Opaque Intervention in Khalkha Mongolian Vowel Harmony: A Contrastive Account*

Ross Godfrey
University of Toronto

SUMMARY

Nevins's (2010) theory of vowel harmony, while not in principle opposed to the Contrastivist Hypothesis of Hall (2007) and Dresher (2009), nevertheless analyzes vowel harmony in certain languages as involving non-contrastive features. In this paper it will be shown that Nevins's analysis of opaque intervention in Khalkha Mongolian vowel harmony, which allows non-contrastive features to play a pivotal role, makes an incorrect prediction. A reanalysis involving only contrastive features will be proposed, with some key alterations made to Nevins's basic theory.

RÉSUMÉ

La théorie de l'harmonie vocalique proposée par Nevins (2010), bien que non complètement opposée à la théorie contrastiviste de Hall (2007) et Dresher (2009), analyse tout de même l'harmonie vocalique observée dans certaines langues comme étant un processus impliquant des traits non contrastifs. Cet article montre que cette analyse de l'opacité de l'harmonie vocalique en mongol khalkha, soit que les traits contrastifs sont au centre du phénomène, fait une prédiction incorrecte. Une réanalyse qui ne contient que des traits contrastifs est ici proposée, incluant des suggestions de modifications à la théorie de Nevins.

1 INTRODUCTION

The Contrastivist Hypothesis (Dresher, 2009, 2011) says that "the phonological component of a language L operates only on those features which are necessary to distinguish the phonemes of

* Thanks to audiences at Phonology at the 21st Century: In Honour of Glyne Piggott and at the University of Toronto for comments. To obtain a copy of Godfrey 2010, the unpublished manuscript from which this paper is based, contact the author at ross.godfrey@utoronto.ca.

McGill Working Papers in Linguistics, Volume 22.1,Winter 2012

L from one another" (originally from Hall (2007)). To determine what features these may be, one can observe what phonological processes there are in a language, and what features would be necessary to account for those. Once these features are determined, they can be organized into a hierarchy using Dresher's Successive Division Algorithm. The order of the hierarchy determines which segments are specified for which features.

This method of determining contrast can account for many instances of vowel harmony, especially those involving transparent vowels: vowels that are transparent in vowel harmony are simply not contrastive for the feature being sought. However, the Contrastivist Hypothesis and the contrastive hierarchy can have a more difficult time accounting for opaque interveners, which participate in harmony only to the extent that they block it, without giving or receiving the feature sought.

There are two ways one could conceivably explain opaque intervention within the Contrastivist Hypothesis. One way is to say that opaque interveners are indeed contrastive for the requisite feature, but, due to some additional requirements, cannot properly act as a source, causing harmony to fail instead. This is similar to the view taken by Nevins (2010), though he is not himself a proponent of the Contrastivist Hypothesis.

The other explanation would be to say that opaque interveners are not contrastive for the requisite feature, and that the vowel blocks harmony for other reasons. Perhaps some instances of harmony are firmly local, and cannot look past any intervening vowel, no matter what features that vowel has. Nevins shies away from this view, believing that locality is never calculated in this absolute way. I argue that, while the former explanation may indeed be correct for some languages, the latter explanation is required for Khalkha Mongolian.

This paper focuses on Khalkha because it has both opaque and transparent intervention in the same system; it is therefore a good 'test' language for any theory that hopes to deal with both. For an extension of the analysis proposed here that makes reference to other languages that have opaque intervention and parasitic harmony, and even some that do not, see Godfrey (2010), on which this paper is based. The analysis proposed here and in Godfrey (2010) is based heavily on Nevins (2010), but I alter and refine his system in such a way that it becomes more compatible with the Contrastivist Hypothesis and the theory of the contrastive hierarchy.

My goal by the end of this paper is to convince the reader that, with a few alterations made to the search mechanism, opaque interveners (in Khalkha Mongolian and otherwise) no longer pose such a problem for the Contrastivist Hypothesis, and that the CH is, as a result, quite compatible with Nevins's theory of vowel harmony.

