On prominence scale interactions in Hayu: a Harmonic Grammar account[1]

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Abstract

This paper investigates prominence scale interactions in verbal agreement in Hayu (Kiranti). The agreement system is very complex in several ways. First, the person and the number scale interact in interesting ways, i.e. they need to be ranked in order to produce the correct output in cases of conflicting preferences; second, the general ranking seems to be reversed in one particular context. This pattern poses a challenge to existing analyses of scale-driven agreement. I propose a Harmonic Grammar-based analysis where an argument's prominence is quantified. In this way, all interactions are correctly derived. The apparent exceptions fall out automatically as cumulative effects.

1. Introduction

Verbal agreement morphology in the Kiranti language Hayu exhibits multidimensional scale effects, i.e. several prominence scales (the person scale S_P and the number scale S_N) interact to determine the agreement controller among the two arguments of a transitive verb (see Corbett 2006 for the terminology). The pattern that emerges is the following: In case of conflicting preferences, where the two scales favor a different agreement controller, the scales are ranked, i.e. one is given preference over the other: $S_P \succ S_N$.

The existing literature on the modeling of scale effects in agreement focuses virtually exclusively on the influence of a single scale on the choice of an agreement controller. The few analyses that take into account scale interactions cannot cover the Hayu pattern. I will show that while an optimality-theoretic (OT) analysis of the pattern is possible, it requires complex (i.e. context-sensitive) constraints and basically restates the observations, but does not explain surface exceptions. Instead, I propose that the scale interactions receive a more principled explanation in Harmonic Grammar (HG): feature values on a scale are weighted to quantify an argument's salience. The weights of different scales are added to produce a harmony score. The agreement rule can then refer to the harmony score and turns out to be very simple: the agreement controller is the argument with the highest harmony score. Exceptions fall out as cumulative effects; no complex constraints are required to capture them. Hayu agreement thus provides an example for the existence of cumulative effects, known from phonology, in morphosyntax.

The paper is structured as follows: Section 2 gives a brief introduction into scale-driven agreement and points out why scale interactions are of particular interest to any theory of agreement. In Section 3 I present the Hayu data, summarize the empirical generalizations that emerge and discuss a potential OT-analysis of the facts. In section 4 I outline the HG-based analysis and argue that it is to be favored over the OT-analysis. Some details concerning the syntax-morphology-interface of the HG-account are outlined in section 5. Section 6 concludes.

2. On prominence scale effects in agreement

In languages in which verbal agreement is driven by prominence scales, only one of the two arguments of a transitive verb controls agreement but the controller can in principle be the subject or the direct object.

Hence, the arguments compete. Which of them wins is determined by prominence scales: the argument that is more prominent on a given scale than its co-argument triggers agreement. (1) lists some of the scales that are known to have an impact on agreement (and other domains of the grammar); note that languages differ in how many distinctions are made and where the cut-off point between two members of the scale lies:

(1) Prominence scales (cf. Hale 1972, Silverstein 1976, Dixon 1994, Stiebels 2002, Siewierska 1990, Wunderlich 2006, Corbett 2006):
    a. Person scale: local person (1st, 2nd) $\succ$ 3rd person
    b. Number scale: pl $\succ$ sg
    c. animacy scale: human $\succ$ animate $\succ$ inanimate

Nocte (Sino-Tibetan) is a language in which the tripartite person scale in (2) is active in agreement. Hence, in order to determine the agreement controller of a transitive verb, we need to compare the person values of both arguments; agreement is with the one that has the more prominent person value. (3) illustrates this for an interaction of a 2nd and a 3rd person argument. The verb always agrees with the 2nd person argument because it is more prominent than its 3rd person co-argument, regardless of grammatical functions ('X $\rightarrow$ Y' means: subject with value X acts upon direct object with value Y, the agreement controller is boldfaced).[2]

(2) Nocte person scale: $1 \succ 2 \succ 3$

(3) Nocte scale effects (Das Gupta 1971:21):

    a. hetho-o
       teach-2
       "You will teach them."   *2 $\rightarrow$ 3*

    b. hetho-h-o
       *teach-*INV*-2*
       "He will teach you."   *3 $\rightarrow$ **2***

In Nocte, only a single prominence scale affects agreement. But in some languages several scales are active. Suppose there is a language in which agreement is influenced by the person and the number scale in (4):

