Multiple tiers, multiple trees: Weak hand holds in Russian Sign Language[1]

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1 Introduction

Sign languages (SLs) are natural languages, but unlike spoken languages they belong to the visual-spatial modality (Sandler & Lillo-Martin 2006). The apparent differences between SLs and spoken languages include the differences in articulators: SLs use two partially independent articulators, namely hands[2]. The presence of two articulators leads to one of the most important differences between SLs and spoken languages: SLs demonstrate a lot of simultaneity on all linguistic levels. However, the simultaneity is neither arbitrary nor unconstrained.

Despite the fact that physiologically the hands can act independently, they rarely do so in SLs. For instance, in some SLs, within single lexical signs hands cannot be specified for different handshapes and different movement patterns: if the handshapes are different, only one of the hand moves (Battison 1978). Going beyond the lexical level, the signers never sign two independent propositions simultaneously on the two hands. However, quite often the hands act partially independently, namely one hand is held in the handshape and location of a sign, while the other hand produces one or more other signs (see (1) below). This situation is called a *weak hand hold*[3] (Vermeerbergen et al. 2007).

This paper aims to discuss how weak hand holds in Russian Sign Language (RSL) can be analyzed within a formal syntactic framework. It is suggested that the formalism of multidimensional trees, independently proposed for spoken languages (De Vries 2009), can be applied to these constructions.

2 Weak hand holds in RSL

Weak hand holds in SLs have received considerable attention lately (for an overview, see Vermeerbergen et al. 2007 and Sáfár & Kimmelman in preparation). They have been found in many SLs and they seem to have similar functions cross-linguistically (ibid.). Some holds appear to be phonetic and are

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[2] In addition, the face and the body are used as articulators as well, but this aspect is not discussed further in this paper.

[3]The term *weak* is used here to emphasize the inactivity of the one hand in comparison to the active role of the other. Another commonly used term is *the non-dominant hand*.

produced for the easy of articulation, while others fulfill prosodic, syntactic or discourse functions. All these types of holds are present in RSL as well.

RSL is the sign language of the Deaf used in Russia and some other former Soviet countries. According to the latest census, it is used by more than 120 000 people in Russia alone. It is severely understudied, although some research on the grammar of RSL has appeared recently (for an overview, see Kimmelman 2012).

To study weak hand holds, a small corpus of RSL has been used, containing one hour of video recordings of short stories by 6 native signers from Moscow. The corpus has been annotated and analyzed by the author, with the help of native signers. In addition, a comparison of weak hand holds in RSL to holds in Sign Language of the Netherlands has been conducted, the results of which are reported in Sáfár & Kimmelman (in preparation).

Based on the analysis of the corpus, several categories of weak hand holds have been identified: phonetic holds, syntactic holds, iconic holds and discourse holds (for a detailed discussion of the classification see Sáfár & Kimmelman (in preparation)). Phonetic holds are produced, for instance, when the weak hand in one sign is then reused (with the same handshape and location) as a part of the following sign. Syntactic holds occur when the head or an argument of an XP is held across the whole XP, presumably to mark the syntactic domain. Iconic holds include holding a hand as a point of reference (ground) to express spatial relations between objects, as well as holding a sign referring to an action to express the fact that this action is simultaneous with another activity (1) [4]. Finally, discourse holds include holding a sign referring to the discourse topic (2).

(1)   H1:   CARRY₁.   SUITCASE   NEED.NOT.   THROW.
      H2:   CARRY₂---
      'He carries [the suitcase and the cage]. He does not need the suitcase.
       He throws it away.'

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[4] Conventions: signs are glossed in capital letters. H1 and H2 stand for the two hands. IX stands for index (pointing sign). --- shows the scope of the weak hand hold.

(2) H1:   THINK   MONKEY.   LOOK.   NICE.
     H2:   IX--
     'She thinks it is a monkey. She looks at it. It is nice.'

In this paper we focus on the possible syntactic analysis for the two illustrated types of holds: 1) holds expressing simultaneity and 2) holds referring to the discourse topic. Applicability of this analysis to other types of holds is discussed in the final section.

3   The linearization problem

Weak hand holds have often been analyzed as a prosodic phenomenon. Sandler (1993, Nespor & Sandler 1999) argued that in Israeli SL the weak hand is one of the phonological features of a sign and that the hold is a feature-spreading process defined on the level of phonological words. Brentari & Crossley (2002) claimed that in American SL weak hand holds also constitute feature spreading on the level of different prosodic domains.