2 A DESCRIPTION OF KHALKHA MONGOLIAN VOWEL HARMONY

In non-initial syllables, Khalkha Mongolian has only three underlying vowels: /i/, /U/, and /E/. The archiphonemes /U/ and /E/ have missing features that are filled in through vowel harmony. /U/ can become either /u/ or /ʊ/, while /E/ can become /e/, /a/, /o/, or /ɔ/. The former undergoes just [ATR] harmony, while the latter undergoes both [ATR] and [round] harmony. These two processes are shown in (1) and (2) (data here and henceforth is from Svantesson et al. (2005)).

(1) *[ATR] harmony in Khalkha*

a.	/xeːɮ-Uɮ/	xeːɮ-uɮ	‘decorate-CAUS’
b.	/saːtʰ-Uɮ/	saːrʰ-ʊɮ	‘be delayed-CAUS’

(2) *[round] and [ATR] harmony in Khalkha*

a.	/xəːɮ-ɮE/	xəːɮ-ɮe	‘decorate-DPST’
b.	/saːtʰ-ɮE/	saːtʰ-ɮa	‘be delayed-DPST’
c.	/oɡ-ɮE/	oɡ-ɮo	‘give-DPST’
d.	/cʰɔːr-ɮE/	cʰɔːr-ɮɔ	‘be pierced-DPST’

The phoneme /i/, which is the only vowel phoneme that can be underlyingly fully specified in non-initial vowels, is transparent to both harmony processes. That is, /i/ cannot be a trigger (or, in Nevins’s (2010) terminology, a ‘source’) for harmony, but neither does it block harmony. This is shown in (3).

(3) */i/ is transparent to harmony*

/poːr-iɡ-E/	poːr-iɡ-o	*poːr-iɡ-e	‘kidney-ACC-RFL’

The phonemes /u/ and /ʊ/, meanwhile, are *opaque* in [round] (but not in [ATR]) harmony. This means that these segments, like /i/, cannot be triggers for [round] harmony, but they *do* block [round] harmony. Examples are shown in (4).

(4) */u/ and /ʊ/ block [round] harmony*

/ɔr-ʊɮ-ɮE/	ɔr-ʊɮ-ɮa	*ɔr-ʊɮ-ɮɔ	‘enter-CAUS-DPST’

Khalkha Mongolian presents a challenge for theories of vowel harmony for the following reasons. First, because the language displays both transparent and opaque intervention, any theory that hopes to adequately account for the data must be able to handle both kinds of intervention. Second, because opaque segments are only opaque for one of two harmony processes in the language, the theory cannot simply stipulate on a vowel-by-vowel basis which interveners will be transparent and which will be opaque.

3 NEVINS’S (2010) ACCOUNT

In Nevins (2010), vowel harmony is conceptualized as involving not a ‘trigger’ of vowel harmony that spreads its features to a ‘target’; instead, a ‘needy’ vowel, underspecified for certain contrastive features, must search for these features from a preceding or following segment. The search is governed by relativized locality; if search is specified to proceed leftward, then search looks in that direction for the closest instance of the feature for which it is looking. The segment which has the desired feature is called the ‘donor’. An illustration is shown below.

(5) *Vowel harmony as 'search and copy'*

a.	C	V	C	V	-	C	V
		[+F]		[–F]			[+F]
		[–G]		[+G]			**[?G]**
b.	C	V	C	V	-	C	V
		[+F]		[–F]			[+F]
		[–G]		**[+G]**			**[+G]**

In (5a), the vowel of the -CV suffix is underlyingly unspecified for the feature [G]. Thus, it searches leftward for the nearest instance of [G]; once found, that value of [G] is copied onto the suffix vowel, as shown in (5b)[1].

Central to Nevins's theory is that segments with the relevant feature (that is, the feature being searched for) can never be skipped. Thus, he predicts that the following type of vowel harmony never occurs.