(4)   a. person scale: $1/2 \succ 3$ b. number scale: pl $\succ$ sg

The crucial question is what happens in such languages if the two scales favor agreement with different arguments. For example, in a 2sg $\rightarrow$ 3pl scenario, the person scale favors subject agreement, while the number scale demands object agreement. Trommer (2006) calls such conflicting scenarios *hierarchy-crossing* contexts; I will use this term in what follows. One pattern that is attested can be found e.g. in Mordvin (Uralic, Béjar 2003). In Mordvin the two scales in (4) determine verbal agreement. In the hierarchy-crossing context 2sg $\leftrightarrow$ 3pl (where '$\leftrightarrow$' means that each of the two could be the subject or the object), each scale simply picks the most prominent value; these values can come from different arguments (= *mixed agreement*). Hence, the resulting agreement will be 2pl because the person scale takes the most prominent person value (=2nd person) and the number scale the most prominent number value (= plural). Crucially, to produce this kind of mixed agreement, the person and the number scale do not interact in any way: each scale is totally blind to which argument the other one chooses as an agreement controller; they may target the same argument (in non-hierarchy-crossing contexts) or different arguments (in hierarchy-crossing contexts). Based on further examples of the Mordvin type, several researchers (working in the Agree framework, see among others Béjar 2003, Anagnostopoulou 2003, Béjar and Řezáč 2003, Laka 1993, Sigurðsson and Holmberg 2008) have concluded that person and number probe *independently* for an agreement controller.

    However, in recent years examples of interacting (i.e. non-independent) scales have been identified: see Bank (2010), Coon and Bale (2014), Despić et al. (2015), Bhatia et al. (2016) on Algonquian languages and Trommer (2006) on Dumi (Kiranti). In these languages, the agreement controller chosen by scale S_x

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[2]In combinations of two 3rd person arguments in Nocte the verbs bears the agreement suffix *-a*, the same marker that occurs on intransitive verbs with a 3rd person subject, cf. DeLancey (1981:94). Crucially, *-a* cannot be doubled in the $3 \rightarrow 3$ context. Hence, there is also hierarchical agreement, but the morphology does not tell us which 3rd person argument is the agreement controller.

is not completely independent of the agreement controller targeted by scale S_y. Hence, neither the person nor the number scale alone determines the agreement controller; rather, the scales have to be combined in order to achieve the desired result. Hayu verbal agreement is another instance of this pattern where scales interact. The currently most prominent analysis of scale effects in agreement in the Agree framework, *relativized probing* (Nevins 2007, Béjar and Řezáč 2009, Preminger 2014), assumes separate probing for person and number and hence can capture mixed agreement of the Mordvin type, but not scale interactions. Several solutions have been proposed (see Bank 2010, Coon and Bale 2014, Despić et al. 2015, Bhatia et al. 2016). But none of these can capture the Hayu data that will be introduced below. Thus, a different mechanism is needed to cover the distribution of agreement markers in Hayu.

3. Scale interactions in Hayu

Hayu is spoken in Eastern Nepal and has basic SOV word order with ergative alignment of case (Michailovsky 1974; 1981). The verb exhibits person and number agreement, expressed by suffixes, with at least one of its arguments (see below for details). (5) provides example sentences with an intransitive and a transitive verb:

(5) Hayu inflection (Michailovsky 1974:6):[3]

    a. gu   bUk-ŋo-m
         I.ABS *rise-1*SG.NON-PST-M
         "I will get up."

    b. mi-ha gu   pUk-ŋo-m
         he.ERG *I*.ABS *rouse-1*SG.NON-PST-M
         "He will get me up."

3.1. Empirical basis: paradigms and generalizations

The agreement paradigms, taken from Michailovsky (1974; 1981; 2003), look as follows: (8) shows the intransitive non-past paradigm of the verb *bUk* 'to get up'; the transitive non-past forms of the verb *pUk* 'to get someone up' are split into two paradigms (1st vs. 2nd and 3rd person objects) for reasons of space, see (6) and (7). *S* stands for 'subject', *O* for 'object'. All paradigms contain underlying forms; the non-standard abbreviations used are *p* and *d* for plural and dual, *e* and *i* for 1st exclusive and inclusive, respectively. The shaded cells are the reflexive combination for which a special paradigm exists (not discussed here).

(6) transitive, non-past, *pUk* 'to get someone up', 1st person objects

↓S →O	1sg	1de	1pe	1di	1pi
1sg					
1de					
1pe					
1di					
1pi					
2sg	pUk-ŋo-Ø	pUk-tshok	pUk-kok		
2du	pUk-ŋo-tshik	pUk-tshok	pUk-kok		
2pl	pUk-ŋo-ne	pUk-tshok	pUk-kok		
3sg	pUk-ŋo-Ø	pUk-tshok	pUk-kok	pUk-tshik	pUk-ke
3du	pUk-ŋo-tshik	pUk-tshok	pUk-kok	pUk-tshik	pUk-ke
3pl	pUk-ŋo-me	pUk-tshok	pUk-kok	pUk-tshik	pUk-ke

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[3]*M* is a final vowel that occurs on main verbs of declarative clauses. *U* corresponds to IPA ʊ (Michailovsky and Mazaudon 1974).

