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A Linearization-Based Theory of Summative Agreement in Peripheral-Node Raising Constructions

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20.1 Introduction

Before I start, I would like to explain what the title of this paper is supposed to mean. The term *peripheral-node raising (PNR)* will be used as a cover term for both right-node raising (RNR) and left-node raising (LNR). RNR is a phenomenon exemplified by an English sentence such as (1), and LNR is a phenomenon that can be regarded as its mirror image (see Yatabe 2001).

(1) My mother likes, but my father dislikes, that movie.

What I call *summative agreement* is a peculiar agreement pattern observed in right-node raising and left-node raising constructions in languages such as Basque (McCawley 1988, p. 533), Dargwa (Kazenin 2002), English (Postal 1998, p. 173; Levine 2001), German (Schwabe 2001; Schwabe and von Heusinger 2001), and Russian (Kazenin 2002). In these languages, when a predicate has two or more subjects (or objects, in the case of Basque) as a result of having been PNRed out of two or more clauses, it does not have to agree with each of its subjects (or objects, respectively). For instance, in these languages, when a verb has two subject NPs that are both singular, the verb can unexpectedly appear in a form that agrees with a plural subject. (2) is an English example of this phenomenon.

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(2) The pilot claimed that the first nurse, and the sailor proved that the second nurse, were spies. <7, 12, 3, 1>[1]
(from Postal 1998, p. 173)

The VP *were spies* in this example has two subjects; in the first clause, it takes the NP *the first nurse* as its subject, and in the second clause, it takes the NP *the second nurse* as its subject. Both the subjects are singular but the verb appears in the plural form. The following German and Russian examples appear to show the same pattern.

(3) Bist du sicher, daß Hans den Saft und Fritz den Wein gestohlen
Are you sure that Hans the juice and Fritz the wine stolen

haben? Ich glaube eher, daß [Hans den Saft und Fritz den
have.PL I believe rather that [Hans the juice and Fritz the

Wein gekauft haben].
wine bought have.PL]

'Are you sure that Hans STOLE the juice and Fritz the wine? I rather believe that [Hans BOUGHT the juice and Fritz the wine].'
(from Schwabe 2001)[2]

(4) Včera kupili: Vasja žurnal, a Kolja slovar'.
yesterday bought.PL Vasja journal but Kolja dictionary

'Yesterday Vasja bought a journal, and Kolja a dictionary.'
(from Kazenin 2002)

The bracketed portion of the German example (3) has the form S-O-S-O-V and arguably involves RNR of a verb cluster out of two clauses, and the Russian example (4) has the form V-S-O-S-O and arguably

[1]The figures immediately following some of the examples show the result of a questionnaire survey that I conducted in 2002, in which I obtained grammaticality judgments from 23 native speakers of English (3 American speakers and 20 British speakers). The notation $<m, n, o, p>$ means that m people said the example was perfect, n people said it was slightly unnatural, o people said it was considerably unnatural, and p people said it was impossible. Each sentence was given 3 points for each speaker who said it was perfect, 2 points for each speaker who said it was slightly unnatural, and 1 point for each speaker who said it was considerably unnatural, and is shown here with no diacritic if it got more than 2.0 points on average, with '?' if it got 2.0 or less but more than 1.5 points on average, with '??' if it got 1.5 or less but more than 1.0 points on average, with '?*' if it got 1.0 or less but more than 0.5 points on average, and with '*' if it got 0.5 or less points.

[2]It is noted in the literature (Schwabe 2001; Schwabe and von Heusinger 2001) that this example is acceptable only when the sentence-final verb clusters are focused. Of the four non-linguist German speakers I consulted, one speaker found the example perfect, two speakers found it slightly unnatural, and one speaker found it somehow comical.

involves LNR of a verb out of two clauses.[3] Notice that, in both of these examples, the predicate is in the plural form, although the subject noun phrase in each clause is singular.

The phenomenon of summative agreement is of considerable theoretical significance, because it contradicts all currently available theories of agreement, as well as all currently available theories of PNR as far as I am aware, although there have been some vague proposals as to how the phenomenon is to be understood.

The aim of this paper is to present a theory that explicitly characterizes patterns of summative agreement. The proposed theory builds on my own theory of PNR, presented in Yatabe 2001, and is based on the view that agreement results from a non-lexical constraint that regulates under what circumstances a domain object can be merged with other domain objects by the compaction operation.

20.2 Two Theories That Do Not Work

I would like to start by describing two conceivable theories of summative agreement and showing that neither of them actually works.

First, it might seem easy to capture the patterns of summative agreement by adding the following combinatory rule to Steedman's Combinatory Categorial Grammar (see Steedman 2000). (According to Steedman's notation, $\mathrm{S}\backslash\mathrm{NP}_{\mathrm{sg}}$ is a verb phrase that is looking for a singular subject NP, and $\mathrm{S}\backslash\mathrm{NP}_{\mathrm{pl}}$ is a verb phrase that is looking for a plural subject NP.)

(5) $$\frac{\mathrm{S}/(\mathrm{S}\backslash\mathrm{NP}_{\mathrm{sg}}) \quad \mathrm{Conj} \quad \mathrm{S}/(\mathrm{S}\backslash\mathrm{NP}_{\mathrm{sg}})}{\mathrm{S}/(\mathrm{S}\backslash\mathrm{NP}_{\mathrm{pl}})}$$

What this rule means is that, if you have the three things written above the horizontal bar, those three things can be combined to produce a constituent belonging to the category shown below the horizontal bar. Given this rule, the English example that we saw earlier could be analyzed as follows.

(6) $$\begin{array}{cccc}
\underline{\text{The p. claimed that the f. n.}} & \underline{\text{and}} & \underline{\text{the s. proved that the s. n.}} & \underline{\text{were spies}} \\
\mathrm{S}/(\mathrm{S}\backslash\mathrm{NP}_{\mathrm{sg}}) & \mathrm{Conj} & \mathrm{S}/(\mathrm{S}\backslash\mathrm{NP}_{\mathrm{sg}}) & \mathrm{S}\backslash\mathrm{NP}_{\mathrm{pl}} \\
\cline{1-3}
\multicolumn{3}{c}{\mathrm{S}/(\mathrm{S}\backslash\mathrm{NP}_{\mathrm{pl}})} & \\
\hline
\multicolumn{4}{c}{\mathrm{S}}
\end{array}$$

We can even extend this analysis to capture the contrast between this example and the following example, where the two clauses are conjoined by the word *or*, instead of the word *and*.