However, at least for some of the types of holds in RSL (and other SLs) it is clear that the prosodic account could not work. In examples like (1) and (2) the hold spreads across several clauses; this means that defined prosodically it should be at least a spread at the level of a whole utterance. Moreover, in both examples the presence of the hold adds meaning to the discourse. In (1) the simultaneity of actions (carrying the cage and throwing away the suitcase) is expressed through the presence of the hold. In (2) the emphasis on the discourse topic is only marked by holding of the pointing sign.

Since it is not possible to say that the weak hand holds in (1) or (2) are prosodic, they should be represented in syntax. Therefore, it is necessary to propose two tiers on which the lexical items are to be linearized: one for each hand. However, if we do that, we also need to formulate the rules of linearization and to describe the restrictions that apply to it.

One hypothesis concerning linearization on two tiers in SL has been briefly discussed in Woll (2007). It has been suggested that syntactic trees do not contain the ordering information (Chomsky 1995), so the order of elements is only

assigned during the linearization process; in SLs, however, this order need not be assigned because two articulators (two tiers) are available. However, this theory does not pose any restrictions on the potential manual simultaneity, while it is actually quite restricted.

For instance, this theory predicts that if signs X and Y are sisters in the syntactic tree [X Y], they can be linearized simultaneously: X on the right hand and Y on the left hand (3a). However, fully simultaneous realization of two independent signs (almost) never happens. What we would see instead is (3b):

(3)   a.   RH: X
            LH: Y
      b.   RH: X-------
            LH: Y

Finally and most importantly the theory which allows syntactic trees to freely linearize on the two tiers does not explain the semantic effects observed in (1) and (2). In order to describe the generation of examples (1) and (2) the following questions should be answered: 1. What is the syntactic position of the sign on the weak hand? 2. What are the rules of linearization for SLs? A possible solution to this problem involves the formalism of multidimensional trees which is presented in the next section.

4   Multidominance in spoken languages

Different researchers (De Vries 2008, 2009, Van Riemsdijk 2006 among many others) argued that multidominant structures are necessary to account for a class of phenomena in spoken languages. Notice that different terms have been used to describe these structures, including *grafts* (Van Riemsdijk), and *external remerge* (De Vries). Below the works of de Vries are discussed as he explicitly formulated the rules of linearization of such structures.

De Vries (2009) claimed that within the standard assumptions of Generative Grammar multidominance is a necessary type of constructions. He argued that there are three basic types of Merge: simple Merge, when two independent elements are joined (4a), Internal Remerge, when an element is joined with a part of itself (also known as movement, (4b, 5)), and External Remerge, when an element is joined with a part of another element (4c, 5). Given that movement is already a multidominant construction (5), the third logical possibility (External Remerge) is not surprising.

(4)   a.   Merge: Merge (A,B) $\rightarrow$ [$_C$ AB]
      b.   Internal Remerge: Merge (B,[$_C$ AB]) $\rightarrow$ [$_E$ B [$_C$ AB]]
      c.   External Remerge: Merge (B,D), where [$_C$ BA] $\rightarrow$ [$_E$ D[$_C$ B]$_D$ A]$_C$

(5)

Internal remerge   *External remerge*
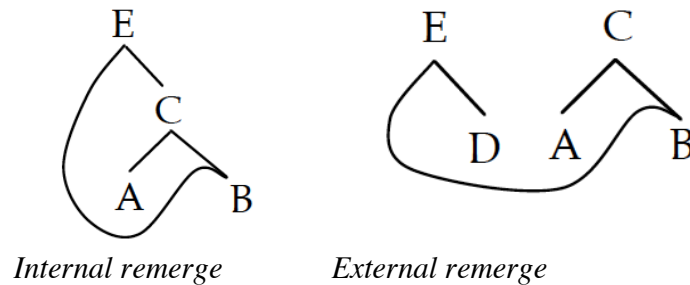
Apart from theoretical reasons to have External Remerge, there are a number of constructions that are best analyzed with this formalism. These constructions include Right Node Raising (6), across-the-board movement (7), free relatives, appositives and others.

(6) John admires ___, but Jill hates Bush.
(7) Which man does John admire ___ but Bill hate ___?