(7)   transitive, non-past, 2nd and 3rd person objects

↓S →O	2sg	2du	2pl	3sg	3du	3pl
1sg	pUk-no-Ø	pUk-no-tshik	pUk-no-ne	pUk-ŋ-Ø	pUk-ŋ-tshik	pUk-ŋ-me
1de	pUk-tshok	pUk-tshok	pUk-tshok	pUk-tshok	pUk-tshok	pUk-tshok
1pe	pUk-kok	pUk-kok	pUk-kok	pUk-kok	pUk-kok	pUk-kok
1di				pUk-tshik	pUk-tshik	pUk-tshik
1pi				pUk-ke	pUk-ke	pUk-ke
2sg				pUk-Ø	pUk-Ø	pUk-me
2du				pUk-tshik	pUk-tshik	pUk-tshik
2pl				pUk-ne	pUk-ne	pUk-ne
3sg	pUk-Ø	pUk-tshik	pUk-ne	pUk-Ø	pUk-tshik	pUk-me
3du	pUk-Ø	pUk-tshik	pUk-ne	pUk-tshik	pUk-tshik	pUk-me
3pl	pUk-me	pUk-tshik	pUk-ne	pUk-me	pUk-me	pUk-me

(8)   intransitive, non-past, *bUk* 'to get up'

S	stem + suffix	S	stem + suffix	S	stem + suffix
1sg	bUk -ŋo	2sg	bUk -Ø	3sg	bUk -Ø
1de	bUk -tshok	2du	bUk -tshik	3du	bUk -tshik
1pe	bUk -kok	2pl	bUk -ne	3pl	bUk -me
1di	bUk -tshik				
1pi	bUk -ke				

The transitive agreement markers are by and large identical to those found with intransitive verbs, only the 1sg exponent exhibits allomorphy (*ŋo* ∼ *no* ∼ *ŋ*). It is obvious that Hayu transitive agreement is scale-driven, at least in large parts of the transitive paradigm. Usually, the verb does not agree with both of its arguments; unless one of the arguments is 1sg, only a single agreement suffix surfaces. And sometimes this suffix expresses features of the subject (e.g. in **2du** → 3pl) and sometimes features of the object (e.g. in 3du → **2pl**), so the agreement controller is not simply determined by grammatical function. Since we are interested in scale effects, I will exclusively focus on contexts in which only one argument agrees with the verb. In these, the following generalizations emerge (note that they also hold for other tenses):

(i) The choice of the agreement controller is driven by the person and the number scale in (9) and (10):

(9)   person scale: $1 \succ 2 \succ 3$ (10)   number scale: plural $\succ$ dual $\succ$ singular

(ii) If the arguments have matching person values, the number scale determines the agreement controller, i.e. the argument that has a more prominent number value becomes the agreement controller (in the following examples, the agreement controller in the context X ↔ Y is boldfaced):

(11)   pUk-**me** (stem–3pl)   **3pl** ↔ 3du
"They.PL will get them.DU up." / "They.DU will get them.PL up."

(iii) If the arguments match in number values, the person scale determines the agreement controller, i.e. the argument that has a more prominent person value becomes the agreement controller:

(12)   pUk-**ne** (stem–2pl)   **2pl** ↔ 3pl
"You.PL will get them.PL up." / "They.PL will get you.PL up."

(iv) If the two arguments have neither matching person nor number values, but both scales favor agreement with the same argument (because both its person and its number value are more prominent than the ones of its co-argument), this favored argument controls agreement.

(13)   pUk-ke (stem–1pi)   **1pi** ↔ 3sg
"We.PI get him up." / "He will get us.PI up."

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(v) The previous contexts were all of the non-hierarchy-crossing type, i.e. the two scales did not pick out different arguments, and hence, the scales did not interact in any interesting way. But now we turn to the *hierarchy-crossing* configurations where the scales do favor different arguments. Unlike in languages like Mordvin, we do *not* get mixed agreement in Hayu in such contexts, e.g. 1de ↔ 3pl; mixed agreement would give us the form in (14), but this is ungrammatical in Hayu. The person and the number value always have to be provided by the same argument in Hayu. What we can observe then is that in such contexts the verb agrees in person and number with the argument that is more prominent on the person scale, in violation of the number scale, compare (15) and (16). Hence, in case of conflict the **scales are ranked** such that the person scale outranks the number scale: **person ≻ number** (a similar pattern can be found in the related language Dumi, see Trommer 2006).