[3] I am assuming that the conjunction word *a* 'but' is not part of the second conjunct.

(7) The pilot claimed that the first nurse, or the sailor proved that the second nurse, $\left\{\begin{array}{l}\text{??were spies. } \langle 0, 9, 8, 6\rangle \\ \quad\text{was a spy. } \langle 9, 8, 2, 2\rangle\end{array}\right\}$[4]

The grammar will not tolerate summative agreement in a case like this if we assign the conjunction word *or* to a syntactic category different from the category of the word *and*.

This line of analysis, however, cannot be on the right track, because this analysis is incapable of capturing the fact that the possibility of summative agreement is partly determined by the meaning of the subject NPs involved, as shown by (8) and (9).

(8) The pilot claimed that the nurse from the United States, and the sailor also claimed that the nurse from the United States, $\left\{\begin{array}{l}\text{?*were spies. } \langle 1, 2, 9, 11\rangle \\ \quad\text{was a spy. } \langle 9, 9, 4, 1\rangle\end{array}\right\}$

(9) The pilot claimed that the nurse from the United States, and the sailor claimed that no one, $\left\{\begin{array}{l}\text{?*were spies. } \langle 0, 5, 10, 8\rangle \\ \quad\text{was a spy. } \langle 6, 14, 1, 2\rangle\end{array}\right\}$

In (8) the two subject NPs refer to the same individual, and in (9) one of the two subject NPs is a quantifier that begins with *no*, and summative agreement is prohibited in both these cases. The restrictions on summative agreement that are exemplified by these sentences would seem difficult to capture within a theory based on Combinatory Categorial Grammar, since in this theory information regarding the meaning of the two subject NPs is not available at the point where two clauses (more precisely, two phrases belonging to the category $S/(S\backslash NP_{sg})$) are conjoined.

Next, it might seem that a purely semantic theory of subject-verb agreement would make it unnecessary to say anything special about summative agreement. More specifically, it might seem possible to capture the observed patterns of summative agreement as well as non-summative agreement by saying that the plural form of a verb phrase is used if and only if that verb phrase is predicated of two or more objects. For instance, the English example in (2) states that there are *two* people who were either claimed or proven to be spies, and this semantic fact could be taken to be the reason why the verb appears in the plural form. If such a semantic account turns out to be appropriate in all cases, then it will not even be necessary to distinguish summative agreement from non-summative agreement.

[4] These figures do not add up to 23 because two speakers did not rate this sentence.

This line of analysis is ultimately not tenable either, however, because subject-verb agreement cannot be regarded as an entirely semantic phenomenon even in a language like English, where the form of subject-verb agreement does seem to be largely determined by semantic factors. This can be seen from the following examples, taken from Morgan 1984.

(10) a. Every student has passed the exam.

b. More than one student has passed the exam.

c. No student $\left\{\begin{matrix}\text{has} \\ \text{*have}\end{matrix}\right\}$ failed the exam.

d. No students $\left\{\begin{matrix}\text{*has} \\ \text{have}\end{matrix}\right\}$ failed the exam.

In (10a) and (10b), the singular form of the verb is used despite the fact that the sentences claim that the number of students who have passed the exam is two or more (assuming that there are two or more students in the case of (10a)). (10c) and (10d) both claim that the number of students who have failed the exam is zero, but the singular form of the verb is used in (10c) and the plural form is used in (10d). These sentences demonstrate that the form of number agreement that materializes on a verb phrase is not necessarily determined by the number of things that the verb phrase is predicated of. The difference in acceptability between (11a) and (11b) below shows that the same can be said about verb phrases that have been PNRed. (Note that the VP *were spies* in (11b) takes a singular NP as its subject in the first clause, and hence cannot be said to agree with each of its subjects.)

(11) a. ?*The pilot claimed that the nurse from the United States, and the sailor claimed that no doctor, were spies.
<0, 0, 11, 4>[5]

b. ?The pilot claimed that the nurse from the United States, and the sailor claimed that no doctors, were spies.
<2, 4, 9, 0>

(11b) is less than perfectly acceptable for many speakers, but there is a clear contrast between (11a) and (11b). This contrast will be difficult to account for within a purely semantic theory of agreement, as the two sentences appear to have the same meaning.

[5] I consulted only 15 speakers (2 American speakers and 13 British speakers) concerning the sentences in (11).

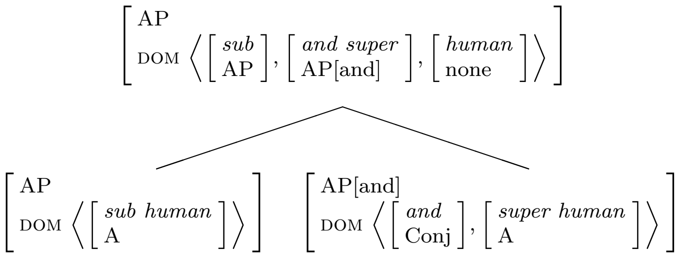

FIGURE 1 Right-node raising of a prosodic constituent

20.3 Peripheral-Node Raising of Predicates

Now I would like to present what I believe to be the correct theory of summative agreement. It is based on my own theory of peripheral-node raising (PNR), so let me briefly describe that theory first.

In the linearization-based theory of PNR presented in Yatabe 2001, it is claimed that PNR comes in two varieties: PNR that dislocates prosodic constituents and PNR that dislocates domain objects. The first type of PNR can be regarded as a species of phonological deletion; it has no semantic effect, and is allowed to fuse and dislocate two or more prosodic constituents even if they do not share identical syntactic or semantic internal structure. The second type of PNR, on the other hand, is an essentially syntactic operation; it does have a semantic effect, and it does not apply unless the things that are to be peripheral-node-raised share identical syntactic and semantic internal structure. Figure 1 shows a structure that is claimed to result from RNR of a prosodic constituent, and Figure 2 shows a structure that is claimed to result from RNR of a domain object. In Figure 1, it is assumed that the morphological words *subhuman* and *superhuman* each consist of two prosodic words, as indicated by use of spacing between the prefixes and the stems. Some people might be inclined to analyze the phrase *sub- and superhuman* as involving coordination of two prefixes, not as involving RNR out of two APs. The analysis depicted in Figure 1 is a reasonable one, however, in light of the existence of examples like *We must distinguish psycho- from sociolinguistic claims* and *the in- and the output of this machine* (Wilder 1997), which show clearly that part of a morphological word can be affected by RNR. (See also Booij 1984.)

