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ROUND LICENSING, HARMONY, AND BISYLLABIC TRIGGERS  
IN ALTAIC\*

**ABSTRACT.** Many Altaic languages restrict round vowel distribution. This paper examines round harmony in Classical Manchu and Oroqen, where round spreading occurs only when the first two syllables of a word are round, that is, it requires a bisyllabic trigger (Zhang 1996). It is argued that the binary threshold emerges from conflict between well-established phonological demands – numeric reference is neither necessary nor desirable. The study isolates two distinct restrictions on rounding in bisyllabic trigger languages: initial round licensing and round spreading – requirements occurring independently in Classical Mongolian and Ulcha. Separating these restrictions is key: each is active in languages with bisyllabic triggers, but they are ranked asymmetrically with respect to a conflicting constraint that restricts features to a tautosyllabic domain. Ranking the tautosyllabic constraint between round licensing and spreading prevents cross-syllable spreading except when violations of tautosyllabicity are independently necessitated by round licensing. As a result, spreading is initiated only when the first two syllables are round. Implications are identified for the characterization of faithfulness. Positional faithfulness constraints play a key role in realizing the privileged status of the root-initial syllable in round licensing and harmony. In addition, the analysis supports the separation of IDENT(F) into IO and OI constraints, which distinguish between the loss and gain of privative feature specifications, respectively. The distinction proves essential in the case of bisyllabic triggers. The constraint interaction that produces the two-syllable trigger threshold is an instance of a general phenomenon explored here, termed *Parasitic Constraint Satisfaction*. This kind of interaction arises when there are two constraints or constraint sets,  $\alpha$  and  $\beta$ , whose satisfaction each necessitates violating a constraint,  $\gamma$ , and they are ranked  $\alpha \gg \gamma \gg \beta$ . When satisfaction of  $\alpha$  compels violations of  $\gamma$  that also permit satisfaction of  $\beta$ , then  $\beta$  is described as parasitic on  $\alpha$ . Two outcomes for Parasitic Constraint Satisfaction are discussed. The first is an emergence of the unmarked, occurring when  $\beta$  is a markedness constraint whose activity emerges in contexts where it is parasitic on  $\alpha$ . The second outcome, where  $\beta$  is a faithfulness constraint, is an emergence of the faithful.

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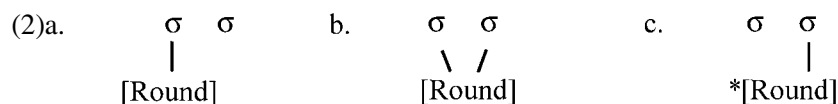
## 1. INTRODUCTION

Within the Altaic family, restrictions on the distribution of round vowels are pervasive. In this paper, I explore the relation between three nonhigh round vowel patterns in Altaic. At the core is a study of round harmony in Classical Manchu (CMA) and Oroqen (Tungus branch of Altaic), which presents an interesting complication to the usual pattern of Tungusic harmony. These languages require round vowels in the first two syllables of a word in order to initiate round spreading, that is, the structure that initiates round harmony – the *trigger* – must be minimally bisyllabic in size (Zhang 1996; Zhang and Drescher 1996). This contrasts with the more familiar condition under which a round vowel in the first syllable is sufficient alone to trigger spreading. The distinction is represented schematically in (1). In the familiar or *canonical* Tungusic round harmony, [Round] linked to the first syllable spreads to succeeding syllables (1a). In the *bisyllabic trigger* case, [Round] does not spread if it is linked only to the first syllable (1bi), but spreading occurs if it has pre-existing affiliations with both of the first two syllables (1bii).

- (1)a. Canonical round harmony  
 (i)  $\sigma \quad \sigma \quad \sigma \quad \sigma$   
       |   · · · ·  
       [Round]
- b. Bisyllabic trigger round harmony  
 (i)  $\sigma \quad \sigma \quad \sigma \quad \sigma$                    (ii)  $\sigma \quad \sigma \quad \sigma \quad \sigma$   
       |    \ / · · · ·  
       [Round]                                        [Round]

Central to this investigation is understanding what underlies the two-syllable requirement – stating this as a minimal size condition on triggers simply expresses a descriptive generalization. Here, I argue that the bisyllabic threshold is produced through the interaction of well-established and conflicting phonological demands, formalized in Optimality Theory (OT) as ranked, violable constraints (Prince and Smolensky 1993). Insight is drawn from comparing simpler but related round vowel restrictions. This study identifies two distinct requirements on rounding in bisyllabic trigger languages: (i) *initial round licensing*, where [Round] must be linked to the initial syllable, and (ii) *round spreading*. These conditions occur independently in other Altaic languages. Licensing alone is active in Classical Mongolian (CMO) (Mongolian branch of Altaic), and spreading from the

first syllable occurs in Ulcha, which displays canonical Tungusic round harmony. The rounding distributions sanctioned by initial licensing are illustrated in (2). The structures in (2a-b) represent well-formed configurations since [Round] is associated to the first syllable, but (2c), where [Round] has only a non-initial link, is ill-formed.



The separation of the requirements of initial round licensing and round spreading is crucial. In languages with bisyllabic triggers each requirement is visibly active, but they are ranked asymmetrically in relation to a conflicting constraint that restricts features to a tautosyllabic domain, that is, a constraint limiting all links of a feature to a single syllable. This ranking structure is key to understanding the two-syllable condition. I argue that threshold effects are an instantiation of a kind of constraint interaction explored here, termed PARASITIC CONSTRAINT SATISFACTION (PCS). In bisyllabic trigger languages, this interaction arises as a consequence of interleaving the tautosyllabicity constraint between licensing and spreading: the lower-ranked spreading constraint is satisfied only when it can be parasitic on tautosyllabicity violations produced by round licensing. The PCS configuration achieves the binary threshold straightforwardly through constraint conflict and ranking, without numeric reference. This is a desirable result, since other trigger sizes that could be characterized numerically (e.g., three syllables, four syllables, and so on) are unattested. A parallel approach is shown to capture a bisegmental trigger phenomenon.

A connected matter concerns the nature of the constraints. Pivotal to the analysis is a family of constraints enforcing tautosyllabicity for features, extending Itô and Mester's (1999) Crisp Edge constraint on prosodic constituency. Such constraints are shown to be independently supported by various syllable-bound feature spreading in Altaic and elsewhere. An important development proposed here is that tautosyllabic feature constraints are assessed bottom-up, with a violation accrued for each offending feature. This assessment proves necessary to understanding bisyllabic triggers. A similar evaluation is adopted for violations of featural markedness constraints – a step that is central in the account of round licensing. Extending research by Beckman (1997, 1998), positional faithfulness constraints are assigned a key role, realizing the prioritized status of the root-initial syllable. These constraints not only capture the trigger role of the initial syllable in round harmony, but also explain its status as a licenser of [Round] via association. The analysis that is proposed for initial round

licensing involves an asymmetric ranking of positional and nonpositional faithfulness with respect to featural markedness, another instance of a PCS configuration – in this case with parasitic satisfaction of faith. An alternative substituting positional markedness constraints (Zoll 1996, 1997) for positional faithfulness proves unsuitable, since it cannot prevent feature specifications deriving from a non-initial syllable from overriding ones in the root-initial syllable. To achieve round spreading, constraints are adopted along the lines of those proposed by Kaun (1995), motivated by her extensive cross-linguistic study of round harmony. The relation between the three rounding patterns of licensing, canonical harmony, and bisyllabic trigger harmony is accomplished in the account via minimally distinct rankings.

The paper is organized as follows. In section 2, I establish the description of canonical Tungusic round harmony, and then present data from CMA and Oroqen illustrating the bisyllabic condition on triggers. The CMO distribution of round licensing without spreading is introduced, adding a third member to the set of related patterns. Section 3 turns to the constraint interactions that produce the spreading and licensing requirements. In section 4, I focus on the analysis of bisyllabic triggers, outlining the important function of the tautosyllabic feature constraint and determining its ranking in relation to the requirements of round licensing and spreading. An alternative condition-based account of two-syllable triggers is considered, and other applications of PCS configurations are discussed. Section 5 considers typological implications, deriving differences in the three rounding patterns through minimal reranking and examining extensions to other rounding distributions. Section 6 contrasts an alternative approach to licensing, and section 7 presents the conclusion.

## 2. THREE ROUND HARMONY PATTERNS

The basic pattern of Tungusic round harmony is familiar from comparative Tungusic studies, such as Kaun (1995), Li (1996), and Zhang (1996), along with the precursors on which they build. In this section I first review the core canonical pattern, which does not impose a size restriction on the trigger for harmony, and then go on to describe the more complex distributional restrictions on round vowels in languages requiring a two-syllable trigger. I subsequently identify a connected pattern in Mongolian that displays initial round licensing without round spreading.

2.1. *Canonical Tungusic Round Harmony*

An example of canonical round harmony occurs in Ulcha, a Tungusic language of Russia (Kaun 1995 drawing on Sunik 1985). The vowels of Ulcha are given in (3). Vowel length is contrastive only in word-initial syllables; and [ε] is also restricted to the first syllable. The vowels participating in round harmony, [a(:)] and [ɔ(:)], are highlighted in a box. Like many Tungusic languages, Ulcha also exhibits a tongue root harmony. This harmony will be apparent in much of the data in this paper but is not the subject of analysis (on this see the Tungusic studies cited above).

(3) *Ulcha vowels*

	Front		Central		Back		
High	i	i:			u	u:	-RTR
	ɪ	ɪ:			ʊ	ʊ:	+RTR
Nonhigh			ə	ə:			-RTR
	ε	ε:	a	a:	ɔ	ɔ:	+RTR

The main properties characterizing the canonical pattern of Tungusic round harmony are as follows with illustration in (4). First, the trigger is subject to a positional restriction that is widely apparent across the Altaic family: the trigger for round harmony must be a vowel in the root-initial syllable. In addition, it must be nonhigh. This is part of a more general requirement that round harmony propagate strictly amongst nonhigh vowels; hence, *targets* – vowels that undergo round harmony – must also be nonhigh. The Ulcha data in (4a) present examples of round harmony from [ɔ(:)] in the initial syllable to following nonhigh vowels. In this type of sequence, rounding must spread, that is, forms matching the structure \*[CɔCa] generally do not occur.<sup>1</sup> High vowels in this system act as *blockers* (vowels that prevent propagation of round harmony). Observe in (4b) that high vowels block round spreading from a preceding vowel, and they are not triggers or targets themselves. Further, although round nonhigh vowels never occur after unround or high vowels, round high vowels occur freely in non-initial syllables after unround vowels, as verified in (4c).

(4)a.

bɔ:nɔ	‘hail (weather)’	ɣɔɔ	‘far’
tɔŋdɔ	‘straight ahead’	tɔtɔŋɣɔ	‘multi-colored’
kɔ:rɔtʃʊvʊ	‘to regret’	dʒɔɣbɔlɔvʊ	‘to prick, stab’

<sup>1</sup> A small number of exceptions are noted and discussed by Kaun (1995, p. 76, n. 19).

b.	ɔjɪlavu	'leggings'	vɔlmɪ	'long'
	kɔ:vɔlavu	'to raise a mast (naut.)'	buqta	'fragment'
	muri	'horse'	bu:li	'lamp wick'
c.	ba:pu	'pack, bunch'	sɪltʃu	'sack for tinder'

A summary of the restricted distribution of nonhigh round vowels in Ulcha is given in (5) along with schematic forms. ("C" represents any consonant.)

(5) *Summary of Ulcha round harmony:*

- a. Triggers are nonhigh round vowels in the initial syllable; targets are also nonhigh, and round nonhigh vowels never occur after an unrounded vowel. Well-formed structures include [Cɔ(:)Cɔ], [Ca(:)Ca], but not \*[Cɔ(:)Ca], \*[Ca(:)Cɔ].
- b. High vowels block round harmony; after a high vowel, a non-high vowel is unrounded, i.e., [Cɔ(:)CɪCa] and [Cɔ(:)CʊCa] are well-formed, but not \*[Cɔ(:)CɪCɔ], \*[Cɔ(:)CʊCɔ].

2.2. *Round Harmony with Bisyllabic Triggers*

An interesting complication in the round harmony of some Tungusic languages has been uncovered in research by Zhang (1996) and Zhang and Dresler (1996). They observe that some languages impose a size-threshold on the trigger of round harmony; in particular, the first two syllables of the word must be round in order to induce round spreading. Examples occur in CMA and Oroqen, as described below.

2.2.1. *Classical Manchu*

CMA (also known as Written Manchu) is the language represented by the Manchu writing system. It was the language of the Manchu court from about the seventeenth century to the early twentieth century and is considered to be based on the Jianzhou dialect of the seventeenth century. The following description and data are mainly from Zhang (1996) and Zhang and Dresler (1996) (drawing on Norman 1978; Seong 1989), supplemented by Li (1996). The vowel inventory is presented in (6); the vowels that alternate in round harmony are [a] and [o].

(6) *Classical Manchu vowels*

	Front	Central	Back	
High	i		u	+ATR
			ʊ	-ATR
Nonhigh		ə		+ATR
		a	o	-ATR

Round harmony in CMA closely resembles the canonical pattern of Ulcha in most respects. Examples of round harmony in CMA are shown in (7). Round spreading amongst nonhigh vowels from a root to suffix is illustrated in (7a). The data in (7b) present instances of unrounded suffix variants for comparison. In these forms we observe that high vowels block round spreading and their rounding specification is independent of preceding vowels, as in the canonical system. The examples in (7c) present cases of round harmony within a trisyllabic root. Note that if the first two syllables contain nonhigh round vowels, a third nonhigh vowel must also be round, that is, \*[CoCoCa] is ill-formed.

(7)a.	dobno-no-	'go to offer'	dorolo-no-	'go to salute'
	botʃo-ŋgo	'colored'	osoxo-ŋgo	'having claws'
	moŋgo-ro-	'speak Mongolian'	obo-xo	'to wash'
b.	baxa-na-	'go to get'	kofori-na-	'to become hollow'
	gosi-ŋga	'loving, compassionate'	arbu-ŋga	'image'
	mondʒi-ra-	'wring the hands'	nomula-xa	'to preach'
c.	dorolon	'rite'	foxolon	'short'
	osoxo	'claw'		

The above show examples of the familiar round harmony pattern in forms where the first two syllables of the root are surface-round. Thus far it would be reasonable to infer that the round second vowel is determined by [Round] spreading from the first vowel, as in Ulcha. However, further data contradict this conclusion. The data in (8) show a rather unexpected outcome for roots containing a nonhigh round vowel only in the initial syllable: round spreading does not occur. [Round] in the initial vowel fails to spread both from root to suffix (8a) and within the root (8b).

