2 W	3 W	L	1
b. → σ(ˈσσ)σσ	1	2	1	1
c. → σσ(ˈσσ)σ	1	2	1	1
d. σσσ(ˈσσ)	2 W	2	1	L

Crucially distinguishing this example from the deletion case discussed in the first section is the fact that the choice among these tied optima *does* affect the ultimate output. The tableaux below illustrate. In (10) the tied candidate σ(ˈσσ)σσ ((9)b) is passed along to the next step; the only candidate available that adds a disyllabic trochee is σ(ˈσσ)(ˈσσ), which ultimately wins because its violation marks are only a subset of those assigned to σ(ˈσσ)σσ. Similarly, when σσ(ˈσσ)σ (tied optimum (9)c) is passed along instead, it also loses to the only available candidate, this time (ˈσσ)(ˈσσ)σ. In both cases the derivations would continue one more iteration to confirm convergence (in the technical sense of 'derivation finished').

[8] If LAPSEATEND were not included then the left- and right-aligned foot candidates are the only possible optima at the first step, with the choice of a bidirectional or right-aligned stress system being decided at the next step by the ranking of *LAPSE and ALIGNWDL. But it's not the case that LAPSEATEND is contributing to this problem in general. In longer words a subsequent step will present a tie whenever multiple ways of building a foot all get rid of the same number of *LAPSE violations, whether LAPSEATEND is present or not.

(10) Step 2, with σ(ˈσσ)σσ input

/σ(ˈσσ)σσ/	LAPSEATEND	*LAPSE	ALIGNWDL	ALIGNWDR
a. σ(ˈσσ)σσ	1 W	2 W	1	1 W
b. → σ(ˈσσ)(ˈσσ)			1	

(11) Step 2, with σσ(ˈσσ)σ input

/σ(ˈσσ)σσ/	LAPSEATEND	*LAPSE	ALIGNWDL	ALIGNWDR
a. σσ(ˈσσ)σ	1 W	2 W	1 W	1
b. → (ˈσσ)(ˈσσ)σ		1		1

Thus, we have a case where the prediction for an input /σσσσσ/ under the ranking in (9) for these constraints would vary between σ(ˈσσ)(ˈσσ) and (ˈσσ)(ˈσσ)σ depending on the intermediate tied form that was chosen to be passed along. In parallel OT, this same ranking would predict just one of these – only σ(ˈσσ)(ˈσσ) – as the optimal candidate, as shown below in (12). As the tableau shows, the candidates that tied on the first iteration in the HS analysis (in (12)b and (12)c) are harmonically bounded by the winner in the parallel OT analysis, conforming to the generalization provided in Section 1.2. Since at least one crucial bounding candidate is not part of the comparison in the first step of the HS analysis, the tied candidates are able to be jointly optimal under this ranking in HS.

(12) Parallel OT outcome with same constraints and ranking

/σσσσσ/	LAPSEATEND	*LAPSE	ALIGNWD	ALIGNWDR
a. (ˈσσ)σσσ	2	3		1
b. σ(ˈσσ)σσ	1	2	1	1
c. σσ(ˈσσ)σ	1	2	1	1
d. σσσ(ˈσσ)	2	2	1	
e. → σ(ˈσσ)(ˈσσ)			1	
f. (ˈσσ)(ˈσσ)σ		1		1
g. (ˈσσ)σ(ˈσσ)	1	1		

3. Non-convergent ties signal a problem

With convergent ties, the choice among the tied candidates is inconsequential to the outcome of the derivation and thus to the prediction the theory makes under that ranking. By extension, convergent ties do not affect the predicted typology of a particular set of constraints. With respect to the coda deletion example, the order in which the consonants are deleted doesn't matter, and so it follows that *how* the choice is made also doesn't matter. But the potential for HS to produce non-convergent ties raises the question of what we should do about them, as clearly the choice between the tied optima does matter in such cases. There are two ways we might answer this question – from the point of view of the theory and from the point of view of the implementation of the theory. Here I'll discuss the theoretical perspective, which suggests the conclusion that non-convergent ties, like tied optima in parallel OT, are A BAD THING. Thus, no way of 'dealing' with such ties will lead to a satisfactory outcome, unless they can be eliminated in a principled way through revision of the constraint set.

From a theoretical perspective, non-convergent ties in HS present a problem that is analogous to that of tied optima in parallel OT. As discussed in the introduction, tied optima are problematic in OT because they are unstable. It's quite likely that other constraints will break the tie and may do so in unexpected and/or arbitrary ways, and as a result, the analysis relinquishes control of the typological predictions under investigation. This argument extends to non-convergent ties in HS. Because ties are not likely to persist when additional constraints are considered, any typological predictions made under rankings that produce non-convergent ties are likewise unstable. Therefore, any essentially arbitrary method of non-convergent tie resolution amounts to a misguided attempt to derive typological predictions where in fact none exist.

To elaborate, a set of constraints that, under some ranking, delivers multiple optima for some input via non-convergent ties, can only make a concrete typological predictions if some 'decision-rule' is implemented to distinguish the candidates at the tie-step.[9] But crucially, any typological prediction that derives from the decision-rule *depends on the constraint set*. When additional constraints are added, languages that were derived as a result of this decision rule may *disappear* from the typology, owing to the instability of such ties. This will happen in cases in which the additional constraints preempt the decision-rule (i.e., break the tie) in a way that favors a tied candidate other than the one preferred by the decision-rule. In other words, a language present in the typological predictions derived from such machinery may fall out of the typology when additional constraints are added.

It is crucial to bear in mind that in cases that do not involve ties, adding constraints will never *reduce* the set of optima, i.e., potential winners, for a given input, and will therefore not be able to eliminate a language from the typology. Adding constraints can (and usually does) *increase* the size of the typology, but adding an infinite number of constraints to CON will not eliminate the languages that are derived through factorial typology of a subset of those constraints (provided those constraints produced no ties). The same set of languages will be derived from rankings that put all the new constraints below the original subset. This property holds only of cases without ties. When tied optima *are* present under some ranking, a tie-breaking constraint will break the tie no matter where it is ranked. So in this specific case, additional constraints can result in the elimination of languages from the predicted typology of a set of constraints, assuming a decision rule that allowed *some* typological prediction to be made in the first place. This potential subversion of the factorial typology means that non-convergent ties indicate a problem with the current constraint set, comparable to the problem posed by tied optima in parallel OT. The presence of non-convergent ties should therefore be taken not just as an inconvenience, but as a signal to reevaluate one's current motivating hypotheses.

[9] I'm using 'decision-rule' as an umbrella term for all kinds of ways of resolving ties in HS that I've thought of or heard other people suggest.