Let us see what this theory predicts about examples that involve PNR of predicates. As it turns out, this theory predicts that when two or more predicates are peripheral-node-raised out of conjoined clauses, what is involved can only be PNR of the first type, which is assumed to be a process of phonological deletion. This prediction is obviously

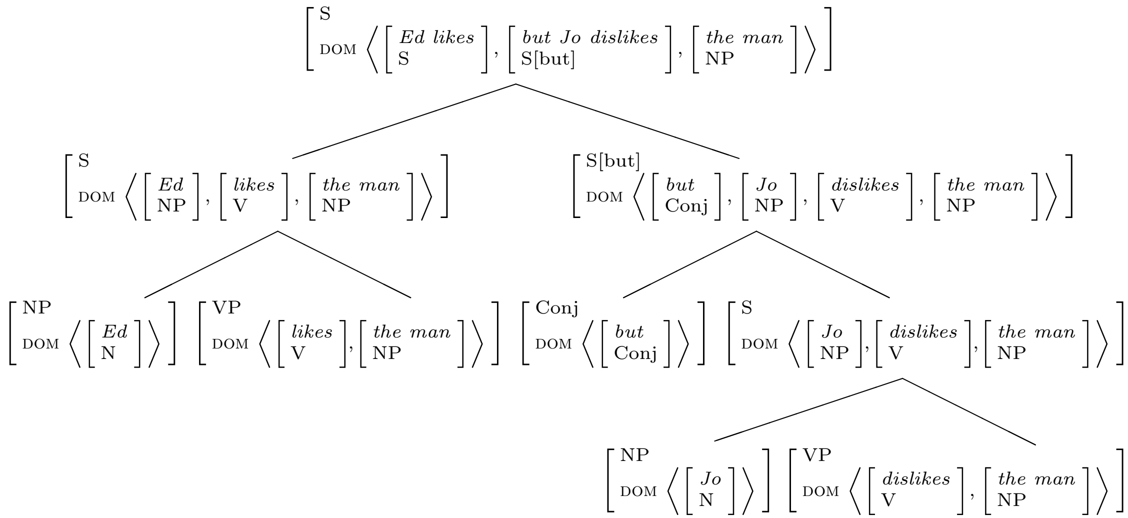

FIGURE 2 Right-node raising of a domain object

incorrect, in light of the existence of summative agreement; since a singular subject is not allowed to combine with a predicate in the plural form, sentences involving summative agreement just cannot be results of simple phonological deletion of a predicate (or predicates) contained in one (or more) of the conjuncts. To see that the theory under discussion indeed makes this incorrect prediction, let us examine the German example again, which is repeated in part in (12).

(12) (Ich glaube eher, daß) Hans den Saft und Fritz den Wein
(I believe rather that) Hans the juice and Fritz the wine
gekauft haben.
bought have.PL
'(I rather believe that) Hans BOUGHT the juice and Fritz the wine.'

Notice that the VALENCE value of the verb cluster which heads the first conjunct cannot be identical to the VALENCE value of the verb cluster which heads the second conjunct; for example, the SUBJ value of the former verb cluster is a list that consists of a *synsem* object whose index is anchored to Hans, whereas the SUBJ value of the latter verb cluster is a list consisting of a *synsem* object whose index is anchored to Fritz, and the two indices cannot be identical to each other. Hence the incorrect prediction that the domain objects corresponding to the two verb clusters cannot be RNRed together.

In order to make the theory work, it is necessary to allow two or more domain objects to be PNRed together even when their VALENCE values (and as a result their CONT values as well) are not identical. Now, what should happen when two or more domain objects with non-identical VALENCE values are PNRed together? Obviously those domain objects must be fused together to produce a single domain object, but what should the VALENCE value of that resultant domain object be? I suggest that the VALENCE value of the newly formed domain object be an amalgamation of the VALENCE values of the domain objects that are PNRed together. More specifically, I suggest that the German example, for instance, be analyzed as in Figure 3. In the proposed theory, when two or more domain objects representing predicates are PNRed together and thus fused together, information as to which *synsem* objects each predicate combines with is collected and stored in the newly created domain object, so to speak.

Let me describe in more detail what is going on in Figure 3. $\boxed{2}$ is the SYNSEM value of the domain object corresponding to the verb cluster in the first conjunct. It contains a SUBJ list and a COMPS list, which show which *synsem* objects this verb cluster combines with; in this case, the

$$\begin{bmatrix}\text{S}\\ \textsc{dom}\left\langle \begin{bmatrix}\textit{Hans den Saft}\\ \text{S}\end{bmatrix}, \begin{bmatrix}\textit{und Fritz den Wein}\\ \text{S[}\textsc{conj}\text{ und]}\end{bmatrix}, \begin{bmatrix}\textit{gekauft haben}\\ \boxed{1}\text{V}\end{bmatrix}\right\rangle\end{bmatrix}$$

$$\begin{bmatrix}\text{S}\\ \textsc{dom}\left\langle \begin{bmatrix}\textit{Hans}\\ \text{NP}_i\end{bmatrix}, \begin{bmatrix}\textit{den Saft}\\ \text{NP}_j\end{bmatrix}, \begin{bmatrix}\textit{gekauft haben}\\ \boxed{2}\text{V}\end{bmatrix}\right\rangle\end{bmatrix} \quad \begin{bmatrix}\text{S[}\textsc{conj}\text{ und]}\\ \textsc{dom}\left\langle \begin{bmatrix}\textit{und}\\ \text{Conj}\end{bmatrix}, \begin{bmatrix}\textit{Fritz}\\ \text{NP}_k\end{bmatrix}, \begin{bmatrix}\textit{den Wein}\\ \text{NP}_l\end{bmatrix}, \begin{bmatrix}\textit{gekauft haben}\\ \boxed{3}\text{V}\end{bmatrix}\right\rangle\end{bmatrix}$$

$$\boxed{1}: \begin{bmatrix}\textsc{cat} \begin{bmatrix}\textsc{head} \begin{bmatrix}\textit{verb}\\ \textsc{agr} \begin{bmatrix}\textsc{num} & \text{pl}\\ \textsc{per} & 3\end{bmatrix}\end{bmatrix}\\ \textsc{val} \begin{bmatrix}\textsc{subj} & \left\langle \begin{bmatrix}\textsc{conj} & \text{und}\\ \textsc{args} & \langle \text{NP}_i, \text{NP}_k\rangle\end{bmatrix}\right\rangle\\ \textsc{comps} & \left\langle \begin{bmatrix}\textsc{conj} & \text{und}\\ \textsc{args} & \langle \text{NP}_j, \text{NP}_l\rangle\end{bmatrix}\right\rangle\end{bmatrix}\end{bmatrix}\end{bmatrix}$$