(8)a.	to-ŋga	'few, rare'	do-na-	'alight in swarm'
	jo-na-	'form a sore'	no-ta	'younger sisters'
	go-xa	'break a promise' (perf.)		
b.	tʃoban	'a lever'	tʃola-	'to fry'
	doran	'virgin land'	podʒan	'firecracker'
	tʃotʃara-	'to act carelessly'		

Based on these data, Zhang (1996) and Zhang and Drescher (1996) establish the descriptive generalization that the first *two* syllables must contain nonhigh round vowels in order for [Round] to spread in CMA. I will call this the *bisyllabic trigger condition*. The implication is that the first two

syllables of the forms in (7a) and (7c) must underlyingly contain round vowels. That is because round harmony actually occurs in those forms, in contrast to the ones in (8).

There is a further point concerning the distribution of round vowels in CMA that must be taken into consideration. First, it must be absolutely clear that vowels in the second syllable are not subject to the neutralizing effect of round spreading. Some minimal pairs contrasting solely in terms of the round specification of the second vowel are given in (9). These unambiguously show that rounding in a second syllable is contrastive after an initial nonhigh round vowel.

(9)a.	dola	'barren land'	dolo	'inside'
b.	doxa	'stick'	doxo	'lime'
c.	noran	'a pile of wood'	noron	'longing'
d.	oxa	'obedient'	oxo	'armpit'

On the basis of these pairs, it may be expected that round nonhigh vowels occur freely in the second syllable. However, a round nonhigh vowel in the second syllable is prohibited following an initial unrounded syllable; in other words, \*[CaCo] roots are ill-formed. Note that this rounding distribution is also excluded in Ulcha. In CMA it is clear that this restriction cannot be attributed to the rounding agreement produced by harmony, since the well-formedness of both [CoCo] and [CoCa] shows that round harmony does not carry from the first to the second syllable – there must be a bisyllabic trigger.

The condition to be explained is that round nonhigh vowels only occur in the second syllable when following a round nonhigh vowel. I suggest that this distribution is the result of an initial licensing requirement, whereby a [Round] feature on a nonhigh vowel must be linked to a nonhigh vowel in the first syllable. Bisyllabic structures of CMA that satisfy licensing are shown in (10a–b). These may be contrasted with the structures in (10c–d) that contain an 'unlicensed' [Round] feature. [CaCo] words are thus ill-formed because [Round] is not associated with the first syllable.

(10)a.	C	o	C	o		b.	C	o	C	a
		\	/							
		[Round]					[Round]			
c.	C	o	C	o		d.	C	a	C	o
		[Round]		*[Round]						*[Round]



A summary description for CMA is presented in (11).

- (11) *Summary of Classical Manchu round harmony and licensing:*
- a. Licensing: Post-initial round nonhigh vowels occur only immediately following a round nonhigh vowel, i.e., [CaCa], [CoCo] and [CoCa] are well-formed, but not \*[CaCo].
  - b. Bisyllabic trigger: [Round] spreads to following nonhigh vowels when the first two syllables contain round nonhigh vowels. High vowels block round harmony, i.e., well-formed structures include [CoCo-Co], [CoCa-Ca], [CoCi-Ca], [CoCu-Ca], but not \*[CoCo-Ca], \*[CoCa-Co], \*[CoCi-Co], \*[CoCu-Co].

2.2.2. *Oroqen*

CMA presented an example of round harmony requiring a bisyllabic trigger. Oroqen, a minority language of northeast China, is a second Tungusic language that exhibits this kind of pattern. I focus here on the evidence Oroqen offers concerning the behavior of long vowels in harmony with a bisyllabic trigger condition (see Zhang 1996 for additional details of Oroqen harmony). The language description and data are from Zhang et al. (1989), Zhang (1996), and Zhang and Drescher (1996).

The vowels of Oroqen are listed in (12). Oroqen presents a richer set of vowel contrasts than CMA; of particular interest is the contrast in vowel length. Round harmony produces alternations between a(:) ~ ɔ(:) and ə(:) ~ o(:).

(12) *Oroqen vowels*

	Front	Central	Back	
High	i i: y		u u:	(neutral) -RTR
			ɯ ɯ:	+RTR
Nonhigh	e:	ə ə:	o o:	-RTR
	ɛ:	a a:	ɔ ɔ:	+RTR

The operation of round harmony in Oroqen is illustrated by the forms in (13a). Here we see round spreading from the root to a suffix when the first two vowels of the root are round and nonhigh. By contrast, the data in (13b) show the occurrence of an unrounded suffix alternant after unrounded or high vowels. From these data it is apparent that Oroqen round harmony is

subject to the usual height restriction: only nonhigh vowels participate in round harmony.

- |        |            |                                       |             |                      |
|--------|------------|---------------------------------------|-------------|----------------------|
| (13)a. | ᠔ᠣ-ᠪᠣ      | 'fish' (def. obj.)                    | ᠲ᠋ᠢᠭᠣᠨᠬᠣ-ᠪᠣ | 'window' (def. obj.) |
|        | ᠮᠣᠲᠢᠭᠣᠨ-ᠮᠣ | 'difficulty' (def. obj.) <sup>2</sup> | ᠔ᠯᠭᠣᠷ-ᠷᠣ    | 'dry' (pres.)        |
|        | ᠣᠣᠯᠣᠷ-ᠷᠣ   | 'boil' (pres.)                        | ᠮᠣᠷᠣ-ᠷᠣ     | 'moan' (pres.)       |
| b.     | ᠲᠣᠷᠠᠬᠢ-ᠪᠠ  | 'boar' (def. obj.)                    | ᠮᠢᠨᠠ-ᠪᠠ     | 'me' (def. obj.)     |
|        | ᠤᠷᠤᠨ-ᠮᠠ    | 'hoof' (def. obj.)                    | ᠵᠠᠪᠤ-ᠷᠠ     | 'walk' (pres.)       |
|        | ᠰᠠᠷᠠ-ᠷᠠ    | 'awake' (pres.)                       | ᠬᠤᠮᠨᠠ-ᠷᠠ    | 'hold' (pres.)       |

As in CMA, round spreading fails in Oroqen when just the first syllable of the root contains a round vowel. Zhang and Drescher make the important observation that even a bimoraic (long) round vowel is insufficient to trigger round spreading on its own, as seen in (14).

- |      |         |                    |        |                 |
|------|---------|--------------------|--------|-----------------|
| (14) | ᠮᠣᠷᠤ-ᠪᠠ | 'tree' (def. obj.) | ᠳᠣᠷ-ᠷᠠ | 'mince' (pres.) |
|      | ᠨᠣᠳᠠᠷ-  | 'throw'            | ᠬᠣᠷᠭᠠ  | 'bridge'        |

These data make evident that the bisyllabic trigger condition in Oroqen is truly a bisyllabic condition not just a bimoraic one. Since CMA lacks a vowel length distinction, it is silent on this matter. A final point is that Oroqen displays the same initial licensing requirement for [Round] that was identified in CMA (and consistent with the distribution in Ulcha): nonhigh round vowels occur in the second syllable of roots only when the initial syllable contains a nonhigh round vowel (that is, \*[CəCo], \*[CaCə] roots are ill-formed).<sup>3</sup>

### 2.3. Classical Mongolian

The above Tungusic harmonies have been observed to occur along with an initial licensing distribution. I turn next to data from Mongolian that reveal an occurrence in Altaic of round licensing alone. CMO represents the

<sup>2</sup> Zhang (1996, p. 189) glosses this form as in the objective case. I assume that it is in fact the definite object case marker, in accordance with Zhang's glosses of other forms with this suffix.

<sup>3</sup> As noted by Zhang (1996) and Zhang and Drescher (1996), Oroqen presents a further restriction on rounding in nonhigh vowels: in order for [Round] to occur in a nonhigh vowel, it must be linked to the first two moras of the stem, i.e., [Co:] and [CoCo] are well-formed, but \*[CoCə] (with initial short vowel) is ill-formed. This interesting requirement plausibly has foundation in perceptual considerations, since rounding contrasts are relatively difficult to perceive in nonhigh vowels (Kaun 1995). The restriction will not be the focus of analysis here, since it is distinct from the condition on trigger-size. As seen in (13–14), spreading must be initiated by a two syllable trigger – not simply a two mora one.

Mongolian written language from about the thirteenth century and is considered the language from which modern Mongolian languages developed. The data and description for CMO are drawn from Poppe (1954, 1955) and Svantesson (1985). The CMO vowels are given in (15). Each unrounded nonhigh vowel is paired with a rounded counterpart.

(15) *Classical Mongolian vowels*

	Front		Back
High	i	y	u
Nonhigh	e	ø	a o

Though the standard dialect of Modern Mongolian (Khalkha) is known for its round harmony, round spreading is not active in CMO. However, CMO displays a licensing distribution for [Round]; that is, round nonhigh vowels only occur in a non-initial root syllable when the initial syllable also contains a round nonhigh vowel, hence forms like \*[CaCo], \*[CuCo] never occur. Examples of round nonhigh vowels occurring in non-initial syllables are given in (16a). As seen in these data, round nonhigh vowels are attested in post-initial positions provided that all preceding syllables contain round nonhigh vowels; in each case, non-initial [Round] is licensed by a link to the initial syllable. The data in (16b) present examples in which an unrounded nonhigh vowel follows an initial round one, signalling that round spreading does not take place. (Note that a front/back harmony is apparent in the vowels here.)

(16)a.	nøkør	‘friend’	ølø	‘gray’
	kømøske	‘eyebrow(s)’	kørøŋge	‘capital’
	moŋγol	‘Mongol’	qomoγol	‘horse dung’
	qodoγodu	‘inner organs’	nomoγodqa	‘to tame’
b.	køke	‘blue’	køge-	‘to foam, to rise’
	kødel-	‘to move’	qola	‘far, distant’
	qota	‘city, corral’	olan	‘many’

As expected, since CMO does not display round spreading, round vowel roots do not regularly induce rounding alternations in suffixes (though such alternations are familiar in Khalkha):

(17)	døtø-ger	‘fourth’	*døtø-gør
	tørø-gseger	‘since he was born’	*tørø-gsøggør
	dotor-a	‘within’	*dotor-o
	omo-rqay	‘proud’	*omo-rqoy

A summary of the distribution of round vowels in CMO is given in (18).

- (18) *Summary of Classical Mongolian round licensing:*
- a. Licensing: a non-initial round nonhigh vowel in a root occurs only immediately following a round nonhigh vowel, i.e., [CoCo], [CøCø] are well-formed, but not \*[CaCo], \*[CuCo], \*[CeCø], \*[CyCø].
  - b. No round harmony: round or unround nonhigh vowels may occur after an immediately preceding nonhigh rounded vowel, i.e., [CoCo], [CoCa], [CøCø], [CøCe] are all well-formed.

CMO completes the set of round vowel patterns to be analyzed here. The three patterns together form a graduated series of conditions on rounding in nonhigh vowels, as described in (19). Across these patterns it holds that round nonhigh vowels occur in a non-initial syllable only when the initial syllable is also round and nonhigh – this distribution I have characterized as initial licensing. Further, in the canonical pattern, [Round] actively spreads to unrounded nonhigh vowels without a condition on trigger size, while in the bisyllabic trigger pattern, [Round] spreads only when there are two consecutive round vowels to initiate spreading.

- (19)a. *Licensing without round harmony: CMO*  
[Round] in a (non-initial) nonhigh vowel must be linked to a nonhigh vowel in the first syllable.
- b. *Bisyllabic trigger round harmony: CMA and Oroqen*  
[Round] in a (non-initial) nonhigh vowel must be linked to a nonhigh vowel in the initial syllable; if the first two syllables are nonhigh and round, [Round] spreads to following nonhigh vowels.
- c. *Canonical round harmony: Ulcha*  
[Round] in a (non-initial) nonhigh vowel must be linked to a nonhigh vowel in the initial syllable; [Round] spreads from a nonhigh vowel to following nonhigh ones.

## 3. ANALYSIS: THE REQUIREMENTS OF LICENSING AND SPREADING

In order to lay the groundwork for understanding the bisyllabic trigger condition, I first develop the analysis of the general round licensing and spreading requirements that are components of the pattern in these languages. The account is formalized within the framework of OT. I assume a basic familiarity with the underpinnings of OT and its formalisms.

3.1. *Licensing and Initial Syllable Privilege*

I start with the constraints and rankings needed for the special status of the initial syllable and the licensing distribution for [Round] – properties shared across the three patterns in (19). I propose to realize these properties through the interaction of featural markedness and faithfulness constraints, including positional faithfulness for features. Featural faithfulness and markedness are motivated by a variety of phonological phenomena: they are indeed basic in standard OT for deriving contrastive distribution and inventory structure, and in concert with context-sensitivity they have been used to achieve allophonic variation and positional neutralization (see Prince and Smolensky 1993; McCarthy and Prince 1995; Beckman 1997; Kager 1999). Making maximal use of these elemental constraints is an important aim given the theoretical assumptions of constraint universality and factorial typology (Prince 1997), and a growing body of research provides a basis for expanding their role to encompass certain cases of cross-segment feature linkage (see, e.g., McCarthy and Prince 1994a; Itô and Mester 1994; Beckman 1995, 1997, 1998; Alderete et al. 1999). An alternative considered in section 6 using an explicit licensing constraint based on positional markedness is argued to not be appropriate for the Altaic rounding patterns.

I adopt the Correspondence Theory of faithfulness (McCarthy and Prince 1995, 1999), wherein featural faithfulness is mediated through identity constraints. Given the observation by Steriade (1995) that [-round] does not appear to be active in assimilation or dissimilation phenomena, I assume that [Round] is a privative feature. (This choice is not crucial, however. The basic approach here is also compatible with a binary treatment of [round].) Following a proposal by Pater (1999), I assume that featural identity constraints may be distinguished for the effects of loss or addition of privative feature specifications (an extension also adopted by McCarthy and Prince 1995, 1999 with modifications for binary features). The identity constraints for [Round] are given in (20). IDENT-IO(Round) penalizes the loss of input [Round] specifications, and IDENT-OI(Round) punishes segments that acquire [Round] specifications in the output. In

the case of bisyllabic triggers, these separate constraints will prove to be essential.

