Ø-Agreement in Turkana

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Abstract
In this paper, I develop a formalism for morphological spellout which captures the conditioning of Ø-agreement by scales in a maximally simple way As a test case, I show that this formalism allows a straightforward analysis of the complex verb agreement and direction marking patterns ("Quirky Inverse Marking") in Turkana.

1. Introduction

In her groundbreaking work on optimality-theoretic morphosyntax, Aissen (1999, 2003b) captures a wide array of morphological hierarchy effects by the combined force of Constraint Conjunction (Smolensky, 1995) and Harmonic Alignment (Prince and Smolensky, 1993). Although the resulting system is formally quite powerful, all morphological phenomena Aissen captures are cases of Ø-morphology. Thus for the Tibeto-Burman language Nocte, Aissen (1999) derives that direction (inverse) marking is Ø in configurations where the subject is higher in animacy than the object. In the same paper she accounts for split-ergative systems, hence for the distribution of Ø subject and Ø object case under specific alignment patterns of the verbal arguments. Similar examples of differential object marking are treated in Aissen (2003b). Again all patterns under consideration involve Ø-morphology for case under an appropriate constellation of different scales. In Aissen (2003a), a bidirectional extension of the system is employed to capture the distribution of Ø object-agreement in Takelma and Tzotzil.

To be sure, the restriction to Ø-morphology is not an idiosyncrasy of Aissen's work, but for the most part a general fact about typological and theoreti-

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cal work on morphological hierarchy effects, and possibly about morphology in general. I make this generalization explicit as the hypothesis in (1):[1]

(1) **Scales-Ø-Generalization:**
Effects of prominence scales on morphological spellout are restricted to the Ø-realization of otherwise expected morphological formatives

I take the Scales-Ø-Generalization as an indication that the Harmonic-Alignment model of morphological hierarchy effects, which employs an intricate all-purpose formalism may be too powerful for the task at hand, and explore the possibility that these effects are due to a much simpler formal system which is capable of nothing else than to license Ø-realization of affixes.

The agreement- and direction-marking system of Turkana (Dimmendaal, 1983, 1986, 1991), an Eastern Nilotic Language spoken by around 350,000 speakers in the east of Lake Turkana in Kenya, is a well-suited testing ground for the formalism because it shows three types of hierarchy effects in a small paradigm. *First*, the affixation of plural affixes is governed by an asymmetry of 1st and non-1st person. *Second*, the appearance of person markers for subject and object is governed by an intricate interaction of different prominence scales, and *third*, Turkana exhibits an inverse marker very similar to the one familiar from Nocte. The distribution of the inverse marker is especially interesting because its use also extends to intransitive 1st person plural forms, a context which should be impossible for an inverse marker under most current approaches. (2) contains the complete set of relevant, where **-te** is the plural suffix, **k-** the inverse prefix, and all other prefixes (a-, i-, and e-) mark person:[2]

[1] I know of only two patterns which are possible counterevidence to (1). *First*, many typologists assume that Ø-marking is just a special case of the preference for short over long formatives in special contexts (cf. Haspelmath, 2008). However, Müller (this volume) argues that this tendency actually follows from Ø-exponence, and general conditions on iconicity. *Second*, in some language affix order seems to be sensitive to scales. For example in Wardaman (Merlan, 1994), the linear order of agreement prefixes for subject and objects reflects the hierarchy $1 \succ 2 \succ 3$. Unfortunately, there are no crosslinguistic studies which would show whether these ordering patterns are accidental properties of single languages, or the effect of general linguistic mechanisms. Other types of scales have been argued to play a role in the ordering of different morphological categories such as agreement and tense. See Trommer (2002) for critical discussion.

[2] The segmentation in (2) is not uncontroversial. Cysouw identifies two affixes, **ka-**, and **ki-** which are not related to **a-**, **i-**, and **k-**. See also section 5 for a discussion of whether plural **k-** is different from inverse **k-**.

(2) **Turkana Verb Agreement**

			Object						
			1		**2**		**3**		**Ø**
			sg	pl	sg	pl	sg	pl	
Subject	**1**	sg			**k-a-**		**a-**		
		pl			k-i-		**k-i-**		
	2	sg	k-**i-** -te				**i- -te**		
		pl							
	3	sg	**k-a- -te**	k-i- -te	**k-i- -te**		**e-**		
		pl							

The paper is structured as follows: In section 2, I introduce the formal framework. Sections 3, 4, and 5 apply the formalism to number agreement, person agreement, and inverse marking in Turkana respectively. Section 6 contains a short summary, and a final appendix (section 7) spells out the formal details of vocabulary insertion in the developed formalism.

2. The formal framework

The model of morphology I am developing here is realizational in the sense of Stump (2001): The morphology component of the grammar provides phonological spellout of abstract morphosyntactic features. Spellout happens in two stages, vocabulary insertion and Ø-licensing. (3) illustrates this architecture schematically for person marking in an intransitive Turkana 1st person verb form (**à-los-ì**, 'I go'), where subject agreement is marked by the prefix **a-**. In the analysis developed in the following sections, this is derived by inserting both the marker **a-** for the feature [+1] and the equally motivated **i-** for [–3]. However, **i-** is marked as phonologically invisible by Ø-licensing and therefore only **a-** is pronounced:

(3) **Grammatical Architecture**

Input:	[+1–3]	(Morphosyntactic heads)
Vocabulary Insertion:	a:[+1] i:[–3]	(Vocabulary Items)
Ø-Licensing	a:[+1] i:[–3]	(Licensing Conditions)
Phonological Interpretation	a	(Phonological Structure)

2.1. Vocabulary Insertion

As in other realizational frameworks such as Amorphous Morphology (Anderson, 1992), Distributed Morphology (DM, Halle and Marantz, 1993) and Distributed Optimality (DO, Trommer, 2003b), the input to morphology is provided by syntax. Here it has the form of an ordered pair of a (phonologically specified) root, and a list of heads (multisets of morphosyntactic features).

Consider the following fragment of Georgian verb inflection (Carmack, 1997; Trommer, 2003b) for the verb **xedav**, to 'see' in (4) (omitting all forms involving 3rd person subjects and objects):[3]

(4) **Georgian Verb Agreement**

		Object				
		1sg	**1pl**	**2sg**	**2pl**	Ø
Subject	**1sg**			g-vedav	g-xedav-t	v-xedav
	1pl			g-xedav-t	g-xedav-t-t	v-xedav-t
	2sg	m-xedav	gv-xedav			xedav
	2pl	m-xedav-t	gv-xedav-t-t			xedav-t

For 2pl → 1sg form, the input to morphology for looks like (5) ("+S" stands in the following for the case feature of subjects and "+O" for the case feature of objects:)

(5) xedav $[+O+1–pl]_1$ $[+S+2+pl]_2$

Vocabulary insertion is a function which maps every input structure to a sequence consisting of a root and additional vocabulary items (VIs), representations of affixes which pair phonological content and morphosyntactic features.[4] Thus given the lexicon of VIs in (6), vocabulary insertion maps the input in (5) to the output in (7), where indices are used as in optimality-theoretic Correspondence Theory (Wunderlich, 2000; Trommer, 2003b): the prefix is coindexed with the first head of (5), and the suffix with its second head.

[3]Phonetically 1pl → 2pl and 2pl → 1pl forms have only one **-t** although two instances of **-t** are expected. I assume that one instance of **t** is deleted by a general rule of Georgian phonology which reduces sequences of identical consonants to singletons (Butskhrikidze, 2002).

[4]The description of the formalism here is rather informal. See the appendix for more details.