(6) *Vowel harmony must obey relativized locality*

a.	C	V	C	V	-	C	V
		[+F]		[–F]			[+F]
		[–G]		[+G]			**[?G]**
b.	C	V	C	V	-	C	V
		[+F]		[–F]			[+F]
		[–G]		[+G]			**[–G]**

Transparent segments are accounted for by assuming that search can in some cases look for only contrastive instances of a particular feature (or only *marked* instances), rather than all instances. Thus, if a segment needs an [ATR] feature, search could be parametrized so that only contrastive instances of [±ATR] are looked for; if a segment does not have [±ATR] contrastively, then it will be skipped in search. This is shown below with regards to transparent /i/ in Khalkha [ATR] harmony, where search is parametrized to look for only contrastive instances of [ATR]. Because /i/ is not *contrastively* [+ATR], it cannot be a donor in [ATR] harmony. Redundant (non-contrastive) instances of [ATR] are italicized below[2].

[1] Search could also proceed rightwards; direction of search varies on a language-by-language basis.

[2] Unmarked instances of [round] are italicized as well; the importance of this will be discussed in 3.2.

(7) *Search can be parametrized to look only for contrastive features*

a.	p	oː	r	-	i	ɡ	-	E
		[–high]			[+high]			[–high]
		[+round]			*[–round]*			[?round]
		[+ATR]			*[+ATR]*			[?ATR]
b.	p	oː	r	-	i	ɡ	-	o
		[–high]			[+high]			[–high]
		[+round]			*[–round]*			[+round]
		[+ATR]			*[+ATR]*			**[+ATR]**

Nevins accounts for opaque segments by assuming that they are visible in the search-and-copy process, but are missing some extra feature that would make them licit sources for copying. Thus, when the search process encounters such a segment, search 'fails' and a default value for the feature being sought is inserted.

Nevins characterizes Khakha [round] harmony as parasitic on height: the suffix /-E/ searches leftward for a marked value of [round], but if one is found on a segment that does not match the suffix for the feature [high] (/u, ʊ/), search will fail. This is shown below.

(8) *Donors in Khalkha [round] harmony cannot be high vowels*

a.	ɔ	r	-	ʊ	ɮ	-	ɮ	E
	[–high]			[+high]				[–high]
	[+round]			[+round]				[?round]
	[–ATR]			[–ATR]				[?ATR]
b.	ɔ	r	-	ʊ	ɮ	-	ɮ	E
	[–high]			[+high]				[–high]
	[+round]			**[+round]**				**[?round]**
	[–ATR]			[–ATR]				[–ATR]
c.	ɔ	r	-	ʊ	ɮ	-	ɮ	E
	[–high]			[+high]				[–high]
	[+round]			**[+round]**				**[–round]**
	[–ATR]			[–ATR]				[–ATR]

In (8b), a marked instance of [round] is found, but cannot be copied from, since the marked instance of [round] is found on a high vowel. Thus, as seen in (8c), a default value of [–round] must be inserted for the suffix vowel, even though the nearest (and second-nearest) instance of [round] is [+round].

It is important to note that, under Nevins's analysis, a segment does not have to have a contrastive [round] feature in order to be visible for [round] harmony. All that is necessary for a segment to be visible is for the segment to be [+round], regardless of whether it is contrastively or redundantly so.

4 A CONTRASTIVIST REANALYSIS

In this section, it will be shown that, given certain alterations to the search mechanism, a Nevins-style approach to vowel harmony can indeed account for the Khalkha data by computing only contrastive features. One may ask whether this is a worthwhile endeavour; after all, refining the search mechanism to be more friendly to the Contrastivist Hypothesis does not argue against Nevins's original account in any way. Hence, it will also be shown that Nevins's account *needs* some refining, since it does not always make the correct predictions.

4.1 AN INCORRECT PREDICTION

Nevins does not explicitly state which considerations lead him to the conclusion that /u/ and /ʊ/ are not contrastive for [round] in Khalkha, but knowledge of his method for determining contrast (the Minimal Difference method, criticized in Dresher (2009, 2011)) allows us to reconstruct his reasoning. Nevins presents the vowel inventory of Khalkha as follows.