(14) *puk-kok (stem-1pe)   mixed agreement: **1de** ↔ **3pl**

(15) *puk-me   (stem-3pl)   1de ↔ **3pl**

(16) puk-**tshok** (stem-1de)   **1de** ↔ 3pl

Regarding the hierarchy-crossing contexts, more needs to be said. There is one exception to the generalization that person outranks number in the case of conflict, namely in contexts in which a 2sg and a 3pl argument interact, regardless of the distribution of grammatical functions (2sg ↔ 3pl). Given the person ≻ number preference that holds in all other hierarchy-crossing contexts in Hayu, we would expect 2sg agreement here. However, what we get is 3pl agreement, compare (17) and (18). Thus, it seems as if the number scale outranks the person scale in this particular context, a reversal of the general scale ranking:

(17) *pUk-Ø (stem-2sg)   **2sg** ↔ 3pl

(18) pUk-**me** (stem-3pl)   2sg ↔ **3pl**

To summarize, the complex Hayu (transitive) agreement paradigm is an example for the non-trivial interaction of several prominence scales in agreement (i.e. scales are ranked in case of conflicting preferences); in addition, there seems to be an exception in one type of context 2sg ↔ 3pl.[4,5]

3.2. *An OT-analysis of Hayu agreement?*

The question is how the Hayu pattern can be analyzed given that scale interactions are not covered by the standard (separate probing) approach to scale-driven agreement. Furthermore, one needs to say something about the exceptional reranking of the scales in the 2sg ↔ 3pl context. Since the person and the number scale are ranked, an obvious framework for the modeling of the interaction could be OT Prince and Smolensky (1993), where constraints are ranked. An analysis along these lines is sketched below:

(19) Constraints:

    a. PERSON: The verb agrees with the argument in person and number that is more prominent on the person scale in (9).

    b. NUMBER: The verb agrees with the argument in person and number that is more prominent on the number scale in (10).

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[4]Note that (a subset of) this context is exceptional in the same way in some of the related Kiranti languages, too.

[5]An anonymous reviewer suggests the following alternative view on Hayu agreement: Recall that whenever one argument is 1sg, there are no scale effects, viz. the transitive verb agrees with both arguments. Let us assume that – for whatever reason – this holds whenever an argument is singular, viz. also in contexts with a 2sg and 3sg argument. Since these have a zero exponent, we will not see more than one exponent on the surface (namely the one representing the potentially non-zero co-argument). But at least we cannot exclude this possibility. Under this view, the 2sg ↔ 3pl context is not exceptional anymore because there are two suffixes now, one for each argument: -Ø for 2sg and -*me* for 3pl. However, as the reviewer also points out, this leads to the wrong predictions for 2sg ↔ 3du contexts, which should surface with the suffix -*tshik* (preceded by the -Ø marker for the 2sg argument) instead of the attested -Ø. Hence, under both the reviewer's alternative view and the view in the present paper, one contexts remains unexplained and requires additional assumptions. I do not have any empirical evidence that would allow me to choose between the views.

(20)   Ranking (incomplete): PERSON ≫ NUMBER

(21)   Candidates:[6]

      a.   V+subject agreement   → *subject = agreement controller*

      b.   V+object agreement   → *object = agreement controller*

The ranking in (20) ensures the general preference for person over number in case of conflicting preferences. In non-hierarchy-crossing contexts, where the arguments have matching person or number values, the constraint referring to the matching feature is not violated by any candidate (none is more prominent on the relevant scale than the other); hence, it's the constraint referring to the non-matching feature that determines the agreement controller. In hierarchy-crossing contexts, where neither person nor number of the arguments match, both candidates will inevitably violate one of the two constraints, since the scales favor different arguments as agreement controller. But given the ranking, a violation of PERSON is more costly than a violation of NUMBER. Consequently, the argument with the more prominent person value will be chosen as the agreement controller, as it violates the only the lower ranked number constraint. This implements the general person ≻ number preference. But what about the exception in the 2sg ↔ 3pl scenario? This seems to require the reverse ranking of constraints, NUMBER ≫ PERSON. Since this is not possible, a solution to this kind of problem that can be found in the literature is to use context-sensitive/indexed constraints. This means that we double the NUMBER-constraint: there is the general version and a context-sensitive version NUMBER $_{[2sg↔3pl]}$ that mentions the exceptional context; these can be ranked differently.