(6) **VIs for Georgian**

a. gv- : [+1+O+pl]
b. m- : [+1+O]
c. g- : [+2+O]
d. v- : [+1+S]
e. t- : [+pl]

(7) m:$[+1+O]_1$-xedav-t:$[+pl]_2$

Vocabulary insertion has four important properties: It allows underspecification, it allows many-to-many mappings (portmanteaus), it is maximal, and it is derivationally ordered:

Vocabulary insertion allows underspecification:

A VI is inserted if the feature structures it specifies are subsets (i.e. proper subsets or identical to) feature structures in the input. This is illustrated by (7), where **m-** is inserted which specifies a subset of the input head [+1+O–pl], and **-t** is inserted which specifies a subset of the features in the [+S+2+pl] head.

Vocabulary insertion allows many-to-many mappings:

For example, Lakämper (2000) argues that in the Potosí Quechua verb form in (8), **-nqa** corresponds to tense and subject agreement, and **-sunki** to subject agreement and object agreement (Lakämper, 2000:119):

(8) rikhu-nqa-sunki ‘(s)he will see you (sg.)’
see-3Fut-3→2

Thus assuming for (8) the input in (9), this might be captured by the portmanteau VIs in (10) resulting in the output in (11):

(9) rikhu $[+Fut]_1$ $[+O+2–pl]_2$ $[+S+3–pl]_3$

(10) **VIs for Potosí Quechua**

a. -nqa : [+Fut][+3+S]
b. -sunki : [+O+2][+3+S]

(11) rikhu-nqa:$[+Fut]_1[+3+S]_3$-sunki:$[+O+2]_2[+3+S]_3$

In (11), single VIs are linked to more than one input head (**-nqa** is linked to $[+Fut]_1$ and $[+O+2–pl]_2$, while **-sunki** linked to $[+O+2–pl]_2$ and $[+S+3–pl]_3$). At the same time, the input head $[+O+2–pl]_2$ is linked to two VIs in the output: **-nqa** and **-sunki**. Note however that the possibility of many-to-many mapping does not extend to the level of the single feature structures in VIs. Thus a feature structure [+1+2] in an output VI may not correspond to two input feature structures where one specifies [+1] and the other one [+2] (or both are specified as [+1+2]). Technically this is ensured by the condition that feature structures in the output (and the input) must have exactly one index.

Vocabulary insertion is maximal:

For any possible linking of VIs to input feature structures, there is an insertion of a VI instance in the output. Hence the same VI can be inserted more than once if there are correspondingly many distinct mappings in the input. Moreover the same input feature may be realized more than once in the output unhampered by the Elsewhere Principle Anderson (1992) or restrictions against redundancy (cf. Wunderlich and Fabri, 1994). This is already illustrated by the Quechua example. A similar case arises if we consider a 2sg → 1pl form for Georgian. Given the VIs in (6) and the input in (12), we predict the output in (13), where m:[+1+O]- and -t:[+pl] are inserted even though the features they express are already spelled out by gv:[+1+O+pl]-:

(12) xedav $[+O+1+pl]_1$ $[+S+2–pl]_2$

(13) m:$[+1+O]_1$-gv:$[+1+O+pl]_1$-xedav-t:$[+pl]_2$

In fact, (13) does not correspond to the correct form which is **gv-xedav**. This problem will be addressed in subsection 2.2.

Vocabulary Insertion is derivationally ordered:

It is carried out through step-by-step affixation of VIs. Thus in (11), first **-nqa** is attached, and in a second step **-sunki**, accounting for the linear ordering of

the affixes. The order of insertion follows the following principles ranked in the sense of Optimality Theory (Prince and Smolensky, 1993):[5]

(14) **Ordering of Vocabulary Insertion:**

VI_1 is inserted before VI_2 if:

1. the leftmost input head to which VI_1 corresponds is more leftwards in the input list than the leftmost input head to which VI_2 corresponds
2. VI_1 contains more feature structures than VI_2
3. VI_1 is ordered before VI_2 in the lexicon of VIs

(14-1) is illustrated by the Quechua form in (11): **-nqa** is inserted first because the highest input head to which it corresponds is the leftmost feature structure in the input, whereas the highest input head to which **-sunki** corresponds is only second in the list. (14-2) accounts for affix order in the following verb form from Potosí Quechua (Lakämper, 2000:121) which I represent as in (16)

(15) rikhu-nqa-sunki-chis ‘(s)he/they will see you (pl.)’
see-3Fut-3→ 2-PL2

(16) rikhu-nqa:$[+Fut]_1[+3+S]_3$-sunki:$[+O+2]_2[+3+S]_3$-chis:$[+2+pl]_2$

While **-sunki** and **-chis** are linked to the same highest input head (object agreement) making them indistinguishable for constraint 1 in (14), the VI of **-sunki** contains more feature structures and is therefore inserted first. Finally, constraint 3 in (14) simply allows for language-specific stipulation for affix order in cases where constraints 1 and 2 do not determine any ordering.

2.2. Ø-Licensing

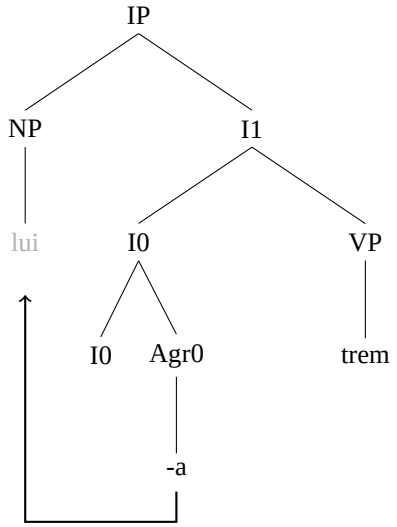
All current approaches to morphological spellout have explicit means to enforce Ø-realization of affixal material whose pronunciation is otherwise expected. In DM, this is achieved by Ø-VIs, impoverishment rules or fusion of heads, in Anderson (1992) through arranging spellout rules in disjunctively

[5] There are two crucial points where the use of constraint ranking in (14) departs from standard OT: First, optimization does not evaluate entire word forms, but single derivational steps (cf. McCarthy, 2007 and Heck and Müller, 2006 for similar approaches in phonology and syntax respectively. Second, the ranking in (14) is assumed to be crosslinguistically fixed.

ordered rule blocks or by applying spellout rules without phonological consequences (which therefore block phonologically visible rules of the same block, see also Stump, 2001), and in optimality-theoretic approaches by specific constraints which block the realization of morphosyntactic features under specific circumstances (Grimshaw, 1997; Wunderlich, 2000).

Here I propose, a very conservative approach to Ø-realization. I take Ø-expression not to be the absence of a specific marker, but a form of presence which is not interpreted by the phonological interface. Licensing Ø-pronunciation of a morpheme which is morphosyntactically present is a concept familiar from decades of research on pro-drop, Ø-pronouns which are allowed in specific languages under specific circumstances. Thus, preceding many similar analyses, Rizzi (1986) argues that in Italian empty subject pronouns are licensed by the presence of a specific type of "strong" agreement. This is illustrated in (17) for the Italian sentence **lui trem-a**, 'he trembles', whose unmarked realization leaves the subject pronoun **lui** unpronounced:

(17) **Pro Licensing in Syntax (Rizzi, 1986)**



Here, I assume that Ø-exponence for affixes is an implementation of the same basic mechanism: Affixes can remain unexpressed if there is an appropriate licensing relation. In fact, I claim that affixes actually must be unexpressed if they are Ø-licensed. This difference to pro-drop is probably related to the fact that to avoid pro-drop in pro-drop languages is only licit if the pronoun

is linked to specific discourse functions (e.g. focus or more generally if it is a non-topic, cf. Grimshaw and Samek-Lodovici, 1998). It is well known that inflectional affixes do not allow a similar integration into discourse relations, and this might motivate that Ø-licensing of affixes makes their Ø-expression obligatory.[6]