(9) *Khalkha Mongolian vowel inventory*:

[–back, –round]	[+back, +round]	
i	u	[+high, +ATR]
	ʊ	[+high, –ATR]
e	o	[–high, +ATR]
a	ɔ	[–high, –ATR]

Presumably, /u/ and /ʊ/ are not contrastive for [round] because [back] and [round] always share a value; that is, whatever a segment's specification for [round], it will always have the same specification for [back]. Thus, it is not only the case that /u/ and /ʊ/ are not contrastive for [round] – indeed, no segment is (at least not by this method of determining contrast).

If [round] harmony in Khalkha looks only for marked instances of [round], then, we should expect not only /i/ to be transparent in [round] harmony, but /e/ and /a/ to be transparent as well[3]. This prediction is somewhat hard to test, since /e/ and /a/ cannot be fully specified in non-initial syllables; underlyingly, there would be only the archiphoneme /E/, which can become one of /e/, /a/, /o/, or /ɔ/, depending on preceding sources of [ATR] and [round]. If vowel harmony is cyclic (that is, a suffix searches for a value only after all stem vowels in non-initial syllables have searched for their vowels), then we would not expect to see a form such as the following:

(10) *An unlikely test case*:
mor-t^{h}e-gE

It would be unfortunate if such a test case did not exist, since it is exactly the kind of scenario required to determine whether /e/ is truly transparent[4]. However, due to other phonological processes

[3] A 'marked' value of [round] is taken simply to be [+round]. Nevins does speak elsewhere (2010, p. 100) about the role of contextual markedness, in which [+round] is marked only for front and non-high vowels, but evidently markedness of [round] in Khalkha is taken to be context-free.

[4] Note that if a suffix with the vowel /E/ attaches to a monosyllabic stem in which the vowel is underlyingly /e/ (allowed in initial syllables), this is not sufficient to tell us whether /e/ is transparent to [round] harmony, since the result will be

in the language, such a case actually can be found, and is seen in Svantesson et al. (2005).

Khalkha has the diphthong /Ei/, in which the first segment is determined, as usual, through vowel harmony. However, phonemic /ei/, /ai/, /oi/, and /ɔi/ do not map straightforwardly to surface forms. Specifically, the diphthong /oi/ actually surfaces as [e]. Because vowel harmony is cyclic, it is this *e* that is present when the next suffix undergoes harmony. Thus, if /e/ is transparent to vowel harmony, we would expect to see the following[5].

(11) *An ungrammatical derivation*:
mor-t^{h}Ei-gE ⟶ mor-t^{h}oi-gE ⟶ mor-t^{h}e-gE ⟶ *mor-t^{h}e-go

In the actual attested form, however, one can see that /e/ is not transparent at all.

(12) *A grammatical derivation; /e/ is a licit source of [–round]*:
mor-t^{h}Ei-gE ⟶ mor-t^{h}oi-gE ⟶ mor-t^{h}e-gE ⟶ mor-t^{h}e-ge 'way-COM-RFL'

Thus, it cannot be the case that [round] harmony in Khalkha looks only for marked values of [round], since it must be able to see /e/ (and, presumably, /a/).

4.2 PROBLEMS FOR A CONTRASTIVIST APPROACH

If an approach compliant with the Contrastivist Hypothesis is to fare any better, it must be shown that all vowels except /i/ are contrastive for both [ATR] and [round] (recall that /i/, unlike /e/, is truly transparent in [round] harmony); this would be done by means of the Successive Division Algorithm (Dresher, 2009). Unfortunately, with the featural specifications that we have been assuming thus far, this is impossible to do. If we assume that only the features [ATR], [high], and [round] are relevant (that is, we assume that these are the first three features chosen in the Successive Division Algorithm), then /i/ must be specified for at least two of these features. This is because none of these features is singly sufficient for distinguishing /i/ from the other vowel phonemes of Khalkha.

There are thus two possible ways in which a Contrastivist analysis could find success. It could be the case that the search mechanism needs to be parametrized in such a way that even segments without the required feature are visible in search[6]. That is, it could be the case that some languages with [round] harmony simply search in one direction for the nearest vowel, with search failing if that vowel does not have a contrastive [round] feature to copy. The other possibility is that the featural

the same either way. Either /e/ is not transparent and will be a licit source of [–round] (since it matches the suffix vowel in height), or /e/ is transparent and a default value of [–round] will be inserted.