(20)a. IDENT-IO(RD)

Let  $\alpha$  be a segment in the input and  $\beta$  be any correspondent of  $\alpha$  in the output. If  $\alpha$  is [Round], then  $\beta$  is [Round].

b. IDENT-OI(RD)

Let  $\alpha$  be a segment in the input and  $\beta$  be any correspondent of  $\alpha$  in the output. If  $\beta$  is [Round], then  $\alpha$  is [Round].

Building on Beckman (1995, 1997, 1998), I assume that faithfulness constraints may be sensitive to the root-initial syllable. In the Altaic rounding patterns seen above, it is evident that this position is assigned a special status in the grammar. The relevant [Round] identity constraint is given in (21). (Note also Kaun 1995, p. 149 for a similar proposal framed in terms of PARSE.)<sup>4</sup> Initial syllable faithfulness for any rounding quality is consistently enforced in these languages, so it will not be necessary to make a distinction between  $I \rightarrow O$  and  $O \rightarrow I$  [Round] mapping violations for the positional constraint (though I do not rule out the possibility).

(21) IDENT- $\sigma_1$ (RD)

Let  $\alpha$  be a segment in the input and  $\beta$  be any correspondent of  $\alpha$  in the output. If  $\beta$  is in the root-initial syllable, then  $\alpha$  and  $\beta$  must have identical specifications for [Round].

Beckman cites evidence from psycholinguistic and phonological domains to establish the privileged nature of the root-initial syllable. The psycholinguistic evidence derives from initiality effects in processing, which include the finding that utterance-initial portions make the best cues for word recognition and lexical retrieval, the special relevance of initial material for word recall in tip-of-tongue states, and the salience of mispronunciations in initial positions. Phonological support comes from languages that neutralize contrasts in non-initial syllables: such effects for vowels are widespread in Altaic, as well as in languages of the Finno-Ugric group and Bantu. Additionally, in languages that neutralize non-initial contrasts, the set of post-initial vowels tends to be less marked in character, and it is frequently

<sup>4</sup> Foundation for faithfulness constraints that are sensitive to privileged positions of some kind exists in a considerable range of work. Further representative examples include Selkirk (1994), McCarthy and Prince (1994b), Padgett (1995b), Urbanczyk (1996), Alderete (1999), Lombardi (1999), and McCarthy (2000).

a subset of the full inventory occurring in the root-initial syllable. In the Altaic patterns examined here, the asymmetry between initial and non-initial syllables with respect to neutralization of rounding specifications motivates ranking initial-syllable faith for [Round] over its nonpositional counterparts, i.e.,  $\text{IDENT-}\sigma_1(\text{Rd}) \gg \text{IDENT-IO}(\text{Rd}), \text{IDENT-OI}(\text{Rd})$ .

The above constraints enforce identity of [Round] feature specifications between input and output, yet not all inputs are faithfully mapped to an output. Markedness constraints that penalize feature co-occurrences can produce this result. The present languages present a licensing restriction on nonhigh vowels; that is, they reveal an effect of the marked combination of [Round] and [–high].<sup>5</sup> Following Kaun (1995, p. 144), I refer to the relevant constraint as \*ROLO.<sup>6</sup>

(22) \*ROLO: \*[Round, –high]

\*ROLO is widely supported by the cross-linguistic rarity of round low vowels (Maddieson 1984; Kaun 1995) and the unround character of ‘default’ vowels. Its general activity within Altaic is evidenced by the preference for nonhigh unround vowels, i.e., [a, e, ə] are favored over [o, ø, ɔ]. The phonetic grounding for this constraint is discussed by Kaun, who argues that a lower jaw position is articulatorily antagonistic to a lip rounding gesture. In the present cases, \*ROLO has the capacity to compel loss of rounding in certain configurations (in hypothetical inputs), though vowel height appears to remain consistently faithful. Accordingly, I assume that  $\text{IDENT}(\text{high})$  is top-ranked and will restrict attention to candidates respecting this constraint.<sup>7</sup>

Turning now to the rankings, I focus first on the privileged character of the initial syllable. Across the rounding patterns, nonhigh round vowels occur freely in the initial syllable. This distribution is achieved with an undominated identity constraint for [Round] in the root-initial syllable. In particular,  $\text{IDENT-}\sigma_1(\text{Rd})$  must outrank \*ROLO. The outcome of this ranking is shown in (23), where the input contains an initial round vowel. The winning candidate is the faithful one in (23a), which satisfies  $\text{IDENT}$  by retaining the [Round] specification. The rival candidate in (23b) fares better with respect to the markedness constraint, but the initial syllable faith violation is fatal.

<sup>5</sup> I adopt [–high] to describe the height of nonhigh vowels undergoing round harmony and licensing, but this particular characterization of vowel height features is not crucial.

<sup>6</sup> For additional applications of \*ROLO, see Kirchner (1993) and Beckman (1997).

<sup>7</sup> The generalization that height is faithful appears to be true of words in the native vocabulary. Some loanwords may be resolved differently, as seen in the discussion of Modern Mongolian in section 6.

(23) IDENT- $\sigma_1$ (Rd)  $\gg$  \*ROLO

	/qola/	IDENT- $\sigma_1$ (Rd)	*ROLO
☞	a. qola		*
	b. qala	*!	

A second property that the patterns share also concerns the prioritized status of the first syllable. Each language exhibits a round licensing requirement; that is, a non-initial round vowel must be dependent on a [Round] specification in a nonhigh vowel in the initial syllable. For this outcome, nonpositional IDENT-IO(Rd) must be added to the hierarchy. We will see presently that it must be situated below \*ROLO. IDENT-IO(Rd) will favor the preservation of input [Round] specifications in any position in the word; hence it can drive outputs with nonhigh round vowels in post-initial syllables. On the other hand, \*ROLO penalizes each combination of [Round] and [–high]. It thereby has the potential to drive the cross-segmental linkage of [Round] among nonhigh vowels in licensing configurations. For this result it is crucial that \*ROLO be interpreted as incurring a mark for each co-occurrence of the specifications [Round] and [–high], and not by each nonhigh round segment. Noting a need for this feature-wise evaluation of featural markedness constraints, Beckman (1997, p. 19) formalizes their interpretation in terms of the principle of Feature-Driven Markedness, which corresponds to the assessment in (24) for \*ROLO.

(24)a. One mark:

$$\begin{array}{c} C \ o \ C \ o \\ \ \ \ / \\ [Rd, -hi] \end{array}$$

b. Two marks:

$$\begin{array}{c} C \ o \ C \ o \\ | \ \ | \ \ | \\ [Rd, -hi] \ [Rd, -hi] \end{array}$$

A third possible configuration in which [Round] is shared across the vowels, but [–high] is not, will incur two violations with respect to \*ROLO, since [Round] co-occurs with [–high] twice in the structure.

The application of the constraints to an input with two nonhigh round vowels is illustrated in (25). Candidates are labeled with brackets that define the domain of segments to which subscripted features are linked. The candidate in (25a) represents a form in which [Round, –high] is linked across syllables, while (25b) has separate [Round, –high] specifications linked to each syllable.



## (25) Licensing of post-initial [Round]

/moŋyol/	IDENT- $\sigma_1$ (Rd)	*ROLO	IDENT-IO(Rd)
a. [moŋyol]Rd,-hi		*	
b. [moŋ]Rd,-hi[yol]Rd,-hi		**!	
c. [moŋ]Rd,-hiʔal		*	*!
d. maŋʔal	*!		**

The winning candidate (25a) has just one occurrence of [Round] and [–high]. This satisfies both of the correspondence constraints and incurs a single mark with respect to \*ROLO. Candidates (25c–d) each lose on the basis of identity violations, (25d) for an unrounded vowel in the first syllable and (25c) for loss of rounding in the second syllable. Note that IDENT-IO(Rd) is decisive in ruling out (25c), though its ranking with respect to \*ROLO is not critical for this particular form. Like (25a), candidate (25b) fully satisfies the identity constraints, but it incurs an extra violation for \*ROLO, because it has two co-occurrences of the [Round] and [–high] autosegments. \*ROLO thus favors outputs in which the autosegments [Round, –high] are minimized together by linking across segments rather than appearing in separate specifications on adjacent syllables. To simplify subsequent tableaux, I will mark only brackets for [Round] linkage, but when it is linked across nonhigh syllables, I will assume [–high] is multiply linked as well, as driven by \*ROLO.

The licensing hierarchy exemplified in (25) also captures the ill-formedness of nonhigh round vowels in a syllable following an unrounded vowel. This is shown in (26) with a hypothetical input /baxo/ for the CMA word [baxa-] ‘get’. [CaCo] forms never surface in any of the three rounding patterns; however, given the principle of Richness of the Base, which hypothesizes that all inputs are possible (Prince and Smolensky 1993, p. 191), we must ensure that the constraint hierarchy selects a grammatical output for any possible input combination of round/unround vowels.

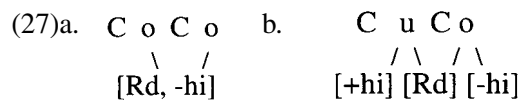
## (26) Ruling out [CaCo]

/baxo/	IDENT- $\sigma_1$ (Rd)	*ROLO	IDENT-IO(Rd)
a. baxa			*
b. ba[xo]Rd		*!	
c. [boxo]Rd	*!	*	

In this case the need for ranking \*ROLO over IDENT-IO(Rd) is evident in comparison of the first two candidates. Candidate (26b), which satisfies nonpositional identity, loses to the unfaithful form in (26a) by virtue of a violation of \*ROLO. Initial syllable identity rules out (26c), which changes

the rounding quality of the first syllable. As a consequence, the /CaCo/ input is mapped to an output that eliminates the unlicensed [Round] feature specification. The above ranking thus achieves the licensing distribution directly through the interaction of featural markedness and faithfulness constraints together with positional prioritization.

A third property shared by the three rounding patterns is the restriction of round licensing to nonhigh vowels. We have seen in (25) above that the current ranking is successful in achieving licensing in words containing a sequence of nonhigh vowels. Let us now contrast this with an instance where a post-initial nonhigh round vowel is preceded by an initial high vowel. A schematic representation of the relevant structures is given in (27).



In (27a), both [Round] and [–high] are linked to the first syllable (i.e., ‘licensed’). On the other hand, in (27b) [Round] is linked to both the initial and non-initial syllable, but [–high] is not. In this case the non-initial vowel does not maintain the specifications [Round, –high] by drawing on the same in the initial syllable, i.e., the specifications [Round] and [–high] are not licensed together. This structure will incur a fatal mark with respect to \*ROLO, and [Round] will be lost in the non-initial syllable. The limitation of licensing to nonhigh vowels is accordingly achieved by \*ROLO favoring structures in which round and height features both share links across segments.

The optimality-theoretic outcome for a case with an initial high vowel is shown in (28).

(28) High vowels do not participate in licensing

	/buqtə/	IDENT-σ <sub>1</sub> (Rd)	*ROLO	IDENT-IO(Rd)
a.	[buq]Rdta			*
b.	[buqtə]Rd		*!	

To conclude this section, we have established that the hierarchy in (28) is responsible for the privileged status of round segments in the initial syllable, and it generates the round licensing distribution along with its restriction to nonhigh vowels. These properties hold across the rounding patterns of Ulcha (canonical harmony), CMA and Oroqen (bisyllabic trigger harmony), and CMO (licensing).

### 3.2. Round Spreading

In addition to the initial licensing distribution, the patterns of canonical harmony and bisyllabic trigger harmony display round spreading, where rounding spreads from nonhigh vowels to unrounded nonhigh ones. In the account of this phenomenon I will draw on two kinds of constraints proposed by Kaun (1995): a spreading imperative and a requirement of uniform rounding gestures. As noted in what follows, these are each motivated on the basis of Kaun's extensive typology of round harmony and her study of its phonetic grounding. Both of these analytical tools thereby take a broader range of rounding patterns into consideration. In this section I focus on the canonical spreading pattern seen in Ulcha. The matter of trigger size is addressed in section 4.

To capture the active spreading of [Round], I adopt a spreading constraint in the spirit of Kaun which requires that the autosegment [Round] spread to all vowels in a word when simultaneously associated to a vowel that is [–high]. The constraint is given in (29), drawing on the formalism of Walker (1998).

(29) SPREAD[Rd]if[–hi]

Let  $r$  be a variable ranging over occurrences of the feature specification [Round],  $l$  be a variable ranging over occurrences of the feature specification [–high],  $v$  be a variable ranging over the set of vowels  $V$  in a word  $\omega$ , and  $v\delta r$  mean that  $r$  is dominated by  $v$ . Then  $(\forall v: v \in V)\forall r[(v\delta r)\&\exists l(v\delta l)] \rightarrow [(\forall v: v \in V)[v\delta r]]$ .

The above formalism expresses the requirement that for any vowel in a word linked to both a [Round] autosegment and a [–high] autosegment, that same [Round] autosegment must also be associated to all other vowels in the word. I interpret violations as gradient: for any [Round] autosegment linked to a [–high] vowel, a mark is accrued for each vowel to which that autosegment is not linked (Ní Chiosáin and Padgett to appear; Walker 1998).<sup>8</sup>

The constraint in (29) posits spreading of [Round] as the consequence of an active spreading requirement. In contrast to the parasitic licensing

<sup>8</sup> Although this constraint identifies vowels as the targets of spreading, it does not exclude [Round] spreading to intervening consonants. Indeed, as argued by Gafos (1996) and Ní Chiosáin and Padgett (to appear), there is good reason to believe that the vocalic gestures which spread in vowel harmony overlap consonants as well. Schematized representations such as those in (24) and (27), which show linkage of vocalic features to vowels only, are not intended to rule out this possibility. An alternative statement of the constraint could frame all segments as targets (see (47)).

distribution, spreading of [Round] to unrounded vowels does not have a firm basis in featural markedness: it neither serves to reduce the number of [Round] autosegments in the output (since unrounded vowels have no [Round] specification) nor does it produce less marked vowels.<sup>9</sup> The use of feature spreading or alignment constraints as the imperative that drives spreading has wide currency in research on spreading phenomena (in addition to the analysts cited above, examples include Kirchner 1993; Akinlabi 1994; Cole and Kisseberth 1994; Padgett 1995b; Pulleyblank 1996; cf. Baković 2000 on AGREE). Although the round spreading constraint could be formulated in terms of edge-alignment, the spreading constraint assumed here is nondirectional, drawing on the observation of Kaun, Baković, and others that the direction of spreading in vowel harmony can follow from independent properties of the grammar, such as morphological structure and positional faithfulness.