$$\boxed{2}: \begin{bmatrix}\textsc{cat} \begin{bmatrix}\textsc{head} \begin{bmatrix}\textit{verb}\\ \textsc{agr} \begin{bmatrix}\textsc{num} & \text{pl}\\ \textsc{per} & 3\end{bmatrix}\end{bmatrix}\\ \textsc{val} \begin{bmatrix}\textsc{subj} & \langle \text{NP}_i\rangle\\ \textsc{comps} & \langle \text{NP}_j\rangle\end{bmatrix}\end{bmatrix}\end{bmatrix}$$

$$\boxed{3}: \begin{bmatrix}\textsc{cat} \begin{bmatrix}\textsc{head} \begin{bmatrix}\textit{verb}\\ \textsc{agr} \begin{bmatrix}\textsc{num} & \text{pl}\\ \textsc{per} & 3\end{bmatrix}\end{bmatrix}\\ \textsc{val} \begin{bmatrix}\textsc{subj} & \langle \text{NP}_k\rangle\\ \textsc{comps} & \langle \text{NP}_l\rangle\end{bmatrix}\end{bmatrix}\end{bmatrix}$$

FIGURE 3 Right-node raising of a verb cluster in German

SUBJ list indicates that the verb cluster takes an NP whose index is i as its subject, and the COMPS list indicates that the verb cluster takes an NP whose index is j as its object. $\boxed{3}$ is the SYNSEM value of the domain object corresponding to the verb cluster in the second conjunct. It also contains a SUBJ list and a COMPS list; the SUBJ list indicates that the verb cluster takes an NP whose index is k as its subject and the COMPS list indicates that the verb cluster takes an NP whose index is l as its object. $\boxed{2}$ and $\boxed{3}$ are fused and produce the SYNSEM object which is tagged as $\boxed{1}$ in this figure. $\boxed{1}$ contains all the information contained in $\boxed{2}$ and $\boxed{3}$. Thus, the SUBJ list of $\boxed{1}$ shows that this verb cluster takes as its subject an NP whose index is i in the first conjunct and an NP whose index is k in the second conjunct, and the COMPS list shows that this verb cluster takes as its object an NP whose index is j in the first conjunct and an NP whose index is l in the second conjunct. In addition, $\boxed{1}$ contains information as to the conjunction word that was used to join the first clause and the second clause; in this case, the SUBJ list and the COMPS list of $\boxed{1}$ both indicate that the two clauses were joined together by the conjunction word *und*.

Incidentally, here and in the rest of this paper, I assume, following Kathol 1999, that a verb has a HEAD feature called AGR. The way the AGR feature is put to use in the grammar will be explained shortly. As Kathol himself notes (see Kathol 1999, fn. 16), the assumption that AGR is a HEAD feature might lead to unwelcome consequences regarding the analysis of coordination of Ss. We may want to pursue the idea that AGR is not a HEAD feature but a VALENCE feature, and is somehow 'emptied' together with the SUBJ list when a predicate is combined with its grammatical subject. In this paper, however, I will continue to assume that AGR is a HEAD feature.

The way two domain objects with non-identical VALENCE values are fused together and produce what might be called phantom coordinate structures inside VALENCE lists is further illustrated in the following example.

(13)
$$\begin{bmatrix} \textit{dom-obj} & \\ \text{SS|CT|VL} & \begin{bmatrix} \text{SUBJ} & \left\langle \boxed{1}\text{NP}_i \right\rangle \\ \text{COMPS} & \left\langle \boxed{2}\text{NP}_j \right\rangle \end{bmatrix} \end{bmatrix} + \begin{bmatrix} \textit{dom-obj} & \\ \text{SS|CT|VL} & \begin{bmatrix} \text{SUBJ} & \left\langle \boxed{1}\text{NP}_i \right\rangle \\ \text{COMPS} & \left\langle \boxed{3}\text{NP}_k \right\rangle \end{bmatrix} \end{bmatrix}$$

$$\longrightarrow \begin{bmatrix} \textit{dom-obj} & \\ \text{SS|CT|VL} & \begin{bmatrix} \text{SUBJ} & \left\langle \boxed{1}\text{NP}_i \right\rangle \\ \text{COMPS} & \left\langle \begin{bmatrix} \text{CONJ} & \text{und} \\ \text{ARGS} & \left\langle \boxed{2}\text{NP}_j, \boxed{3}\text{NP}_k \right\rangle \end{bmatrix} \right\rangle \end{bmatrix} \end{bmatrix}$$

In this example, the two domain objects that are to be fused together have identical SUBJ lists, although they have non-identical COMPS lists. In this case, the SUBJ list of the resultant domain object is identical to the SUBJ list of each of the two input domain objects, while the COMPS list of the resultant domain object is an amalgamation of the COMPS lists of the two input domain objects.[6]

The definitions of functions and relations that are needed to implement the proposed analysis are given in the Appendix. They are admittedly somewhat complicated, but the proposed analysis is in essence quite straightforward, and provides a basis for developing an adequate account of summative agreement.

20.4 A Non-Lexical Theory of Agreement

The theory of agreement that I propose takes Kathol's theory of agreement (see Kathol 1999) as a point of departure. In Kathol's theory, agreement is enforced by lexically encoded constraints that require identity between a portion of the AGR value of a predicate and a portion of the AGR or INDEX values of the elements in that predicate's VALENCE lists. For instance, in his theory, each personal verb in German is associated with a constraint that requires its own NUMBER and PERSON values to be identical to the AGR|NUMBER and the INDEX|PERSON value of the sole element in its SUBJ list. Now, Kathol's analysis as it stands now, like Pollard and Sag's analysis of agreement (see Pollard and Sag 1994) that it is intended to supersede, fails to capture the pattern of summative agreement, at least when combined with the theory of PNR that I presented above; neither the first conjunct nor the second conjunct in a sentence like (2) or (12) will be allowed to be generated, because the subject and the predicate do not agree in number in either of the conjuncts in such a sentence.

I submit that the lexical entry for each predicate does not impose any constraint on the AGR or INDEX values of the elements in its VALENCE lists. As an alternative means to enforce agreement, I propose the constraint in (14), a constraint that a sign is required to satisfy if it is to undergo compaction. (Here I disregard object-verb agreement.)