[5] One could deny that vowel harmony is cyclic in Khalkha and say instead that the suffix should be receiving its value of [round] from the /o/ that exists in the intermediate form only. But this would also predict the incorrect result mor-t^{h}ɔ-go.

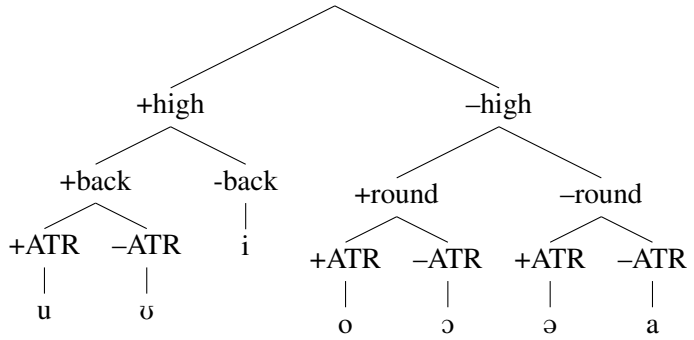
[6] This possibility is rejected by Nevins; see Godfrey (2010), however, for further demonstration that it is necessary in many cases if one has Contrastivist assumptions. Admittedly, the question may boil down to which principle one feels to be more worthy of preservation in the theory: relativized locality or contrast. If the former is deemed more important, then one might be more inclined to allow non-contrastive features the option of playing a role in vowel harmony. If the latter is deemed more important, then one might be more inclined to allow non-relativized (i.e. strict) locality the option of playing a role in vowel harmony. This admission does not detract from the main purpose of this paper, which is to show that one can hold to Contrastivist assumptions in dealing with languages with opaque intervention in vowel harmony such as Khalkha, and to show that Nevins's account, which allows non-contrastive features to play a role, is inadequate.

specifications given earlier are incorrect; that is, a reanalysis might show that there is in fact a single feature that can distinguish /i/ from every other vowel in Khalkha Mongolian. While only one possibility is necessary to give an adequate account of Khalkha vowel harmony from a Contrastivist perspective, I will argue that both kinds of reanalysis are necessary. This is more for conceptual than empirical reasons; the best account from a Contrastivist perspective will be one in which the archiphonemes found underlyingly correspond exactly with nodes on a contrastive hierarchy.

4.3 FEATURAL REANALYSIS

Using the Successive Division Algorithm of Dresher (2009), one could imagine the following contrastive hierarchy for vowels in Khalkha Mongolian.

(13) *Contrastive hierarchy: [high] > [back] > [round] > [ATR]*



The first division is [high], which separates /u, ʊ, i/ from /o, ɔ, ə, a/. Next is [back], which I will argue is only contrastive among the high vowels. Next is [round], which is only contrastive among the non-high vowels, [back] having already served to distinguish /u, ʊ/ from /i/. The final division necessary to give each vowel phoneme of Khalkha a unique feature specification is [ATR].

In the feature specifications given by Nevins (see (9)), /e, a/ were considered [–back] vowels. But this may not be the correct choice. Consider, for instance, the vowel /a/. It is curious that Nevins (following Svantesson (1985)) labels this a [–back] vowel, since the symbol normally refers to a [+back] vowel. Furthermore, Dresher and Zhang (2005) refer to its [+ATR] counterpart as /ə/, noting that "[t]he formant frequencies for this vowel given by (Svantesson, 1985, pg. 290-293) are at least as consistent with [ə] as with [e]" (pg. 68, n.19)[7]. Therefore, the pair of vowels /a/ and /e/ (henceforth /ə/) may in fact not be front vowels after all. It may then be the case that all non-high vowels in Khalkha are back or central vowels, which means that the feature [back] would make no distinctions among these vowels.

Is there any evidence, however, that [back] plays an active role in the phonology of the language? Indeed, it seems that [–back] does. The epenthetic consonant /g/ surfaces as uvular /ɢ/ if the

[7] It now becomes questionable whether it is quite proper to use the symbol ə to refer to a [+ATR] vowel. What is important for the purposes of this discussion is simply that the vowel in question could conceivably be [+back].

preceding vowel is [–ATR], except if the following vowel is /i/, as shown in (14)[8].

