

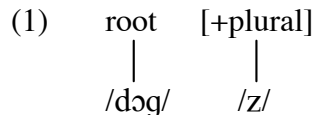
Item-and-Arrangement or Item-and-Process?¹

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Abstract. The choice of gender marker (or class marker) in Catalan masculine nominals is determined partially by a phonological constraint. In this paper this phenomenon is used to evaluate some differences between an Optimality Theory-based Item-and-Arrangement (IA) model, in which each morphosyntactic feature has a corresponding exponent (or more than one), and Item-and-Process (IP) models, in which words are built through processes, not by the addition of affixes. While an explanation of the phenomenon is fairly straightforward in the IA model, it runs into several problems under an IP model.

1. Item-and-Arrangement and Item-and Process morphology

Hockett (1954) coined the terms *Item-and-Arrangement* (IA) and *Item-and-Process* (IP) to refer to two different views of the mapping between phonological form and morphosyntactic (and semantic) information. In the IA model a word like *dogs* is viewed as a set of morphemes which include a root with its corresponding exponent or morph, *dog* /dɔg/, and a plural morpheme with its corresponding morph, *s* /z/. In this model, then, each piece of morphosyntactic information is paired with some morph or exponent. This relation appears schematized in (1).



In the IP model a word like *dogs* is viewed as the result of an operation, called by some authors a Word Formation Rule, that applies to a root paired with a set of morphosyntactic features, and modifies its phonological form. A Word Formation Rule for plural appears in (2a); its application to the word *dogs* is shown in (2b). An important point to bear in mind is that in this model the resulting phonological sequence, here /dɔgz/, is a single piece, not a composite of two morphs.

(2) a. Word Formation Rule for Plural

[+N]
[+Pl]
/X/ → /Xz/

b. [+N]
[+Pl]
/dɔg/ → /dɔgz/

In recent times the IA view of morphology has been argued for and developed in theories like Distributed Morphology (Halle and Marantz 1993). The IP model has been defended recently in works like Anderson (1992) and Aronoff (1994).

¹ The content of this paper is part of a talk (“In defense of a morphous morphology”) and subsequent discussion in a meeting of the Network Core Mechanisms of Exponence, coordinated by Jochen Trommer, held in Leipzig, January 11-12, 2008. All possible errors of interpretation of what was said are my own.

One of the main problems for the IA model is that often the mapping between morphosyntactic information and phonological information is not a one-to-one relationship. In some cases, for a given word there are more morphosyntactic features than morphs. For instance, in a Spanish verbal form like *miro* ‘I watch’ the ending *-o* (all there is leaving the root aside) could potentially be associated with features related to person, number, tense or, mood, to mention the more obvious options. Models like Distributed Morphology make available different types of mechanisms to account for such mismatches: fusion of morphosyntactic features, impoverishment (loss) of one or more morphosyntactic features, realization as \emptyset for certain features, etc. The question is then which are the more adequate operations in each case, the usual critique being that the model offers too many solutions to a given problem.² An even worse problem for the IA model is the existence of phenomena in which morphological information is not associated with a specific phonological segment or a sequence of segments but with a phonological feature, a discontinuous set of segments (as in root-and-pattern morphology), or a loss of segmental information (subtractive morphology), to name a few of them. In none of these cases is morphological information encoded in a phonological piece affixed to a stem. This is the type of evidence that led researchers like Anderson to argue for an IP model of morphology, as illustrated by the quotation in (3).

- (3) “If we accept the evidence that the range of morphological possibilities in natural languages includes some processes that cannot properly be represented as the addition of an affix, we must conclude that a general morphological theory should admit both affixational and non-affixational rules. Since a process-based approach naturally accommodates affixation, but not vice versa, the alternative we should prefer is to explore a theory of morphological processes.”