(14) A sign α cannot undergo compaction (i.e. it is not allowed to serve as the argument of the *totally_compact* function) unless the following constraint is satisfied:
For each domain object β in α's order domain such that β's SUBJ list contains an element that does not appear inside α's SUBJ list,

[6] Phantom coordinate structures inside COMPS lists do not have any function except in languages like Basque, which exhibits summative agreement with respect to object-verb agreement (see McCawley 1988, p. 533).

the SYNSEM|CAT|HEAD|AGR value of β is required to be in the *subj_verb_agreement* relation with the sole element in β's SUBJ list.

This can be informally paraphrased as in (15).

(15) Subject-verb agreement is enforced at the point (in a bottom-up tree construction) where either the SUBJ list of a domain object is emptied or the SUBJ list of a domain object disappears altogether.

The *subj_verb_agreement* relation, which is mentioned in (14), is defined as follows. This is a formulation intended for English. The *per_agr* relation, which is mentioned in (16), is defined in (17), and the functor symbol c, which also shows up in (16), is defined in (18). Roughly speaking, c(α) is an appropriate description of an object X if and only if either α is an appropriate description of X or X is a possibly nested phantom coordinate structure such that α is an appropriate description of each of its 'conjuncts'.[7]

(16)
$$
\begin{array}{lll}
\multicolumn{3}{l}{\text{subj\_verb\_agreement}\left(\boxed{1},\boxed{2}\right) \equiv} \\
 & \multicolumn{2}{l}{\left(\boxed{1}:\begin{bmatrix}\text{PER} & \boxed{3}\\ \text{NUM} & \boxed{4}\end{bmatrix} \wedge \boxed{2}:\left[\text{CONT}|\text{INDEX}\begin{bmatrix}\text{PER} & \boxed{3}\\ \text{NUM} & \boxed{4}\end{bmatrix}\right]\right)} \\
\vee & \Big(& \boxed{2}:\left[\text{ARGS}\left\langle\boxed{a_1},\ldots,\boxed{a_n}\right\rangle\right] \\
 & \wedge & \text{subj\_verb\_agreement}\left(\boxed{1},\boxed{a_1}\right) \\
 & \wedge & \cdots \\
 & \wedge & \text{subj\_verb\_agreement}\left(\boxed{1},\boxed{a_n}\right)\Big) \\
\vee & \Big(& \boxed{1}:\begin{bmatrix}\text{PER} & \boxed{5}\\ \text{NUM} & \text{pl}\end{bmatrix} \\
 & \wedge & \text{per\_agr}\left(\boxed{5},\boxed{2}\right) \\
 & \wedge & \boxed{2}:\left[\text{CONJ} \ \boxed{6}\right] \\
 & \wedge & \boxed{6} \neq \text{or} \\
 & \wedge & \neg\exists\boxed{7}\exists\boxed{8}\left[\boxed{2}:\text{c}\left(\left[\text{CONT}|\text{INDEX} \ \boxed{7}\left[\text{NUM} \ \text{sg}\right]\right] \vee \left[\text{CONT}\begin{bmatrix}\text{LTOP} & \boxed{8}\\ \text{KEY}|\text{RELN} & \text{no}\\ \text{INDEX}|\text{NUM} & \text{sg}\end{bmatrix}\right]\right)\right]\Big)
\end{array}
$$

[7]The formulation in (16) makes use of the features LTOP and KEY, which are standard ingredients of Minimal Recursion Semantics (MRS) (see Copestake et al. 1999). The theory described in the present paper (especially the material in the Appendix) presupposes the modified version of MRS proposed in Yatabe 2001, in which the SYNSEM|CONT values of signs are assumed to represent only constructional meaning. However, the way the LTOP feature and the KEY feature are assumed to behave in the proposed theory is much the same as the way they are assumed to behave in the original version of MRS.

(17) $\text{per\_agr}\left(\boxed{1},\boxed{2}\right) \equiv$

$$
\begin{array}{lll}
& \boxed{2} : \left[\text{CONT}|\text{INDEX}|\text{PER} \quad \boxed{1}\right] & \\
\vee & \Big(& \boxed{1} = 1 \\
& \wedge & \boxed{2} : \begin{bmatrix} \text{CONJ} & \boxed{3} \\ \text{ARGS} & \left\langle \boxed{a_1}, \ldots, \boxed{a_n} \right\rangle \end{bmatrix} \\
& \wedge & \boxed{3} \neq \text{or} \\
& \wedge & \left(\text{per\_agr}\left(1, \boxed{a_1}\right) \vee \cdots \vee \text{per\_agr}\left(1, \boxed{a_n}\right)\right) \Big) \\
\vee & \Big(& \boxed{1} = 2 \\
& \wedge & \boxed{2} : \begin{bmatrix} \text{CONJ} & \boxed{3} \\ \text{ARGS} & \left\langle \boxed{a_1}, \ldots, \boxed{a_n} \right\rangle \end{bmatrix} \\
& \wedge & \boxed{3} \neq \text{or} \\
& \wedge & \left(\text{per\_agr}\left(2, \boxed{a_1}\right) \vee \cdots \vee \text{per\_agr}\left(2, \boxed{a_n}\right)\right) \\
& \wedge & \neg\left(\text{per\_agr}\left(1, \boxed{a_1}\right) \vee \cdots \vee \text{per\_agr}\left(1, \boxed{a_n}\right)\right) \Big) \\
\vee & \Big(& \boxed{2} : \left[\text{ARGS} \quad \left\langle \boxed{a_1}, \ldots, \boxed{a_n} \right\rangle\right] \\
& \wedge & \left(\text{per\_agr}\left(\boxed{1}, \boxed{a_1}\right) \wedge \cdots \wedge \text{per\_agr}\left(\boxed{1}, \boxed{a_n}\right)\right) \Big)
\end{array}
$$

(18) $\boxed{1} : \text{c}(\alpha) \equiv$

$$
\begin{array}{ll}
& \boxed{1} : \alpha \\
\vee & \left(\boxed{1} : \left[\text{ARGS} \left\langle \boxed{a_1}, \ldots, \boxed{a_n} \right\rangle\right] \wedge \boxed{a_1} : \text{c}(\alpha) \wedge \cdots \wedge \boxed{a_n} : \text{c}(\alpha)\right)
\end{array}
$$