(22)   Additional (indexed) constraint:
      NUMBER $_{[2sg↔3pl]}$: The verb agrees with the argument in person and number that is more prominent on the number scale in the context 2sg ↔ 3pl.

With the ranking in (23), the general person ≻ number preference is turned into a number ≻ person preference in the context 2sg ↔ 3pl.

(23)   Extended ranking: NUMBER $_{[2sg↔3pl]}$ ≫ PERSON ≫ NUMBER

Although this (sketch of a) OT-analysis gets the facts right, it is not very insightful. The exception in the 2sg ↔ 3pl scenario is just stated, written into a constraint, but not derived or explained.

4.   An HG-analysis of Hayu agreement

The goal of this section is to develop an analysis that correctly derives the agreement controller in all contexts without treating the 2sg ↔ 3pl scenario as exceptional. I will present a HG-inspired analysis in which this scenario falls out automatically as a cumulative effect.

4.1.   HG vs. OT

HG (Légendre et al. 1990, Smolensky and Légendre 2006) is the predecessor of OT (Prince and Smolensky 1993). In both OT and HG, there is an input and a set of corresponding output candidates; the input is mapped onto an output candidate through a process of optimization with the help of violable constraints. In OT, these constraints are ranked and stand in a *strict dominance* relation. This means that a single violation of a high ranked constraint (Constraint A in (24)) is fatal for candidate 1 if the competing candidate 2 does not violate A; crucially, this holds no matter how often candidate 2 violates lower ranked constraints (Constraint B in (24)). Hence, all constraints that are lower ranked than the highest ranked one for which the two candidates differ can be ignored for the evaluation process.

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[6]Of course there are more candidates (e.g. the verb doesn't agree at all or it agrees with both arguments, etc.) and these need to be ruled out by other, higher ranked constraints. Since the analysis will be abandoned anyway, I will not develop it in more detail here.

(24)   OT – strict dominance:

	Constraint A	Constraint B
cand. 1	*!	
☞ cand. 2		****

This is not the case in HG, however. To see this, we consider some basic assumptions of HG. First of all, there is no ranking of constraints in HG. Rather, the importance of a constraint is expressed by its weight *w* (a numerical value); the higher the weight, the more important the constraint. The winner among the competing candidates is the one with the highest *harmony score* $\mathcal{H}$, which is calculated as follows:

(25)   Calculation of $\mathcal{H}$ in HG:
   a.   The number of violations (standardly represented by a negative integer) of a constraint $\mathcal{C}$ is multiplied with $\mathcal{C}$'s weight $\rightarrow$ this gives us $\mathcal{H}$ for each individual constraint
   b.   The overall $\mathcal{H}$ of a candidate is the sum of the $\mathcal{H}$s of the harmony scores of the individual constraints: $\mathcal{H}_{Cons.1} + \mathcal{H}_{Cons.2} + ...$

For example, in (26) candidate 1 violates constraint A with weight 3 once (hence its $\mathcal{H}$ is -3). Candidate 2 violates a less important constraint (weight 1) four times and hence receives a $\mathcal{H}$ of -4. Candidate 1 is the winner because it has the highest $\mathcal{H}$ (-3 > -4). (If constraint B were violated only twice by candidate 2, the latter would be the winner, since $\mathcal{H}$ -3 < -2). This example also shows that strict dominance does not hold in HG. Unlike in OT, we can get *cumulative effects*: a high number of violations of (a) light (low weighted) constraint(s) can outweigh a low number of violations of a heavier (high weighted) constraint. In (26) the effect is achieved by multiple violations of a single lighter constraint.

(26)   HG – weights (illustrated with violations – negative integers):

	Constraint A	Constraint B	$\mathcal{H}$
weight	w=3	w=1	
☞ cand. 1	* (-1)		-3 (-1x3)
cand. 2		**** (-4)	-4 (-4x1)

But it can also result from the interaction of several lighter constraints as in (27): The overall $\mathcal{H}$ of the less important constraints B and C together for candidate 2 is worse than the one for candidate 1 that violates a more important constraint only once. Hence, constraint B and C team up. This is possible because we add the $\mathcal{H}$ of all constraints to calculate the overall $\mathcal{H}$ of a candidate.

(27)   HG – cumulative effect:

	Constraint A	Constraint B	Constraint C	$\mathcal{H}$
weight	w=3	w=2	w=1	
☞ cand. 1	* (-1)			-3 (-1x3)
cand. 2		* (−1)	** (−2)	-4 (-1x2)+(-2x1)

   To mimic cumulative effects in OT, we need a complex constraint: either indexed constraints of the type illustrated for Hayu in section 3.2, or Local Conjunction.[7] Many problems with the use of this complex type of constraint have been identified in the OT/HG literature, see e.g. Smolensky and Légendre (2006),

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[7](i) provides a definition of Local Conjunction (LC, Smolensky 1995). (ii) illustrates how the cumulative effect in (26) can be modeled in OT through LC.