Anderson (1992: 68)

The goal of this paper is to show that, in spite of the existence of morphological phenomena that can be better viewed as processes, it is not true for all cases that “a process-based approach naturally accomodates affixation, but not vice versa.” The case that will be reviewed here is the choice of gender / class exponent in masculine nominals in Catalan. The paper is organized as follows: in section 2 the crucial facts of Catalan are presented. In section 3 it is shown how these facts can be accounted without any problem in an IA model of Optimality Theory. Section 4 is devoted to showing the types of problems an IP model has to face in dealing with the same facts. Finally, section 5 contains some concluding remarks.

2. Gender/class assignment in Catalan

In Catalan, most masculine nominals end in a consonant or a stressed vowel. In IA terms they are said to have a \emptyset morph for masculine. We can call this set *class 1*. The plural is formed by adding a final *s*, as in Spanish and other languages. Some examples of class 1 nominals appear in (4).

- (4) Catalan class 1 nominals
singular *plural*

² Oltra-Massuet and Arregi (2005), for instance, claim that the ending *-o* is the exponent of a terminal node that corresponds to the fusion of Tense and Agr.

llit	llits	‘bed(s)’
cor	cors	‘heart(s)’
mussol	mussols	‘owl(s)’
amic	amics	‘friend(s)’

A much smaller set of masculine nominals end in *o*, realized as /u/ in many dialects; let us call them *class 2*.

(5) Catalan class 2 nominals

<i>singular</i>	<i>plural</i>	
mico	micos	‘monkey(s)’
toro	toros	‘bull(s)’
lavabo	lavabos	‘bathroom’

So far, the basic system of gender-related vowels (or class markers or theme vowels, as are often called in the literature) is fairly similar to that of Spanish, the main difference being that in Spanish the more common exponent is *o*, not \emptyset .³ However, in Catalan there is a set of words which belong to class 1 in the singular but to class 2 in the plural. Some examples appear in (6).⁴

(6)	<i>singular (class 1)</i>	<i>plural (class 2)</i>	
	gos	gossos	‘dog(s)’
	cas	casos	‘case(s)’
	embús	embussos	‘obstruction(s)’
	peix	peixos	‘fish(es)’
	despatx	despatxos	‘desk(s)’

The set of words that show the pattern illustrated in (6) is not random; all the words share the property that they end in a sibilant. The presence of the *o* marker in the plural avoids having a sequence of sibilants (*[góss], *[péʃs], *[əmbúss], etc., which would be the outcome if the class 1, \emptyset , marker were chosen. Sequences of sibilants are categorically prohibited in Catalan, and the language resorts to different strategies to avoid this contact. The strategies used are fusion (between words), epenthesis (in cliticization), and the choice of a different exponent, as in the present case.⁵

3. An account in an Item-and-Arrangement model of Optimality Theory

³ Throughout this paper I will ignore the debate concerning the nature of endings in nominals, and I will be using, for convenience, either terms related directly to gender (like ‘masculine’) or class-related terms (like ‘class 1’). This question is tangential to the main issue under discussion.

⁴ In Catalan spelling, a *ss* sequence represents a single voiceless alveolar fricative; the sequence *ix* represents a postalveolar voiceless fricative.

⁵ For a description and an analysis of the different strategies used to avoid sequences of sibilants see Bonet and Lloret (2002).

Within Optimality Theory (OT), sequences of identical elements are penalized by the constraint OCP.⁶ And this constraint, here referring to sequences of sibilants, is ranked very high in Catalan. Other constraints have to determine what strategies are chosen to avoid the conflict. Some facts and aspects of the analysis I outline here for the choice of class marker in Catalan are ignored for the sake of argumentation; for a full analysis see Bonet, Lloret and Mascaró (2007).

As mentioned in section 2, most nominals in Catalan have a \emptyset exponent, while a much smaller set have the *o* /u/ exponent. This preference relation can be captured using Distributed Morphology notation as is done in (7).