As mentioned above, the *subj_verb_agreement* relation is a relation that is required to hold between the SS|CAT|HEAD|AGR value ($\boxed{1}$), and the SS|CAT|VAL|SUBJ|FIRST value ($\boxed{2}$) of a domain object. (The SS|CAT|VAL|SUBJ|FIRST value of a domain object is the sole element in its SUBJ list.) The first disjunct in the right-hand side of the definition of this relation (i.e. line 2 of (16)) deals with cases that do not involve phantom coordinate structures. The second disjunct (i.e. lines 3–6) deals with cases in which a predicate agrees with each 'conjunct' of a phantom coordinate structure.[8] And the third disjunct (i.e. lines 7–12) specifies constraints on summative agreement; lines 9–10 block

[8]This formulation is based on the assumption that a sentence like *The pilot claimed that the first nurse, and the sailor proved that the second nurse, was a spy* <9, 8, 5, 1>, which some authors take to be ungrammatical (Postal 1998, p. 173; Levine 2001), is in fact grammatical, as well as on the assumption that this sentence can be a result of RNR of a domain object, as opposed to RNR of a prosodic constituent.

summative agreement in cases like (7), and lines 11–12[9] block summative agreement in cases like (8), (9), and (11a), but not in cases like (11b) above or cases like (19) and (20) below.[10]

(19) The pilot claimed that every nurse, and the sailor proved that every doctor, $\left\{\begin{array}{l}\text{?were spies. <4, 10, 6, 3>}\\ \text{ was a spy. <14, 7, 2, 0>}\end{array}\right\}$

(20) The pilot claimed that more than one nurse, and the sailor proved that more than one doctor, were spies. <9, 12, 1, 1> (Cf. (10b))

Let me step back a little and clarify the overall picture using the simple example in Figure 4. The VP node at the bottom of the figure has an order domain which contains a domain object corresponding to the verb *speaks*, and this domain object has a SUBJ list which is not empty. The NP node, which is also at the bottom of the figure, combines with this VP node to produce an S node. This NP serves as the subject of the VP, so the SUBJ list associated with the VP node itself is emptied at this point. However, the SUBJ list associated with the domain object corresponding to the verb, that is, the SUBJ list inside $\boxed{4}$, is not emptied at this point; notice that the order domain associated with the S node still contains a domain object corresponding to the verb, a domain object which has a non-empty SUBJ list. I assume, as I do in Yatabe 2001, that the root node is required to undergo total compaction. In the case at hand, this means that the S node must undergo total compaction. The result of the compaction is the top node in the figure, tagged $\boxed{1}$; this top node is a domain object, whereas the other nodes in the figure are signs. Now, the SUBJ list in $\boxed{3}$ *does* get emptied when the S node undergoes compaction; notice that the sole element in the SUBJ list of $\boxed{3}$, i.e. NP_i, does not appear inside the SUBJ list of $\boxed{5}$, which is empty. Therefore subject-verb agreement is enforced at this point, due to the constraint given in (15) (or (14)). The AGR value of $\boxed{3}$ indicates that this verb should combine with a third-person singular subject under normal circumstances, and the sole element in the SUBJ list of $\boxed{3}$, i.e. NP_i, indeed *is* a third-person singular NP; thus

[9]Here I am assuming that the KEY|RELN value of NPs like *no doctor* and *no one* is 'no'. This means that the theory proposed here presupposes the so-called DP hypothesis. I am also assuming that each elementary predication has a feature called RELN, whose value indicates the type of relation involved.

[10]Lines 11–12 of (16) predict that a phantom coordinate structure *does* sanction summative agreement if more than one of its 'conjuncts' is a quantifier whose KEY|RELN value is 'no'. This prediction is made because no two quantifiers ever share the identical LTOP value. This is a correct prediction to the extent that a sentence like *The sailor claimed that no nurse, and the pilot proved that no doctor, were spies* is acceptable.

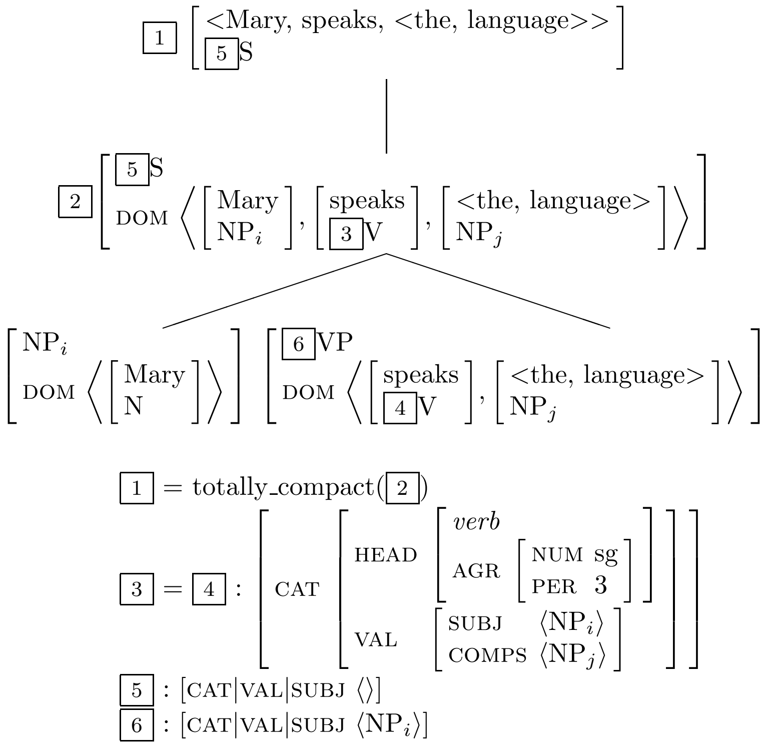

FIGURE 4 A simple example of subject-verb agreement

it is determined that the total compaction that applied to $\boxed{2}$ to yield $\boxed{1}$ was legitimate.

The precise location where subject-verb agreement is enforced makes no difference in a simple case like this, but it does make a difference in examples involving PNR. Let me describe in informal terms what this theory claims is taking place in the example illustrated in Figure 3. In this example, the verb cluster *gekauft haben* is not required to agree with the subject NP of the first conjunct or that of the second conjunct because the SUBJ list of the domain object representing this verb cluster stays intact while we are constructing each of these conjuncts. The verb cluster is required to agree with whatever fills its subject argument slot only at the location where the domain object representing the verb cluster (or some phrase containing the verb cluster) is merged with some other domain objects and its SUBJ list is emptied or disappears altogether. The location where this takes place is not shown in this figure; but at that location, the SUBJ list of the domain object representing the verb cluster will be identical to the SUBJ list in $\boxed{1}$, and the *subj_verb_agreement* relation (the German version of which has not been formulated here but is assumed to be similar in essential respects to the English version in (16)) *will* hold between the relevant elements in that domain object.

