Syntactic Constraints

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Abstract

Harmonic bounding relations among syntactic candidates entail economy of structure. No phrase satisfies all syntactic constraints, hence every phrase has a cost: the violations it incurs. The more phrases a candidate contains, the more violations it incurs. Ranking is critical in selecting a candidate with more output structure, which can never harmonically bound a smaller candidate. In contrast, a smaller candidate can harmonically bound a larger, because its violations can be a proper subset of those incurred by the larger. This general result is illustrated for the distribution of complementizers in Korean and English. While optima containing multiple functional projections can be picked by ranked universal constraints, the number of functional projections is limited by harmonic bounding.
1 Introduction

*Economy of Structure* is an important component in determining the set of structures and hence grammatical sentences allowed by a grammar. Economy of structure follows, I argue here, from Optimality Theory directly, not from auxiliary stipulations of economy. It follows from the logic of harmonic bounding, an architectural property of the theory, which results in a general preference for smaller structures over larger ones. The result holds given a particular set of universal constraints on structure. This paper exemplifies some of the ways in which economy of structure constrains the set of grammatical sentences using examples from English and Korean.

I will argue that the distribution of certain complementizers in English and Korean can be explicated in terms of simple and general constraints on syntactic structure. English and Korean have distinct complementizer systems. Nevertheless there is no difference between them at a more abstract level. They are subject to the same constraints, and show the same harmonic bounding effects.

Optimality Theory (Prince and Smolensky 2004) provides a principle which chooses an optimum among a set of competitors which do not violate the same constraints. Under this principle: “An *optimal output* form for a given input is selected from among the class of competitors in the following way: a form that, for every pairwise competition involving it, best satisfies the highest-ranking constraint on which the competitors conflict, is optimal.” (Grimshaw 1997).

The interaction of the posited constraints guarantees that “larger candidates”, those with more structure, can harmonically bound “smaller” candidates, but not vice versa. Harmonic bounding is analyzed in Samek-Lodovici and Prince 2002. They state “Candidate sets are typically unbounded in size, but the set of distinct possible optima is inevitably finite. Almost all candidates are 'losers', doomed never to surface because under any ranking there are superior alternatives. Such losers are said to be 'harmonically bounded'.”

In Table 1, C1-C8 are constraints, and a and b are the outputs paired with input $i$. These candidates stand in a special relation: candidate a is harmonically bounded by candidate b. The violations of b are a proper subset of the violations of a. Constraints C1, C5 and C7 prefer b. C2, C4, C6 and C8 do not distinguish between them. Hence no ranking of constraints can prefer a over b, and a is an inevitable loser, not optimal in any grammar.
I show here that larger structures can be harmonically bounded by smaller ones, but not vice versa. This is because the set of universal constraints guarantees that any phrase will incur at least one violation. This is the “cost” of the phrase. As a result, a phrase is possible only where extra structure is preferred by at least one constraint (Grimshaw 2001, 2002). If there is no constraint which prefers the extra structure, a candidate without the phrase harmonically bounds the larger candidate.

2 The constraints

The constraints which result in the key relationships of harmonic bounding are given in (1)-(5). The first three are alignment constraints (McCarthy and Prince 1993).

1. **HDLFT**: Every X-zero is at the left edge of an X-max.
2. **SPECLFT**: Every specifier is at the left edge of an X-max.
3. **COMPLFT**: Every complement is at the left edge of an X-max.

The last two constraints I call “obligatory element constraints”. They require the presence of particular elements: the head and the specifier. **OBHD** played a central role in the analysis of Grimshaw 1997. **OBSPEC**, which mandates that a phrase has a specifier, has an obvious similarity to **ONSET** (Prince and Smolensky 2004). The constraint **SUBJECT** and similar constraints posited in Grimshaw 1997, Grimshaw and Samek-Lodovici 1998, and Samek-Lodovici 2005, are special cases of **OBSPEC**, which is responsible for the widespread obligatoriness of subjects, often characterized as an effect of the “EPP” (Chomsky 1981). (An **OBCOMP** constraint may also exist but would not play a role in the analysis here.)

4. **OBHD**: A phrase has a head.
5. **OBSPEC**: A phrase has a specifier.