Ø-licensing has basically the same formal properties as vocabulary insertion: **Ø-licensing allows underspecification:** A vocabulary item is Ø-licensed iff there is at least one licensing condition which Ø-licenses it or a subset of its morphosyntactic features. **Ø-licensing allows many-to-many-mappings:** VIs corresponding to more than one input head can be Ø-licensed by the same licensing condition. A portmanteau VI *V* is Ø-licensed if all its feature structures are Ø-licensed. **Ø-licensing is maximal:** A specific licensing condition is applied for all possible combinations of features which trigger it. **Ø-licensing is derivationally ordered:** Conditions licensing Ø-VIs corresponding to higher input feature structures are applied first, conditions licensing Ø-VIs corresponding to more input feature structures apply first, and licensing conditions ordered higher in the language specific list of licensing conditions apply first, cf. (14)) In addition, Ø-licensing has a fourth property not shared by vocabulary insertion:

Ø-licensing is mediated indirectly by prominence and entailment scales:

(18) is a typical example of a prominence scale (1st and 2nd person are ranked higher than 3rd person), and (19) is an entailment scale for person which will be crucial for the analysis of intransitive person marking in Turkana: The feature specification [+1] of a given head entails that the head is also [–3]:[7]

(18) **Prominence Scale for Person:** $\left\{ \begin{matrix} +1 \\ +2 \end{matrix} \right\} \succ +3$

(19) **Entailment Scale for Person:** $\left\{ \begin{matrix} +1 \\ +2 \end{matrix} \right\} \succ -3$

[6]Constraints which require the Ø-realization of pronouns or, more generally, functional elements have been independently proposed in Chomsky (1981) (“Avoid Pronoun”) and Pesetsky (1998) (“Telegraph”).

[7]1st person exclusive = [+1–2–3], 2nd person = [–1+2–3], and 3rd person = [–1–2+3] (cf. Trommer, 2008).

Any specific Ø-VIs in a particular language is licensed by a specific licensing condition. Licensing conditions are derived from universal licensing schemata, which refer in a specific way to universal scales such as (18) and (19). Thus scales and schemata are universal, but whether a language adopts a specific licensing condition, or not is a matter of arbitrary parametric choice. The single licensing scales and schemata I assume will be introduced, and illustrated in the following sections.

2.3. An Illustrative Example: Georgian Verb Inflection

To illustrate the basic working of Ø-licensing, I will return to the Georgian data presented in (4). One interesting property of this paradigm is that the 1st person subject marker **v-** is suppressed in forms with 2nd person objects although this VI is predicted by the insertion formalism. Thus for the input in (20) ('I see you (sg.)') we get the incorrect output in (20-b) after vocabulary insertion:

(20) a. xedav $[+2+O–pl]_1$ $[+1+S–pl]_2$
b. v:$[+1+S]_2$-g:$[+2+O]_1$-xedav

Previous research has characterized phenomena of this type as a kind of competition process ("hierarchy-based competition"): Affixes realizing different arguments compete for a single morphological slot, where prominence hierarchies determine the winner of competition (cf. Noyer, 1992; Trommer, 2006a). Here I show that this pattern can be fruitfully subsumed under the notion of Ø-licensing without loosing the tight connection of these processes to prominence scales.[8] More evidence for the same approach will be found in the person marking system of Turkana. The central schema for linking prominence scales to Ø-marking in transitive agreement is given in (21), where F_1 and F_2 are features, H_1 and H_2 variables over input feature structures ("heads"), and C stands for a meta-feature such as [Per(son)] or [Num(ber)]:[9]

[8]The following analysis owes a lot to Béjar (2003) although at a relatively abstract level.

[9]A meta-feature is an atomic expression which matches any feature of a specific type. thus [Person] matches [+1], [–1], [+2],[–2], [+3] and [–3]. Note that different instances of a specific meta-feature in a licensing condition do not necessarily match the same instantiations of the meta-feature. Thus the first instance of [Per] in (22) matches [+2] in (23), while the second instance matches [+1].

(21) **Schema for Superiority Licensing**

Condition:	$F_1 \geq F_2$ for scale S
Form:	Overt C of a F_1 head licenses Ø-C of a F_2 head

A licensing schema allows to derive a specific licensing condition by instantiating (replacing) all variables in the schema by concrete values (features, meta-features, feature structures, …) which satisfy the condition(s) of the schema. Thus instantiating C by person and S by (18) we derive the following licensing condition, since according to S [+2] ≥ [+1] (the feature structure in brackets serves as an abbreviation for the condition):

(22) Overt [Per] of a [+2] head licenses Ø-[Per] of a [+1] head ([+2][+1])

(22) licenses Ø-realization of a person feature if this spells out a head H_1 which contains the feature-value pair [+1] and the same input list contains a head H_2 containing the feature-value pair [+2]. The full derivation of the 1sg → 2sg form is shown in (23):

(23) **Spellout: 1sg → 2sg**

Input:		xedav $[+O+2–pl]_1$ $[+S+1–pl]_2$
Insertion:		v:$[+S+1]_2$-g:$[+O+2]_1$-xedav
Ø-Licensing:	[+2][+1]	v:$[+S+1]_2$-g:$[+O+2]_1$-xedav
Phonology:		g xedav

Let us now return to problem raised in 2.1 that vocabulary insertion for 2sg → 1pl forms inserts **m-** and **-t** since they are they are compatible with the features of the underlying object agreement head [+O+1+pl] although these affixes don't show up phonologically.

In previous analyses of these data (Anderson, 1992; Trommer, 2003c), suppression of **m-** and **-t** follows from the Elsewhere Principle:[10] Insertion of a more specific marker blocks insertion of less specific markers. Here I reinterpret the basic insight underlying this approach: There is no blocking of less specific markers. All VIs which are compatible with a given input are inserted. However after insertion, VIs which realize for a specific input head a subset of the features which are already spelled out by a more specific marker

[10]The Elsewhere Principle is called Subset Principle in Halle (1997).

are Ø-licensed and hence not pronounced. Thus for a 2sg → 1pl form, vocabulary insertion produces in fact the structure in (24) (repeated from (13)):

(24) m:[+1+O]$_1$-gv:[+1+O+pl]$_1$-xedav-t:[+pl]$_2$

That **m-** and **-t** are not pronounced follows now from the licensing schema in (25):

(25) **Schema for Entailment Licensing**

Condition:	Feature structure F_1 entails feature structure F_2
Form:	Overt F_1 licenses Ø F_2 of the same head

Since the entailment scales in (26) trivially hold (every feature structure which is characterized as [+1+pl] is also characterized as [+pl] and as [+1]), (25) allows us to posit the licensing conditions in (27):

(26) **Entailment Scales**

a. [+1+pl] ≻ [+pl]
b. [+1+pl] ≻ [+1]

(27) **Licensing Conditions**

a. Overt [+1+pl] licenses Ø [+pl] of the same head ([+1+pl+pl])
b. Overt [+1+pl] licenses Ø [+1] of the same head ([+1+pl+1])

The full derivation of a 2sg → 1pl form is shown in (28):

(28) **Spellout: 2sg → 1pl**

Input:		xedav [+O+1+pl]$_1$, [+S+2–pl]$_2$
Insertion:		gv:[+O+1+pl]$_1$-m:[+O]$_1$-xedav-t:[+pl]$_1$
Ø-Licensing	[+1+pl+1]	gv:[+O+1+pl]$_1$-m:[+O]$_1$-xedav-t:[+pl]$_1$
	[+1+pl+pl]	gv:[+O+1+pl]$_1$-m:[+O]$_1$-xedav-t:[+pl]$_1$
Phonology:		gv- -xedav

Obviously the same analysis extends to most uncontroversial application of the Elsewhere Principle to morphological spellout: Whenever one marker specifies a subset of the features of a second one, this induces an entailment scale resulting in a licensing condition which allows to render the less specific

marker phonologically invisible.[11] In section 4.1, we will see that entailment licensing also extends to cases which can not be easily accommodated by conditions on subsets.