In order to have an analogous account of the summative agreement facts in English, we need to abandon or at least weaken the assumption (endorsed in Dowty 1996, Kathol and Pollard 1995, and Yatabe 2001) that tensed sentences are always required to undergo total compaction in English. This move is independently motivated by the existence of examples like (21).

(21) I had hoped that it was true for many years that Rosa Luxemburg had actually defected to Iceland. (from Gazdar 1981)

In this example, the phrase *that Rosa Luxemburg had actually defected to Iceland* appears to have been extraposed out of a tensed sentence. According to the linearization-based view of extraposition most explicitly developed in Kathol and Pollard 1995, this means that a tensed sentence is sometimes allowed to undergo strictly partial, as opposed to total, compaction.

What I have proposed in this section amounts to saying that agreement is a phenomenon that results from a non-lexical constraint that regulates under what circumstances a domain object can be merged with other domain objects by the compaction operation. This non-standard view of agreement is forced on us because any effort to lexicalize the patterns of summative agreement will force us to encode in the lexical entry for each predicate whether, how, and how many times it will have to undergo PNR, arguably a bizarre type of information to be encoded in the lexicon.

20.5 Conclusion

To conclude, I have presented a linearization-based theory that explicitly characterizes patterns of summative agreement in right-node raising and left-node raising constructions. In the process, I argued that subject-verb agreement results from a non-lexical constraint that regulates under what circumstances a sign is allowed to undergo compaction. I refer to the proposed theory as a linearization-based theory because it makes use of order domains, but I hope to have shown that a lot more than just linearization takes place inside order domains. In fact, I have argued in Yatabe 2001 that semantic composition mostly takes place inside order domains, and it has been my contention in this paper that agreement, one of the quintessential syntactic phenomena, also takes place in order domains.

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Appendix

The analysis proposed in Section 20.3 can be formalized as in (22)–(29). Here, I concentrate on RNR of domain objects, ignoring RNR of prosodic constituents and LNR. Note that the formulation below presupposes the modified version of Minimal Recursion Semantics presented in Yatabe 2001, in which semantic composition is mostly carried out inside order domains. Note also that MOD is treated as a VALENCE feature in this formulation. This makes it possible to deal with examples in which a relative clause appears to have been PNRed, for example.

(22) Suppose $\boxed{1} \cdots \boxed{n}$ are the daughters of the phrase $\boxed{0}$, the DOM value of $\boxed{0}$ is $\boxed{d_0}$, and the SYNSEM|CONT|KEY|RELN value of $\boxed{0}$ is $\boxed{\text{Conj}}$. Then the relation between $\boxed{d_0}$, $\boxed{1} \cdots \boxed{n}$, and $\boxed{\text{Conj}}$ must conform either to 'constraints of the usual type' (which give rise to a structure not involving RNR or LNR) or to the the following constraints:

(i) $n \geq 2$, and

(ii) for some list $\left\langle \boxed{L_1}, \cdots, \boxed{L_n} \right\rangle$ that is obtained by arbitrarily reordering the elements of the list $\langle \boxed{1}, \cdots, \boxed{n} \rangle$, $\text{rnr}\left(\left\langle \boxed{L_1}, \cdots, \boxed{L_n} \right\rangle, \boxed{d_0}, \boxed{\text{Conj}} \right)$.

(23)
$$
\begin{aligned}
&\text{rnr}\left(\left\langle \boxed{L_1}, \cdots, \boxed{L_n} \right\rangle, \boxed{d_0}, \boxed{\text{Conj}} \right) \equiv \\
&\boxed{L_1} : \left[\text{DOM } \boxed{M_1} \oplus \boxed{N_1} \right] \wedge \cdots \wedge \boxed{L_n} : \left[\text{DOM } \boxed{M_n} \oplus \boxed{N_n} \right] \\
&\wedge \boxed{N_1} \neq \langle\rangle \wedge \cdots \wedge \boxed{N_n} \neq \langle\rangle \\
&\wedge \boxed{d_0} = \Big\langle \text{totally\_compact}\left(\text{cut\_right}\left(\boxed{N_1}, \boxed{L_1} \right) \right), \\
&\qquad\quad \cdots, \text{totally\_compact}\left(\text{cut\_right}\left(\boxed{N_n}, \boxed{L_n} \right) \right) \Big\rangle \oplus \boxed{N_0} \\
&\wedge \text{fuse\_each}\left(\left\langle \boxed{N_1}, \cdots, \boxed{N_n} \right\rangle, \boxed{N_0}, \boxed{\text{Conj}} \right)
\end{aligned}
$$

(*totally_compact* and *cut_right* are functions, whereas *rnr* and *fuse_each* are relations. I assume that the *totally_compact* function is defined as in Yatabe 2001, (28).)

(24) $$\text{cut\_right}\left(\boxed{a}, \begin{bmatrix}\text{SYNSEM} & \boxed{1}\\ \text{DOM} & \boxed{b}\end{bmatrix}\right) = \begin{bmatrix}\text{SYNSEM} & \boxed{1}\\ \text{DOM} & \text{subtract\_right}(\boxed{a}, \boxed{b})\end{bmatrix}$$

(25) subtract_right $(\boxed{a}, \boxed{b})$ is
   (i) the non-empty list $\boxed{c}$ such that $\boxed{c} \oplus \boxed{a} = \boxed{b}$, if such $\boxed{c}$ exists, and
   (ii) undefined, otherwise.

(26) $$\begin{aligned}&\text{fuse\_each}\left(\left\langle \boxed{K_1}, \cdots, \boxed{K_n} \right\rangle, \boxed{K_0}, \boxed{\text{Conj}}\right) \equiv\\ &\quad \left(\boxed{K_1} : \langle\rangle \wedge \cdots \wedge \boxed{K_n} : \langle\rangle \wedge \boxed{K_0} : \langle\rangle\right)\\ &\vee \left(\boxed{K_1} : \left\langle \boxed{1} \mid \boxed{L_1} \right\rangle \wedge \cdots \wedge \boxed{K_n} : \left\langle \boxed{n} \mid \boxed{L_n} \right\rangle \wedge \boxed{K_0} : \left\langle \boxed{0} \mid \boxed{L_0} \right\rangle\right.\\ &\qquad \wedge \text{fuse}\left(\left\langle \boxed{1}, \cdots, \boxed{n} \right\rangle, \boxed{0}, \boxed{\text{Conj}}\right)\\ &\qquad \left.\wedge \text{fuse\_each}\left(\left\langle \boxed{L_1}, \cdots, \boxed{L_n} \right\rangle, \boxed{L_0}, \boxed{\text{Conj}}\right)\right)\end{aligned}$$

