Identity and Featural Correspondence: the Athapaskan Case

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0. Introduction

Correspondence Theory (McCarthy and Prince 1995) represents a departure from the Containment-based OT (Prince and Smolensky 1993, M&P1993) in its formalization of Faithfulness. In Correspondence Theory (henceforth CT) the relationship between an input and its output candidates is seen as a relation mapping each element in one string (S_1) onto an element in a second string (S_2). This mapping, according to M&P(1995), applies to segments and tones but not to features. In this paper I challenge this view of features in CT and argue, following the position assumed by Lamontagne and Rice (1995) and Lombardi (1995), that features do correspond and, like segments, are coindexed with one another. The empirical basis for the argument comes from patterns of coalescence in two Athapaskan languages, Navajo and Chipewyan. These patterns demonstrate the status of features as correspondent elements that need to be governed by Faithfulness in a manner parallel to segments.

The paper is structured as follows. First, I give a short overview of Correspondence and outline some of the differences between the Containment-based OT and CT with respect to the representation of coalescence. Then I outline the two hypotheses regarding the treatment of features in CT. Finally, I present examples of a coalescence pattern in Navajo and Chipewyan which illustrates the need for featural correspondence in Input-Output mapping.

* I wish to thank the members of the phonology project in the Department of Linguistics at the University of Toronto for their helpful comments and suggestions. Those from Keren Rice, Greg Lamontagne, Janet Grijzenhout, and Elan Dresher are particularly acknowledged. All errors, of course, are my own.

K. Kusumoto (ed.), NELS 27, 93-101

1. The Framework: Correspondence Theory

In their presentation of Correspondence Theory M&P (1995) outline some striking similarities in the constraints governing the input-output and reduplicant-base[1] relations. Based on these parallels they develop the theory of Correspondence dealing with identity relations between different forms (at the input, output, base, and reduplicant representations). In CT, the principle of *Containment* set out in Prince and Smolensky (1993) no longer holds. Containment-based OT admits no outright deletion from the input: any elements in the input are part of the output, whether they are parsed (and phonetically realized) or not. The presence of unparsed input elements represents a violation of the Faithfulness constraint PARSE, but in order for PARSE to penalize unfaithful outputs, it must be able to 'see' the unparsed material. Correspondence-based OT allows the deletion of input elements; such deletion is penalized through constraints requiring a one-to-one correspondence of input to output elements[2], and constraints requiring identity between correspondents.

The set of Correspondence constraints which are directly parallel to the PARSE family of constraints is the MAX family of constraints. The basic PARSE constraint is given in (1) and the MAX constraint formulation is given in (2).

(1) PARSE (Prince and Smolensky 1993: 85)
Underlying segments must be parsed into syllable structure.

This constraint requires that any input segment occupy a position in a syllable and therefore be phonetically realized.

(2) MAX (McCarthy and Prince 1995: 370)
Every element of s_1 has a correspondent in s_2.

This constraint says that every segment in the input is coindexed with a segment in the output. Coindexation indicates that one coindexed element corresponds to another segment with the same index and vice versa.

Both of these constraints serve to restrict phonetic forms which are missing segments contained in the input, however they differ in terms of exactly what they require of output candidates. For example, in the tableaux in (3) and (4) I demonstrate the evaluation of a pair of candidates with respect to the two different Faithfulness constraints. In each tableau, one candidate is completely faithful to the input and one candidate is not.

(3) INPUT -> /paunka/

Candidates	PARSE
☞ 1. .paunka.	
2. .paun<k>a.	*!

In the first candidate, all output segments occupy a syllable position and are therefore phonetically realized. The second candidate contains a segment which is not incorporated into a syllable. This unparsed segment (<k>) creates a PARSE violation and will not be realized phonetically.

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[1] This pair is in reference to the relationship between a reduplicating morpheme and the stem that it copies.

[2] The same constraints require a one-to-one correspondence of reduplicant-base and reduplicant-input elements.

(4) INPUT -> /p_1 a_2 u_3 n_4 k_5 a_6 /

Candidates	MAX
☞1. p_1 a_2 u_3 n_4 k_5 a_6	
2. p_1 a_2 u_3 n_4 a_6	*! (k_5)

In this tableau, the first candidate contains a correspondent for all the input segments (correspondents are coindexed) so MAX is satisfied. In the second candidate there is no correspondent for the segment k_5 in the INPUT and this violates MAX.

