Working with licensing constraints

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1. Introduction

In this paper I will discuss the central role of licensing constraints (henceforth "LC's") in phonological systems and how they may be viewed as one of the principal engines of phonological events. LC's were originally designed to explain restrictions on the combinatorial properties of elements. Given a theory of phonological expressions (to be given below), the underlying assumption is that any syntactically well-formed combination of elements should be present in a phonological system *unless explicitly excluded*. Since, as far as we know, no language expresses the full range of theoretically possible combinations of elements, LC's were proposed as language-specific constraints on such possibilities. A subset of a small set of possible LC's is sufficient to define the lexical set of, say, nuclear expressions of a given linguistic system. Recent work has shown that the usefulness of LC's extend far beyond their original *raison d'être*. In particular it is a pleasure to recognise the two seminal articles of Monik Charette and Aslı Göksel (Charette and Göksel 1996, 1998) which have provided the leadership in this field and the inspiration for this present work. I will briefly review part of their work in a later section. In the following section, I give a succinct summary of the element theory of phonological representations.[1] This will make clear to the reader the types of representations to which LC's are applicable.

2. The element theory: a summary

2.1. Elements

E, the set of elements is defined below.

(1) E = {A, I, U, H, L, ?}

and an identity element, usually represented as "_" in phonological expressions. Each element is a monovalent, (potentially) interpretable phonological expression. Its actual interpretation depends on (i.) what phonological constituent (see below) dominates it and (ii.) whether it occupies a head or operator position within a phonological expression (see below).

2.2. Phonological expressions

All speech sounds are phonological expressions. A phonological expression is defined as an ordered pair

Phonological Expression = (O,H)

such that:

i. O • E (O possibly empty)
ii. H • E (possibly the identity element)
iii. H • O

By convention, the first member of the ordered pair is called the operator(s), the second, the head of the phonological expression. Expressions headed by the identity operator are called *headless*. All other expressions are called *headed*. The head of an expression is said to *license* its (set of) operators. By way of illustration consider the (Southern British) English set of stressed branching nuclei. They are represented in the following table:

(2)

({},A)	*far*
({},I)	*fee*
({},U)	*too*
({A},I)	*pay*
({A},U)	*foe*
({U},A)	*saw*

LC's involve the combinatorial possibilities of the elements A, I and U. We shall see in a later section that the elements H and L have their own licensing constraints, at least when they are manifestations of tone. The element ? is problematic and indeed may be spurious.[2] Limiting ourselves to A, I and U and following the definition of a phonological expression given above, we have the following possible (nuclear) expressions.

(3)

({},A)	({A},I)	({A,I},U)	({A},_)	({A,I,U},_)
({},I)	({A},U)	({A,U},I)	({I},_)	({},_)
({},U)	({I},A)	({I,U},A)	({U},_)	
	({I},U)		({A,I},_)	
	({U},A)		({A,U},_)	
	({U},I)		({I,U},_)	

We can see that there are 20 possible expressions involving the elements A, I and U. Columns 1, 2 and 3 contain headed expressions consisting of 1, 2 and 3 elements, respectively. Column 4 and 5 contain the headless expressions. The final expression in column 5 is the "empty" expression, containing no head and the empty set of operators. Table (2) contains far less than 20 expressions (6, to be exact) so LC's for English must be postulated in order to generate exactly those 6 expressions.

(4) English LC's (stressed branching nuclei)
  i. All expressions are headed.
  ii. I and U may not combine.
  iii. I must be a head.

LC (4i) states that all expressions must be headed. This eliminates all of the expressions in columns 4 and 5 of (3).

(5)

({},A)	({A},I)	({A,I},U)	~~({A},_)~~	~~({A,I,U},_)~~
({},I)	({A},U)	({A,U},I)	~~({I},_)~~	~~({},_)~~
({},U)	({I},A)	({I,U},A)	~~({U},_)~~	
	({I},U)		~~({A,I},_)~~	
	({U},A)		~~({A,U},_)~~	
	({U},I)		~~({I,U},_)~~	

LC (4ii) states that all expressions containing I and U are to be excluded. Note that some expressions have already been ruled out by (4i).