(27) $$\begin{aligned}&\text{fuse}\left(\left\langle \boxed{1}, \cdots, \boxed{n} \right\rangle, \boxed{0}, \boxed{\text{Conj}}\right) \equiv\\ &\quad \boxed{0} = \boxed{1} = \cdots = \boxed{n}\\ &\vee \left(\neg\left(\boxed{1} = \cdots = \boxed{n}\right)\right.\\ &\qquad \wedge \boxed{1} : \begin{bmatrix}\text{SYNSEM} & \boxed{S_1}\\ \text{PHON} & \boxed{P}\end{bmatrix} \wedge \cdots \wedge \boxed{n} : \begin{bmatrix}\text{SYNSEM} & \boxed{S_n}\\ \text{PHON} & \boxed{P}\end{bmatrix}\\ &\qquad \wedge \boxed{0} : \begin{bmatrix}\text{SYNSEM} & \boxed{S_0}\\ \text{PHON} & \boxed{P}\end{bmatrix}\\ &\qquad \left.\wedge \text{fuse\_synsem}\left(\left\langle \boxed{S_1}, \cdots, \boxed{S_n} \right\rangle, \boxed{S_0}, \boxed{\text{Conj}}\right)\right)\end{aligned}$$

(28) $$\begin{aligned}&\text{fuse\_synsem}\left(\left\langle \boxed{1}, \cdots, \boxed{n} \right\rangle, \boxed{0}, \boxed{\text{Conj}}\right) \equiv\\ &\boxed{1} : \begin{bmatrix}\text{CAT} & \begin{bmatrix}\text{HEAD} & \boxed{a}\\ \text{VAL} & \begin{bmatrix}\text{SUBJ} & \boxed{b_1}\\ \text{COMPS} & \boxed{c_1}\\ \text{MOD} & \boxed{d_1}\end{bmatrix}\end{bmatrix}\\ \text{CONT} & \begin{bmatrix}\text{LTOP} & \boxed{e_1}\\ \text{INDEX} & \boxed{f_1}\\ \text{SEMHEAD} & \boxed{g_1}\\ \text{EP} & \boxed{h_1}\\ \text{H-CONS} & \boxed{i_1}\\ \text{H-STORE} & \boxed{j}\end{bmatrix}\end{bmatrix} \wedge\end{aligned}$$

$$
\cdots \wedge \boxed{n} : \begin{bmatrix} \text{CAT} & \begin{bmatrix} \text{HEAD} & \boxed{a} \\ \text{VAL} & \begin{bmatrix} \text{SUBJ} & \boxed{b_n} \\ \text{COMPS} & \boxed{c_n} \\ \text{MOD} & \boxed{d_n} \end{bmatrix} \end{bmatrix} \\ \text{CONT} & \begin{bmatrix} \text{LTOP} & \boxed{e_n} \\ \text{INDEX} & \boxed{f_n} \\ \text{SEMHEAD} & \boxed{g_n} \\ \text{EP} & \boxed{h_n} \\ \text{H-CONS} & \boxed{i_n} \\ \text{H-STORE} & \boxed{j} \end{bmatrix} \end{bmatrix}
$$

$$
\wedge \boxed{0} : \begin{bmatrix} \text{CAT} & \begin{bmatrix} \text{HEAD} & \boxed{a} \\ \text{VAL} & \begin{bmatrix} \text{SUBJ} & \boxed{b_0} \\ \text{COMPS} & \boxed{c_0} \\ \text{MOD} & \boxed{d_0} \end{bmatrix} \end{bmatrix} \\ \text{CONT} & \begin{bmatrix} \text{LTOP} & \text{none} \\ \text{INDEX} & \text{none} \\ \text{SEMHEAD} & \text{none} \\ \text{EP} & \boxed{h_1} \oplus \cdots \oplus \boxed{h_n} \\ \text{H-CONS} & \boxed{i_1} \cup \cdots \cup \boxed{i_n} \\ \text{H-STORE} & \boxed{j} \end{bmatrix} \end{bmatrix}
$$

$$
\begin{aligned}
&\wedge \text{fuse\_valence}\left(\left\langle \boxed{b_1}, \cdots, \boxed{b_n} \right\rangle, \boxed{b_0}, \boxed{\text{Conj}}\right) \\
&\wedge \text{fuse\_valence}\left(\left\langle \boxed{c_1}, \cdots, \boxed{c_n} \right\rangle, \boxed{c_0}, \boxed{\text{Conj}}\right) \\
&\wedge \text{fuse\_valence}\left(\left\langle \boxed{d_1}, \cdots, \boxed{d_n} \right\rangle, \boxed{d_0}, \boxed{\text{Conj}}\right)
\end{aligned}
$$

(29)
$$
\begin{aligned}
&\text{fuse\_valence}\left(\langle \boxed{1}, \cdots, \boxed{n} \rangle, \boxed{0}, \boxed{\text{Conj}}\right) \equiv \\
&\quad (\boxed{1} : \langle\rangle \wedge \cdots \wedge \boxed{n} : \langle\rangle \wedge \boxed{0} : \langle\rangle) \\
&\vee \Bigg(\boxed{1} : \left\langle \boxed{a_1} \mid \boxed{L_1} \right\rangle \wedge \cdots \wedge \boxed{n} : \left\langle \boxed{a_n} \mid \boxed{L_n} \right\rangle \wedge \boxed{0} : \left\langle \boxed{a_0} \mid \boxed{L_0} \right\rangle \\
&\quad \wedge \Bigg(\boxed{a_0} = \boxed{a_1} = \cdots = \boxed{a_n} \vee \Bigg(\neg \left(\boxed{a_1} = \cdots = \boxed{a_n} \right) \\
&\qquad \wedge \boxed{a_0} : \begin{bmatrix} \text{CONJ} & \boxed{\text{Conj}} \\ \text{ARGS} & \left\langle \boxed{a_1}, \cdots, \boxed{a_n} \right\rangle \end{bmatrix} \Bigg) \Bigg) \\
&\quad \wedge \text{ fuse\_valence}\left(\left\langle \boxed{L_1}, \cdots, \boxed{L_n} \right\rangle, \boxed{L_0}, \boxed{\text{Conj}}\right) \Bigg)
\end{aligned}
$$

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