(14) *Preceding [–ATR] and following [–back] can affect epenthetic /g/*

a.	/xuː-gər/	⟶	xuːgər	
b.	/sana-gar/	⟶	sana-ɢar	(due to preceding [–ATR] vowel)
c.	/sana-gin/	⟶	sana-gin	(due to following [–back] vowel, despite preceding [–ATR] vowel)

Thus it seems that there is justification for including [back] as a feature in addition to [round], and it seems conceivable that vowels might not necessarily have the same values for the features [back] and [round]; /ə/ and /a/ could actually be [+back, -round] vowels, contra the analysis given by Nevins.

Returning to the hierarchy given in (13), it should be noted that underlying vowel specifications in non-initial syllables correspond exactly to certain nodes on the hierarchy. For instance, the archiphoneme /U/ corresponds to the node above /u, ʊ/, while the archiphoneme /E/ corresponds to the node that encompasses all of /e, a, o, ɔ/.

4.4 ALTERING THE SEARCH MECHANISM

In Nevins's account, search is parametrized in the following way. Khalkha [ATR] harmony is relativized only to contrastive instances of [ATR]; Khalkha [round] harmony is relativized to marked instances of [round], with an orthogonal requirement that the donor be [–high]. In my analysis, [ATR] harmony in Khalkha is subject to the same relativization, but [round] harmony searches not for [round], but for vowels in general. If the first vowel found has a contrastive value for [round], then that value will be copied; if the vowel does not have a contrastive value for [round], then search terminates and the default [–round] is chosen. As previously mentioned, this kind of parametrization is not allowed by Nevins, but it does not deviate too much from the kinds of parameters that are endorsed by Nevins – the key difference is that it allows the feature being copied to be different from the feature being searched for.

The revamped algorithm for [round] harmony is shown in (15)[9].

[8] Nevins (2009) suggests that it is actually the [ATR] quality of the following vowel that determines whether the epenthetic consonant surfaces as ɡ or ɢ, and that the redundant [+ATR] specification of a following i is responsible for epenthetic ɡ surfacing as a velar in (14c). This analysis, however, may make an incorrect prediction. As discussed by Svantesson et al. (2005), the dorsal fricatives [x] and [χ] are restricted in their distribution, with [x] occurring in [+ATR] words and [χ] occurring in [–ATR] words. However, unlike with epenthetic /g/, a following /i/ does not force what would otherwise be uvular fricatives to surface as velar, as shown in (i). The key example is (b) below; velar [x] must surface, even though it is followed by *i*.

Following /i/ does not count as [+ATR] context for dorsal fricatives

a.	su[x]-ig		'axe-ACC'
b.	a[χ]-ig	*a[x]-ig	'elder brother-ACC'

This is easily accounted for if we assume that two assimilatory processes are involved in the case of epenthetic /g/ - one that looks leftward for an [ATR] feature and one triggered by a following [–back] vowel - while only one assimilatory process is involved in the case of dorsal fricatives, with [–back] playing no role.

[9] It can be noted that, in this view, the 'parasitic' nature of Khalkha [round] harmony is not encoded in the grammar itself (that is, it is not explicitly stated that search shall terminate if the source does not match the needy vowel in height). The

(15) *A revised algorithm for Khalkha [round] harmony*

a. Step 1: A Khalkha vowel needing a value for [round] searches leftward for *any vowel*.
b. Step 2: Once found, it copies that vowel's contrastive [round] feature, if existent.
c. Step 3: If that vowel does not have a contrastive [round] feature, search terminates in failure, and default [–round] is inserted.

4.5 ORDERED SEARCH

The other ingredient that is necessary for this analysis to work is a restriction on the order in which the missing features of the archiphoneme are filled. A key aspect of the proposal advanced here (but not in Nevins) is that after one feature is copied, search proceeds *from where it left off*. Consider the following demonstration, where [ATR] harmony takes place before [round] harmony. The bullet-point demonstrates the current position of search; the underline indicates the starting point.