(6)

({},A)	({A},I)	~~({A,I},U)~~	~~({A},_)~~	~~({A,I,U},_)~~
({},I)	({A},U)	~~({A,U},I)~~	~~({I},_)~~	~~({},_)~~
({},U)	({I},A)	~~({I,U},A)~~	~~({U},_)~~	
	~~({I},U)~~		~~({A,I},_)~~	
	({U},A)		~~({A,U},_)~~	
	~~({U},I)~~		~~({I,U},_)~~	

Finally, LC (4iii) eliminates all expressions where I is not a head as seen below.

(7)

({},A)	({A},I)	~~({A,I},U)~~	~~({A},_)~~	~~({A,I,U},_)~~
({},I)	({A},U)	~~({A,U},I)~~	~~({I},_)~~	~~({},_)~~
({},U)	~~({I},A)~~	~~({I,U},A)~~	~~({U},_)~~	
	~~({I},U)~~		~~({A,I},_)~~	
	({U},A)		~~({A,U},_)~~	
	~~({U},I)~~		~~({I,U},_)~~	

The order in which these LC's are applied is, of course, irrelevant. Furthermore, as stated above, some phonological expression may be excluded by more than one LC. In sum, a small set of LC's can generate the set of permissible (nuclear) expressions in a given language. But is delimiting the set of permissible expressions the only work that LC's do? This is the question to which we turn in the next section.

3. LC's and Turkish vowel harmony: a discussion of Charette and Göksel (1996, 1998)

Given the form in which LC's are expressed, it is not unnatural to suppose that a licensing relation exists between head and operator of a phonological expression. Specifically, it has been suggested that heads of expressions may license their operators. For example, in many languages we note that the element A may occur as a head as in ({},A) but all expressions of the form (X,A) are illicit (where X represents some non-null subset of E, the set of elements). This constraint may be expressed as follows:

(8) A may not license operators.

Assuming this "intra-expression" licensing does exist, then the term *paradigmatic licensing* would be an appropriate expression to designate such licensing. Following this line, we can also suppose that inter-nuclear interactions such as vowel harmony involve a similar sort of licensing. We can term this type of licensing, *syntagmatic licensing*. With these terms in mind and with the understanding of how LC's work in the definition of expression-inventories as illustrated above, we can now formulate the contribution of Charette and Göksel as follows:

(9) The Charette-Göksel (CG) Hypothesis
Paradigmatic LC's are recapitulated syntagmatically.

Put simply, (9) means that the same LC's that define, say, the nuclear inventory of a language also define inter-nuclear relations as in vowel harmony. In their articles (see above) Charette and Göksel present detailed analyses of several Turkic languages. For illustrative purposes I will limit my discussion to their analysis of Turkish.

Charette and Göksel posit the following LC's for Turkish (1998: 71).

(10) i. Operators must be licensed[3]
ii. A is not a licenser
iii. U must be a head

The LC's in (10) generate the following phonological expressions for Turkish. Note that they allow for the "empty" expression shown in the final row of this table.

(11) Turkish Nuclear Expressions

Expression	Turkish Letter
({},A)	a
({},I)	i
({},U)	u
({I},U)	ü
({A},I)	e
({A},U)	o
({A,I},U)	ö
({},_)	ı

Now we can apply the Turkish nuclear LC's to the case of Turkish vowel harmony. The central claim of (9) is that the facts of Turkish vowel harmony can be derived from these LC's. Let us see how Charette and Göksel do this. I reproduce their table (Charette and Göksel 1998: 69) which displays the complete harmony facts of Turkish.