- (7) Vocabulary Item for masculine
 [-feminine] \Leftrightarrow { \emptyset > u}

What (7) says is that the feature [-feminine], a terminal node, has two exponents, with a preference relation, and both exponents constitute the input to the phonology (they are inserted at the same time). Many cases of phonologically conditioned allomorphy have been studied in Optimality Theory, and many of the approaches assume multiple inputs (see, for instance, Mascaró 1996a,b, Tranel 1996, Perlmutter 1998 or Lapointe 1999). One crucial aspect of multiple inputs is that candidates with either allomorph do not violate faithfulness constraints; therefore the choice of allomorph is left to makedness constraints. The novelty in the present case is the preference relation between the allomorphs, a preference relation that has been argued for in Mascaró (2007), and Bonet, Lloret and Mascaró (2007). The faithfulness constraint that ensures that the less preferred allomorph is penalized is PRIORITY, informally defined in (8).

- (8) PRIORITY: Respect lexical priority (ordering) of allomorphs

In cases where there is no phonological conflict, PRIORITY favors the choice of the preferred allomorph, \emptyset , as illustrated in (9). The candidates (9a) and (9c) both have the \emptyset allomorph, but (9c) is ruled out because it has an epenthetic vowel (it appears underlined for clarity).

- (9) *gos* [gós] ‘dog’


/gos + { \emptyset > u}/	OCP	DEP	PRIORITY
a. \Rightarrow gós			
b. gósu			*!
c. gós <u>ə</u>		*!	

When the nominal masculine element is plural, the exponent of the [+plural] terminal element, /s/, also appears in the input. In this environment, OCP is violated when the \emptyset allomorph is chosen and nothing is done to prevent the contact between the sibilants, as shown in (10a). This fatal contact can be avoided if the less preferred allomorph /u/ is chosen, (10b), or if the preferred allomorph is chosen and an epenthetic vowel is inserted, as in (10c). The ranking DEP >> PRIORITY ensures that

⁶ OCP stands for *Obligatory Contour Principle*, the term coined by Leben (1973) to refer to sequences of identical tones.


the optimal candidate is the one that violates PRIORITY, the candidate with the /u/ allomorph, (10b).

(10) *gossos* [gósus] ‘dogs’

/gos + {∅ > u} + s/	OCP	DEP	PRIORITY
a. góss	*!		
b.  gósus			*
c. gósəs		*!	

When OCP is not violated in plural nominals, PRIORITY determines that the ∅ allomorph is chosen consistently. This is shown in (11).

(11) *cors* [kórs] ‘hearts’


/kɔr + {∅ > u} + s/	OCP	DEP	PRIORITY
a.  kórs			
b. kórus			*!

In a fairly small set of nominals the marked allomorph /u/ is chosen over ∅, as the examples in (5) illustrate. This choice has to be marked lexically somehow because it is not predictable. This lexical marking is assumed to be a subcategorization frame indicated by a subscript *u* on the root; a word like *toro* ‘bull’ has the root /tɔr_u/. The constraint that tries to ensure that subcategorization requirements are obeyed is RESPECT, informally defined in (12):

(12) RESPECT: Respect idiosyncratic lexical specifications

The tableau in (13) illustrates how words like *toro* are obtained. Notice that, in spite of the lexical specification, all masculine allomorphs appear in the input.

(13) *toro* [tór_u] ‘bull’

/tɔr _u + {∅ > u}/	RESPECT	PRIORITY
a. tór	*!	
b.  tór _u		*

As it has been shown, then, an IA approach, an approach based on affixes, combined with Optimality Theory can account in a fairly easy way for the distribution of masculine-related endings.

4. A possible account within an Item-and-Process model?

As mentioned in section 1, in IP models like Anderson (1992) or Aronoff (1994) inflected words are obtained through Word Formation Rules. In Anderson (1992) it is explicitly stated that the morphosyntactic representation of a given word consists of “an unordered list of its morphologically relevant features” (Anderson 1992: 90). The example in (14) illustrates this point. At the output of syntax the Georgian adjective

axalebi ‘new-PL-NOM’ that appears in (14a) consists of the root /axal/ plus an unordered set of morphosyntactic features, as in (14b).