These constraints are not in any sense “economy constraints”; in fact, individually they can prefer larger, more complex structures over smaller, simpler ones. It is the collective effects of general constraints on structure that enforce economy.

The constraints select the core phrase structures of English and Korean. In both grammars, the ranking of **SPECLFT** above **HDLFT** and **COMPLFT**
elminates candidates with right specifiers, regardless of the ranking of HDLFT relative to COMPLFT. Specifiers are always at the left of a phrase in both languages, barring adjunctions and other perturbations of structure.

Now the two grammars diverge. Optimal X-bars are left-headed in English, right-headed in Korean. HDLFT must dominate COMPLFT in English, while COMPLFT dominates HDLFT in Korean (see (6)-(7)). In the English optimum, the head is as close as possible to the left edge, while in the right-headed optimum, it is the complement that is as close as possible to this edge. The English X-bar best satisfies HDLFT while the Korean X-bar best satisfies COMPLFT. (Note the key role played here by COMPLFT, a constraint which has little effect in English, but chooses right headed structures when it dominates HDLFT.) Tables 2 and 3 each show the evaluation of two candidates, with a verb and two arguments as the input and alternative arrangements of a phrase as the output.

<table>
<thead>
<tr>
<th>Verb (argument, argument)</th>
<th>SPEC LFT</th>
<th>HD LFT</th>
<th>COM LFT</th>
</tr>
</thead>
<tbody>
<tr>
<td>a W [SPEC [HD COMP]]</td>
<td></td>
<td>*</td>
<td>**</td>
</tr>
<tr>
<td>b [SPEC [COMP HD]]</td>
<td></td>
<td>**</td>
<td>*</td>
</tr>
</tbody>
</table>

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<td>*</td>
</tr>
<tr>
<td>b W [SPEC [COMP HD]]</td>
<td></td>
<td>*</td>
<td>**</td>
</tr>
</tbody>
</table>

(6) SPEC LFT >> HD LFT >> COM LFT English
(7) SPEC LFT >> COM LFT >> HD LFT Korean

The constraint ranking is different in English and Japanese but the candidates and the constraints are always the same. (I factor out lexical differences: Korean words in Korean candidates, English in English.) Thus the violations incurred by each candidate on these constraints are the same for every grammar, as exemplified by Tables 2 and 3. The difference is the optimum selected, because this is decided by ranking, which is not constant across grammars. The constancy of violations under the logic of OT underlies the economy of structure, as we will see shortly.

No order among a specifier, a head, and a complement in a single phrase can satisfy all three of the alignment constraints because only one of the elements can be at the left edge. Two of the three constraints must be violated in every phrase containing three elements. Moreover, since one of the three elements must be separated from the left edge by the other two, the rightmost element necessarily incurs two violations of the alignment constraint governing
its position. (If the alignment constraints are “gradient”, (McCarthy and Prince 1993), one violation is incurred for every element separating an aligning item from the left edge of the phrase.) The total number of alignment violations in a phrase containing a head, a specifier and a complement must therefore be three, exactly as the tableaux show. By the same reasoning, every candidate containing two elements incurs one alignment violation, regardless of order.

A phrase can escape the penalties imposed by the alignment constraints if it contains only one element (specifier, head or complement), or if it contains no elements. If the phrase contains one element, two alignment constraints are vacuously satisfied, and the sole element in the phrase is left aligned. If the phrase is entirely empty, all three alignment constraints are vacuously satisfied. However, each empty phrase violates both obligatory element constraints. Here and throughout I use “_” to indicate an empty position.

(8) Violations in one-element phrases and empty phrases. (English order.)

\[
\begin{align*}
[\_\_ \text{COMP}], & \quad [\_\_] \quad \text{violates OBSPEC and OBHD} \\
[\_ \text{HD} \_], & \quad \text{violates OBSPEC} \\
[\text{SPEC} \_\_], & \quad \text{violates OBHD}
\end{align*}
\]

In sum, any phrase necessarily violates at least one of these markedness constraints. Every phrase has a cost in the form of guaranteed constraint violation. No matter how phrases are combined, a structure incurs more violations of the alignment and/or obligatory element constraints than any structure it properly contains. This is the foundation of harmonic bounding, and thus of economy of structure.