(i)   a.   The local conjunction of C_1 with subhierarchies { $C_2 \gg C_3 \gg ... C_n$ } yields the subhierarchy { C_1 & $C_2 \gg C_1$ & $C_3 \gg ... C_1$ & C_n }.
       b.   The local conjunction of C_1 and C_2 in domain D, C_1 & C_2, is violated when there is some domain of type D in which both C_1 and C_2 are violated.
       c.   Universally, C_1 & C_2 dominates C_1, C_2.

Pater (2009), Jesney (2015) for discussion. In what follows, I will show that a HG analysis of Hayu not only avoids the use of complex constraints, but also derives the apparent exception in 2sg ↔ 3pl scenarios without a context-specific constraint.

4.2. HG-analysis: constraints, weights, and tableaux

The basic idea of the analysis is as follows: The choice of the agreement controller in Hayu is driven by the person and the number scale. Thus, we quantify how prominent an argument is on each scale. We do this by assigning a numerical value, i.e. a weight, to each value of the two features in accordance with (28):

(28)   The more prominent a feature value is on a prominence scale, the higher its numerical value.[8]

Put differently, we assign rewards (numerical values) to an argument for its feature values: the more prominent the value is on the scale, the higher the reward it receives. The weights chosen for each person and each number value in Hayu are listed in (29). Note that the distance between adjacent elements on each scale is constant: it's 1.5 for person and 1.0 for number. That the factor (and hence the weight) for person is higher than the one for number implements the observation that person is more important in determining the agreement controller in Hayu than number (remember the general preference person ≻ number).

(29)   Simple weights:

person	number
w(1ST) = 4.5	w(PL) = 3
w(2ND) = 3	w(DU) = 2
w(3RD) = 1.5	w(SG) = 1

(30) $\mathcal{H}$ = added weights (w(person) + w(number)):

1pl	**7.5** (4.5+3)	2pl	**6** (3+3)	3pl	**4.5** (1.5+3)
1du	**6.5** (4.5+2)	2du	**5** (3+2)	3du	**3.5** (1.5+2)
1sg	**5.5** (4.5+1)	2sg	**4** (3+1)	3sg	**2.5** (1.5+1)

To calculate the overall $\mathcal{H}$-score of an argument, we simply add the numerical value (weight) of its person value to that of its number value, cf. (31). The derived overall (i.e. combined person/number) $\mathcal{H}$ is shown in (32) in descending order (the further to the left, the higher $\mathcal{H}$).

(31)   Harmony score $\mathcal{H}$ of an argument = sum of scores for person and number: w(person) + w(number)

(32)   Combined P+N scale (descending $\mathcal{H}$): 1pl ≻ 1du ≻ 2pl ≻ 1sg ≻ 2du ≻ ⊏3pl ≻ 2sg⊐ ≻ 3du ≻ 3sg

Finally, we compare the resulting $\mathcal{H}$-scores of the two verbal arguments and choose the one with the highest $\mathcal{H}$ as the agreement controller (= the leftmost one in (32)). The Hayu agreement rule is now very simple:

(33)   Agreement rule in Hayu: The verb agrees with the argument that has the highest $\mathcal{H}$.

This algorithm correctly derives the agreement controller for all contexts with hierarchical agreement, including the hierarchy-crossing contexts.[9] All we need to do is to locate the two arguments of the verb on the combined person/number scale in (32) and have the verb agree with the one that is further to the left. For example, in a 1du ↔ 3sg (descriptively: both scales pick out the same argument), agreement is with the

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(ii)   OT – cumulative effect by local conjunction:

	Cons. B&C	Cons. A	Cons. B	Cons. C
cand. 1	*		*	*
☞ cand. 2		*		

[8]A similar concept has been applied in HG-phonology; cf. the literature on scalar constraints (Kimper 2011, Pater 2012, McPherson and Hayes 2015, Hsu and Jesney 2015).

[9]Note that this system predicts the same reversal of preferences for the scenario 1sg ↔ 2pl, with the 2pl argument controlling agreement. However, we cannot check whether this is borne out since Hayu, for whatever reason, simply does not have scale-driven agreement in contexts involving a 1sg argument; instead, the verb agrees with both arguments. The mechanism introduced here is intended to determine the agreement controller in case of competition between arguments, which we do not find in 1sg ↔ 2pl in Hayu.