- (14) a. (Anderson 1992, 139 (1g))
 es axalebi
 this new-PL-NOM
 “these new ones (nom. pl.)”
- b. $\left[\begin{array}{l} +N \\ +Pl \\ +Nom \end{array} \right]$
 /axal/

In order to obtain the right phonological expression of this set of features, two Word Formation Rules have to apply, one targeting the feature [+Pl] and the other one targeting [+Nom]. These word formation rules appear in (15).

- (15) Number and Case assignment in Georgian
- a. (Anderson 1992, 139 (2))
 $\left[\begin{array}{l} +N \\ +Pl \end{array} \right]$
 /X(a)/ → /Xeb/
- b. (Anderson 1992, 140 (4a))
 $\left[\begin{array}{l} +N \\ +Nom \end{array} \right]$
 /X/ = /Y[-Syllabic]/ → /Xi/

Crucially these two word formation rules have to apply in a fixed order to ensure that the output /axalebi/ and not */axalieb/ is obtained. This is illustrated in (16).

- (16) a. /axal/ $\xrightarrow{(15a)}$ /axaleb/ $\xrightarrow{(15b)}$ /axalebi/
- b. /axal/ $\xrightarrow{(15b)}$ /axali/ $\xrightarrow{(15a)}$ */axalieb/

Going back to Catalan, and following this type of approach, two Word Formation Rules can introduce class 1 and class 2; these rules appear in (17);⁷ an additional rule, (18), targets the [+plural] feature.

- (17) Possible word formation rules for classes
- a. $\left[\begin{array}{l} +N \\ \text{class 1} \end{array} \right]$
 /X/ → /X/

⁷ Anderson (1992) does not address the issue of noun classes, but Aronoff (1994) does. Here I adapt the approach in Aronoff (1994) for Spanish to the notation used in Anderson (1992).

- b. [+N]
 [class 2]
 /X/ → /Xu/

(18) Word formation rule for Number

- [+N]
 [+Pl]
 /X/ → /Xs/

These rules can apply with no problems to nominals that consistently belong to class 1 or class 2, as shown in (19). First the rules referring to the realization of classes apply, (17a) and (17b), and afterwards, through rule (18), the plural is realized.

(19)a. *cors* [kórs] ‘hearts’ (cf. *cor* [kór] ‘heart’):

- (17a) (18)
 /kór/ → /kór/ → /kórs/

b. *toros* [tórus] ‘bulls’ (cf. *toro* [tóru] ‘bull’):

- (17b) (18)
 /tóru/ → /tóru/ → /tórus/

However, a problem arises with nominals that belong to class 1 in the singular but to class 2 in the plural. This problem is illustrated in (19). First, rule (17a) applies to the stem *gos*, since it belongs to class 1 (at least in the singular); afterwards the word formation rule for plural adds the final *s*. At that point a sequence of sibilants is created, and the question is what to do next.

(19) *gossos* [gósus] ‘dogs’ (cf. *gos* [gós] ‘dog’):

- (17a) (18)
 /gos/ → /gos/ → /goss/ → ??

Since the rule realizing the class has already applied it cannot apply again; and, if it did, it would attach the vowel at the edge of the stem, not inside it (**/gossu/*), and that would not solve the OCP problem. The solution could be left to the phonology, since the problem is phonological. But then the question would concern the nature of the inserted vowel, the epenthetic vowel in (Eastern) Catalan being a schwa, [ə], as illustrated by the examples in (20).

- (20) [ə]stop pobl[ə] ‘village’
 [ə]scannejar ‘to scan’ vendr[ə] ‘to sell’

While [ə] is a typical epenthetic vowel, a completely unmarked segment, [u] is hardly ever chosen as an epenthetic vowel in any language, unless some copy mechanism favors it.⁸ In this case, moreover, this epenthetic segment would be restricted to masculine nominals. A purely lexical solution to the problem should also be rejected. Saying that there is a set of items that are lexically specified as belonging

⁸ On vowel quality in epenthesis see, for instance, Uffman (2006).

to class 1 in the singular and to class 2 in the plural would be just a way of restating the facts, plus it would miss the generalization that this difference in behavior is due to a phonological problem; it is predictable.