A parametric account (see, for example, Saito and Fukui 1998, and papers in Alexiadou and Hall (1997)) has a totally different logic. It protects each language from the constraint governing the other. The difference between the two grammars and thus languages is the result of their being subject to different (versions of the) constraints.

(9) Japanese:   X final in X-bar, X-bar final in XP  
      English:   X initial in X-bar, X-bar final in XP

Both the English and the Japanese outputs satisfy their respective constraints fully. English violates the Japanese version of the constraints, and Japanese the English version, but in each language every phrase is perfect: there is no cost to a phrase. Economy of structure cannot be derived from the nature of phrases, in a parametric theory.

3 Economy and Complementizers

A large body of recent research has established that there are several head positions and hence projections in the region of a clause where

Such structures often go by the names, “CP recursion”, or “Split CPs”, although only in a few cases are all the phrases projections of the same head. What determines the number of such projections that occurs in any given clause in any given language? Each layer of structure has a cost: the violations which it necessarily imports. A phrase is therefore possible when its benefits exceed its costs. The benefits can exceed the costs only by virtue of ranking. If a faithfulness or markedness constraint requiring the presence of a functional head dominates the structural constraints which otherwise limit the size of projections, an additional projection will appear in the optimum. A functional head such as a complementizer expresses or “parses” functional morphosyntactic properties specified in the input. (Baković and Keer 2001 and Ackema 2001 investigate cases where complementizers are not faithful to input.)

Bhatt and Yoon (1992) analyze complementizers in Korean in the following way. The particle -ko, which occurs in only in subordinate clauses, and occurs regardless of whether the clause is interrogative or propositional, is a Subordinator. The particles -ni and -ta are Type markers. They occur in both subordinate and main clauses; -ta in propositions and -ni in interrogatives.

(10) a. -ko [+ sub]
    b. -ta [+ dec]
    c. -ni [+ int]

(11) a. John-i wa-ss-ta
    John-nom come-past-dec
    “John came”
       Bill-top John-nom come-past-dec-sub thinks
       Bill thinks that John came
    c. John-i wa-ss-ni?
       John-nom come-past-int
       “Did John come?”
       Bill-top John-nom come-past-int-sub asked
       “Bill asked if John came”

As illustrated in Table 4, faithfulness constraints referring to these features (FAITHSUB and FAITHTyp) prefer candidates which contain the
appropriate heads, and hence candidates with two complementizers over candidates with one.

Table 4

<table>
<thead>
<tr>
<th>Complementizers motivated by faithfulness</th>
</tr>
</thead>
<tbody>
<tr>
<td>think (Bill, P)</td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>W [ _ [ _ IP ta ] ko ] V</td>
</tr>
<tr>
<td>a [ _ IP ta ] V</td>
</tr>
<tr>
<td>b [ _ IP ko ] V</td>
</tr>
</tbody>
</table>

Table 4 represents the assessment of the candidates in the form of a Comparative Tableau (Prince 2002). The winning candidate appears as “W”, and the columns represent the preferences of each constraint, in a comparison between each losing candidate and W. If the constraint prefers the losing candidate, “L” appears in the cell, if it prefers the winner, “W” appears. The structure of W is in Figure 1.

Looking at Figure 1 and Table 4 we see that a complement-head phrase in Korean violates HDCALLFT once (a head-complement phrase in English violates COMPLFT once). W contains two such phrases (apart from IP which is constant across candidates), one headed by ko and one by ta. The smaller candidates contain only one such phrase. Thus HDCALLFT prefers a and b to the winner. OBSPEC makes the same choice, so the markedness constraints would choose a
or b. However, W satisfies both FAITHSUB and FAITHTYP, since -ko encodes +sub and -ta encodes +dec. The two smaller candidates, a and b, each violate one of these faithfulness constraints. Every constraint which favors a loser must be dominated by at least one constraint which prefers the winner (Prince 2002). The larger candidate W is therefore optimal in a ranking where both FAITHSUB and FAITHTYP dominate OBSPEC and HDLFT. Table 4 orders the constraints so as to be consistent with the known rankings; the one just established, and the previously known ranking in (7): SPECLFT >> COMPLFT >> HDLFT.