1du argument ($\mathcal{H}$ 6.5 > 2.5). In a 1du → 2du context (descriptively: the number value matches, but person values differ) agreement is with 1du again ($\mathcal{H}$ 6.5 > 5). In almost all hierarchy crossing contexts, e.g. in 1du ↔ 2pl, agreement is with the argument that is higher on the person scale, here 1du ($\mathcal{H}$ 6.5 > 6). The reader may verify that this is true for the other hierarchy-crossing scenarios. Crucially, the apparent exception in 2sg ↔ 3pl contexts (boxed in (32)), where the preference seems to be reversed (number ≻ person), falls out without any additional assumptions: indeed, the score of 3pl is higher than that of 2sg ($\mathcal{H}$ 4.5 vs. 4); but given the weights in (29), this is the only hierarchy-crossing contexts in which this reversal happens, as can be verified in (32). Under this HG analysis, we do not have to introduce indexed constraints or any other complex constraint, nor do we have to stipulate a reversal of the general person ≻ number preference.

To properly formalize this idea in HG, we only need to postulate a constraint for each person and for each number value that rewards an argument for bearing this particular person or number value, respectively. The constraints have the weights given to each value in (29).

(34)   a.   1ST: Assign a reward for the presence of the person value 1.   *w=4.5*
        b.   2ND: Assign a reward for the presence of the person value 2.   *w=3*
        c.   3RD: Assign a reward for the presence of the person value 3.   *w=1.5*
        d.   PL: Assign a reward for the presence of the number value pl.   *w=3*
        e.   DU: Assign a reward for the presence of the number value du.   *w=2*
        f.   SG: Assign a reward for the presence of the number value sg.   *w=1*

Note that instead of penalizing the absence of licensing by the use of negative integers (indicating a violation of a constraint), as done in standard HG (and OT), I have been using positive integers throughout to express a candidate's compliance with a licensing criterion, indicating a reward for fulfillment of a constraint.[10] But nothing crucial hinges on this; the analysis could also be implemented based on constraint violations.

There are at least two candidates for each context X → Y to represent the agreement controller. One corresponds to X (meaning X is the agreement controller) and the other to Y (meaning Y is the agreement controller). If a candidate has the person value a and the number value b, the constraints referring to a and to b are fulfilled and hence get a reward (+1). Those that mention a different value are ignored, i.e. they do not get a reward. If a constraint is fulfilled, the $\mathcal{H}$ for this constraint is +1 (number of rewards) multiplied with its weight. Finally, to calculate the overall $\mathcal{H}$ of a candidate, we add the $\mathcal{H}$-scores of all constraints for which this candidate got a reward. This is illustrated for a few contexts in the following tableaux. But the result is the same as before: the agreement controller is the argument whose person-number value has the higher $\mathcal{H}$-value, i.e. is further to the left on the combined scale in (32).

(35)   Person and number diverge, scales pick out the same argument:

1pi ↔ 3sg	1ST w=4.5	2ND w=3	3RD w=1.5	PL w=3	DU w=2	SG w=1	$\mathcal{H}$
☞ c1: 1pi	+1			+1			7.5 ((+1x4.5)+(+1x3))
c2: 3sg			+1			+1	2.5 ((+1x1.5)+(+1x1))

(36)   Person and number diverge, hierarchy-crossing (person ≻ number):

1de ↔ 3pl	1ST w=4.5	2ND w=3	3RD w=1.5	PL w=3	DU w=2	SG w=1	$\mathcal{H}$
☞ c1: 1de	+1				+1		6.5 ((+1x4.5)+(+1x2))
c2: 3pl			+1	+1			4.5 ((+1x1.5)+(+1x3))

With the "exceptional" scenario in (37), we can illustrate that we are dealing with a cumulative effect: person and number values of relatively low importance can team up and overcome a combination with a more important person or number value. In this example, the 2sg argument has a higher person prominence than its 3pl competitor, but the latter has a higher number prominence. In fact, the 3pl argument fulfills

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[10]For arguments for the use of rewards and hence positive integers in HG-phonology see Kimper (2011), Kaplan (2016).

two less important constraints compared to its competitor, which fulfills the more important 2ND. But since the difference between pl and sg is greater than the one between 2nd and 3rd person (w(number) = 3 vs. 1, w(person) = 3 vs. 1.5), person+number of the 3pl argument overcome the $\mathcal{H}$-score of the 2sg competitor.