(12)

Stem	Gloss	Plural	2nd Pers. Poss.
kil	'clay'	*kil-ler*	*kil-in*
kül	'ash'	*kül-ler*	*kül-ün*
kul	'subject'	*kul-lar*	*kul-un*
kel	'bald patch'	*kel-ler*	*kel-in*
köy	'village'	*köy-ler*	*köy-ün*
kol	'arm'	*kol-lar*	*kol-un*
kas	'muscle'	*kas-lar*	*kas-ın*
kıl	'hair	*kıl-lar*	*kıl-ın*

I briefly summarise the facts shown in (12) below.

(13) Turkish vowel harmony
 i. All nuclear expressions may appear in the N_1[4] position.
 ii. Only ({},A) and ({},_) may appear in other positions.
 iii. I spreads from N_1 to any position.
 iv. U spreads only to a headless position.
 v. A does not spread.

Charette and Göksel proceed to derive the harmony facts in (13) from the Turkish LC's in (10). *A* is not a licenser (10ii) paradigmatically so *A* cannot license anything syntagmatically. Harmonic spreading is viewed by Charette and Göksel as a form of licensing. Thus, we can derive (13v). *U* must be a head (10iii) so *U* can only spread into a headless expression (13iv). *U* cannot spread to a position containing ({},A) since that expression is headed and, as (10iii) states, *U* must be a head. There are no LC's involving *I* and so *I* is expected to spread freely. Thus, we can derive (13iii).

Charette and Göksel's analysis gives us some rather fine-grained predictions. When *I* spreads to a recessive harmonic position containing *A* as a head (as in *kel-ler* < *kel-lar*) then *I* must appear as an operator. *I* can either be a head or an operator in an expression. It will happily occupy the operator position in the suffix vowel of *kel-ler*. Notice that *A* must not switch from head to operator in this situation, otherwise there would be no reason why the element *U* could not spread in like circumstances (e.g., *kul-lar* would become **kul-lor*). But this means that the 2 "e's" of *kel-ler* must be different: the first contains the expression ({A},I) whilst the second contains ({I},A). This means that the 2 "e's" of *kel-ler* must be pronounced differently since they do not have the same representation. As Charette and Göksel note, this is entirely correct: the 2 "e's" of *kel-ler* are indeed pronounced differently.

One may wonder if the appearance of the expression ({I},A) is not a violation of LC (10ii). In fact, it is not *A* that is licensing *I* in the operator position, but rather the *I* in the N_1 positions that licenses itself in the suffix vowel of *kel-ler*.

In sum, Charette and Göksel show that starting from a set of LC's and their hypothesis (9), the properties of Turkish vowel harmony can be derived. They need not be stipulated. In the next section I will show other properties of vowel harmony that are natural consequences of LC's. To illustrate this point I turn to Finnish vowel harmony.[5]

4. LC's and Finnish vowel harmony

Finnish vowel harmony can be succinctly expressed by viewing the following table.

(14)

Harmony	No Harmony	Neutral
"ü"	"u"	"i"
"ö"	"a"	"e"
"ä"	"o"	

Each column of (14) contains a set of nuclei which behave alike with respect to vowel harmony. Nuclei from column 1 may not co-occur with nuclei from column 2. The nuclei from column 3, the so-called "neutral vowels" may occur with nuclei from either column 1 or column 2 (but of course not both simultaneously). Is there any formal property shared by the vowels in each of these 3 columns that would allow for a natural expression of these harmony facts? The answer is provided by the licensing constraints necessary to generate the set of Finnish nuclear expressions, to wit

(15) Finnish LC's
i. All expressions are headed
ii. U must be a head

The LC's in (15) generate the nuclear expressions organised into the harmonic table (14) above.