This ranking chooses the larger structure over the smaller in a subordinate clause, but no ranking chooses a yet larger structure, such as c, with more than two complementizers. Candidate c is no more faithful than W, in fact is may be less so, if the constraint UNIQUE (Grimshaw 2006a) is violated when a single input element has two output correspondents. This candidate also incurs one additional OBSPEC violation and one additional HDLFT violation. No constraint prefers it to W, so it is harmonically bounded. Ranking chooses among structures which are not harmonically bounded.

To put the point another way, the third CP layer imports one alignment violation and one obligatory element violation. We can think of this layer of structure informally as “extraneous”. Its presence in the output of candidate a does harm and does no good. This case shows that some extra structure is motivated by constraint ranking. Extraneous structure is ruled out by harmonic bounding. Rankings can force the presence of additional structure, but only minimally. The presence of structure above and beyond that which allows best-satisfaction of the constraints leads to harmonic-bounding.

The main clause optimum, which has the structure in Figure 1, but without Sub and its projection, contains only a Typ head, because this candidate harmonically bounds a candidate with both Typ and Sub (as well as one which includes Sub alone). This is because FAITHSUB is vacuously satisfied in a main clause, so its ranking has no effect there.

Table 5
Complementizers in main clauses

<table>
<thead>
<tr>
<th>come (John) + past + dec -sub</th>
<th>FAITH SUB</th>
<th>FAITH TYP</th>
<th>OBSPEC</th>
<th>OBS HD</th>
<th>SPEC LFT</th>
<th>COMP LFT</th>
<th>HD LFT</th>
</tr>
</thead>
<tbody>
<tr>
<td>W   [ _ IP ta]</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>b   [ _ IP ko]</td>
<td>*W</td>
<td>*W</td>
<td>*</td>
<td>*</td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

This brings us to the analysis of English that. Observing that it marks subordination (so is not found in main clauses) and that it marks propositions (so is not found in interrogatives) Bhatt and Yoon suggest that it is both a subordinator and a type marker. The analysis I give here pertains to verbs including assert, respond, and argue which require that in their complements. (See Bolinger 1972 for discussion. iii Subordinate clauses without that are analyzed in Doherty 1997, Grimshaw 2006b, in prep.)
Grimshaw

(12)  
   a. The minister responded that the bill would pass.  
   b. *The minister responded the bill would pass.

Table 6
A complementizer in a subordinate clause

<table>
<thead>
<tr>
<th>respond (minister, P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P= pass (bill) + fut + dec +sub</td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
</tr>
<tr>
<td></td>
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<td></td>
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<tr>
<td></td>
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<tr>
<td></td>
</tr>
</tbody>
</table>

As in Table 4, I do not record IP-internal violations in Table 6. The constraints are ordered to reflect the previously known ranking SPECLFT >> COMPLFT >> HDLFT from (6), and are consistent with the rankings yet to be determined.

The CP layer (bolded in W) imports violations of OBSPEC and COMPLFT. Its specifier is empty and the complementizer separates IP from the edge of CP. However, the CP layer makes it possible to satisfy FAITHSUB and FAITHTyp because that is associated with both +sub and +typ, if we follow Bhatt and Yoon. (The +fut specification is realized by would, its form determined by sequence of tense.)

The ranking of either FAITHSUB or FAITHTyp over OBSPEC and COMPLFT chooses the larger structure, with the faithfulness constraint(s) forcing the presence of a phrase despite the preference of the markedness constraints. The subordinate clause therefore has the structure within CP-1(Long Adjunct not included) in Figure 2:

(13)  
   that [ +sub ], [ +typ ]

(14)  
   FAITHSUB or FAITHTyp >> OBSPEC, COMPLFT
In contrast, *that* is impossible in main clauses, where the smaller structure is optimal.