A restriction on triggers is incorporated in (29): [Round] spreads only from nonhigh vowels. Kaun finds support for the activity of a nonhigh trigger restriction across a variety of the round harmony patterns in her study. This property is suggested to have foundation in phonetic principles. Kaun (1995, p. 178) observes that rounding distinctions in nonhigh vowels are more difficult to perceive than rounding contrasts in high vowels. Spreading of [Round] from a nonhigh trigger thus has a functional basis: extending the domain of [Round] in the word improves the likelihood that the listener will perceive a subtle featural contrast.<sup>10</sup>

The spreading constraint will conflict with the faithfulness constraint that prohibits unrounded input segments from gaining a [Round]

<sup>9</sup> The lack of basis in featural markedness is not specific to a privative interpretation of [Round]. Even if [Round] were assumed to be a binary feature (which is itself questionable), \*[-round] would not alone be sufficient to drive spreading, since it would not limit harmony to nonhigh vowels. An alternative constraint targeting \*[-round, -high] is not well-supported, since there is no indication that this combination of features is marked; indeed cross-linguistic generalizations suggest that the absence of rounding is preferred on nonhigh vowels.

<sup>10</sup> An alternative formulation of the spreading constraint as simply SPREADROLO, i.e., spread [Round] and [-high], would predict the possibility of a height harmony in which [-high] spreads only to [Round] vowels, a pattern that is to the best of my knowledge unattested. The constraint in (29) is not faced with this drawback, since it focuses on [Round] spreading. The present approach does not, however, exclude the possibility of [Round] and [-high] spreading together, since a general feature markedness constraint \*F, penalizing featural autosegments, might incidentally cause [-high] to be multiply-linked across a string of adjacent nonhigh syllables (on constraints of the \*STRUC family, see Prince and Smolensky 1993, citing Zoll p.c.). In addition, in a string of syllables that are round and nonhigh, \*ROLO will favor multiple-linking of both [Round] and [-high], as noted above.

specification in the output. In languages with active round spreading, SPREAD[Rd]if[–hi] must dominate IDENT-OI(Rd), as seen in (30). Spreading to a nonhigh unrounded vowel in (30a) violates IDENT-OI(Rd), but this outcome wins over a candidate that fails to spread [Round] in (30b). A third candidate (30c), which vacuously satisfies spreading by losing the input specification of [Round] in the initial syllable, is ruled out by ranking IDENT- $\sigma_1$ (Rd) over nonpositional IDENT-OI(Rd).

(30) IDENT- $\sigma_1$ (Rd), SPREAD[Rd]if[–hi]  $\gg$  IDENT-OI(Rd)

	/gɔra/	IDENT- $\sigma_1$ (Rd)	SPREAD[Rd]if[–hi]	IDENT-OI(Rd)
a.	[gɔrɔ]Rd			*
b.	[gɔ]Rdɾa		*!	
c.	gara	*!		

Note that in the suffixing Altaic languages, the progressive direction of spreading will follow from IDENT- $\sigma_1$ (Rd) and the dominance of faithfulness for roots over affixes (McCarthy and Prince 1994b). A post-initial round vowel will not trigger regressive spreading to an unrounded initial vowel, but rather will lose rounding, because it fails to be licensed (see (26)).

It should be pointed out that in the canonical round harmony pattern, where round spreading is granted high priority, the round licensing distribution falls under the set of cases that can be captured with the spreading constraint together with initial syllable faithfulness. That is, with respect to [Round], the multiple linking configurations required to obey spreading are a superset of those needed to satisfy the set of constraints that achieve licensing. As a result, in a language with canonical harmony, the multiple linking outcome for a /CɔCɔ/ input could be attributed to either the spreading ranking or the licensing ranking. The set of constraints that produce licensing will independently be needed for CMO, where no round spreading is observed, and in bisyllabic trigger languages, where licensing of nonhigh round vowels in the second syllable occurs apart from spreading, as observed in section 2.2.

Let us now consider the lack of high vowel participation in round spreading. The failure of high round vowels to act as triggers follows straightforwardly from the formulation of the spreading constraint. This result is demonstrated in (31). We see here that since the initial round vowel is not [–high], SPREAD[Rd]if[–hi] does not drive [Round] to spread. Accordingly, the faithful output in (31a) is more harmonic than the spreading candidate in (31b). IDENT- $\sigma_1$ (Rd) rules out a candidate in which initial rounding is lost. The lack of spreading is similarly obtained for

words like [buqta] ‘fragment’, where a nonhigh unrounded vowel follows a high round one.

(31) [Round] does not spread from high vowels

	/mʊrɪ/	IDENT-σ <sub>1</sub> (Rd)	SPREAD[Rd]if[-hi]	IDENT-OI(Rd)
↖	a. [mʊ]Rdɪɪ			
	b. [mʊrʊ]Rd			*!
	c. mɪrɪ	*!		

While SPREAD[Rd]if[-hi] captures the restriction of triggers to nonhigh vowels, it is silent in regard to the height of target vowels. From a cross-linguistic perspective, this achieves a good result. Among the round harmony patterns that display a preference for nonhigh triggers, Kaun finds that some spread to vowels of any height (e.g., Yakut), while others target only nonhigh vowels. To capture cases where [Round] spreads only among vowels of the same height, Kaun (1995, p. 142) proposes a uniformity constraint, which prohibits a [Round] specification from linking across vowels of different heights, as in (32). Drawing on an observation that the lip-rounding gesture in high vowels versus nonhigh ones is qualitatively different, she suggests that this constraint is an instantiation of a more general requirement in the phonology-phonetics interface that a single phonological specification should correspond to phonetically uniform gestural targets.

(32) UNIFORM[Rd]

A [Round] autosegment may not be multiply-linked to vowels that are distinctly specified for height.

The UNIFORM[Rd] constraint is not specific to nonhigh vowels. As predicted, Kaun identifies round harmony patterns that are restricted to nonhigh vowels only and to high vowels only. She also cites cases where both high and nonhigh vowels participate, but trigger and target must agree in height (Yokuts). It should be observed that although UNIFORM[Rd] prevents cross-height round linkage, it does not obviate \*ROLO. This constraint is necessary to restrict initial licensing to nonhigh vowels. If just \*[Round] were assumed to drive licensing, we would wrongly predict that high vowels would also be subject to licensing via association to initial round vowels of matching height. Moreover, taking into account Kaun’s typology, \*ROLO is needed to obtain round harmony patterns in which only high vowels are targeted by spreading from vowels of any height (1995, p. 163).

In the Tungusic round spreading patterns, UNIFORM[Rd] must outrank SPREAD[Rd]if[–hi] to prevent [Round] from spreading to high vowels. IDENT- $\sigma_1$ (Rd) must also dominate the spreading constraint to prevent satisfaction of spreading by loss of initial [Round]. These rankings are illustrated in (33).

(33) IDENT- $\sigma_1$ (Rd), UNIFORM[Rd]  $\gg$  SPREAD[Rd]if[–hi]

/vɔlmi/	IDENT- $\sigma_1$ (Rd)	UNIFORM[Rd]	SPREAD[Rd]if[–hi]	IDENT-OI(Rd)
a. [vɔl]Rdmi			*	
b. [vɔlmʊ]Rd		*!		*
c. valmi	*!			

The optimal output in (33a) violates SPREAD[Rd]if[–hi], since [Round] has not spread to the second vowel. The competing candidate in (33b) obeys spreading, but it incurs a fatal mark with respect to UNIFORM[Rd]. Candidate (33c) loses on the basis of a positional faithfulness violation.<sup>11</sup>

### 3.3. Summary

To review, we have established two subhierarchies for cross-syllable linkage patterns of [Round]:

(34)a. *Initial-Licensing*: IDENT- $\sigma_1$ (Rd)  $\gg$  \*ROLO  $\gg$  IDENT-IO(Rd)

b. *Spreading*: IDENT- $\sigma_1$ (Round), UNIFORM[Rd]  $\gg$   
 SPREAD[Rd]if[–hi]  $\gg$  IDENT-OI(Rd)

The ranking in (34a) corresponds to the initial licensing distribution, seen in isolation in CMO and observed in conjunction with a round spreading distribution in canonical harmony and bisyllabic trigger harmony. The spreading ranking in (34b) is capable of achieving the canonical harmony pattern, including the cross-syllable linkage associated with initial licensing. We will see below that both subhierarchies are unambiguously active in the bisyllabic trigger pattern.

<sup>11</sup> Zhang and Dresher (1996) raise an interesting point of contrast in the patterning of high vowels in Tungusic round harmony *versus* the round harmony found in modern Mongolian languages, such as Khalkha. In Tungusic round harmony, high front unrounded vowels are opaque, as seen in (4). However, in Khalkha, [i] is transparent to round harmony (e.g., [mɔrin-ɔ:s] ‘horse’ (abl.), Svantesson (1985, p. 312)). The details of the analysis of transparent vowels are peripheral to the main issues examined here; however, they could be handled in conjunction with the approach to spreading proposed here either via violable EXPRESSION constraints (Cole and Kisseberth 1994; see also Goldrick and Smolensky 1999 on Turbidity) or along the lines of a sympathetic faithfulness approach (Walker 1998).

## 4. ANALYSIS OF TRIGGER SIZE

At this point I turn to the problem of the two syllable trigger size. To recall the facts, some representative examples from CMA and Oroqen are given below. Recall that round spreading occurs when the first two syllables of the root contain round nonhigh vowels (35a). However, if only the first root syllable contains a nonhigh round vowel, spreading does not occur (35b). Initial licensing is also observed. Round nonhigh vowels occur in the second syllable only when following an initial nonhigh round vowel. Because of the bisyllabic trigger condition, this distribution is not attributable to spreading, as evidenced by the pairs in (35c).

(35)	<i>Classical Manchu</i>		<i>Oroqen</i>	
a.	dobno-no	‘go to offer’	olo:ro	‘boil’ (pres.)
b.	do-na	‘alight in swarm’	do:rə	‘mince’ (pres.)
c.	noron	‘longing’	bo:do	‘kitchen knife’
	noran	‘a pile of wood’	po:sə	‘winnowing fan’

Zhang and Drescher (1996) observe that although the two-syllable condition in CMA and Oroqen might suggest a source in prosody, they have not found evidence to connect the threshold condition and prosodic structure. They raise this possibility since the bisyllabic trigger requirement for round harmony resembles binarity conditions found on constituency in foot structure (though often in foot structure binarity may be satisfied either at the syllabic *or* moraic level, a property not true of Oroqen trigger size). Even so, it is not clear how this (partial) resemblance could be utilized to elucidate the trigger condition. Presumably if there were a connection, the trigger would be coincident with the head-foot, given that the stressed syllable is known to serve as the source for spreading in certain other harmonies (e.g., nasal harmony in Guaraní; Beckman 1998). However, in CMA and Oroqen, main stress is word-final (Li 1996, p. 20), signalling that the head-foot falls at the end of the word rather than the beginning where harmony is initiated.<sup>12</sup> Moreover, even if the trigger for round harmony and foot structure could somehow be matched, this would not itself solve the problem: the requirements that the trigger be a foot and that both syllables in the foot be underlyingly [Round] – not simply the stressed syllable – would still remain to be explained.

<sup>12</sup> In CMA primary stress is word-final except in non-imperative verbs, where it is penultimate.



In this section I develop an analysis of bisyllabic triggers that does not express a condition on the trigger for harmony – indeed, the notion of ‘trigger’ has no formal status in the theory but rather emerges from the interplay of independently-established phonological demands in the system. I argue that no reference to numeric quantity is required to explain the two-syllable threshold: this property arises directly from the interaction between the rankings that achieve the requirements of spreading and licensing in combination with a constraint on prosodic constituency that limits the links of a feature to a tautosyllabic domain.

#### 4.1. *The Tautosyllabic Feature Constraint*

A common property of the spreading and licensing requirements is that they each produce representations in which [Round] spans more than one syllable. Consequently, they work in opposition to a constraint restricting [Round] to a tautosyllabic domain, that is, banning cross-syllable feature linkage. I will argue that this conflict is essential to producing bisyllabic triggers. First, it is important to establish the precise content of the tautosyllabicity requirement. Stated informally, it requires that if an occurrence of a feature specification [Round] is dominated by some syllable, then that syllable uniquely dominates that occurrence of [Round].

The restriction of links of a given element to the domain of a certain prosodic constituent is not a new concept in phonology. It is basic to the requirement of *crisp edges* for a phonological category (PCat) (Itô and Mester 1999). A given PCat is said to have crisp edges if all material belonging to that PCat is wholly contained within it – hence CRISPEGE[PCat] prohibits multiple linking between prosodic categories. Itô and Mester identify instances of CRISPEGE[PCat] functioning at various levels of the prosodic hierarchy. Crispness at the syllable level is needed for stem-suffix juncture phenomena in Axininca Campa and more generally to rule out geminates and similar cases of double-linking; CRISPEGE[Ft] is suggested to capture the distribution of ambisyllabicity in most dialects of English, and crispness at the level of PrWd figures in the Prosodic Morphology of Sino-Japanese.<sup>13</sup> In the present case, the relevant constraint-type is CRISPEGE[σ], which requires that the elements dominated by a syllable (e.g., segments, features) have no links to another syllable. I propose to extend the constraint scheme to allow the expression of feature-specific tautosyllabicity restrictions, as in (36) for [Round].

<sup>13</sup> Additional applications of Crisp Edge constraints are discussed in the work of Merchant (1995), Noske (1997), and Baker (2000).

(36) CRISPEGE( $\sigma$ , [Round]):

A syllable has crisp edges with respect to any occurrence of [Round] that it dominates.