(16)

Harmony	No Harmony	Neutral
({I},U) "ü"	({},U) "u"	({},I) "i"
({A,I},U) "ö"	({},A) "a"	({A},I) "e"
({I},A) "ä"	({A},U) "o"	

Comparing (16) with (14) is quite revealing. In (16) the formal properties of each subset of nuclear expressions stands out clearly. The "harmony" column is characterised as the set of all nuclear expressions containing *I* as an operator. The "no harmony" column is the set of all nuclear expressions not containing the element *I*. Finally, the "neutral" column is the set of all nuclear expressions containing *I* as a head. The expression of Finnish vowel harmony follows quite naturally from the LC-generated set of nuclear expressions.

(17) Finnish Vowel Harmony
If a nuclear expression in a phonological domain contains *I* as an operator, the element *I* must be present (as head or operator) in every nuclear expression in the phonological domain.

From (17) the facts of Finnish vowel harmony described above can be easily derived. No expression in the "harmony" column can co-occur with an expression from the "no harmony" column. All "harmony" expressions have *I* as an operator, and according to (17) every nuclear expression in the same domain must contain an *I*. But the expressions in the "no harmony" column are precisely those that do *not* contain *I*. Thus, mixing "harmony" and "no harmony" expressions violates (17). The "neutral" expressions, i.e. those containing *I* as a head, may freely co-occur with "harmony" expression. They satisfy the requirement that every expression of the domain must contain the element *I*. They do contain the element *I*. "Neutral" expressions may also co-occur with "no harmony" expressions. The requirement that every expression in a domain must contain the element *I* is limited to those expressions having *I* in the *operator* position. This is not the case for the "neutral" expressions.

There is a pleasing rigidity found in the relation between the Finnish LC's and Finnish vowel harmony. Given the inventory of Finnish nuclear expressions, we are obliged to postulate the set of LC's in (15). These LC's generate a set of expressions shown in (16) which provide the formal basis for distinguishing the 3 behavioural classes of nuclear expressions. Simply put, if Finnish didn't have the set of vowels that it has, it wouldn't have the vowel harmony that it has. Suppose for example Finnish had the following hypothetical vowel system:

(18)

Harmony	No Harmony	Neutral
({U},I) "ü"	({},U) "u"	({},I) "i"
({A,U},I) "ö"	({},A) "a"	({A},I) "e"
	({A},U) "o"	({U},A) "O"

We have simply replaced the expression ({I},A), with the expression ({U},A). Notice, however, that the LC's must change to reflect this new nuclear inventory. In fact they become identical to those of (4) without (4ii). A glance at (18) shows that there are no no longer formal properties that distinguish the columns. The element *I* is not an operator in any expression. This property cannot distinguish column 1 from column 3. Likewise, *I*-headed expressions are found in both column 1 and column 3. We have lost the formal characterisation of the "neutral" set of nuclear expressions. This example clearly illustrates the link between LC's and the possible harmonic systems associated with them. An English nuclear system could not coexist with a Finnish harmonic system.

5. LC's and tonal systems

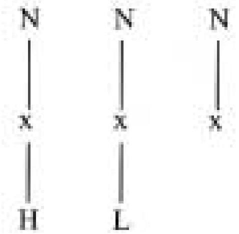
To this point we have considered LC's and their role in harmonic systems. The LC's involved in defining nuclear inventories were a subset of (1), viz. A, I and U. I will now consider two of the remaining elements, H and L, and their role in LC's that define certain tonal systems. To begin this discussion, I will present a very short theory of tones.[6]

Discussion of tonal systems is often quite confusing. For example, Mandarin (Putonghua) is said to have "4 tones". I will show that the use of *tone* in this context is inaccurate. What Mandarin has are 4 *tonal patterns*. This notion becomes crucial when I proceed to the elaboration of a theory of tones. I present the following definitions:

(19) A *tone* is part of nuclear expression associated to one or more skeletal positions.

Taking the simplest case, and assuming that the elements H and L mark "high tone" and "low tone" respectively, when they appear in the *operator* position of a nuclear expression, a single skeletal position may have at most 3 (level) tonal contrasts:

(20) Tonal expressions



In (20) the elements H and L are simply abbreviations for any nuclear expressions ({H,X},Y) and ({L,X},Y), respectively. They represent "high tone" and "low tone", respectively. The third structure of (20), covers the case where neither H nor L are present, i.e. any phonological expression (X,Y) where H •X & L •X. This is the so-called "toneless" or "mid tone" expression.