3. Number Agreement

We start the analysis of Turkana with the most simple morphological subsystem of Turkana verb agreement, subject marking for number which consists basically of a plural suffix. Whereas there are a number of different allomorphs of this suffix, depending on verb classes and tense/aspect/mood, all behave roughly in the same way with respect to other agreement affixes, and in the following I will use the allomorph **-te** as representing all of its coallomorphs. As shown in (29), **-te** marks plural subjects independently from object agreement, but is blocked for 1st person subjects:

(29) **Turkana Plural Marking**

			Object						
			1		**2**		**3**		**Ø**
			sg	pl	sg	pl	sg	pl	
Subject	**1**	sg							
		pl			-Ø				
	2	sg							
		pl	-te				-te		
	3	sg							
		pl	-te						

The fact that the plural suffix is absent exactly in the first person is probably not an accident. As Nevins (2007) notes, based on a long tradition in the typological literature, there is a general tendency for inflectional systems to neutralize marked distinctions in the context of other marked distinctions (1st person is the most marked person, and plural the most marked number category in Turkana), and Noyer (1992) cites data similar to the Turkana case

[11] Note that the analysis here does not predict that the Elsewhere Principle holds without exceptions. Since languages may or may not adopt licensing conditions for specific entailment scales, languages may allow double exponence for specific features even if this violates the Elsewhere Principle. This might solve the problem of the often observed phenomenon of extended exponence (cf. Müller, 2006 for recent discussion).

from Afro-Asiatic, where dual marking is systematically suppressed in the context of 1st person, but not in the context of 2nd and 3rd person.

I interpret markedness here as maximal prominence for a given scale, which predicts neutralization if a set of categories cooccurring in an input head are maximally prominent in distinct scales. This is implemented formally by the Ø-licensing schema in (30), where F_1, F_2, …, F_n are features (i.e., specific feature value pairs), and S_1, S_2, …, S_n prominence scales:

(30) **Schema for Cumulative Complexity Licensing**

Condition:	F_1, F_2, …, F_n are maximal in S_1, S_2, …, S_n
Form:	F_2, …, F_n license Ø F_1 of the same input head

Instantiating (30) by the basic prominence scales for number and person in (31), we get the licensing condition in (32):

(31) **Prominence Scales for Number**

[+pl] is maximal in [+pl] $\succ$ [–pl]

[+1] is maximal in $\left\{ \begin{matrix} [+1] \\ [+2] \end{matrix} \right\} \succ$ [+3]

(32) **Licensing Condition**
[+1] licenses Ø [+pl] of the same input head ([+1+pl])

If the plural suffix is specified as in (33), we get the derivation in (34). **-te** is inserted for all persons, but is rendered invisible for phonology by Ø-licensing in the 1st-person form.

(33) -te : [+pl+S]

(34) **Derivation of Number Spellout**

		1pl	**2pl**	**3pl**
Input:		[+1+pl]	[+2+pl]	[+3+pl]
Insertion:		-te	-te	-te
Ø-Licensing:	[+1+pl]	-te	-te	-te
Phonology			-te	-te

4. Person Agreement

An intriguing characteristic of Turkana verb inflection is that the language has subject and object agreement for person, but at the same time only three distinct person markers, and maximally one person marker for any given verb form. Which person marker actually shows up in a particular verb form is crucially dependent on the relative prominence of person features in scales. In subsection 4.1, I discuss intransitive agreement, and in subsection 4.2 the more complex pattern in transitive forms.

4.1. Intransitive Person Agreement

As shown in (35), two of the person prefixes can be identified with traditional person categories: **a-** occurs only in 1st person forms, **e-** only in 3rd person forms. However **i-** appears not only in all 2nd person forms, but also in the 1pl:

(35) **Person Marking in Intransitive Forms**

Subject	**1**	sg	a-
		pl	i-
	2	sg	
		pl	
	3	sg	e-
		pl	

Therefore, I suggest the VIs in (36), where **i-** is characterized as [–3] which is compatible with both, [+1], and [+2] (cf. footnote 7):

(36) **Vocabulary Items**

a- : [+1]
i- : [–3]
e- : [+3]

Now the fact that **a-** is Ø in the 1pl while **i-** extends to this paradigm cell follows completely from the formal apparatus we have already developed. By reverting context and target for applying (30) to the scales (31), we get the licensing condition in (37): Where (32) captures Ø-number in the context of overt person, (37) derives Ø-person in the context of overt number:

(37) **Licensing Condition**
[+pl] licenses Ø [+1] of the same input head ([+pl+1])

(38) shows how the licensing condition in (37) derives the correct marking for 2sg and 1pl forms. **i-** is inserted in both contexts, in the 1pl the additionally inserted **a-** is Ø-licensed and hence invisible:

(38) **Spellout: Intransitive Person**

		1pl	**2sg**
Input:		[+1–3+pl]	[+2–3–pl]
Insertion:		**a-i-**	**i-**
Ø-Licensing:	[+pl+1]	**a-i-**	**–**
Phonology:		**i-**	**i-**

This raises the question why **i-** is Ø in 1sg forms where it should also appear given its lexical entry. Intuitively, **i-** is unnecessary in the 1sg because independently inserted **a-** makes it redundant to pronounce a separate [–3] marker. In other words, [+1] entails [–3] (in the assumed feature system, every [+1] head is also [–3], cf. footnote 7). Hence Ø-exponence can be derived by the entailment licensing scheme in (25) repeated as (39):

(39) **Schema for Entailment Licensing**

Condition:	Feature structure F_1 entails feature structure F_2
Form:	Overt F_1 licenses Ø F_2 of the same head

Applied to the entailment scale in (40), we get the licensing condition in (41):

(40) **Entailment Scale:** [+1] $\succ$ [–3]

(41) **Licensing Condition**
Overt [+1] licenses Ø [–3] of the same head (**[+1**–3**]**)

(42) illustrates the spellout for all intransitive singular forms. Whereas the output of 2sg and 3sg corresponds to a single inserted VI, for 1sg two VIs are inserted, and **i-** gets invisible by (41):

(42) **Spellout: Intransitive Person**

		1sg	**2sg**	**3sg**
Input:		[+1–3–pl]	[+2–3+pl]	[+3–pl]
Insertion:		**a-i-**	**i-**	**e-**
Ø-Licensing:	[+1–3]	**a-**i-	–	–
Phonology:		**a-**	**i-**	**e-**

Returning to the 1pl, (37) and (41) illustrate the important point that licensing conditions must be crucially ordered: In this context [+pl] would license Ø-realization of **a-** by (37), and (41) Ø-realization of **i-**, but only if **a-** is not rendered invisible. Hence [+pl+1] must be given priority over [+1–3]. Since both conditions target VIs corresponding to the same head, this order must be regulated by language-specific stipulation. The interaction of both licensing conditions is illustrated in (43) for all plural forms:

(43) **Interaction of Entailment and Complexity Licensing**

		1sg	**1pl**	**2sg**
Input:		[+1–3–pl]	[+1–3+pl]	[+2–3–pl]
Insertion:		**a-i-**	**a-i-**	**i-**
Ø-Licensing:	[+pl+1]	–	a-**i-**	–
	[+1–3]	**a-**i-	–	–
Phonology:		**a-**	**i-**	**i-**

4.2. Transitive Person Agreement

The distribution of person markers in transitive forms is quite complex. The same three affixes are used as in intransitive forms, but in some combinations they express, phi-features of the object, not of the subject (e.g. in 3sg → 1sg forms):