The more formal definition that I propose for CRISPEGE( $\sigma$ , F) is given in (37) (with straightforward extension to the more general CRISPEGE(PCat, F)). This formulation of the constraint augments Itô and Mester's statement of CRISPEGE by making precise the characterization of violation assessment – the emphasis here is on the ill-formedness of the cross-syllabic element. This focus resembles that suggested in Bird's constraint on 're-entrant' structures (1995, p. 62), which bans representations in which a node of the structure is immediately dominated by more than one node (besides itself). In order to facilitate this characterization, aspects of Itô and Mester's formal definition are stated somewhat differently here, though it maintains their result: multiple linking across PCats is banned.

(37) CRISPEGE( $\sigma$ , F): ('TAUTOSYLL[F]')

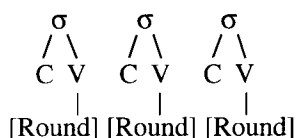
- i. Let  $s_i$  and  $s_j$  be variables ranging over the category of syllables  $\sigma$ ,  $f$  be a variable ranging over occurrences of the feature specification F, and  $s\delta f$  mean that  $f$  is dominated by  $s$ . Then for all  $f$  the following must hold:

$$(c) \quad \forall s_i[s_i\delta f \rightarrow \forall s_j[s_j\delta f \rightarrow s_j = s_i]]$$

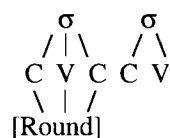
- ii. A mark is incurred for each occurrence  $f$  which falsifies (c).

Part (i) of (37) expresses the requirement that for every occurrence of a feature specification F dominated by some syllable, there is no syllable distinct from the first in which that feature occurrence is contained; that is, a feature occurrence cannot belong to more than one syllable. Consider the structures in (38). CRISPEGE( $\sigma$ , [Rd]) is violated in each of the structures in (38c–d), because a [Round] autosegment is linked across syllable boundaries; otherwise it is satisfied, as in (38a–b).

## (38)a.



## b.





Zoll (1996) observes that the mode of assessment of constraint violations needs to be made explicit (note also Beckman 1997, p. 19, who makes a similar move in formulating the principle of Feature-Driven Markedness). Part (ii) of (37) expresses that violations of feature tautosyllabicity are accrued for each offending feature (rather than by syllable). Every occurrence of a feature linked to more than one syllable will incur a violation, that is, one mark is assessed if a featural autosegment is linked to two syllables, as in (38d), or if it is linked to three or more syllables, as in (38c). Interestingly, this autosegmental evaluation matches that of Feature-Driven Markedness, discussed in section 3. Because of its feature-oriented interpretation, violation of a Crisp Edge constraint is gradient feature-wise but categorical syllable-wise. This bottom-up assessment of marks will prove to be critical in producing the parasitic constraint satisfaction that yields bisyllabic triggers. I take as the null hypothesis that the bottom-up interpretation is universal for Crisp Edge constraints; however, if further research were to reveal otherwise, it might conceivably be considered a parametric property.

Members of the family of CRISPEDGE( $\sigma$ , F) constraints will be violated by cross-syllable feature spreading in vowel harmony and they will be respected in cases of syllable-bound spreading. Feature spreading restricted to the syllable provides cross-linguistic evidence for this set of constraints: ranking CRISPEDGE( $\sigma$ , F) over the constraint producing spreading obtains the tautosyllabic domain. Examples of this sort include nasalization in Kaingang (Wiesemann 1972; Piggott and van der Hulst 1997), Cairene Arabic emphasis harmony (Lehn 1963; Broselow 1979), and Turkish palatalization and velarization of velar stops (Clements and Sezer 1982). The data in (39) illustrate syllable-bound spreading in Turkish (Turkic branch of the Altaic family).

(39)	<i>Palatalization</i>		<i>Velarization</i>	
	k <sup>j</sup> ir	‘dirt’	k <sup>v</sup> ur	‘meadows’
	tek <sup>j</sup>	‘single’	g <sup>v</sup> az	‘gas’
	g <sup>j</sup> yr	‘abundant’	k <sup>v</sup> ul	‘slave’
	døk <sup>j</sup>	‘pour’	ok <sup>v</sup>	‘arrow’
	k <sup>j</sup> yrk <sup>j</sup>	‘fur’	k <sup>v</sup> urk <sup>v</sup>	‘forty’
	nek <sup>j</sup> tar	‘nectar’	bok <sup>v</sup> sit	‘bauxite’
	hak <sup>j</sup> ik <sup>v</sup> at	‘truth’	mik <sup>v</sup> a	‘mica’

The examples on the left show bidirectional palatalization within the syllable conditioned by a front vowel, and those on the right show velarization in the context of a tautosyllabic back vowel. The activity of CRISPEDGE( $\sigma$ , F) is apparent here in the limit on the extent of spreading.

#### 4.2. No Trigger Threshold: Canonical Round Harmony

Having established the content of the tautosyllabic feature constraint, I now turn to the rankings needed for different trigger sizes in Tungusic round harmony, starting with those for canonical round harmony and then comparing the bisyllabic trigger languages.

In the canonical pattern (Ulcha), [Round] spreads from the first syllable with no condition on trigger size. The cross-syllable feature linkage produced by spreading violates the Crisp Edge constraint for [Round]. The spreading constraint thus supercedes CRISPEDGE( $\sigma$ , [Rd]), henceforth named by the more transparent referent ‘TAUTOSYLL(Rd)’. This is shown in (40), in combination with the ranking, IDENT- $\sigma_1$ (Rd)  $\gg$  SPREAD[Rd]if[–hi]  $\gg$  IDENT-OI(Rd), that was determined for round spreading. (UNIFORM[Rd] is omitted here, since I focus at this point only on forms with nonhigh vowels.) We see below that candidate (40a), which violates TAUTOSYLL(Rd), wins over alternatives that violate spreading (40b) and initial syllable faith (40c).

#### (40) SPREAD[Rd]if[–hi] $\gg$ TAUTOSYLL(Rd)

/gɔra/	IDENT- $\sigma_1$ (Rd)	SPREAD[Rd]if[–hi]	IDENT-OI(Rd)	TAUTOSYLL(Rd)
a. [gɔrɔ]Rd			*	*
b. [gɔ]Rdra		*!		
c. gara	*!			

As mentioned above, languages with canonical harmony can achieve the selection of any output with a [Round] feature linked across syllables with nonhigh vowels via the spreading constraint. Although the distribution

corresponding to round licensing also holds in the canonical patterns, this outcome can be credited either to IDENT- $\sigma_1$ (Rd) and SPREAD[Rd]if[–hi] outranking TAUTOSYLL(Rd) or to the licensing ranking (IDENT- $\sigma_1$ (Rd)  $\gg$  \*ROLO  $\gg$  IDENT-IO(Rd)) over TAUTOSYLL(Rd). The tableau in (41) shows the multiply-linked outcome for an input containing two round vowels. Though the licensing constraints are situated at the top of the hierarchy in the tableau, this does not represent a crucial ranking. As signalled by the parenthetical exclamation marks, fatal marks for candidates (41b) and (41c) can be attributed either to constraints that compose the licensing ranking or to the spreading constraint. If \*ROLO and IDENT-IO(Rd) were located below TAUTOSYLL(Rd), the multiply-linked candidate would still be selected as the winner.

- (41) Licensing via either SPREAD[Rd]if[–hi] or \*ROLO  $\gg$  IDENT-IO(Rd) dominating TAUTOSYLL(Rd)

/tɔŋdɔ/	IDENT- $\sigma_1$ (Rd)	*ROLO	IDENT-IO(Rd)	SPREAD [Rd]if[–hi]	IDENT-OI[Rd]	TAUTOSYLL (Rd)
a. [tɔŋdɔ]Rd		*				*
b. [tɔŋ]Rd[dɔ]Rd		**(!)		*(!)*		
c. [tɔŋ]Rdɔda		*	*(!)	*(!)		
d. tɔŋda	*!		**			

For canonical Tungusic round harmony, the ranking IDENT- $\sigma_1$ (Rd)  $\gg$  SPREAD[Rd]if[–hi]  $\gg$  IDENT-OI(Rd), TAUTOSYLL(Rd) will thus suffice, although the pattern is also consistent with high prioritization of the licensing ranking, as seen in many other Altaic languages.<sup>14</sup>

#### 4.3. Two-Syllable Threshold: Bisyllabic Trigger Round Harmony

Next I examine round harmony with bisyllabic triggers. I focus here on examples from CMA, but the same rankings will also apply to Oroqen. Recall that in this pattern progressive spreading of [Round] is observed only when the first two syllables contain round nonhigh vowels. In addition, a licensing effect is apparent for round vowels in the second syllable, that is, [CoCo], [CaCa], and [CoCa] words are well-formed in CMA, but \*[CaCo] is excluded.

I suggest that the primary difference between languages with bisyllabic trigger harmony *versus* those displaying the canonical pattern lies in the ranking of the tautosyllabicity requirement. In languages with canonical

<sup>14</sup> The mapping of hypothetical /CaCɔ/ inputs to [CaCa] in canonical harmony languages could be attributed to the licensing ranking \*ROLO  $\gg$  IDENT-IO(Rd) occurring anywhere in the hierarchy below IDENT- $\sigma_1$ (Rd). Alternatively, this outcome could be achieved by ranking SPREAD[Rd]if[–hi] over IDENT-IO(Rd).

harmony, spreading dominates TAUTOSYLL(Rd). In the case of bisyllabic triggers, the reverse ranking holds, i.e., SPREAD[Rd]if[-hi]  $\gg$  IDENT-OI(Rd) is situated below TAUTOSYLL(Rd). Round harmony is thus unable to spread [Round] from a single round syllable:

(42) TAUTOSYLL(Rd) dominates spreading ranking

	/tʃoban/	TAUTOSYLL(Rd)	SPREAD[Rd]if[-hi]	IDENT-OI(Rd)
☞	a. [tʃo]Rdban		*	
	b. [tʃobon]Rd	*!		*

On the other hand, the demand of licensing can force violations of round tautosyllabicity. This is evident in forms where the first two syllables are underlyingly round, e.g., /botʃo-/ ‘color’, which map to an output with a single [Round] feature linked to both syllables, satisfying licensing and violating TAUTOSYLL(Rd). In contrast to the case of canonical harmony, the multiple-linking here cannot possibly be attributed to the spreading constraint (compare (41)), because licensing of [Round] in the second syllable is independent of round harmony in bisyllabic trigger languages. Selection of the optimal output in (43a) over candidates (43b–c) indicates that the placement of \*ROLO and IDENT-IO(Rd) over the tautosyllabicity constraint is necessary.<sup>15, 16</sup>

(43) Licensing ranking supercedes TAUTOSYLL(Rd)

	/botʃo/	IDENT-σ <sub>1</sub> (Rd)	*ROLO	IDENT-IO(Rd)	TAUTOSYLL(Rd)
☞	a. [botʃo]Rd		*		*
	b. [bo]Rd[tʃo]Rd		**!		
	c. [bo]Rdtʃa		*	*!	
	d. batʃa	*!		**	

The ranking that has been established for the bisyllabic trigger languages thus far is one in which the set of constraints that achieves licensing dominates TAUTOSYLL(Rd), which in turn outranks the constraints that produce

<sup>15</sup> Since \*ROLO also drives cross-syllable linkage of [-high], it must additionally outrank TAUTOSYLL(-high).

<sup>16</sup> Unlike non-initial root vowels, nonhigh suffix vowels do not display a licensing distribution for rounding; rather they become [Round] only by virtue of spreading from the root. In the case of bisyllabic triggers a suffix thus has a round vowel only after a root with round vowels in the first two syllables, never after a monosyllabic round-vowel root. This pattern can be achieved by drawing on the intrinsic ranking of Root-Faith over Affix-Faith (McCarthy and Prince 1994b, 1995) in combination with the featural tautosyllabicity constraint. A likewise treatment is appropriate for CMO, where nonhigh suffix vowels are usually unround: they do not originate rounding and round spreading does not occur in the language.

spreading. Putting this together in (44), we achieve an intriguing result: the bisyllabic trigger condition arises directly from the constraint interaction. In a form where the first two syllables are underlyingly [Round], the force of the licensing constraints causes a single [Round] feature to be linked to the first two syllables, as in (44a–b) – alternatives lose to higher-ranked constraints. Both (44a) and (44b) tie on violation of TAUTOSYLL(Rd) (see highlighted portion of tableau). With tautosyllabicity violated in order to satisfy licensing, the decision is handed over to the spreading requirement. SPREAD[Rd]if[–hi] selects the form in which [Round] extends to the suffix vowel (44a); that is, there is spreading when the first two syllables are [Round].

- (44) TAUTOSYLL(Rd) intervenes between licensing and spreading rankings

	/bo̞t̞o̞ŋga/	ID-σ <sub>1</sub> (Rd)	*RoLo	ID-IO(Rd)	TAUTOSYLL (Rd)	SPREAD [Rd]if[-hi]	ID-OI(Rd)
a.	[bo̞t̞o̞ŋgo]Rd		*		*		*
b.	[bo̞t̞o̞]Rdŋga		*		*	*!	
c.	[bo]Rd[t̞o̞]Rdŋga		**!			****	
d.	[bo]Rd[t̞a̞ŋga		*	*!		**	
e.	bat̞a̞ŋga	*!		**			

What we see in (44) is that spreading prevails only when tautosyllabicity violations are independently compelled by a higher-ranked consideration, namely licensing. Because the minimal conditions under which licensing induces violation of TAUTOSYLL(Rd) are when the first *two* syllables are underlyingly round, the bisyllabic trigger condition simply emerges from the ranking without mention of the number two. Observe that in order to obtain this result it is essential that TAUTOSYLL(Rd) is assessed in relation to offending features rather than syllables (see (37ii)). A [Round] autosegment linked to two syllables or to three thus incurs equal violations, producing an ‘in for a penny, in for a pound’ effect for cross-syllable feature linkage. If a mark were instead accrued for each syllable with cross-linkage, (44a) would lose to (44b) on tautosyllabicity violations, predicting the wrong outcome.