These constructions cannot be analyzed through movement because they do not show the properties traditionally associated with movement, such as island effects. For instance, compare (8a) to (8b): the latter is ungrammatical because the wh-movement cannot cross the boundary of a complex noun phrase, while the former is grammatical, because, under the External Remerge analysis, no movement is involved. Further arguments in favor of External Remerge can be found in works of Riemsdijk and de Vries.

(8)   a. Mary likes [men who sell ___], but she hates [men who buy *cars*].
   b. *What does Mary likes [men who sell ___]?

De Vries (2009, 2012) have proposed yet another kind of merge, namely P*arenthetical Merge*, which is independent of the three aforementioned types of merge. In the examples above merging elements always created the c-command relationship between them. However, parenthetical merge is oblique with respect to the c-command relationship: the elements of the parenthetical are not c-commanded by the elements of the main sentence and do not c-command them.

     Parenthetical merge can combine with multidominance but is independent of it; the combination of both mechanisms is called "amalgams". For instance, (9) contains a parenthetical clause *I think it's a didgeridoo*, while the NP *a didgeridoo* is also shared as it belongs both to the main clause and to the parenthetical clause (De Vries 2011).

(9)   a. Joop got *I think it's a didgeridoo* for his birthday.
      b.

$[_{TP} [_{DP} Joop]_i [T [[_{vP} t_i got DP] for his birthday]]]$
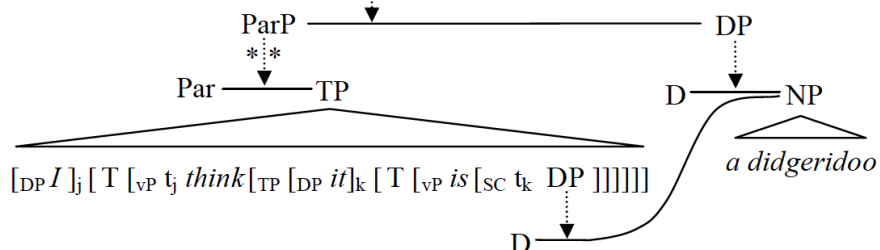
In examples like (9) and (10) where parenthetical merge and External Remerge are combined, interesting effects arise. For instance, (10a) is ungrammatical because of the Principle C violation: *Ed* belongs to both the main and the parenthetical clause, and in the main clause it is c-commanded by the coreferent pronoun *he*. However, (10b) is grammatical because *Ed* only belongs to the parenthetical clause which is not transparent for the c-command relation, so it is not c-commanded by the coreferent pronoun *he*.

(10)   a.   *He_i had seen *I think it was Ed_i* on tv yesterday..
       b.   He_i had seen – *Ed_i said it was Anna* on tv yesterday.

Since External Remerge and Internal Remerge create multidominance, it is necessary to explicitly formulate the rules of linearization of such structures. Note that linearization rules for Internal Remerge and External remerge should be different, because in the former case the node is spelled-out in the left-most position (8b), while in the latter case it is spelled-out in the right-most position (8a).
   De Vries (2009) describes the linearization as a graph traversal procedure. An assumption in this procedure is that the relation of precedence is defined for sisters in the tree (Langendoen 2003, contrary to Chomsky (1995)). The traversal mechanism is formulated in the terms of selecting nodes and performing linearization (spell-out). For the present discussion the relevant part of the rule is formulated in (11).

(11)   *Spell-Out of Remerged Nodes* (De Vries 2009:381)
       A node with more than one parent is linearized if and only if
   (i)   the current parent is not dominated by any other parent, and
       (ii)   – every parent has been traversed, or
              – the current parent dominates every other parent that has not been traversed

Consider the linearization of a movement configuration (12). In this configuration terminal node α is dominated by three parents: γ_1, γ_2 and γ_3. γ_1 is not dominated by any other parent of α, so (11-i) is satisfied. According to the second part of the (11-ii) condition, α will be spelled-out in the left-most configuration (as a daughter of γ_1, because γ_1 dominates both γ_2 and γ_3). In (13) the linearization of an External Remerge configuration is visualized. γ_1 is not dominated by any other parent of α, so (11-i) is satisfied. Since γ_1, γ_2 and γ_3 do not dominate each other, according to condition (11-ii), α will be spelled-out in the right-most configuration, when all other parents except for γ_3 will have been traversed. This agrees with the observed facts.