(44) **Turkana Hierarchy-Based Competition**

			Object						
			1		**2**		**3**		**Ø**
			sg	pl	sg	pl	sg	pl	
Subject	**1**	sg			k-a-		**a-**		
		pl			k-i-		k-**i-**		
	2	sg	k-i-				**i-**		
		pl							
	3	sg	k-**a-**	k-**i-**	k-**i-**		e-		
		pl							

The appearance of person markers follows three crucial generalizations:

- In all forms, either subject or object trigger person agreement, but never both
- 1st and 2nd person argument always trigger agreement in the context of a 3rd-person argument
- Otherwise the subject triggers agreement

Obviously person-marking in Turkana exhibits a more general type of "hierarchy-based competition" for person as the one we have already seen for Georgian. The relevant licensing schema from (21) is repeated in (45):

(45) **Schema for Superiority Licensing**

Condition:	$F_1 \geq F_2$ for scale S
Form:	Overt C of a F_1 head licenses Ø-C of a F_2 head

Applied to the person scale in (46), and inserting again person for C, we get the licensing conditions in (47):

(46) **Person Scale:** $\left\{ \begin{matrix} +1 \\ +2 \end{matrix} \right\} \succ +3$

(47) **Licensing Conditions**

a. Overt [Per] of a [+1] head licenses Ø-[Per] of a [+3] head ([+1][+3])
b. Overt [Per] of a [+2] head licenses Ø-[Per] of a [+3] head ([+2][+3])
c. Overt [Per] of a [+1] head licenses Ø-[Per] of a [+2] head ([+1][+2])
d. Overt [Per] of a [+2] head licenses Ø-[Per] of a [+1] head ([+2][+1])

Thus (47-a) licenses Ø-realization of a person feature if this spells out a head H_1 which contains the feature-value pair [+3] and the same input list contains a head H_2 containing the feature-value pair [+1]. Now recall from section 2.2 that Ø-licensing – just as vocabulary insertion – follows the order of a given input list, hence Ø-licensing is applied first to VIs which correspond to higher feature structures on the input list. Assuming that object agreement in Turkana is closer to the verbal root than subject agreement, this derives the basic subject preference in the data. (48) shows the derivation of transitive forms with 2sg and 3sg arguments **e-** is licensed to be Ø in both forms because it expresses person for a [+3] head in the context of overt **i-** which realizes person for a [+2] head (the licensing conditions not relevant here are omitted):

(48) **Spellout: 2sg ↔ 3sg**

		2sg → 3sg		**3sg → 2sg**	
Input:		$[+3]_O$	$[+2–3]_S$	$[+2–3]_O$	$[+3]_S$
Insertion:		**e-**	**i-**	**i-**	**e-**
Ø-Licensing$_O$:	[+2][+3]	**e-**	**i-**	–	
Ø-Licensing$_S$:	[+2][+3]	–		**i-**	e-
Phonology:			**i-**	**i-**	

In forms with a 1sg and a 3sg argument, [+1][+3] and [+1–3] cooperate to ensure that only **a-** gets phonologically visible:

(49) **Spellout: 1sg ↔ 3sg**

		1sg → 3sg		**3sg → 1sg**	
Input:		$[+3]_O$	$[+1–3]_S$	$[+1–3]_O$	$[+3]_S$
Insertion:		**e-**	**a-i-**	**a-i-**	**e-**
Ø-Licensing$_O$:	[+1][+3]	e-	**a-i-**	–	
	[+1–3]	–		**a-**i-	**e-**
Ø-Licensing$_S$:	[+1][+3]	–		**a-**i-	e-
	[+1–3]	e-	**a-**i-	–	
Phonology:			**a-**	**a-**	

The most intricate case are transitive forms with 1st and 2nd person arguments. Here there is potentially Ø-licensing for all person markers for both arguments. However, the cyclic application of Ø-licensing to object markers before subject markers ensures that object agreement gets invisible before Ø-licensing for subjects can use it as a licensing context in the second cycle. As a consequence only subject marking remains visible. Note also that for the

2sg → 1sg form both subject agreement markers undergo Ø-licensing by the same licensing condition:

(50) **Spellout: 1sg ↔ 2sg**

		2sg → 1sg		**1sg → 2sg**	
Input:		$[+1–3]_O$	$[+2–3]_S$	$[+2–3]_O$	$[+1–3]_S$
Insertion:		**a-i-**	**i-**	**i-**	**a-i-**
Ø-Licensing$_O$:	[+1][+2]	–		i-	**a-i-**
	[+2][+1]	**a-i-**	**i-**	–	
	[+1–3]	–		–	
Ø-Licensing$_S$:	[+2][+1]	–		–	
	[+2][+1]	–		–	
	[+1–3]	–		i-	**a-i-**
Phonology:			**i-**		**a-**

5. Inverse Marking

In inverse-marking languages, transitive verb forms have a special marker if the object is higher (or equal) than the subject for a specific prominence hierarchy. While some inverse marking languages also have an overt direct marker for transitive forms where the subject is hierarchically higher than the object (e.g. most Algonquian languages), in Turkana as in Nocte (Aissen, 1999; Trommer, 2003b), direct forms have no special affix. (51) shows the distribution of the inverse marker **k-** in Turkana. Basically, it occurs in forms where the subject is 3rd person and the object 1st or 2nd person, and in forms where both arguments are non-3rd person. Hence under the person hierarchy in (18), **k-** is restricted to contexts where the object is hierarchically higher than the subject as we would expect from a prototypical inverse marker:

(51) **Turkana Quirky Inverse Marking**

			Object						
			1		**2**		**3**		**Ø**
			sg	pl	sg	pl	sg	pl	
Subject	**1**	sg			**k-**a-		a-		
		pl					**k-**i-		
	2	sg	**k-**i-				i-		
		pl							
	3	sg	**k-**a-				e-		
		pl							

What is unusual about Turkana **k-** is that it extends to intransitive 1pl forms, which is unexpected for an inverse marker, which by assumption singles out specific transitive configurations. Therefore most previous analyses of Turkana verbal inflection have assumed that the inverse **k-**, and the **k-** found in intransitive 1pl forms are two different formatives (Dimmendaal, 1983; Trommer, 2003b). However, Cysouw (1998) provides compelling evidence against the assumption that this is a case of accidental homophony. As Cysouw shows in detail, other closely related Nilotic languages show basically the same pattern of syncretism between 1pl and inverse configurations even though the morphophonological details are quite different. To take just one example, in Karimojong, the allomorphs **iki-** and **itɔ-** are used for intransitive 1pl, but also for transitive 2 → 1 and 3 → 1 forms. Other forms which are marked as inverse in Turkana (transitive 3 → 1 and 1 → 2 forms) have the related prefix allomorphs **aka-**, **ɔkɔ-**, and **ɛkɛ-**:

(52) **Quirky Inverse in Karimojong (Novelli, 1985)**

			Object						
			1		**2**		**3**		**Ø**
			sg	pl	sg	pl	sg	pl	
Subject	**1**	sg			aka- ɔkɔ- ɛkɛ-		a-		
		pl					iki- itɔ-		
	2	sg	iki- itɔ-				i-		
		pl							
	3	sg	aka- ɔkɔ- ɛkɛ-				ɛ-		
		pl							

While **iki-** bears some obvious resemblance to Turkana **k-**, **ito-** does not, which makes it unlikely that the syncretism of 1pl and inverse configurations is accidental. Interestingly enough, there are two sets of allomorphs which correspond to Turkana **k-**, but these do not single out intransitive 1pl from transitive inverse forms, but specific inverse forms from other inverse and the 1pl forms. My analysis will therefore be based on the assumption that **k-** is in all contexts – transitive or intransitive – formally the same vocabulary item. More specifically, I will claim that **k-** fulfills both the criteria for being a number marker and an inverse marker. Now a necessary condition for the appearance of **k-** is that either (53-a) or (53-b) holds:

(53) **Necessary Conditions for the Appearance of k-**

a. there is agreement with a plural argument **or**
b. there is agreement with two (singular or plural) arguments

These apparently unconnected cases actually form a natural class once we adopt the Iconic Representation of Number (IRN), a theory of the formal representation of number developed in Trommer (2006b), which claims that different numbers are hierarchical trees containing instances of a single formal item, the number element "•". In a two-number system such as Turkana, singular and plural are represented as follows:

(54) **The Iconic Representation of Number (Trommer, 2006)**

Singular	**Plural**
•	• | •

Here I will adopt a formally slightly simpler version of this theory where plural corresponds to a feature structure which contains two number elements [••], and singular to a feature structure with only one ([•]).[12] **k-** is now represented as in (55): It contains two feature structures where each contains a single number element:

(55) **Representation of k-**

k- : [•+S] [•]

Under this representation, **k-** is a number marker since it specifies number features, and adopting the claim that the class of direct/inverse-markers is in principle coextensive with the class of portmanteau agreement affixes (Trommer, 2003a), it is also an inverse morpheme.