(21) Tonal Inventories
i. Simple: H or Toneless
ii. Complex: H, L or Toneless

I claim that tonal inventories are limited to two types: those that have 2 level tonal contrasts, the simple case, and those that have 3 level tonal contrasts, the complex case. I claim 2 tone systems are never ambiguous. In theory, we could have 3 possible 2 tone systems given the above definitions: H and Toneless, L and Toneless and H and L. My claim is that all 2 tone systems are H and Toneless. Furthermore, I must make the outrageous claim that all tonal systems purported to have more than 3 level tonal contrasts on a single position, are either misanalysed or mistranscribed.[7]

(22) Tonal Patterns

i. The scope of tonal patterns is a phonological domain.
ii. Tonal patterns are defined using LC's referring to the elements H and L.
iii. A tonal pattern must have a head which can be intrinsic or positional.
iv. H is an intrinsic head.
v. Tonal patterns are left-headed; N_1 is a positional head.

Tonal patterns are further subject to the following constraints. I would like to suggest that these constraints are universal.

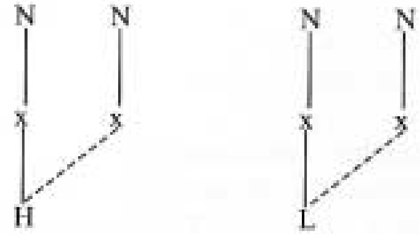
(23) Constraints and behaviour of tonal LC's

i. Extended OCP: A tonal element my only appear once in a tonal pattern.
ii. A tone spreads rightward from a head position to a toneless position.

Taken together (22) and (23) define the universal properties of tonal patterns. The extended OCP (23i) means that not only are successive identical tones excluded from a tonal pattern (the traditional OCP) but even non-adjacent identical tones are excluded. Thus tonal patterns, HH_ or H_H are both ruled out by (23i).

(23ii) states that tonal patterns H_ and L_ (where H and L occupy the head position of the pattern, typically N_1) are interpreted as follows.

(24) Tone spreading



(24) shows that the tones occupying the left (head) position of the pattern spread rightward to the toneless position being interpreted as "level high" and "level low", respectively. Note that without (22) and (23) we have the following logical possibilities for tonal patterns.

(25) t^n

where t represents the number of tonal contrasts and n, the number of nuclei in the pattern. Concretely, for a system containing 3 tonal contrasts and a pattern consisting of 2 nuclei, there are $3^2 = 9$ logical possibilities. These are given below:

(26)

H H	_H	L H
H_	_ _	L_
HL	_L	L L

The set of possible tonal patterns in (26) is immediately reduced by (23i) to (27).

(27)

~~H H~~	_H	L H
H_	_ _	L_
HL	_L	~~L L~~

The interpretation required by (23ii) yields the final result for tonal patterns consisting of 2 tonal markings.

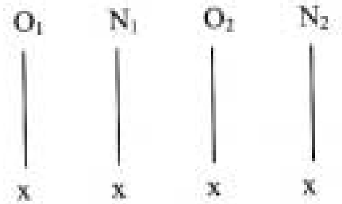
(28)

~~H H~~	_ H	L H
H _ = "H H"	_ _	L _ = "L L"
HL	_ L	~~L L~~

With these preliminaries out of the way, I can now proceed to a discussion of tonal licensing constraints in Mandarin.