From these tableaux we see that MAX will penalize many of the same candidates as the Containment-based PARSE constraint. However, these constraints do diverge on certain output representations. Consider, for example, the evaluation of the additional candidates in (5) and (6). These candidates represent an output candidate in which the two input consonants n_4 and k_5 have coalesced to form a single consonant $ŋ_{4,5}$ with features of both n_4 and k_5.

(5) INPUT -> /p_1 a_2 u_3 n_4 k_5 a_6 /

Candidates	MAX
3. p_1 a_2 u_3 $ŋ_{4,5}$ a_6	

This candidate has a single output root node coindexed as the correspondent for both the fourth and fifth segments in the input. Thus both input segments have correspondents in the output, and MAX is satisfied. Whether the output correspondent bears features of both of its input correspondents is outside of the concern of MAX. The question of featural correspondence is addressed by a different set of constraints discussed in the next section.

Now consider the treatment of coalescence by PARSE.

(6) INPUT -> /p a u n k a /

Candidates	PARSE
3. p a u n <k> a \ | F	*

Representing coalescence in a Containment-based approach must be done with the spreading of features from an unparsed segment. Since the root-node itself cannot be deleted under Containment, a PARSE violation will be incurred.

The two constraints MAX and PARSE, then, are not simply notational variants of one another but instead constitute different requirements on input-output relations. Correspondence Theory differs substantially from Containment-based OT in the representations that it entails and the predictions it makes. One clear example of the differences between these two conceptions of Faithfulness is in the case of coalescence as described above: MAX will not penalize coalesced segments but PARSE will. In fact, a candidate which has coalesced two segments instead of deleting one will be preferred by MAX, and therefore coalescence will in a sense be motivated by the need to satisfy MAX. PARSE has no such preference for coalesced segments: both coalescence and failure to parse a root node amount to the same violation of PARSE. However, coalescence may be motivated in the interest of satisfying a type of PARSE constraint which is relativized to features such as PARSE(Feature). When some high-ranking constraint compels the non-parsing of a root node, coalescence provides the opportunity for the features of the unparsed root node to find a realization on a neighbouring segment, satisfying PARSE(Feature).

Thus it is an interesting consequence of the formulations of Faithfulness constraints that segmental faithfulness motivates coalescence in Correspondence Theory while featural faithfulness motivates coalescence in Containment-based OT. An obvious question arising out of this difference is whether there is any empirical difference in terms of predictions falling out of these two views. The discussion in the following sections explores this question, contrasting one view of featural faithfulness in CT which is similar to the Containment-based view of features particularily in terms of its relationship to coalescence with another view in which feature faithfulness is concieved of quite differently.

2. Features and Faithfulness

Correspondence deals with the identity relations between different forms at the input, output, base, and reduplicant representations. Correspondence is defined formally as follows:

(7)*Correspondence* (M&P 1994:3):
Given two strings S_1 and S_2, related to one another as reduplicant/base, output/input, etc. correspondence is a function f from any subset of elements of S_2 to S_1. Any element α of S_1 and any element β of S_2 are correspondents of one another if α is the image of β under correspondence; that is $\alpha = f(\beta)$.

Basically, each segment from one string is mapped onto an element of the second string and is said to correspond with that element. Such correspondence is indicated by coindexation. The hypothetical example given in (8) demonstrates the mapping relation between input and output strings.

(8) I/O Correspondence

String 1	/p_1 a_2 u_3 k_4 t_5 a_6/
	| | | | | |
String 2	[p_1 a_2 u_3 k_4 t_5 a_6]

Along with other constraints governing this mapping between strings is the MAX constraint given above in (2) ensuring that every input segment has an output correspondent. Like the MAX constraint, these correspondence constraints refer specifically to segments.There are two competing proposals for the treatment of features within the theory. The first, put forth by M&P (1995), is that features do not correspond but instead are subject to identity constraints requiring featural identity between corresponding segments. The second is that features, like segments, do enter into a correspondence relation and are coindexed with each other (Lamontagne and Rice 1995, Lombardi 1995). This view is parallel to the Containment-based view of features: sub-segmental elements are governed by Faithfulness to subsegmental elements. This proposal will therefore have similar consequences with respect to coalescence as a PARSE(feature) account.

Under the assumption that features are governed by identity and not correspondence, M&P (1995) propose the constraint IDENTITY to ensure that corresponding segments look alike. This constraint may be broken down into a set of constraints, each governing individual features as in (9).