(15) The bill will pass

\*That the bill will pass

<table>
<thead>
<tr>
<th>pass (bill)</th>
<th>+future</th>
<th>+dec</th>
<th>-sub</th>
</tr>
</thead>
<tbody>
<tr>
<td>W</td>
<td>[Spec I VP]</td>
<td>*L</td>
<td></td>
</tr>
<tr>
<td>a</td>
<td>[ _ that</td>
<td>Spec I VP]</td>
<td>*W</td>
</tr>
</tbody>
</table>

As before, the candidates tie on SPEC_LFT, HDLFT and OBHD. (I show IP-internal violations in Table 7, since they are relevant here.) The smaller candidate with no CP layer is preferred by COMPLFT and OBSPEC. The inclusion of *that* makes it possible to realize +dec, but at the cost of realizing +sub, which conflicts with the input specification. The CP candidate violates
F\textsc{aithSub}, and the IP candidate violates \textsc{Faithtyp}. The IP candidate is chosen in the ranking of (16):

(16) \textsc{Faithtyp} or \textsc{complft} or \textsc{obspec} >> \textsc{Faithtyp}

The main clause therefore has the structure within IP in Figure 2.

In a subordinate clause, ranking prefers the larger structure over the smaller. Nevertheless, \textit{harmonic bounding} imposes a limit on its size. It must be a CP and no bigger than a CP. (17) is ungrammatical. CP recursion is in principle possible, but not here.

(17) *The minister responded \textcolor{red}{that} \textcolor{red}{that} the bill would pass

Table 8

<table>
<thead>
<tr>
<th>respond (minister, P) [P = \text{pass (bill) +fut +dec +sub} ]</th>
<th>\textsc{Faithtyp}</th>
<th>\textsc{Faithtyp}</th>
<th>\textsc{obspec}</th>
<th>\textsc{obspec}</th>
<th>\textsc{obspec}</th>
<th>\textsc{obspec}</th>
<th>\textsc{comp}</th>
<th>\textsc{comp}</th>
</tr>
</thead>
<tbody>
<tr>
<td>W V [ _ \textcolor{red}{that} IP ]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a V [ _ \textcolor{red}{that} _ \textcolor{red}{that} IP ]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>\textcolor{red}{**W}</td>
<td></td>
<td>\textcolor{red}{**W}</td>
<td></td>
</tr>
</tbody>
</table>
intervenes between the two complementizers the double CP structure is much improved. (See Grimshaw 2006b for an analysis of the short adjunct cases.)

(18) a. *The minister responded that soon that the bill would pass.
    b. *The minister responded that at some time in the very near future that the bill would pass.

If these long adjuncts are located in a specifier position, the constraints as ranked for English choose the candidate containing two occurrences of that, which is not harmonically bounded in this case. They choose the structure in Figure 2, which includes every element within CP-2.

<table>
<thead>
<tr>
<th>Table 9</th>
<th>Preposed Constituent in Specifier position</th>
</tr>
</thead>
<tbody>
<tr>
<td>respond (minister, P)</td>
<td>P= LA pass (bill) +fut +dec+sub</td>
</tr>
<tr>
<td></td>
<td>FAITH SUB</td>
</tr>
<tr>
<td>W  V [ _ that [LA that IP]]</td>
<td>*</td>
</tr>
<tr>
<td>a  V [ _ that [LA _ IP]]</td>
<td>*</td>
</tr>
<tr>
<td>b  V [ _ _ [LA that IP]]</td>
<td>*</td>
</tr>
<tr>
<td>c  V [ _ that [ _ that [LA that IP]]]</td>
<td>**W</td>
</tr>
</tbody>
</table>

Table 9 shows the violations incurred by the two-that candidate, a candidate with three occurrences of that and two candidates with only one that. iv (Edges targeted for alignment are bolded, “LA” stands for a long adjunct in specifier position, and IP-internal violations are not shown.) The input is identical to the previous two cases, apart from the inclusion of a long adjunct, which I simply represent as LA in the input. The long adjunct is the specifier in all candidates under consideration. SPEC LFT and the faithfulness constraints (apart from UNIQUE, alluded to above) are satisfied in all candidates. HD LFT and COMPL FT both prefer a and b, which each have just one complementizer. However, ObHD prefers the desired winner. Thus, a ranking in which ObHD dominates HDLFT and COMPLFT chooses the double that candidate. This ranking is independently established for English in Grimshaw 2001, 2002. It enforces the presence of a head even though a phrase with a head incurs more alignment violations than one with no head.