Mandarin is said to have 4 "tones". This turns out to be mistaken. What Mandarin has, is 4 *tonal patterns*. The scope of these tonal patterns is phonological word. In the case of all Han languages studied to date, this pattern takes the form shown in (29) below.[8]

(29) The Han Template



The Han template consists of 4 positions: 2 onset-nucleus pairs. The Mandarin tonal patterns are expressed on the nuclear projection of (29), to wit, N_1, and N_2. Traditionally, Mandarin "tones" are described as follows:[9]

(30) Mandarin "tones"
i. High Level (tone 1)
ii. High Rising (tone 2)
iii. Low Rising (tone 3)
iv. Falling (tone 4)

In sum, Mandarin tonal patterns consist of one level tone, 2 rising tones and 1 falling tone My assumption is that this is not a random distribution of possible tonal patterns but that it follows directly from tonal LC's. I propose the following LC's for Mandarin:

(31) Mandarin Tonal LC's
i. Tonal inventory = complex (H, L, _)
ii. Mandarin tonal patterns have an intrinsic head.

(31i) stipulates that both H and L are available for tonal marking, along with toneless positions. From (31ii) and (22iii, iv) it follows that any Mandarin tonal pattern is licit provided that it contains the element H. A tonal pattern must have a head. Mandarin tone patterns have an intrinsic head. H is the intrinsic head. From the 7 possible tonal patterns given in (27), only 4 meet the requirements of (31). They are shown below.

(32) i. H _ ii. _ H iii. L H iv. H L

The patterns of (32) are all and only the tonal patterns containing the H element. Recall that according to (23ii), H _ must be interpreted as "H H". This leaves us with one level tonal pattern (32i), 2 rising patterns (32ii, iii) and one falling pattern (32iv). Of course this matches actual Mandarin tonal patterns (30) perfectly. In sum, acquiring the Mandarin tonal system involves only learning the content of (31). The actual tonal patterns follow from this theory of tones.

6. Conclusion

In this article I have tried to show that the use of LC's in phonology can be extended far beyond a mere catalogue of nuclear expressions. Work in this area is still in its infancy. The extension of LC's to non-nuclear systems such as onsets lies largely in the future. I believe that the examples given here serve as a strong indication that this direction of research will be extremely fruitful.

Notes

1. This section is drawn largely from (Kaye in prep. a).
2. For discussion of this point see (Jensen 1994).
3. This allows for headed expressions plus the "empty nuclear expression".
4. The N_1 position refers to the first nucleus in a phonological domain.
5. I am grateful to Lorna Gibb for discussion of Finnish vowel harmony.
6. More detailed discussion of this theory is to be found in (Kaye in prep. b).
7. This includes much of my work on Vata and other Kru languages where my sin was misanalysis.
8. See Chiu (1994) and Goh (1997) for discussion.
9. Frequently these so-called tones are described in terms of integers ranging from 0 to 5. I regard numbers as inappropriate for the analysis of tonal systems.

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Rules vs. constraints in modeling phonological change: the case of Raddoppiamento Fonosintattico*

Michele Loporcaro

0. Introduction

For those trained as linguists during the second half of the twentieth century, the notion of rule has come to be considered as a matter of course, as something intrinsic to our understanding of linguistic structure. Things have been changing recently, though. While the term "rule" continues to be used, there is now an increasing shift towards non-dynamic (i.e. static, or "declarative") models of linguistic description. In these models, whose most successful representative is nowadays Optimality Theory (henceforth **OT**), the grammar of any specific language is described as the product of a ranking of universal violable constraints selecting among candidate outputs. Thus, the rule component is dispensed with.

In this paper, I will tackle the question from the vantage point of phonological change. Many instances of change which were previously described as changes in the rule component have been recently reanalyzed within OT as the product of constraint re-ranking. Consider for instance Löhken's (1997) treatment of vowel lengthening in Middle High German. No lengthening rule is assumed (see e.g., the rule in Vennemann 1972: 191). At stage (1a) a constraint FILL-μ, preventing lengthening, outranks STRESS-μμ, imposing that all stressed syllables be bimoraic; the reverse is true in (1b), and this reversal represents the change.

(1) Löhken (1997): vowel lengthening in Middle High German (e.g., [tu.gent] > [tū.gent])