(9) IDENT(F) (M&P 1995:370)
Correspondent segments have identical feature values for the feature F.

Under this view, features do not stand in a correspondence relation with one another. Instead, corresponding segments must be identical with respect to individual features. In (10) I demonstrate the evaluation of a candidate which contains a non-identical output correspondent.

(10) Input /p_1 a_2 u_3 n_4 k_5 a_6 /

Candidate	MAX	IDENT(F)
4. p_1 a_2 u_3 n_4 $ʔ_5$ a_6		* k_5 :$ʔ_5$

In this candidate, the fifth output element $ʔ_5$ corresponds with the input segment *t*. Since these correspondents have different place specifications, they violate IDENT(F). Notice that this candidate does not violate the constraint MAX because there is still a one-to-one mapping between input and output elements.

If we assume that features do correspond, then they are subject to a MAX constraint specific to features, as in the constraint in (11).

(11) MAX(F)
Every feature of S_1 has a correspondent in S_2.

In this view, input features are mapped onto output features and vice versa, just as in the treatment of segments. Featural identity of corresponding segments is achieved through satisfaction of featural correspondence. The following tableau gives a candidate parallel to the one in (10) evaluated in terms of featural correspondence.

(12) Input /p_1 a_2 u_3 k_4 t_5 a_6 /
            |
          dor_5

Candidate	MAX(F)
4. p_1 a_2 u_3 n_4 $ʔ_5$ a_6	*[dor]$_5$

In the input there is a feature cor_5, associated to the fifth input segment. In the output, there is no correspondent for this feature despite the fact that there is a correspondent for the input host segment. This represents a violation of MAX(F).

Thus, the same type of candidates represent violations in both treatments of features. I now turn to the discussion the empirical differences between these two proposals, particularly in view of coalescence patterns in two Athapaskan languages, Navajo and Chipewyan, and demonstrate how such patterns provide support for featural correspondence.

3. Coalescence $C_1C_2C_3 \rightarrow C_{1,2}C_{2,3}$: the case for featural correspondence

In one pattern of coalescence found in both Chipewyan and Navajo[3] we see features of the second segment in a triconsonantal cluster on both the first and third input consonants. The root node of the second consonant is not present; that is, there are only two consonants in the output. In the following four examples, the first output consonant

[3]For a complete analysis of all four patterns of coalescence in these languages, see Causley (1996).

bears the laryngeal value of the first underlying consonant and the lateral features of the second underlying consonant. The second output consonant has the laryngeal value of the second input consonant and the manner and place features of the third input consonant[4].

Chipewyan

(13)	huɬze	'you pl. hunt'
	/huh-l-se/	(cf. helze 's/he hunts'; huhtsaɣ '2dpl cries')
(14)	yɛk'ódɛnɛɬy	'he has learnt it'
	/yɛ-k'ó-dɛ-né-ɵ-l-shá/	

In (13) and (14) the underlying voiceless fricatives *h* and *ɵ* respectively, coalesce with the second underlined consonant *l* to give a voiceless lateral fricative ɬ. The *l* also coalesces with the third underlined consonants which go from the voiced fricatives *s* and *sh* to their voiced counterparts *z* and *y* .

Navajo

(15)	disooɬɣɪz	'you dpl. ducked'
	/disooh-l-xɪz/	(cf. wohcha 'you (dpl) are crying')
(16)	ʔádóɬzhééh	'you dpl are shaving yourselves'
	/ʔád-óh-l-shééh/	(cf. ʔádílzhééh 'you are shaving yourself')

In (15) the first consonant in the cluster (*h*) coalesces with *l* to give a voiceless lateral fricative ɬ, and the *l* also coalesces with the voiceless fricative *x* to give *ɣ* . In (16), the *h* coalesces with *l* to give ɬ,, and the voiceless fricative *sh* becomes *zh* in combining with the *l*. How can we account for these patterns in Correspondence Theory given the two competing view of features outlined above?

To begin with, I will outline some assumptions common to both hypotheses which will help to simplify the number of constraints, and therefore number of candidates, in the tableaux. First, I assume that the coalescence is driven by a need to simplify input clusters in the interest of satisfying a high-ranking syllable structure constraint. I omit this constraint from the tableaux that follow. Second, I assume that constraints on feature cooccurence (such as *[strident][lateral]) ultimately determine the featural make up of coalesced output segments[5]. These assumptions hold under both views of features, therefore I leave such constraints out of the tableaux.