(37) Person and number diverge, hierarchy-crossing (number $\succ$ person):

2sg $\leftrightarrow$ 3pl	1ST w=4.5	2ND w=3	3RD w=1.5	PL w=3	DU w=2	SG w=1	$\mathcal{H}$
c1: 2sg		+1				+1	4 ((+1x3)+(+1x1))
☞ c2: 3pl			+1	+1			4.5 ((+1x1.5)+(+1x3))

5. More on the syntax-morphology interface

In this section I will briefly add a few assumptions on the syntax-morphology interface that will clarify how the derivation of agreement in Hayu proceeds. As for the syntax, I assume that a verbal head, say v, agrees in person and number with both arguments of a transitive verb. Hence, in the Agree framework (Chomsky 2000; 2001), this means that v bears two unvalued ϕ-feature sets, each consisting of a person and a number slot, that are valued under Agree with a ϕ-valued argument.[11] The valued ϕ-sets are shown in (38):

(38) { P:v, N:v }, { P:v, N:v } (P = person, N = number, v = any value)

Afterwards, the harmony score $\mathcal{H}$ is calculated for each of the ϕ-feature sets on v according to the HG-based mechanism presented in section 4.2. The winner, i.e., the ϕ-set with the highest $\mathcal{H}$-score, remains on v, while the one with the lower $\mathcal{H}$-score is deleted; more precisely, it is marked as invisible for vocabulary insertion, but it is not literally erased (this is necessary as the deleted values are needed as context features that trigger allomorphy, see below). Deletion happens in all contexts except for those in which a ϕ-set contains { P:1, N:sg } – remember that the verb agrees with *both* arguments whenever one of them is 1sg.[12]

Finally, the ϕ-set(s) remaining on v is/are realized by an exponent in the postsyntactic morphological component. This means that I adopt a realizational model of morphology, here Distributed Morphology (Halle and Marantz 1993; 1994). In this framework, the exponents, called vocabulary items (VIs), are inserted into syntactic terminal nodes that carry the morpho-syntactic features. Among the existing VIs the one that has the largest subset of the features of the syntactic terminal node is inserted (cf. the Subset Principle and the Specificity Principle). I postulate the VIs in (39) for Hayu agreement suffixes; note that person features are decomposed as in (40) in order to create natural classes of person that VIs can refer to. Finally, the allomorphs of the 1sg exponent require context specifications; in addition to the VI in (39a), we need the allomorphs in (41).[13] Syncretism (e.g. between 1di/2du/3du) is derived by underspecifying VIs. For example, /tshik/ is underspecified for person and can thus spread into several contexts (dual).

(39) Vocabulary items in Hayu:

    a. /ŋ/ $\leftrightarrow$ [+1 –2 sg]
    b. /tshok/ $\leftrightarrow$ [+1 –2 du]
    c. /kok/ $\leftrightarrow$ [+1 –2 pl]
    d. /tshik/ $\leftrightarrow$ [du]
    e. /ke/ $\leftrightarrow$ [+1 +2 pl]
    f. /Ø/ $\leftrightarrow$ [sg]
    g. /ne/ $\leftrightarrow$ [–1 +2 pl]
    h. /me/ $\leftrightarrow$ [–1 –2 pl]

(40) Decomposition of person features (cf. Noyer 1992, Frampton 2002):

[+1] = speaker, [+2] = addressee

1excl	[+1 –2]	1incl	[+1 +2]
2	[–1 +2]	3	[–1 –2]

(41) Allomorphs of 1sg exponent ŋ: ŋo~*no*:

    a. /no/ $\leftrightarrow$ [+1 –2 sg] / __ [–1 +2 Abs]
    b. /ŋo/ $\leftrightarrow$ [+1 –2 sg Abs –pst]

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[11] If the probe sets are on v, they can target both the external and the internal argument of the verb if Agree applies under m-command, and can hence target both Spec$v$P as well as elements in the c-command of v.

[12] For reasons of space I will refrain from a formal implementation of the deletion process and its exception in 1sg-contexts, but this will also involve competition and can hence easily be added to the HG-analysis presented so far.

[13] The allomorphs of the 1sg exponent are supposed to also cover their occurrences in the past paradigm, hence their specific context restrictions.

6. Conclusions

I have shown that Hayu verbal agreement exhibits scale interactions, i.e. several prominence scales need to be combined and ranked to determine the agreement controller of a transitive verb. Such interactions are problematic for existing accounts of hierarchical agreement. I have argued that a HG-analysis in which an argument's prominence on a scale is quantified provides a more principled explanation of the facts than an OT-analysis, because unlike in the latter, apparent exceptions fall out without further stipulations as cumulative effects.

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