Crucially, the representation in (55) predicts that it can be inserted in exactly the configurations described in (53) as is schematically shown in (56). **k-** can be inserted in 3sg → 1sg forms (and more generally in all transitive forms) because each number element in the VI matches one number element in the input. The same is true for 1pl subject forms (and all other forms with a plural subject). In the 1sg (and all intransitive singular forms), **k-** cannot be inserted because the first number element of the VI matches the single number element of the input feature structure, but the input doesn't have a second • to match the second one:[13]

[12]This means that feature structures are formally multisets. See the appendix for details.

[13]Note that the first feature structure of **k-** cannot be linked to the object because the first feature structure of the VI is specified [+S]. This excludes a further conceivable linking of the number elements in forms with plural objects.

(56) **Possible Insertion Contexts for k-**

	1sg	**1pl**	**3sg → 1sg**
Input:	[●+S+1]	[●●+S+1]	[●+S+3] [●+O+1]
	*		
VI:	[●+S] [●]	[●+S] [●]	[●+S] [●]

(57) shows in which contexts **k-** is inserted:

(57) **Insertion of k-**

			Object						
			1		**2**		**3**		**Ø**
			sg	pl	sg	pl	sg	pl	
Subject	**1**	sg							
		pl							
	2	sg							
		pl							
	3	sg							
		pl		**k-**					

This predicts **k-** correctly for all paradigm cells where it actually occurs, but also for additional parts of the paradigm where **k-** does not appear, namely for the intransitive 2pl and 3pl forms, and for all forms with a 3rd person object apart from the 1pl subject forms. This discrepancy is shown in (58) where the forms for which **k-** is predicted, but not pronounced are indicated by black shading:

(58) **Insertion vs. Pronunciation of k-**

			Object						
			1		**2**		**3**		**Ø**
			sg	pl	sg	pl	sg	pl	
Subject	**1**	sg			**k-**				
		pl							
	2	sg							
		pl							
	3	sg	**k-**						
		pl							

In the following, I will argue that all problematic forms, where **k-** is inserted, but not realized are cases which license Ø-exponence of **k-** for principled reasons. In particular, I will show that Ø-realization follows from the fact that **k-** is a number and an inverse marker at the same time.

5.1. **k-** as a Number Affix

Let us start with intransitive 2nd and 3rd person plural forms, where **k-** is inserted just as in 1pl forms. Recall from section 3 that these are exactly the forms where plural of the subject is already independently marked by the plural suffix which adapting the entry from (33) to the Iconic Representation of Number has the form in (59):

(59) -te : [●●+S]

Now it is clear that the formal representation [●●+S] entails the representations [●+S] and [●] which are subsets of [●●+S]. Hence we have the entailment scale in (60), which inserted in the Schema for entailment licensing from (25) repeated in (61) gives us the licensing condition in (62) (see section 2.2 on Ø-licensing of portmanteaus):

(60) **Entailment Scale for Number**

$$[\bullet\bullet+S] \succ \left\{ \begin{array}{c} [\bullet+S] \\ [\bullet] \end{array} \right\}$$

(61) **Schema for Entailment Licensing**

Condition:	Feature structure F_1 entails feature structure F_2
Form:	Overt F_1 licenses Ø F_2 of the same head

(62) **Licensing Condition:**
Overt [●●+S] licenses Ø [●+S][●] of the same head ([●●●●])

(63) shows how this accounts for the correct realization of plural in all intransitive forms. In the 1pl, [+1●●] Ø-licenses plural **-te**. As a consequence there is no Ø-licensing for **k-** by [●●●●] since this depends on an overt plural marker in the word form. In contrast for 2pl and 3pl forms **-te** is phonologically visible and [●●●●] induces Ø-spellout for **k-**:

(63) **Spellout of k- and -t**

		1pl	**2pl**	**3pl**
Input:		[+1●●]	[+2●●]	[+3●●]
Insertion:		**k- -te**	**k- -te**	**k- -te**
Ø-Licensing:	[+1●●]	**k-** -te	**–**	**–**
	[●●●●]	**–**	k- **-te**	k- **-te**
Phonology:		**k-**	**-te**	**-te**

5.2. **k-** as an Inverse Affix

The second set of data for which **k-** is predicted by its lexical entry, but does not actually appear phonologically, are transitive forms with 1st, 2nd, and 3rd-person subject and a 3rd person object. Crucially, these are direct forms (the subject is higher or equal than the object on the person hierarchy), and I will derive the non-pronunciation of **k-** in these cases from the fact that it has the formal characteristics of an inverse marker.

I will adopt the approach to inverse marking developed in Trommer (2003a), where inverse markers are characterized as VIs with two different feature structures specifying agreement features, and the distribution of inverse markers is only partially captured by their lexical entries, but derives in crucial respects from constraints on their realization in direct contexts.

More concretely I will use the licensing schema in (64), where a congruent scale contrast is a pair of features pairs (F_1/F_2, F_1'/F_2') such that $F_1 \succeq F_1'$, and $F_2 \succeq F_2'$. A direction marker is any VI of the form $[\ ]_{Agr}$ $[\ ]_{Agr}$, and a direction marker is linked *under* the congruent scale contrast (F_1/F_2, F_1'/F_2')

iff one of its feature structures realizes a head specified as F_1 and F_2, and the other one realizes a head specified as F_1' and F_2':

(64) **Schema for Direct Licensing**

Condition:	M is complex, C is a congruent scale contrast
Form:	Linking direction marker M under C licenses Ø M

For the scales in (65), and substituting [●+S][●] for M, we get the licensing conditions in (66):

(65) **Relevant Scales and Congruent Scale Contrasts**

[+1] ≿ [+3] and [+S] ≻ [+O] ⇒ ([+1]/[+S],[+3]/[+O])
[+2] ≿ [+3] and [+S] ≻ [+O] ⇒ ([+2]/[+S],[+3]/[+O])
[+3] ≿ [+3] and [+S] ≻ [+O] ⇒ ([+1]/[+S],[+3]/[+O])

(66) **Licensing Conditions:**

a. Linking under ([+1]/[+S],[+3]/[+O]) licenses Ø [●][●] ($[\bullet][\bullet]^{[+1][+3]}_{[+S][+O]}$)

b. Linking under ([+2]/[+S], [+3]/[+O]) licenses Ø [●][●] ($[\bullet][\bullet]^{[+2][+3]}_{[+S][+O]}$)

c. Linking under ([+3]/[+S][+3][+O]) licenses Ø [●][●] ($[\bullet][\bullet]^{[+3][+3]}_{[+S][+O]}$)

(67) shows the licensing conditions in action. **k-** is inserted in both 3sg → 1sg and 1sg → 3sg forms, but in the latter configuration, **k-** is marked as phonologically invisible:

(67) **Spellout: 1sg ↔ 3sg**

		1sg → 3sg	**3sg → 1sg**
Input:		[+1●+S][+3●+O]	[+3●+S][+1●+O]
Insertion:		k- [●+S] [●]	k- [●+S] [●]
Ø-Licensing:	$[\bullet][\bullet]^{[+1][+3]}_{[+S][+O]}$	k- [●+S] [●]	–
	$[\bullet][\bullet]^{[+2][+3]}_{[+S][+O]}$	–	–
	$[\bullet][\bullet]^{[+3][+3]}_{[+S][+O]}$	–	–
Phonology:			k-

Exactly the same contrast is derived for forms with one 2nd and one 3rd person argument:

(68) **Spellout: 2sg ↔ 3sg**

		2sg → 3sg	**3sg → 2sg**
Input:		[+2●+S][+3●+O]	[+3●+S][+2●+O]
Insertion:		k- [●+S] [●]	k- [●+S] [●]
Ø-Licensing:	[●][●]$^{[+1][+3]}_{[+S][+O]}$	–	–
	[●][●]$^{[+2][+3]}_{[+S][+O]}$	k- [●+S] [●]	–
	[●][●]$^{[+3][+3]}_{[+S][+O]}$	–	–
Phonology:			k-

If both arguments are non-3rd person, **k-** is inserted, and retained because there is no licensing condition which would allow to suppress it phonologically:

(69) **Spellout: 1sg ↔ 2sg**

		1sg → 2sg	**2sg → 1sg**
Input:		[+1●+S][+2●+O]	[+2●+S][+1●+O]
Insertion:		k- [●+S] [●]	k- [●+S] [●]
Ø-Licensing:	[●][●]$^{[+1][+3]}_{[+S][+O]}$	–	–
	[●][●]$^{[+2][+3]}_{[+S][+O]}$	–	–
	[●][●]$^{[+3][+3]}_{[+S][+O]}$	–	–
Phonology:		k-	k-

5.3. Forms with **k-** as Inverse- *and* Number-Affix

A final complication arises with contexts where **k-** is inserted twice since it matches the number elements once by virtue of a plural subject, and once by matching number elements in the feature structures for subject and object agreement. In other words, **k-** is inserted once as a number affix and once as a direction affix. This happens for example in 1pl → 3sg forms:

(70) **Double Insertion for k-**

	1pl → 3sg	**1pl → 3sg**
Input:	[●●+S+1] [●+O+3]	[●●+S+1] [●+O+3]
VI:	[●+S] [●]	[●+S] [●]

Hence insertion leads actually to the distribution in (71), where some of the **k-k-** cases here correspond to phonological **k-** and some to the complete phonological absence of **k-**:

(71) **Single and Double Insertion of k-**

			Object						
			1		**2**		**3**		**Ø**
			sg	pl	sg	pl	sg	pl	
Subject	**1**	sg			**k-**				
		pl			**k-k-**				**k-**
	2	sg	**k-**				**k-**		
		pl	**k-k-**				**k-k-**		**k-**
	3	sg	**k-**						
		pl	**k-k-**						**k-**

k-k-forms have three possible outcomes. *First* in **k-k-**forms with a 2nd or 3rd person plural subject, both instances of **k-** are Ø-licensed, direction-marking **k-** by direct licensing, and number **k-** by entailment licensing triggered by plural **-te**. This is shown in (72) for a 2pl → 3sg form (here number elements bear indices to indicate by which match the VIs are licensed):

(72) **Spellout: 2pl → 3sg**

		2pl → 3sg
Input:		[+2●$_1$●$_2$+S][+3●$_3$+O]
Insertion:		k:[●$_1$+S][●$_2$] k:[●$_2$+S][●$_3$]
Ø-Licensing:	[●][●]$^{[+1][+3]}_{[+S][+O]}$	k:[●$_1$+S][●$_2$] k:[●$_2$+S][●$_3$]
	[●][●]$^{[+2][+3]}_{[+S][+O]}$	–
	[●][●]$^{[+3][+3]}_{[+S][+O]}$ [●●●●]	– k:[●$_1$+S][●$_2$] k:[●$_2$+S][●$_3$]
Phonology:		

Second, in direct forms with a 1pl subject and a 3rd person object, direction **k-** (the one spelling out number elements of both heads) is Ø-licensed, whereas plural **k-** is maintained since it is not linked under a congruent scale contrast:

(73) **Spellout: 1pl → 3sg**

		1pl → 3sg
Input:		[+1●$_1$●$_2$+S][+3●$_3$+O]
Insertion:		k:[●$_1$+S][●$_2$] k:[●$_2$+S][●$_3$]
	[●][●]$^{[+1][+3]}_{[+S][+O]}$	k:[●$_1$+S][●$_2$] k:[●$_2$+S][●$_3$]
Ø-Licensing:	[●][●]$^{[+2][+3]}_{[+S][+O]}$	–
	[●][●]$^{[+3][+3]}_{[+S][+O]}$	–
	[●●●●]	–
Phonology:		k

Third in forms with a 1pl subject and a 2nd person object, both instances of **k-** are retained in the morphology:

(74) **Spellout: 1pl → 2sg**

		1pl → 2sg
Input:		[+1●$_1$●$_2$+S][+2●$_3$+O]
Insertion:		k:[●$_1$+S][●$_2$] k:[●$_2$+S][●$_3$]
Ø-Licensing:	[●][●]$^{[+1][+3]}_{[+S][+O]}$	–
	[●][●]$^{[+2][+3]}_{[+S][+O]}$	–
	[●][●]$^{[+3][+3]}_{[+S][+O]}$	–
	[●●●●]	–
Phonology:		k k

Following (Dimmendaal, 1983), I assume that this is actually correct, and a rule of consonant degemination (as Georgian Turkana has no geminate consonants), reduces **k-k** phonetically to **k**.

6. Summary

In this paper, I have shown that hierarchy effects in pronominal agreement can be straightforwardly captured by licensing conditions which enforce Ø-realization of vocabulary items. This suggests that approaches invoking Local Conjunction and Harmonic Alignment might be overtly powerful tools for capturing the consequences of scales for morphological spellout since a much simpler formalism appears to be equally adequate. It remains a fruitful question, whether the range of possible scale effects can be further restricted. A potentially relevant generalization emerges if we compare the licensing schemata introduced in this paper with respect to the relative prominence of Ø-licensors and Ø-licensees:

(75) **Types of Licensing**

	Licensor	**Ø-Licensee**	**Conditions**
Cumulative Complexity	High	High	same head different scales
Superiority	High	Low	different heads same scale
Direct	Congruent Linking	Complex Marker	different heads same scale
Entailment	High	Low	same head same scale

With the exception of direction licensing (which is difficult to classify in these terms because it targets portmanteaus, not simple markers), only input feature structures which correspond to high elements in scales can be licensors. Whether this generalization extends to other hierarchy-effects and licensing schemata (e.g. for differential case-marking) is a question for future research.

7. Appendix: Details of Vocabulary Insertion

Features:

A feature is either an ordered attribute-value pair (e.g. (1, +) usually abbreviated as +1), or a single privative feature (e.g. •).

Feature Structures:

A feature structure is a multiset of features. Multisets are a mathematical construct which are largely equivalent to sets with the only exception that multisets can differ by having the same elements in different cardinality (cf. Knuth, 1969 for details, and Gazdar et al., 1985 for another linguistic application). Thus the sets {a, b, c} and {a, a, b, c} are identical ({a, b, c} and {a, a, b, c} are different notations for the same set), but the multiset $\{a, b, c\}_m$ differs from the multiset $\{a, a, b, c\}_m$ since the first contains "a" once, and the latter twice. In the following and in the rest of the paper, I use the standard notation for morphological feature structures as a shorthand for multisets. Hence [+1–2••] is abbreviating the multiset $\{(1, +), (2, –), •, •\}_m$. An indexed feature structure is an ordered pair of a feature structure and a natural number (e.g. ([+3+Agr••], 1) abbreviated as $[+3+Agr••]_1$). To distinguish the n different instances of the same element in a multiset, I will assign distinct (superscripted) indices from 1 to n to them (e.g. $[+3+Agr•^1•^2]_1$).