Assuming that features do not correspond with one another means that input and output feature specifications are governed by IDENT(F) as in the tableau in (17).

[4]The third consonant in each of these clusters is the stem-initial fricative. I assume, following Rice 1994, that stem-initial fricatives such as these which show predictable voicing alternations lack a laryngeal specification underlyingly.

[5]For a detailed discussion of such constraints see Causley (1996).

(17) INPUT / $h_1 + l_2 + s_3$/

lat vc

Candidates	MAX	IDENT(F)
1. h_1 s_3	*!	
2. $ɬ_{1,2}$ $s_{2,3}$ [lat] [vc]		*C_1 → [lat] * C_3 → [vc] ...
☛3. $ɬ_{1,2}$ s_3 [lat]		*C_1 → [lat]
☛4. h_1 $s_{2,3}$ [vc]		* C_3 → [vc]

The high-ranking MAX constraint rules out the first candidate which lacks a correspondent for the second input consonant. MAX will ensure that coalescence, and not deletion, will take place in any successful candidate therefore all the remaining candidates involve coalescence. In the second candidate, both ouput consonants bear features of the second input consonant. This means that IDENT(F) is violated twice since both coalescences entail the non-identity of input-output correspondent pairs: the output correspondent of C_1 is [lateral] while the input one is not, and the output correspondent of C_3 bears the feature [voice] while its input correspondent does not. Thus, according to this tableau, the third and fourth candidates should be tied as optimal. In any case, coalescence should be minimal and restricted to a single instance per form: only in the single coalescences in the third and fourth candidates is the satisfaction of MAX achieved at a minimal cost to IDENT(F).

Despite this, the optimal candidate in reality is the second one, where double coalescence occurs. The problem with the featural identity hypothesis is that because there is no correspondence between features, there is no motivation for the preservation of features outside of the root node to which they are underlyingly associated. Preserving a feature $F\alpha$ in the output when there is no correspondent to the input $C\alpha$ will not gain anything for faithfulness since the absence of $F\alpha$ will only be penalized where $C\alpha$ has a correspondent in the output: if $F\alpha$ is not present in the output, it means that $C\alpha$ in the output will not be identical featurally to $C\alpha$ in the input. In fact, the presence of $F\alpha$ in the output without the presence of $C\alpha$ will undoubtedly cost something in terms of identity for another segment which hosts $F\alpha$ in the output while its input correspondent does not.

Now let us turn to the hypothesis that features do enter into correspondence relations. Under this view, the preservation of features is motivated by the need to satisfy MAX(F), which requires that an input feature have an output correspondent, regardless of whether or not its input host root node has a correspondent in the output. In (18), I give the evaluation of the same candidate set from (17), only this time the candidates are evaluated with respect to MAX(F).

(18) INPUT /h$_1$ + l$_2$ + s$_3$/
∧
lat$_2$ vc$_2$

Candidates	MAX	MAX(F)
1. h$_1$ s$_3$	*!	* ([lat]$_2$) * ([vc]$_2$)
☞2. ɬ$_{1,2}$ s$_{2,3}$ | | [lat]$_2$ [vc]$_2$		
3. ɬ$_{1,2}$ s$_3$ | [lat]$_2$		*! ([vc]$_2$)
4. h$_1$ s$_{2,3}$ | [vc]$_2$		*! ([lat]$_2$)

The first candidate lacks a correspondent for the second input consonant altogether and so is ruled out by MAX. The third candidate lacks a correspondent for the feature [voice]$_2$ and the fourth a correspondent for the feature [lateral]$_2$ and so these candidates represent worse candidates than the second, which has a correspondent for both of these features.

MAX(F) therefore serves to select the correct output candidate on the basis of faithfulness to input features. This constraint does not exist in a view which does not assume featural correspondence, therefore such a view cannot account for double coalescence patterns.

5. Conclusion

In this paper I have shown that features in CT must be treated in a fashion parallel to segments. Features cannot be governed simply by a constraint such as IDENT(F) requiring the identical featural specification of a corresponding pair of segments. I have presented compelling evidence in favour of viewing features as elements which bear their own index and correspond with each other. The argument comes from coalescence patterns in Navajo and Chipewyan, situations where it appears that features have a status independent of the root node to which they are associated in the input. In this discussion I demonstrate that the best way to motivate the preservation of input features in the output is to assume featural correspondence and therefore a constraint requiring the presence of output correspondents for input features. An account of these coalescence patterns, on the other hand, is not available under a featural identity hypothesis.

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