Another point to note in (44) is that the separation of IDENT-IO(Rd) and IDENT-OI(Rd) is necessary to achieving selection of (44a) with the bisyllabic trigger effect. If a single IDENT(Rd) constraint were ranked below TAUTOSYLL(Rd), we would instead expect (44d) to win. Alternatively, if IDENT(Rd) were ranked over TAUTOSYLL(Rd), (44b) would be optimal. Connected to the IDENT-IO/OI split is a more general point that the sets of constraints that produce licensing and spreading are situated at different points in the hierarchy, though both are visibly active. The asymmetrical

ranking configuration of licensing and spreading is crucial to achieving the bisyllabic threshold. I will refer to the resulting constraint interaction as PARASITIC CONSTRAINT SATISFACTION, described formally in (45). It arises when there are two constraints or sets of constraint rankings,  $\alpha$  and  $\beta$ , each of whose satisfaction involves violating a third constraint,  $\gamma$ , and they are ranked:  $\alpha \gg \gamma \gg \beta$ . In this situation, provided that satisfaction of  $\beta$  incurs no violations of the intermediate constraint beyond those incurred in the satisfaction of  $\alpha$ , then  $\beta$  is satisfied only when violations of  $\gamma$  are independently compelled by  $\alpha$ . That is, satisfaction of  $\beta$  is parasitic on  $\alpha$ .

(45) *Parasitic Constraint Satisfaction:*

Let  $\alpha$  and  $\beta$  be optimality-theoretic constraints whose satisfaction in some word,  $\omega$ , causes violation of a constraint  $\gamma$ . Then satisfaction of  $\beta$  is *parasitic* on satisfaction of  $\alpha$  if the constraints are ranked  $\alpha \gg \gamma \gg \beta$ , and  $\beta$  is satisfied in  $\omega$  only when  $\alpha$  is also satisfied in  $\omega$ , and the number of marks  $i$  incurred in  $\gamma$  for satisfaction of  $\alpha$  is equal to the number of marks  $j$  incurred for satisfaction of  $\alpha$  and  $\beta$  together.

An elegant result of calling on the PCS configuration is that it predicts two types of triggers cross-linguistically: (i) no size restriction (i.e., canonical harmony) and (ii) bisyllabic triggers. Because TAUTOSYLL(Rd) is violated when [Round] is linked across at least two syllables, the constraint is compatible with a bisyllabic minimum, but not a trisyllabic or quadrisyllabic requirement, a prediction that matches the attested patterns. The special status of binarity thus follows from the optimality-theoretic structure of the grammar.

This account credits TAUTOSYLL(Rd) with a pivotal role. Interestingly, Oroqen provides independent evidence for the activity of this constraint in Tungusic. Zhang (1996) describes a phenomenon wherein nonlabial consonants become labialized before nonhigh round vowels. Examples are given in (46a). (This detail was not shown in the previous phonemic transcriptions of Oroqen.)<sup>17</sup> Labialization does not occur before high round vowels, as seen in (46b).

- |        |                      |            |                      |         |
|--------|----------------------|------------|----------------------|---------|
| (46)a. | d <sup>w</sup> ɔ:    | ‘mince’    | n <sup>w</sup> ɔ:da: | ‘throw’ |
|        | k <sup>w</sup> ɔ:rgə | ‘bridge’   | k <sup>w</sup> ɔ:kan | ‘child’ |
| b.     | ku:mə                | ‘windpipe’ | tʉ:ra                | ‘read’  |
|        | gʉgda                | ‘high’     |                      |         |

<sup>17</sup> Zhang also notes that word-initially, a labial glide is inserted before a nonhigh round (long) vowel. Presumably this takes place to supply a syllable onset.



The data in (46a) show round spreading among segments within a syllable. I propose to view this phenomenon as a very general one: [Round] spreads to tautosyllabic segments from a nonhigh vowel. In this connection, two details of Zhang's description need some additional attention. First, Zhang does not transcribe coda consonants as labialized. While it might be the case that the labialization is purely regressive, in the absence of instrumental data to confirm this I will assume that the phenomenon involves bidirectional spreading within the syllable, though the labialization might not be well-perceived in codas. The fact that articulatory properties of coda consonants tend to be difficult to perceive has been widely discussed in the literature (see Steriade 1994; Padgett 1995b; Blevins to appear; and citations therein). The key observation is that codas tend to correlate with positions that are unreleased. In other words, segments in this position lack the offset phase of the consonantal constriction along with the burst that accompanies it, which is known to provide highly perceptible acoustic cues to contrasts such as place, including labialization. In an unreleased position, labialization thus might not be perceived, even if the rounding gesture is executed. Such consonants could accordingly be transcribed in fieldwork as nonlabialized.

The second detail concerns the status of short nonhigh vowels. Zhang reports that short vowels do not trigger consonant labialization. In this case, too, I suggest that phonological round spreading takes place, but it might not be well-perceived in this context. Although the detailed phonetic realization of the Oroqen vowels is not discussed by Zhang, a study of Oroqen (Baiyinna dialect) by Li (1996, p. 90) finds that long nonhigh vowels are produced with a greater degree of rounding than short nonhigh vowels. This suggests that the feature [Round] in long vowels is realized with a more exaggerated and perceptible lip-rounding gesture, translating to more perceptible labialization on neighboring consonants. In the environment of a short nonhigh vowel, the weaker execution of lip rounding could result in the failure for consonant labialization to be perceived and transcribed, even though the rounding gesture extends to consonants. These perceptual subtleties do not, however, deny the possibility that a more general round spreading is at play, namely, one in which [Round] spreads from all nonhigh vowels to tautosyllabic consonants.

Labialization triggered by nonhigh vowels can be attributed to a familiar constraint: SPREAD[Rd]if[–hi] – naming all segments as targets. The occurrence of consonant labialization within the syllable, even when round harmony does not take place, serves as an additional cue for the function of the [Round] tautosyllabicity constraint in the grammar of Oroqen. It provides further support for the ranking TAUTOSYLL(Rd) >>

SPREAD[Rd]if[–hi], consistent with the hierarchy determined for bisyllabic triggers above. Since labialization can produce structures in which [Round] is associated across more than one segment, this phenomenon signals that SPREAD[Rd]-if[–hi] outranks a constraint that prohibits cross-segmental linkage for [Round]: CRISPEGE(seg, [Rd]). (Evidence for the activity of a CRISPEGE(seg) constraint in another language is discussed in the next section.) The resulting hierarchy is illustrated in (47). In order to focus on the labialization here, the higher-ranked constraints producing the licensing distribution are not shown, and only candidates obeying initial-licensing are considered.<sup>18</sup>

- (47) Labialization: TAUTOSYLL(Rd)  $\gg$  SPREAD[Rd]if[–hi]  $\gg$  CRISPEGE(seg, [Rd])

	/nɔːdaː/	TAUTOSYLL(Rd)	SPREAD[Rd]if[–hi]	CRISPEGE(seg, [Rd])
a.	[n <sup>w</sup> ɔː]Rdɔːdaː		**	*
b.	n[ɔː]Rdɔːdaː		***!	
c.	[n <sup>w</sup> ɔːd <sup>w</sup> ɔː]Rd	*!		*

The optimal output in (47a) spreads [Round] from a nonhigh vowel to tautosyllabic consonants, violating the segmental Crisp Edge constraint. Candidate (47b), which obeys CRISPEGE(seg, [Rd]), is ruled out by an additional spreading violation. Comparison of (47a) and (47c) shows that although the spreading constraint can induce round spreading within the syllable, it is not strong enough to induce spreading across syllables. As seen in (44), cross-syllable spreading of [Round] occurs only when violation of TAUTOSYLL(Rd) is independently driven by licensing.

#### 4.4. Other Applications of Parasitic Constraint Satisfaction

The application of PCS ranking structures is not limited to bisyllabic triggers in vowel harmony. The approach suggests a possible explanation for another threshold effect in spreading, namely, a case seen in a reduplicative CV construction in the Petit Diboum dialect of Feʔfeʔ-Bamileke (Hyman 1972, 1973). Though high vowels are copied faithfully, a default vowel is substituted for nonhigh vowels in the reduplicant in this structure. In the general case (48a), the substituted vowel is high, back and unrounded, the ‘unmarked’ vowel quality for this language. However, there are two exceptions: the prefix vowel is [i] if the first consonant and vowel of the

<sup>18</sup> I will not be concerned here with the apparent nonparticipation of labial consonants in labialization, since it is peripheral to the present investigation. An explanation appealing to perceptual factors could be developed along the lines of Ní Chiosáin and Padgett (to appear). See also Zhang (1996, p. 165) for an alternative calling on the OCP.

base are each coronal (the consonant is alveolar or palatal and the vowel is front), as in (48b), and the prefix vowel is [u] if the first consonant and vowel are both peripheral (the consonant is velar or labial and the vowel is back and round, qualities characterized by Hyman (1972) as [+grave]), as in (48c).<sup>19</sup>

(48)a.	pe:	'to hate'	→ pɯ-pe:	pɛn	'to accept'	→ pɯ-pɛn
	to	'to punch'	→ tɯ-to	cɔh	'to be severe'	→ cɯ-cɔh
	ke:	'to refuse'	→ kɯ-ke:	kæʔ	'to fry'	→ kɯ-kæʔ
b.	te:	'to remove'	→ ti-te:	tɛn	'to stand up'	→ ti-tɛn
	tæʔ	'to bargain'	→ ti-tæʔ	je:	'to see'	→ ji-je:
	cɛn	'to moan'	→ ci-cɛn	cæʔ	'to trample'	→ ci-cæʔ
c.	pɔh	'to be afraid'	→ pu-pɔh	mo	'to kill time'	→ mu-mo
	ko	'to take'	→ ku-ko	kɔh	'to be small'	→ ku-kɔh

The generalization is that the substituted vowel agrees with the base vowel in color (backness/rounding) only when the first consonant and vowel of the base agree in color. This can be analyzed as the result of spreading of color from the base to the default prefix vowel: a spreading that is only initiated when color features are linked to *two* segments; that is, there must be a bisegmental trigger. A parallel analysis to the bisyllabic trigger one immediately suggests itself. A constraint prohibiting cross-segmental feature linkage dominates a constraint driving spreading from root to prefix, preventing spreading from taking place (hence the default [ɯ]). The spreading constraint can only be satisfied when violation of the cross-segment linkage constraint is otherwise compelled, as in the case where the first consonant and vowel of the base share color. This is an instance of PCS: satisfaction of spreading is dependent on the cross-segmental linkage violations induced by a higher-ranked constraint.

The basic approach is sketched in (49–50). The high-ranked constraint promoting feature linkage between a consonant and vowel that agree in color is an OCP constraint that forbids separate instances of matching color features occurring in adjacent segments. This constraint, or the combination of constraints that produce this outcome, I have called OCP(color).<sup>20</sup> OCP(color) outranks CRISPEGE(seg, color), and this in turn dominates SPREAD(color). An example with a bisegmental trigger is given in (49).

<sup>19</sup> Thanks to Scott Myers for bringing these data to my attention.

<sup>20</sup> See Itô and Mester (1996) and Alderete (1997) for proposals that OCP effects may be derived by self-conjunction of feature markedness constraints. In making reference to the class of color features, I assume the basis proposed in Feature Class Theory (Padgett 1995a).

The top-ranked OCP(color) is satisfied by a consonant-vowel representation in which a single instance of a color feature is linked to both segments, as in (49a–b). It rules out (49c), where two separate [Coronal] feature specifications occur on the consonant and vowel in the root.<sup>21</sup> Candidates (49a–b) tie again on CRISPEGE(seg, color): following (37) they each incur one mark for a multiply-linked instance of [Coronal]. SPREAD(color) is the deciding constraint. It selects (49a), in which [Coronal] spreads to the prefix vowel, over (49b), where spreading to the prefix fails. (Only violations of root [Coronal] spreading are marked here.)

- (49) Bisegmental trigger: OCP(color)  $\gg$  CRISPEGE(seg, color)  $\gg$  SPREAD-COLOR

	/RED-te:/	OCP(color)	CRISPEGE(seg, color)	SPREAD-COLOR
<sup>us</sup> a.	[ti-te:] <sub>Cor</sub>		*	
b.	tuu-[te:] <sub>Cor</sub>		*	*!*
c.	tuu-[t] <sub>Cor</sub> [e:] <sub>Cor</sub>	*!		*****

Crucially, the CRISPEGE violations in (49) are driven by OCP(color), producing the conditions for parasitic satisfaction of spreading. In forms where the OCP constraint is satisfied without requiring violation of CRISPEGE, spreading fails, yielding a default prefix vowel, as in (50). Hence there must be a bisegmental trigger.

- (50) Unitary feature linkage fails to trigger spreading

	/RED-to/	OCP(color)	CRISPEGE(seg, color)	SPREAD-COLOR
<sup>us</sup> a.	tuu-[t] <sub>Cor</sub> <sup>o</sup>			***
b.	[ti-t] <sub>Cor</sub> <sup>o</sup>		*!	*

The PCS configurations that we have seen thus far could be regarded as a special circumstance of the emergence of the unmarked (TETU; McCarthy and Prince 1994a). The familiar ranking that gives rise to TETU interleaves a constraint on phonological structure between faithfulness constraints for separate domains. For instance, in the ranking Faith-IO  $\gg$  Phono-constraint  $\gg$  Faith-BR, the force of the Phono-constraint will not be apparent in input-output mappings, since it is outranked by Faith-IO. However, it will become visible in Faith-BR mappings, producing TETU in reduplication. The binary trigger conditions can be viewed as another kind of TETU effect arising in a different ranking structure. A Crisp Edge constraint dominates a spreading constraint, restricting the force of spreading in the general case. However, the supercedence of edge crispness by

<sup>21</sup> I assume here that the feature specification shared by [t] and [e:] is [Coronal], but this particular choice of feature characterization is not essential to the analysis.

another requirement that produces cross-category feature linkage, such as the OCP or licensing, allows the spreading constraint to become apparent strictly in contexts where the higher-ranked constraint (set) neutralizes the limiting effect of Crisp Edge. In other words the PCS configuration enables the activity of a dominated Phono-constraint to emerge in a specific environment.