(16) *[round] harmony proceeds where [ATR] harmony leaves off*

a.	p	o:	r	-	i	-	g	E
		[–high]			[+high]			[–high]
		[+round]			[–back]			[?round]
		[+ATR]						[?ATR]
b.	p	o: •	r	-	i	-	g	E
		[–high]			[+high]			[–high]
		[+round]			[–back]			[?round]
		[+ATR]						**[+ATR]**
c.	p	**o: •**	r	-	i	-	g	**o**
		[–high]			[+high]			[–high]
		[+round]			[–back]			**[+round]**
		[+ATR]						[+ATR]

In (16b), [ATR] harmony proceeds first, and looks leftward for the nearest contrastive [ATR] feature. Once found the value is copied. In (16c), [round] harmony begins where [ATR] harmony left off, and looks (if necessary) in the same direction for the nearest vowel. Since the search has already started off at a vowel, then search does not even need to proceed leftwards at all, since a potential source has already been found. Because this source has a contrastive [round] feature, the value of this feature is copied.

In this system, the search-and-copy mechanism will always attempt to copy a value for [round] from the same vowel that [ATR] was copied from, for the following reasons. First, because 'back-tracking' is not permitted, search cannot look for [round] on vowels which were already skipped in [ATR] harmony. Second, because [round] harmony simply looks for any vowel, there is no need for search to proceed further leftward; it is already 'at' a vowel.

parasitic nature of Khalkha [round] harmony instead falls out from independent reasons; because the non-high vowels are the only vowels that are contrastive for [round], they will be the only licit sources.

Compare this to a system in which [round] harmony, like [ATR] harmony, searches leftward beginning from the suffix vowel.

(17) *[round] harmony does not proceed from where [ATR] harmony leaves off*

a.	p	o:	r	-	i	-	g	E̲
		[–high]			[+high]			[–high]
		[+round]			[–back]			[?round]
		[+ATR]						[?ATR]
b.	p	o: •	r	-	i	-	g	E̲
		[–high]			[+high]			[–high]
		[+round]			[–back]			[?round]
		[+ATR]						**[+ATR]**
c.	p	o:	r	-	i	-	g	E̲
		[–high]			[+high]			[–high]
		[+round]			[–back]			[?round]
		[+ATR]						[+ATR]
d.	p	o:	r	-	**i •**	-	g	**E̲**
		[–high]			[+high]			[–high]
		[+round]			[–back]			[?round]
		[+ATR]						[+ATR]
e.	p	o:	r	-	**i •**	-	g	ə̲
		[–high]			[+high]			[–high]
		[+round]			[–back]			**[–round]**
		[+ATR]						[+ATR]

In this system, a different prediction is made. At (17c), search begins again from the starting point, and the nearest vowel is /i/. Because this vowel is not contrastive for [round], default [–round] is inserted.

If [round] harmony, parametrized to search for all vowels, proceeds from where [ATR] harmony leaves off, then we can explain why /i/ is transparent for [round] harmony. Because /i/ is transparent in [ATR] harmony (by virtue of not having a contrastive [ATR] feature), it will always be skipped in the first search (which is for contrastive [ATR] features). Next, because of the principle of 'no backtracking', the second search (which is for any vowel, and either copies a contrastive [round] feature or fails, inserting default [–round]) will always begin at a vowel other than /i/. This search never needs to proceed further leftward, since it can always attempt to copy [round] (whether it succeeds or not) from the vowel from which it copied [ATR].

This principle, along with the others discussed so far, is illustrated with Khalkha examples in the next section.

4.6 SUMMARY AND DEMONSTRATION

Khalkha vowel harmony can be described as follows.