Indexed Lists:

An indexed list is a set of indexed feature structures such that the indices of the feature structures impose a complete transitive order on the set. An example is given in (76), which abbreviates $\{[+3+Agr••]_1, [+3+Agr•]_2\}$

(76) $[+3+Agr••]_1\ [+3+Agr•]_2$

Inputs:

An input is an ordered pair of a lexical root (a string of phonemes) and an indexed list, e.g. (77) which abbreviates (xedav, $\{[+3+Agr••]_1, [+3+Agr•]_2\}$).

(77) xedav $[+3+Agr••]_1\ [+3+Agr•]_2$

Vocabulary Items:

a vocabulary item is a triple (P, O, L), where P is a string of phonemes (the phonological content of the affix), O is either "prefix" or "suffix" (the affixal orientation of the affix), and L is an indexed list.

Possible Mappings:

To get a simple definition of the insertion algorithm, we need definitions of a number of auxiliary notions resulting in a precise definition of the mapping of a VI to an input:

(78) **Definition Partition:** A partition of an indexed feature structure F with index i is a multiset of indexed feature structures $S = \{F_1, \ldots, F_n\}_m$ such that all elements of S are non-empty, have the index i, and $F_1 \cup \ldots \cup F_n = F$.

(79) and (80) enumerate all partitions of the indexed feature structures in (77):

(79) **Partitions of** $[+3+Agr\bullet]_2$:

a. **P21:** $\{[+3]_2, [+Agr]_2, [\bullet]_2\}_m$
b. **P22:** $\{[+3+Agr]_2, [\bullet]_2\}_m$
c. **P23:** $\{[+3\bullet]_2, [+Agr]_2\}_m$
d. **P24:** $\{[+3]_2, [+Agr\bullet]_2\}_m$

(80) **Partitions of** $[+3+Agr\bullet\bullet]_1$:

a. **P11:** $\{[+3]_1, [+Agr]_1, [\bullet]_1, [\bullet]_1\}_m$
b. **P12:** $\{[+3+Agr]_1, [\bullet]_1, [\bullet]_1\}_m$
c. **P13:** $\{[+3]_1, [+Agr\bullet]_1, [\bullet]_1\}_m$
d. **P14:** $\{[+3\bullet]_1, [+Agr]_1, [\bullet]_1\}_m$
e. **P15:** $\{[+3]_1, [+Agr]_1, [\bullet\bullet]_1\}_m$
f. **P16:** $\{[+3+Agr]_1, [\bullet\bullet]_1\}_m$
g. **P17:** $\{[+3\bullet]_1, [+Agr\bullet]_1\}_m$
h. **P18:** $\{[+3+Agr\bullet]_1, [\bullet]_1\}_m$
i. **P19:** $\{[+3+\bullet\bullet]_1, [+Agr]_1\}_m$
j. **P110:** $\{[+Agr+\bullet\bullet]_1, [+3]_1\}_m$

(81) **Definition Possible Split:** A possible split of an indexed list $I = \{F_1, \ldots, F_n\}$ is a multiset $S = S_1 \cup \ldots \cup S_n$ such that S_i is a partition of F_i $(1 \leq i \leq n)$.

For the input list in (77), every union of one partition of the first feature structure and one partition of the second feature structure is a possible split. (82) lists some examples:

(82) **Some Possible Splits of (77):**

a. **P21** ∪ **P11** = $\{[+3]_1, [+\text{Agr}]_1, [\bullet]_1, [\bullet]_1, [+3]_2, [+\text{Agr}]_2, [\bullet]_2\}_m$
b. **P21** ∪ **P13** = $\{[+3]_2, [+\text{Agr}]_2, [\bullet]_2, [+3]_1, [+\text{Agr}\bullet]_1, [\bullet]_1\}_m$
c. **P24** ∪ **P13** = $\{[+3]_2, [+\text{Agr}\bullet]_2, [+3]_1, [+\text{Agr}\bullet]_1, [\bullet]_1\}_m$

(83) **Definition Possible Mapping:** A *possible mapping* of a VI V to an input I is an injective function F from the indexed list of V to the indexed list of I such that

a. the feature structure of F(FS) = the feature structure of FS
b. for every ordered pair (a, a') and (b, b') in F:
If Index(a) < Index(b) then Index(a') ≤ Index(b')

For example, two possible mappings of the VI in (84) and the input in (77) (based on (82-a)) are shown in (85) (recall that superscripts indicate the different occurrences of $[\bullet]_1$ in (82-a)):

(84) la- $[\bullet]_1$ $[\bullet]_2$

(85) a. $[\bullet]_1 \rightarrow [\bullet^1]_1, [\bullet]_2 \rightarrow [\bullet^1]_2$
b. $[\bullet]_1 \rightarrow [\bullet^1]_1, [\bullet]_2 \rightarrow [\bullet^2]_1$

Finally, to avoid the proliferation of mappings which are basically identical, I define the notion of a minimal possible mapping:

(86) **Definition Minimal Possible Mapping:** M is a minimal possible mapping if it is a possible mapping, and there is no possible Mapping M' such that M can be transformed into M' by assigning lower token indices to multiset members in the range of M.

Thus (87-a) is a possible mapping, but not minimal because it can be transformed into the possible mapping (86-a) by changing $[\bullet^2]_1$ to $[\bullet^1]_1$. (86-b) could be transformed by the same replacement into (87-b), but (87-b) is not a possible mapping (it is not injective), hence (86-b) is also minimal.

(87) a. $[\bullet]_1 \rightarrow [\bullet^2]_1, [\bullet]_2 \rightarrow [\bullet^1]_2$
b. $[\bullet]_1 \rightarrow [\bullet^1]_1, [\bullet]_2 \rightarrow [\bullet^1]_1$

Insertion Algorithm

The insertion algorithm basically produces an ordered list of all possible mappings for an input and a lexicon of VIs, and inserts the corresponding VIs. The ordering of the list corresponds to the ranked constraints in (14). The smallest input index of a possible mapping M (abbreviated as SIM(M)) is the smallest index of the indexed feature structures in the range of M, and the smallest output index of a possible mapping M (abbreviated as SOM(M))is the smallest index of the indexed feature structures in the domain of M. The output is a list of base and affixes where affixes are ordered pairs of a phonological string and an indexed list. "←" assigns the value on its right to a variable on its left, and "+" is the concatenation operator for lists:

(88) **Insertion Algorithm:**

Input: An input I = (B, IL) and a list of VIs $[V_1 \ldots V_n]$

Create an ordered list O such that:

i) O contains all minimal possible mappings from V_i to I, , $1 \leq i \leq n$
ii) for every two members M_1 and M_2 of O the following holds:

If M_1 precedes M_2 in O then:

1. $SIM(M_1) \leq SIM(M_2)$
2. If $SIM(M_1) = SIM(M_2)$ then $range(M_1) \geq range(M_2)$
3. If $SIM(M_1) = SIM(M_2)$ and $range(M_1) = range(M_2)$ then $SOM(M_1) \leq SOM(M_2)$

For every element M of O corresponding to VI V = (P, O, L):

Base ← [B]
List ← L
Replace the indices of L by the indices of the corresponding elements in M
Affix ← [(P,L)]

If O = prefix then: Base ← Affix+Base
If O = suffix then: Base ← Base+Affix

Return Base

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