Although the binary triggers might be recognized as a kind of TETU, not all PCS cases could fall under this rubric. In instances where a faithfulness constraint achieves parasitic satisfaction, the outcome is an emergence of the faithful. An example of this type can in fact be found among the core rankings established for the rounding patterns examined here, namely, the licensing ranking:  $\text{IDENT-}\sigma_1(\text{Rd}) \gg *ROLO \gg \text{IDENT-IO}(\text{Rd})$ . Note the elements of the PCS configuration:  $*ROLO$  outranks  $\text{IDENT-IO}(\text{Rd})$  with the result that nonhigh round vowels are excluded in the general case (i.e., [CaCo] is ill-formed); however, the placement of  $\text{IDENT-}\sigma_1(\text{Rd})$  admits structures in which nonhigh round vowels occur in the initial syllable (i.e., [CoCa]). Parasitic satisfaction occurs in a form that has two nonhigh round vowels underlyingly. The tableau illustrating the outcome here is repeated below (from (25)).  $\text{IDENT-}\sigma_1(\text{Rd})$  and  $*ROLO$  rule out candidates (51d) and (51b), which lose initial rounding or do not license [Round], respectively. The remaining two candidates tie on violations of  $*ROLO$ . The decision falls to  $\text{IDENT-IO}(\text{Rd})$ , which chooses the output in (51a) that preserves rounding in both syllables. This is a classic emergence of the faithful under PCS: the activity of  $\text{IDENT-IO}(\text{Rd})$  with respect to nonhigh vowels becomes visible only when a violation of  $*ROLO$  is necessitated by higher ranking  $\text{IDENT-}\sigma_1(\text{Rd})$ .

(51) Parasitic licensing of [Round]

	/monɣol/	$\text{IDENT-}\sigma_1(\text{round})$	$*ROLO$	$\text{IDENT-IO}(\text{Rd})$
a.	[monɣol] <sub>Rd</sub>		*	
b.	[mon] <sub>Rd</sub> [ɣol] <sub>Rd</sub>		**!	
c.	[mon] <sub>Rd</sub> ɣal		*	*!
d.	maŋɣal	*!		**

The occurrence of PCS effects with both Phono-constraints and faithfulness constraints suggests that these kinds of constraint interactions may prove to be fairly widespread once ongoing research is directed towards identifying such phenomena. By way of counterpoint, however, it is worthwhile to note that bisyllabic trigger conditions are comparatively rare. This might be attributable to the fact that the data to cue the restriction are relatively subtle. In languages with bisyllabic triggers, [CoCa] words are the only structures that signal the PCS ranking structure. All other forms are

compatible with a canonical harmony ranking – indeed, it took some time before the bisyllabic trigger generalization was uncovered by researchers documenting these languages. It is conceivable that language change tends to develop away from such subtleties when the set of forms to reveal them is not very robust. For instance, if the number of [CoCa] words in a bisyllabic trigger language were few, subsequent generations of speakers could possibly generalize a canonical harmony pattern on the basis of the preponderance of words. The [CoCa] words might then gradually evolve into normalized [CoCo] structures or they might shift to the status of frozen exceptions (on a possible treatment of exception words in the lexicon, see Itô and Mester 1995). These matters of the prevalence of PCS rankings and the possibility that certain cases might be eschewed in language evolution are interesting issues for further research.

#### 4.5. *An Alternative Condition-based Analysis*

I turn briefly now to comparing a previous condition-based analysis of the two-syllable triggers. In their foundational study, Zhang and Dresher (1996) develop a rule-based account of round harmony with bisyllabic triggers. They express the restriction on triggers as a formal condition, a device common within the framework they adopt. The Syllable Condition that they propose for round harmony in CMA and Oroqen is as follows: “[Round] must be linked to two adjacent syllables of nonhigh vowels in a morpheme in order to spread” (p. 19).<sup>22</sup>

While the Syllable Condition is descriptively adequate, it does not supply an explanation for the stipulated restriction. On the other hand, the PCS analysis achieves the threshold effect through constraints with independent motivation in the system. Moreover, the Syllable Condition must state a numeric minimum on the trigger. This signals a serious drawback for the condition-based approach: there are no clear boundaries on what may constitute a possible trigger restriction. For instance, conditions requiring three-syllable minimums or higher can be formulated just as readily, although such requirements are wholly unattested. The fact that binarity has a special status here is left unexplained. The PCS analysis circumvents this problem by eliminating any reference to numbers. The two-syllable requirement is incidental to the constraint interaction, as the size-minimum stems directly from the PCS ranking structure. In this configuration, once any multiple linking is achieved, maximal multiple linking becomes optimal. Key to this result is the bottom-up reckoning of marks for tautosyllabic feature constraints. Thus, rather than declaring a two-

<sup>22</sup> The phrasing of this condition has been modified to conform to the terminology used in the present paper. I have substituted [Round] for [Labial] and nonhigh for low.

constituent threshold for triggers, the emergence of such phenomena in natural language is utilized to provide insight into how violations are levied for cross-constituent elements.

## 5. TYPOLOGICAL OVERVIEW

### 5.1. *The Ranking Relation between the Three Rounding Patterns*

In addition to elucidating conditions on trigger size, an aim of this research is to develop an account that reflects the relation between the three rounding patterns of licensing, canonical harmony, and bisyllabic trigger harmony. The preceding sections have established that these arise from the interplay of three major constraints or sets of constraints: licensing, spreading, and tautosyllabicity. In order to provide an overview of the differences and similarities between the language patterns, I present summary tableaux below, showing the outcome for a variety of input forms with different combinations of round and unround nonhigh vowels for each case. I then briefly address the potential extension of these constraints to some other rounding patterns in Altaic.

First, a summary of the rankings established for trigger size conditions in bisyllabic trigger languages *versus* those for canonical languages is given in (52). The important difference here is that the set of constraints that achieve spreading are ranked above tautosyllabicity in the canonical languages, but for bisyllabic trigger patterns, they have moved below TAUTOSYLL(Rd). A second point is that the set of constraints that produce licensing must dominate tautosyllabicity in bisyllabic trigger languages, but in canonical systems, given the placement of the spreading requirement over TAUTOSYLL(Rd), and the fact that licensing is obeyed in a subset of the cases that spreading is, the ranking of the licensing hierarchy in relation to the others is immaterial. It is the demotion of spreading that makes the force of licensing firmly apparent and produces the PCS ranking that yields bisyllabic triggers. In both languages, IDENT- $\sigma_1$ (Rd) is top-ranked. UNIFORM[Rd] could also be situated at this point in each hierarchy, but I have omitted it here, since the focus in this section is on the different outcomes seen in forms with nonhigh vowels.

- (52)a. Canonical harmony: Spreading supercedes tautosyllabicity  
 $ID-\sigma_1(Rd) \gg \underbrace{SPREAD[Rd]if[-hi]}_{Spreading} \gg ID-OI(Rd), (*RoLo \gg ID-IO(Rd)) \gg$   
 $TAUT-\sigma(Rd)$  *Licensing*

- b. Bisyllabic trigger: Tautosyllabicity supercedes spreading  
 $ID-\sigma_1(Rd) \gg \text{Licensing} \gg ID-IO(Rd) \gg TAUT-\sigma(Rd) \gg$   
 $\text{SPREAD}[Rd]if[-hi] \gg ID-OI(Rd)$   
*Spreading*

For verification of the hierarchy for canonical harmony, the outcomes for three key inputs (represented schematically) are presented in (53). In this tableau, I have located the licensing constraints above  $TAUTOSYLL(Rd)$ , since this is consistent with its most common placement in Altaic.

(53) Canonical round harmony

		$ID-\sigma_1(Rd)$	$SPREAD[Rd]$	$ID-OI(Rd)$	*RoLo	$ID-IO(Rd)$	$TAUT-\sigma(Rd)$
/CoCo/	$\epsilon^{\sigma}$ a.[CoCo]Rd				*		*
	b.[Co]RdCa		*(!)		*	*(!)	
	c.[Co]Rd[Co]Rd		*(!)*		**(!)		
	d. CaCa	*!				**	
/CoCa/	$\epsilon^{\sigma}$ a.[CoCo]Rd			*	*		*
	b.[Co]RdCa		*!		*		
/CaCo/	$\epsilon^{\sigma}$ a. CaCa					*	
	b. Ca[Co]Rd		*(!)		*(!)		
	c. [CoCo]Rd	*!		*	*		*

The summary tableau for the bisyllabic trigger pattern is contrasted in (54):

(54) Bisyllabic trigger harmony

		$ID-\sigma_1(Rd)$	*RoLo	$ID-IO(Rd)$	$TAUT-\sigma(Rd)$	$SPREAD[Rd]$	$ID-OI(Rd)$
/CoCo/	$\epsilon^{\sigma}$ a.[CoCo]Rd		*		*		
	b.[Co]RdCa		*	*!		*	
	c.[Co]Rd[Co]Rd		**!			**	
	d. CaCa	*!		**			
/CoCa/	$\epsilon^{\sigma}$ a.[Co]RdCa		*			*	
	b.[CoCo]Rd		*		*!		*
/CaCo/	$\epsilon^{\sigma}$ a. CaCa			*			
	b. Ca[Co]Rd		*!			*	
	c. [CoCo]Rd	*!	*		*		*
/CoCo-Ca/	$\epsilon^{\sigma}$ a.[CoCoCo]Rd		*		*		*
	b.[CoCo]RdCa		*		*	*!	
	c.[Co]RdCaCa		*	*!		**	

Let us compare now the cases of round licensing and canonical harmony. Both patterns display a licensing distribution, but while spreading is seen in canonical harmony, it is not active in the round licensing pattern. To prevent spreading from occurring in languages that display only round licensing,  $ID-IO(Rd)$  must dominate  $SPREAD[Rd]if[-hi]$ . The rankings for licensing alone *versus* harmony are contrasted in (55). Note that in the licensing constraint hierarchy,  $TAUTOSYLL(Rd)$  must be ranked below the complex of constraints producing licensing, since licensing is what



yields multiply-linked representations. I have listed the no-spreading ranking, IDENT-OI(Rd) >> SPREAD[Rd]if[-hi], at the bottom of the hierarchy together with TAUTOSYLL(Rd); however, the constraints that produce no-spreading could in fact be located anywhere in the hierarchy below IDENT-σ<sub>1</sub>(Rd).

- (55)a. Canonical harmony: Spreading ([Round] spreads to unround)  
 ID-σ<sub>1</sub>(Rd) >> SPREAD[Rd]if[-hi] >> ID-OI(Rd), (\*RoLo >> ID-IO(Rd)) >>  
*Spreading* *Licensing*  
 TAUT-σ(Rd)
- b. Round licensing: No-Spreading ([Round] does not spread to unround)  
 ID-σ<sub>1</sub>(Rd) >> \*RoLo >> ID-IO(Rd) >> ID-OI(Rd) >> SPREAD[Rd]if[-hi],  
*Licensing* *No-Spreading*  
 TAUT-σ(Rd)

The above contrast reflects the historical development of Mongolian. CMO displayed just licensing, but in Khalkha, this developed into full round harmony among the nonhigh vowels. From an optimality-theoretic perspective, this amounts to a demotion of IDENT-OI(Rd) below the spreading constraint in the transition from CMO to Modern Mongolian.

Again, to verify the hierarchy, outputs for three key forms under licensing are given in (56).

(56) Round licensing

		Id-σ <sub>1</sub> (Rd)	*RoLo	Id-IO(Rd)	Id-OI(Rd)	SPREAD[Rd]	TAUT-σ(Rd)
/CoCo/	ᠮᠣᠴᠣ a. [CoCo]Rd		*				*
	b. [Co]RdCa		*	*!		*	*
	c. [Co]Rd[Co]Rd		**!			**	*
	d. CaCa	*!		**			*
/CoCa/	ᠮᠣᠴᠠ a. [Co]RdCa		*			*	*
	b. [CoCo]Rd		*		*!		*
/CaCo/	ᠮᠣᠴᠠ a. CaCa			*			*
	b. Ca[Co]Rd		*!			*	*
	c. [CoCo]Rd	*!	*		*		*

5.2. Extensions to Other Rounding Distributions in Altaic

Next I briefly outline some additional rounding distributions in Altaic that can be obtained through different rankings among the set of constraints called on above to achieve licensing. See Kaun (1995) for rankings that achieve further round harmony patterns.

In Ola Lamut (Tungusic; Li 1996, p. 146), nonhigh rounded vowels are strictly limited to the initial syllable and there is no round harmony. As

in the languages examined above, this is a case where initial syllable faith outranks \*ROLO, which in turn outranks nonpositional faith for [Round]. However, non-initial round vowels may not be rescued in Ola Lamut by dependent linking to [Round] in the initial syllable. Here the constraint enforcing featural tautosyllabicity is consistently respected, so the Ola Lamut pattern is captured by ranking TAUTOSYLL(Rd) at the top of the hierarchy. West-Siberian Tatar (Turkic; Korn 1969, p. 103) is even more conservative: nonhigh round vowels are excluded in all positions – historically, nonhigh round vowels have raised to their high counterparts. In this case it is \*ROLO which is top-ranked, taking precedence even over initial syllable identity. Sanziani Manchu, one of the Modern Manchu dialects, represents the other extreme: post-initial round nonhigh vowels occur after round or unround vowels (Li 1996, p. 180; see this source for tracing of the historical remnants of round harmony). This distribution derives from the rise of nonpositional faith over markedness, producing a free distribution of rounding in nonhigh vowels. The ranking pattern of each of these languages exhibits a further variation on the possible hierarchies of the established constraints, as summarized below in (57). The constraint set is clearly a productive one, even within the Altaic family alone.

- (57)a. Ola Lamut: Nonhigh round vowels are limited to the initial syllable.  
 Ranking: TAUTOSYLL(Rd), IDENT- $\sigma_1$ (Rd)  $\gg$  \*ROLO  $\gg$  IDENT-IO(Rd)
- b. West-Siberian Tatar: Nonhigh round vowels are excluded in all positions.  
 Ranking: \*ROLO  $\gg$  IDENT- $\sigma_1$ (Rd), IDENT-IO(Rd)
- c. Sanziani Manchu: Nonhigh round vowels occur freely in all positions.  
 Ranking: IDENT-IO(Rd)  $\gg$  \*ROLO

Before closing this section, let us make note of one more pattern that the constraints adopted here are capable of producing. Thus far we have seen instances of spreading and licensing together and licensing without spreading. Another possibility that is predicted is round spreading without licensing. This pattern is achieved in a hierarchy where SPREAD[Rd]if[–hi] dominates IDENT-OI(Rd) to produce round spreading, but IDENT-IO(Rd) outranks \*ROLO, so that round nonhigh vowels may occur freely in post-initial syllables. If IDENT- $\sigma_1$ (Rd) were prioritized in the language, [Round] could then appear in a post-initial syllable following an initial unrounded

vowel. This distribution is generally difficult to find, since licensing is widely enforced in Altaic, where round harmony is richly attested. However, plausible signs of the pattern are developing in Ordos, a Mongolian dialect. Mostaert (1926–1927) observes that after an initial syllable containing [i], nonhigh round or unround vowels may occur (58a). Yet the language exhibits round spreading, as seen in (58b).