The main problem for this IP model arises from the claim that rules have to apply sequentially, while in the case at hand the assignment to a class in the plural depends on information that is not yet available when realizing class information. Within an IP model it is not easy, though, to give up this claim. Given that it is assumed that inflection-related features are part of an unordered set, the only way of getting the right surface order is to apply Word Formation Rules sequentially. This is not a problem in an IA model as the one assumed in section 3, because in this type of model it is the syntax (in some cases together with some morphological operations) that determines the surface order of morphs. The basic differences between the two models are illustrated in (21). In both models a set of features has to be ultimately associated with a phonological sequence, here /tɔrus/ ‘bulls’. In (21a) only the sequential application of Word Formation Rules can give as a result /tɔrus/ instead of */tɔrsu/. In (21b), in which for concreteness the type of structure argued for in Oltra-Massuet and Arregi (2005) has been assumed, this problem does not exist, because there is a one-to-one mapping between the structurally and linearly organized morphosyntactic information and the corresponding exponents.

(21) a. <i>IP model</i>	b. <i>IA model</i>
$\begin{bmatrix} +N \\ +Pl \\ \text{class 2} \end{bmatrix}$	$\begin{array}{cccc} \sqrt{\quad} & n & Th & N^{\circ} \\ \vdots & \vdots & [class\ 2] & [+pl] \\ \vdots & \vdots & \vdots & \vdots \\ /tɔr/ & \emptyset & /u/ & /s/ \end{array}$
/tɔrus/	

Unfortunately, assuming, for the sake of argumentation, that in the IP model Word Formation Rules can apply freely does not readily solve the OCP-related problem.⁹ The Word Formation Rules in (17) can apply only if the right class (class 1 or class 2) is mentioned in the morphosyntactic feature matrix. However, this type of information should not be present in examples like *gossos* ‘dogs’, because the choice of marker both in the singular and in the plural is predictable: the \emptyset that appears in the singular is predictable because this is the unmarked class marker for masculine nominals; the *-o* /u/ that appears in the plural is the marker that prevents a contact of sibilants.


Stephen Anderson (p.c.) suggests that in fact the *o* in words like *gossos* could have an epenthetic nature, following the analysis he outlines for the extension /ɛʃ/ in the verbal system of Surmiran, a form of Swiss Rumantsch (Anderson 2008). If this

⁹ One line of approach that could be pursued in the IP model, without having to abandon the idea of unordered feature matrices, might be to say that word formation rules apply freely and that phonological constraints determine which one is the optimal output. For the particular example used in (21), if we compare /tɔrus/ and */tɔrsu/, we can see that */tɔrsu/ violates FINAL-C (a prosodic word has to end in a consonant), while this constraint is not violated by /tɔrus/. Of course, one should check whether this line of approach would work for other cases, in Catalan (nominal but also verbal inflection) and in other languages with a richer inflectional system, a mission that lies far beyond the scope of this paper.

desirable to have a theory as restrictive as possible, not a theory in which anything goes.

There could be a different line of approach that might escape part of the problems just mentioned, although other potential problems would need to be worked out. Some authors (Hammond 2000, Russell 1995 or Yip 1998, among others) have proposed that exponents of morphemes are introduced by morphemic constraints; they are not present in the input. This line of research could be adapted to an IP model by having all the Word Formation Rules in (17) as ranked constraints, interspersed with phonological constraints; that would have the same effect as apply the Word Formation Rules freely. We could try to capture the difference between *gos* ‘dog’ and *gossos* ‘dogs’ as is shown in (25) and (26). Notice that the features related to class have been ignored both in the input and in the constraints; the order between the constraint realizing /X/ → /X/ (what has been called class 1) and the one realizing /X/ → /Xu/ (what has been called class 2) reflects the markedness relation between the two classes, which in section 3 was expressed through the ordering of morphs in the input. This move voids the need for specifying class membership in predictable cases. Under this view accounting for the singular *gos* is straightforward.