Any candidate containing three complementizers, even one with this input, is harmonically bounded for familiar reasons (see candidate c). It contains an extraneous phrase, which accrues additional violations of ObSPEC and COMP LFT, and no constraint prefers it to the winner. In sum, two complementizers are better than one when a long adjunct is in specifier position, by virtue of ranking but three complementizers are worse than two, by harmonic bounding.

The rankings motivated here are (19) for English and (20) for Korean:

(19) SPEC LFT >> HDLFT >> COMP LFT

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\[
\text{FAITHSUB or COMPLFT or OBSPEC} \gg \text{FAITHTyp} \\
\text{FAITHSUB or FAITHTyp} \gg \text{OBSPEC, COMPLFT}
\]

\[(20) \quad \text{SPECLFT} \gg \text{COMPLFT} \gg \text{HDLFT} \\
\text{FAITHSUB, FAITHTyp} \gg \text{OBSPEC, HDLFT}
\]

The rankings in (19) and (20) are both compatible with more than one total ranking. The phenomena examined here do not determine the complete rankings for Korean and English, hardly a surprise. To show that there is at least one consistent ranking for each language, I provide the ranking diagrams in Figures 3 and 4.

Figure 3 Korean Rankings

```
  SPECLFT
   |    
  COMPLFT
   |    
  HDLFT
     |    
  FAITHSUB    FAITHTyp
```

Figure 4 English Rankings

```
  FAITHSUB
   |    
  SPECLFT
   |    
  OBSPEC
   |    
  HDLFT
   |    
  COMPLFT
   |    
  FAITHTyp
```
4 Conclusion

The distribution of complementizers, and hence the shape and size of clauses, is governed by faithfulness constraints which are satisfied via the realization in an output of features in the corresponding input. Their distribution is also governed by markedness constraints which assess the presence and position of elements in phrases.

In the rankings governing Korean and English, these constraints determine differences in grammatical patterns for the two languages. One is head final, the other head medial. One has a two head complementizer system, and the other a single syncretic complementizer. English has no complementizer in a main clause, Korean has one of its two complementizers in these clauses. These choices are determined by the ranking of conflicting constraints, which differs from grammar to grammar.

The choice of more complex structures over less complex is not general. It depends on ranking, and thus is language specific; it depends on the input and thus holds in some cases but not in others, and it depends on the comparison: it is found only in comparisons where there is conflict among the relevant constraints.

The preference for simpler structures is found for all rankings and thus is universal, it is independent of the input, and thus holds in all cases, and it holds regardless of the interaction between the relevant constraints. Ranked constraints can only choose from among candidates that are not harmonically bounded. A candidate containing more phrases can never harmonically bound one containing fewer. It can only be preferred under a particular ranking. Since the larger candidate necessarily violates the constraints under discussion more than the smaller, the violations of the larger cannot be a proper subset of the violations of the smaller.

The choice of less economical structures over more economical alternatives is contingent: it holds for some kinds of phrases under particular rankings. The choice of economical structures over less economical alternatives is general: it holds for all kinds of phrases under all rankings of the responsible constraints, i.e. for all grammars. Economy of structure is entailed.
References

Grimshaw, Jane. In prep. The size and shape of clauses: Economy of structure as harmonic bounding.


This paper is part of a larger project which has been assisted by a plethora of colleagues, whose help I am extremely grateful for. I thank Daniel Altshuler, Seunghun Lee and Alan Prince for their contributions to this particular piece of the research.

There is a knotty problem in the background here. Can the input for a single clause contain more than one specification of e.g. +dec, and if so, how does this affect the assessment of faithfulness?

That also occurs in subjunctive and relative clauses, which are not analyzed here.

There is a further one-complementizer candidate, of the form [Spec that IP], where the long adjunct is the specifier. This candidate satisfies ObSpec and has one less Complft violation than W. Nonetheless, it is not optimal because of the existence and ranking of a constraint which assesses violations of alignment at the edge of subordinate clauses: Hdlftsub. This proposal is made in Grimshaw 2006b.