(58)a.	$\widehat{d}z\text{iro}$ :	‘amble’	$\widehat{d}z\text{ilan}$	‘lean’
	idonon	‘last year’	idex $\widehat{k}xy$	‘to eat’
b.	$\widehat{t}j\text{oxor}$	‘speckled’	* $\widehat{t}j\text{oxar}$	
	oht <sup>h</sup> ok	‘Ordos banner’	*oht <sup>h</sup> ak	
	$\emptyset$ :rg $\emptyset$ n	‘broad’	* $\emptyset$ :rgen	

The above data indicate characteristics of a language with round spreading but no licensing. The absence of licensing seems to be a developing property in Ordos. According to Mostaert’s description, round nonhigh vowels do not occur following an initial nonhigh unrounded vowel, i.e., while [CiCo] words are attested, [CaCo] forms are not. The fact that the loss of licensing has evolved in words containing [i] in the initial syllable might be connected to the neutrality of [i] in Mongolian round harmony patterns. It is conceivable that the absence of words with other unrounded vowels before a nonhigh rounded vowel stands as a residue of the historical development at this stage. A study of modifications in rounding patterns in recent borrowings could prove fruitful in further investigation of this possibility.

From a wider theoretical perspective, the potential for patterns of spreading without licensing comes about through the split of IDENT-IO/OI(F) constraints. In order for a form like [CiCo] to be optimal in a language with round spreading, it is necessary not only for there to be a no-licensing ranking, but also IDENT-IO(Rd) must outrank SPREAD[Rd]if[–hi] to prevent vacuous satisfaction of spreading via deletion of rounding in the second syllable, as illustrated in (59). Of course, if there is active spreading in the language in general, SPREAD[Rd]if[–hi] must dominate IDENT-IO(Rd), yielding an asymmetrical ranking for IO and OI faith.

## (59) No licensing combined with an active spreading ranking

	/d̥ʒiro:/	ID-σ <sub>1</sub> (Rd)	ID-IO(Rd)	*ROLO	SPREAD[Rd]if[-hi]	ID-OI(Rd)
⊕	a. d̥ʒi[ro:]Rd			*	*	
	b. d̥ʒira:		*!			
	c. [d̥ʒyro:]Rd	*!		*		*

If IDENT were instead bidirectional, then this single constraint would have to outrank \*ROLO in a language without licensing. To achieve spreading, the spreading constraint must dominate IDENT(Rd), since it compels faithfulness violations. However, these rankings in combination actually produce a spreading and licensing distribution. [Round] in a non-initial syllable is lost in order to satisfy the spreading constraint, as seen in (60). Rounding in a nonhigh vowel will only be retained when it originates in an initial syllable (as determined by initial syllable faith) or when it is post-initial but can be licensed by a specification originating in the initial position.

## (60) Bidirectional IDENT(Rd): spreading implies licensing

	/d̥ʒiro:/	IDENT-σ <sub>1</sub> (Rd)	SPREAD[Rd]if[-hi]	IDENT(Rd)	*ROLO
⊕	a. d̥ʒira:			*	
⊕	b. d̥ʒi[ro:]Rd		*!		*
	c. [d̥ʒyro:]Rd	*!		*	*

If I → O and O → I faith for features were not separated, it is not clear how a rounding pattern like that seen in Ordos would be handled. The IDENT-IO/OI separation also plays a crucial role in the analysis of bisyllabic triggers proposed here. Research on phenomena involving other features provides further reason to believe that this split is necessary in the IDENT family. See, for example, McCarthy and Prince (1995, 1999), Pater (1999), Lombardi (1995), and Pulleyblank (1996) (the latter two assume separate MAX and DEP constraints for features rather than IDENT-IO/OI, but with similar effect). The occurrence of harmonies involving other features that display spreading without a licensing distribution additionally signals a need for the theory to admit patterns of this type. Examples include emphasis harmony (Davis 1995; Watson 1999), nasal harmony (Walker 1998), and vowel harmony in certain Mongolian dialects, where a [-ATR] or back vowel can occur following an initial [i] (e.g., Buriat, Ordos, Classical Mongolian; Svantesson 1985, p. 308). Hence, although licensing and spreading often occur together, the locus of explanation for this tendency cannot reside in a universal bidirectional formulation of IDENT(F) constraints – such a move would be too restrictive. However, the source of the

frequent correlation between these patterns remains an open question for further study.

## 6. AN ALTERNATIVE APPROACH TO INITIAL PRIVILEGE

The present account calls on positional faithfulness to achieve the special status of the initial syllable in Altaic rounding patterns. An alternative approach in OT to capturing effects of positional privilege in vowel harmony formulates the constraint in terms of positional markedness; that is, it requires that certain feature specifications (i.e., [Round]) be associated to some prominent position, such as the initial syllable or root (Ringen and Vago 1998). This approach differs from positional faithfulness because rather than preserving a feature-specification that originates in the initial position, it requires that a given feature specification originating in any position have a link to the initial syllable in the output. While positional markedness has been used fruitfully for floating features or feature transfer phenomena (see, e.g., Zoll 1996, 1997; Walker 1997), it is not appropriate for Altaic round vowel distributions, since the rounding quality of the first syllable remains consistently faithful: it is not overridden by the need to license a [Round] specification deriving from a non-initial syllable. Accordingly, suffixes never induce a rounding alternation in the initial syllable of a root.<sup>23</sup> Initial faithfulness is also seen in the historical development of polysyllabic roots. Though round licensing would not produce synchronic alternations within a root, diachronic evidence indicates that [Round] in a post-initial root vowel does not displace the rounding quality of the first syllable.

In the earliest stages of Mongolian, round nonhigh vowels were restricted exclusively to the initial syllable. In the CMO phase, the round licensing distribution developed and then in Khalkha this evolved into full round harmony. Interestingly, post-initial round nonhigh vowels normally developed only in words that had round nonhigh vowels in the initial syllable at some earlier stage; that is, the identity of rounding in the initial syllable was strictly obeyed in the evolution of licensing and spreading.

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<sup>23</sup> An affixed root structure is not in itself conclusive, however, since it could perhaps be independently explained by an asymmetry in root *versus* affix faithfulness (McCarthy and Prince 1994b).

Forms of type [CaCa] thereby remained unchanged, but [CoCa] developed into [CoCo] (Poppe 1955; Binnick 1980):

- (61) *Classical Mongolian* *Khalkha*  
 oron < \*oran ‘place’ øndøg < \*øndegen ‘egg’  
 øløs < \*øles- ‘to become hungry’ xodʒno < \*qojina ‘after’

These vowel changes reveal that inputs of the form /CoCo/, which would have mapped to [CoCa] at the early stages of Mongolian, were free to remain faithful to the non-initial rounding by the CMO phase and later. However, (hypothetical) /CaCo/ inputs regularly mapped to [CaCa] through all stages in the native vocabulary, and thus, initial rounding never emerged in a form that had previously appeared as [CaCa]. The generalization is one of positional faithfulness: the rounding quality of the initial syllable is maintained. Since positional markedness makes no reference to positional identity, it does not exclude [Round] from emerging in words that did not have initial [Round] at an earlier stage.

To illustrate the problem, let us briefly sketch the positional markedness approach to round licensing in Mongolian. First, in Ancient Mongolian, round nonhigh vowels were strictly limited to the first syllable. To achieve this positional limitation, a constraint LICENSE-ROLO would be undominated, requiring that [Round, –high] be linked to the root-initial syllable. Since licensing of [Round] in a non-initial syllable via linkage to the initial syllable is not permitted, TAUTOSYLL(Rd) is also undominated. In order for [Round] to ever survive in a nonhigh vowel, IDENT-IO(Rd) must outrank \*ROLO. Hence, an input of the form /CoCo/ will preserve rounding identity only in the first syllable, and /CaCo/ will lose non-initial rounding. (Since hypothetical inputs are considered here, schematic forms are used in tableaux.)

- (62) Initial round vowels only: LIC-ROLO, TAUTOSYLL(Rd) >> IDENT-IO(Rd) >> \*ROLO

		LIC-ROLO	TAUTOSYLL(Rd)	IDENT-IO(Rd)	*ROLO
/CoCo/	a.[Co]RdCa			*	*
	b.CaCa			**!	*
	c.[CoCo]Rd		*!		*
	d.[Co]Rd[Co]Rd	*!			**
/CaCo/	a.CaCa			*	*
	b.[CoCo]Rd		*!		*
	c.Ca[Co]Rd	*!			*

In later stages of Mongolian, round licensing developed, enabling non-initial [Round] to survive if linked to the initial syllable. TAUTOSYLL(Rd)

was thus demoted below IDENT-IO(Rd) alongside \*RoLo. /CoCo/ forms thereby map faithfully to the output, but now /CaCo/ inputs map to [CoCo]. This allows the possibility that round nonhigh vowels could develop in words that had an unround nonhigh vowel in the initial syllable at an earlier stage – a prediction that is not borne out.<sup>24</sup>

(63) Round licensing: Demotion of TAUTOSYLL(Rd)

		LIC-RoLo	IDENT-IO(Rd)	*RoLo	TAUTOSYLL(Rd)
/CoCo/	☞ a.[CoCo]Rd			*	*
	b.CaCa		*!		
	c.[Co]RdCa		*!	*	
/CaCo/	⊗ a.[CoCo]Rd			*	*
	☞ b.CaCa		*!		
	c.Ca[Co]Rd	*!		*	

Borrowings make a related point. Loan words in Modern Mongolian have been nativized to varying degrees. Some forms retain the vowel sequence as pronounced in the source language, even though this does not obey native round harmony, e.g., [avtobus-] ‘bus’ (Russian; Svantesson 1985). However, other words have been modified to conform with the native phonology. The examples in (64a) indicate that loans with non-initial [o] may lose the vowel or its labialization (Street 1962, p. 68). Inspection of transliterated borrowings listed in Lessing (1960) reveals that (semi-)nativized loans may also display raising of nonhigh round vowels following an unrounded vowel (64b).<sup>25</sup> Crucially, all nativizations remain faithful to [Round] in a nonhigh vowel in the initial syllable (64c). This is predicted by positional faithfulness but is not an implication of positional markedness.

<sup>24</sup> Note that IDENT-OI(Rd) cannot be called on to rule out the winning candidate for a /CaCo/ input in (63). In addition to round licensing, Khalkha displays round spreading, which is captured by SPREAD[Rd]if[–hi] ≫ IDENT-OI(Rd). The existence of active spreading in the language signals that IDENT-IO(Rd) dominates SPREAD[Rd]if[–hi] (i.e., [Round] does not delete in order to avoid violation of spreading). This places IDENT-OI(Rd) below IDENT-IO(Rd).

<sup>25</sup> For reasons of space, I will not elaborate the details of analysis of co-existing phonological patterns and exceptions. For possible treatments in OT of the different patterns and/or resolutions in the grammar for nonnativized or partially nativized borrowings *versus* the native vocabulary, see Itô and Mester (1995) on faithfulness rankings specific to different lexical strata and Inkelas et al. (1997) on prespecification.

(64)a.	ara:dʒi <u>y</u>	‘radio’	(Russian, <i>radio</i> )
	tara:ɡt <u>ər</u>	‘tractor’	(Russian, <i>tractor</i> )
b.	ʧas <u>u</u> y	‘diploma, patent’	(Tibetan, <i>bka-cog</i> )
	ɡely <u>ŋ</u> ma	‘young nun’	(Tibetan, <i>dge slong ma</i> )
	ʧaim <u>u</u>	‘mustard (plant)’	(Chinese, <i>kai-mo</i> )
	dar <u>u</u> ʧa	‘chief, superior’	(Persian, <i>dāroʧā</i> )
c.	joʧa	‘union’	(Sanskrit, <i>yoga</i> )
	doŋsol	‘congratulation’	(Tibetan, <i>mdongs gsol</i> )

## 7. CONCLUSION

This paper has argued that insight into languages with bisyllabic triggers can be gained by situating them in connection with the simpler related patterns of canonical round harmony and licensing. The resulting analysis achieves the bisyllabic threshold directly from the interaction of well-motivated constraints, in particular, by ranking a constraint on featural tautosyllabicity between the constraints producing licensing and those producing spreading. This configuration yields parasitic satisfaction of spreading when violations of tautosyllabicity are independently compelled by licensing. The fact that bisyllabic trigger languages exhibit both licensing and spreading emerges as significant: the occurrence of separately ranked constraints that each drive multiple feature linking are a critical element in producing trigger threshold effects. An elegant outcome of the PCS approach is the absence of any direct size requirement on the trigger; the binary minimum follows from the optimality-theoretic competition. Furthermore, this approach captures the connection between bisyllabic trigger patterns and the related canonical harmony and licensing patterns straightforwardly through minimal constraint reranking.

An innovation of the present account is the bottom-up assessment of tautosyllabicity violations for features. The account of licensing developed in this study also finds support for a bottom-up evaluation of structural markedness in the interpretation of feature co-occurrence constraints. The interaction of markedness and positional identity is shown to produce the licensing distribution in another PCS configuration – in this case one in which a faithfulness constraint attains parasitic satisfaction. Hence two kinds of outcomes are attested for PCS rankings: emergence of the un-



marked and emergence of the faithful. The discovery of other examples of parasitic interactions is a promising avenue for ongoing research.

A last point is that evidence is accrued here for positional identity constraints. These play a central role in explaining the special licensing and trigger status of the root-initial syllable along with the consistent preservation of its rounding quality. Positional markedness constraints are not suitable for the parasitic licensing effects examined here, because they cannot prevent features that originate in non-initial positions from superceding specifications in the initial syllable. This must provoke continued inquiry into the range of position-sensitive restrictions in language, and signals a need for careful diagnosis of whether their basis lies in positional faithfulness or markedness.

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