(25) *gos* [gós] ‘dog’

$\begin{bmatrix} [+N] \\ [-Pl] \end{bmatrix}$ /gos/	OCP	$\begin{bmatrix} [+N] \\ [+Pl] \end{bmatrix}$ /X/ → /Xs/	[+N] /X/ → /X/	[+N] /X/ → /Xu/
a.  gós				*
b. gósu			*!	

In the plural, candidates like *[góss], (26b), and *[góssu], (26c), are ruled out by OCP, which is highly ranked. Candidate (26a), the singular, would constitute a strategy to avoid the effects of OCP, but this candidate is ruled out because it does not show the added [s] which is required by the rule realizing the plural, /X/ → /Xs/.¹¹ The question now is how candidate (26d) must be evaluated with respect to the morphemic constraint realizing the plural, /X/ → /Xs/. Literally, this constraint states that the candidate should be identical to the input with the addition of an adjacent [s], the problem being that the [s] is not adjacent. So, strictly speaking, candidate (26d) should be ruled out by this constraint. The same problem arises for several candidates with respect to other morphemic constraints (indicated with a question mark in the relevant cells). Under this interpretation, candidate (26a) would wrongly be selected as the optimal candidate (because they would fare even with respect to the second constraint and the decision would be left to the third constraint. Giving up adjacency (by proposing formulations of the type /X/ → /X(Y)s/) might be a dangerous move. I leave aside other aspects that should be addressed in relation to the type of morphemic constraints used here.¹²

¹¹ In (10) (section 3) a singular candidate was not considered as an alternative to avoid the effects of OCP. Such candidate would be ruled out by the constraint MAX, because a segment from the input would not appear in the output.

¹² The use of morphemic constraints presents additional difficulties related to the fact that the phonological information introduced by them cannot be controlled by faithfulness constraints. For a discussion of this issue, see Bonet (2004).

(26) *gossos* [gósus] ‘dogs’

$\left[\begin{array}{l} +N \\ +Pl \end{array} \right]$ /gos/	OCP	$\left[\begin{array}{l} +N \\ +Pl \end{array} \right]$ /X/ → /Xs/	[+N] /X/ → /X/	[+N] /X/ → /Xu/
a. gós		*!		*
b. góss	*!		?	*
c. góssu	*!		?	?
d. ? \rightarrow gósus		?	?	

Additional questions would arise with words like *toro(s)* ‘bull(s)’, which have a marked masculine ending both in the singular and in the plural; it is not clear how this information should be encoded. A more general problem, not restricted to this particular case, is how the ordering of “morphemes” would be determined in this approach, if constraints / rules introducing this information are not applied sequentially.

5. Concluding remarks

In Catalan the choice of masculine marker depends not only on the stem of the word but also on the presence or absence of a plural marker; there is “look-ahead”. The interaction between phonological and morphological factors is fairly easy to account for if one assumes an account based on morphemes, an IA model, in which a preference relation between morphs is combined with an evaluation of possible candidates through ranked constraints, as in Optimality Theory. We have considered different explanations within an IP model, but all of them presented very serious problems, contrary to what might have been expected *a priori*, namely the idea, mentioned in (3), that anything that can be accounted for in an IA model can also be explained in a process-based approach, an IP model.

Many of the problems that an IP model has to face are related to the assumption that inflected words contain all inflection-related features in an unordered feature matrix, which means that some other mechanism must ensure the right surface ordering of phonological information. So, an obvious question would be whether this assumption is really needed in an IP model. The answer, in my view, is that, if one wants to keep an IP model, it would not make sense to have different terminal nodes with specific morphosyntactic features (e.g. one with gender related features, another one with number related features) but without the possibility of hosting corresponding exponents; this move would take us precisely to an IA model.

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