(18) *Summary of Khalkha vowel harmony*

a. *Underlying vowels*
   (i) Vowels in non-initial syllables can be underlyingly /i/, /U/, or /E/.
   (ii) The segment /i/ is specified for [+high, -back], which is enough to differentiate it from every other segment.
   (iii) The archiphoneme /U/ is specified for [+high, +back], and needs a value for [ATR] to be fully contrastively specified (since [+high, +back] could be either /u/ or /ʊ/).
   (iv) The archiphoneme /E/ is specified only for [–high]; it needs values for [round] and [ATR] to be fully specified.

b. *[ATR] harmony*
   Proceeds leftward and looks for the nearest contrastive instance of [ATR]. Once found, the value is copied. If none is found, default [+ATR] is inserted.

c. *[round] harmony*
   Only if necessary. Occurs after [ATR] harmony. Begins from where [ATR] harmony left off, and looks for the nearest vowel. (In practice, this will always be the vowel from which [ATR] was copied.) If this vowel has a contrastive [round] feature, it is copied. If not, default [–round] is inserted.

Examples are shown below. See also (16) for an additional demonstration.

(19) *Example I*

a.	ɔ	r	-	ʊ	ɮ	-	ɮ	E̲
	[–high]			[+high]				[–high]
	[+round]			[+back]				[?round]
	[–ATR]			[–ATR]				[?ATR]
b.	ɔ	r	-	ʊ •	ɮ	-	ɮ	E̲
	[–high]			[+high]				[–high]
	[+round]			[+back]				[?round]
	[–ATR]			**[–ATR]**				**[–ATR]**
c.	ɔ	r	-	**ʊ •**	ɮ	-	ɮ	**a̲**
	[–high]			[+high]				[–high]
	[+round]			[+back]				**[–round]**
	[–ATR]			[–ATR]				[–ATR]

In (19), default [–round] is inserted as the vowel that the search mechanism is attempting to copy [round] from does not have a contrastive [round] feature.

(20) *Example II (from underlying mor-t^hEi-E)*

a.	m	o	r	-	t^h	ə	-	g	E̲
		[–high]				[–high]			[–high]
		[+round]				[–round]			[?round]
		[+ATR]				[+ATR]			[?ATR]
b.	m	o	r	-	t^h	ə •	-	g	E̲
		[–high]				[–high]			[–high]
		[+round]				[–round]			[?round]
		[+ATR]				**[+ATR]**			**[+ATR]**
c.	m	o	r	-	t^h	**ə •**	-	g	ə̲
		[–high]				[+high]			[–high]
		[+round]				**[–round]**			**[–round]**
		[+ATR]				[+ATR]			[+ATR]

5 CONCLUSION

This paper has discussed vowel harmony in only one language; I have merely shown that, if one allows additional sorts of parametrization in Nevins's search-and-copy approach to vowel harmony, and if one assumes different featural specifications for vowels in Khalkha, then an analysis of Khalkha vowel harmony that conforms to Contrastivist assumptions can be found. In Godfrey (2010), the revisions to the search-and-copy system discussed here are extended to other languages, which as a result can also be made to conform to Contrastivist expectations. Importantly, however, the analysis proposed here can account for cases such as *mor-t^hə-gə*, in which the ə of the first suffix can be clearly seen to be non-transparent.

REFERENCES

Dresher, B. E. (2009). *The Contrastive Hierarchy in Phonology*. Cambridge University Press.

Dresher, B. E. (2011). Is Harmony Limited to Contrastive Features? Paper presented at the Montreal-Ottawa-Toronto Phonology Workshop (Phonology in the 21st Century: In Honour of Glyne Piggott.

Dresher, B. E. and Zhang, X. (2005). Contrast and phonological activity in Manchu vowel systems. *Canadian Journal of Linguistics*.

Godfrey, R. (2010). Opaque Intervention in Vowel Harmony. Unpublished course paper.

Hall, D. (2007). *The role and representation of contrast in phonological theory*. PhD thesis, University of Toronto.

Nevins, A. (2009). Review of the Phonology of Mongolian by J.O. Svantesson et al. *Phonology*, 26.

Nevins, A. (2010). *Locality in Vowel Harmony*. MIT Press.

Svantesson, J. (1985). Vowel Harmony Shift in Mongolian. *Lingua*, 67.

Svantesson, J., Tsendina, A., Karlsson, A., and Franzén, V. (2005). *The Phonology of Mongolian*. Oxford University Press.