(12)   Linearization of Internal Remerge (De Vries 2009:380)
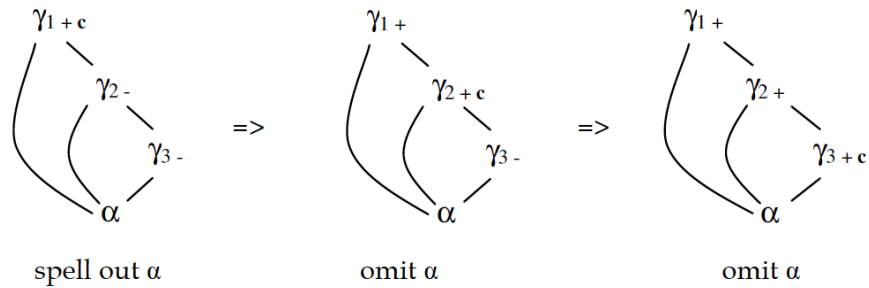
(13)   Linearization of External Remerge (De Vries 2009:379)
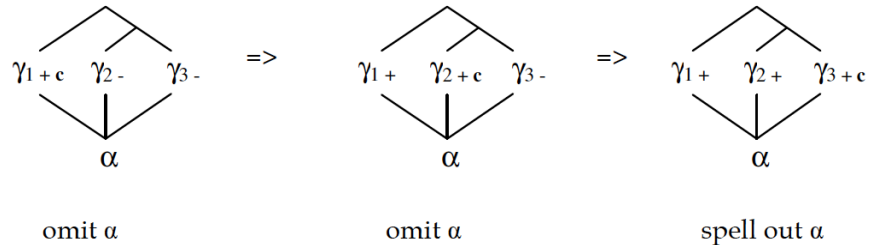
Having introduced the mechanism of generation and linearization of multidominant structures, it is now possible to turn to the analysis of weak hand holds in RSL.

5   Multidominance and weak hand holds

The hypothesis pursued in this paper is very simple: in RSL (and presumably other SLs) the nodes created through External Remerge are linearized on the second tier, which is activated precisely for this purpose. First, let us consider the syntactic structure of examples (1) and (2), and then the linearization rules.

5.1 Syntax of weak hand holds

Example (2) consists of three sentences sharing the node *IX*. This constituent has different syntactic roles within each of the sentence, but it belongs to all of them (14).

(14)
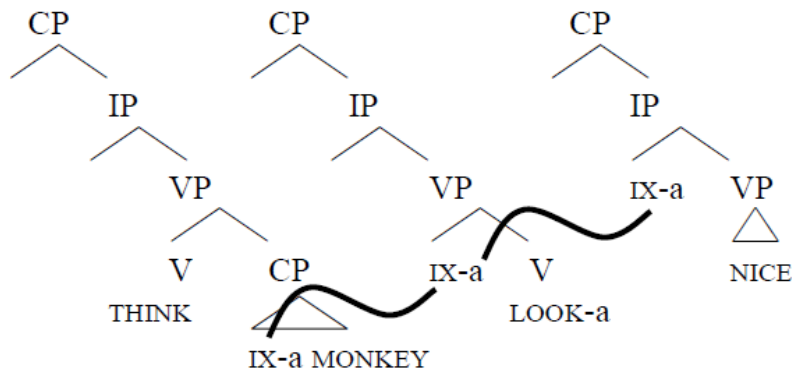
'She thinks it is a monkey. She looks at it. It is nice.'

Example (1) is less straightforward: it is not the case that the sign *CARRY₂* belongs to the four sentences. It is possible to suggest that the shared node in this case is a zero scene-setting topic (for more information on scene-setting topics in RSL see Kimmelman in preparation). The scene-setting topic sets the temporal and spatial framework for the situation described in the sentence. In this case the fact that the node is shared produces the relevant semantic effect, namely that the activities described in the sentences occur simultaneously (15). Since the shared node is a null element, special rules of linearization have to be formulated.

(15)
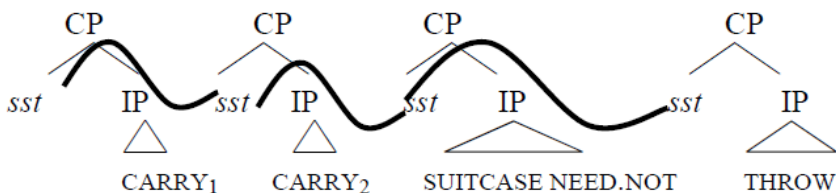
'He carries [the suitcase and the cage]. He does not need the suitcase. He throws it away.'

5.2 Linearization of holds

The main rule of linearization for external remerge in SL would be formulated as in (16). Note that condition (ii) is designed to account for examples like (15) where the shared node is phonologically empty. Despite being stipulated, it is not illogical: if activation of the second tier is caused by the presence of a shared node, then some mechanism should be involved to compensate for the fact that the shared node can be phonologically empty.

(16) *Spell-Out of Externally Remerged Nodes in RSL*
    (i)   A node with more than one parent (and the parents of which do not dominate each other) is linearized on the second tier.
    (ii) If the node is phonologically empty, the next node in the line gets linearized on the second tier.

The linearization of (1) and (2) can be visualized as (17) and (18). In (17) the shared node is the zero scene-setting topic, so the verb *CARRY₂* is linearized on the second tier. In (18) the shared node *IX* is linearized on the second tier.

(17)

CP   CP   CP   CP

sst   IP   *sst*   IP   *sst*   IP   *sst*   IP

CARRY₁   CARRY₂   SUITCASE NEED.NOT   THROW

H1: [[CARRY₁]₍int.phrase₎ [SUITCASE NEED.NOT]₍int.phrase₎ [THROW]₍int.phrase₎]₍utterance₎
H2: [CARRY₂---]₍utterance₎

'He carries [the suitcase and the cage]. He does not need the suitcase. He throws it away.'

(18)

CP   CP   CP

IP   IP   IP

VP   VP   IX-a   VP

V   CP   IX-a   V   NICE

THINK   LOOK-a

IX-a MONKEY

H1: [[THINK MONKEY]₍int.phrase₎ [LOOK-a]₍int.phrase₎ [NICE]₍int.phrase₎]₍utterance₎
H2:   [IX-a---]₍utterance₎

'She thinks it is a monkey. She looks at it. It is nice.'

Note that the question of synchronization of utterances between the tiers is an independent issue. The linearization rules (1) specify the conditions in which the second tier is activated and (2) specify the node that is linearized on the second tier. As for the synchronization of the tiers, independent prosodic rules should account for that. Based on the examples from RSL, the following rules can be suggested:

(19)   *Prosodic alignment of tiers in RSL*
      (i)   If two tiers are active, each one is mapped onto a single utterance.
      (ii)   If two utterances appear on two tiers, their edges should be aligned.
      (iii)   If one sign has to constitute an utterance, it is realized as a hold, not as repetition of the full sign.

The first condition in (19) is stipulated. It is easier to suppose that the second tier also contains an utterance, if so does the first tier, but one can also formulate a rule creating a phonological word on the second tier if necessary.

    The fact that the edges of the utterances on the two tiers coincide is probably caused by the fact that only one structure is projected onto both tiers. However, if we look at (2) we can see that the left edges of the utterances appear not to be aligned: the sign *IX* starts not simultaneously with the first sign *THINK* on the first tier, but after the *THINK* is completed. This is probably caused by the same grammaticalized cognitive constraint that prohibits independent movement of two hands within lexical signs (Battison 1978) (20).

(20)   *Symmetry constraint*[5]
      If two hands move simultaneously, they have to be specified for the same handshapes and movement.

Since simultaneous realization of *THINK* and *IX* would violate this constraint, the second tier is not perfectly aligned with the first one. The same constraint actually causes the hold to be realized as a hold (19-iii): otherwise two hands would be moving independently throughout the whole utterance.

    Example (1) seems to contradict this generalization: the beginnings of signs *CARRY1* and *CARRY2* are synchronized. However, within this construction the phonological constraint in (20) is not violated, because both signs contain the same handshape and movement. Therefore, the full synchronization is possible.

## 5.3   Multi-rooted structures

As de Vries (2009) noted, structures as in (14) and (15), namely multi-rooted trees, cannot be linearized by the standard linearization procedure, because it is not possible to define where the traversing starts. In order for linearization to apply, the sub-trees created by External Remerge should be merged together at some point to form a single-rooted tree. The most straightforward way to change a multi-rooted structure is coordination. In (6) the object *Bush* is dominated both by *John admires* and *Bill hates*. This would create a multi-rooted structure as in (21a), but due to coordination, the structure is single-rooted (21b) (De Vries 2009:361).

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[5] Based on the *Symmetry Condition* from Battison 1978.
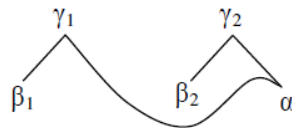
(21) a.   b.
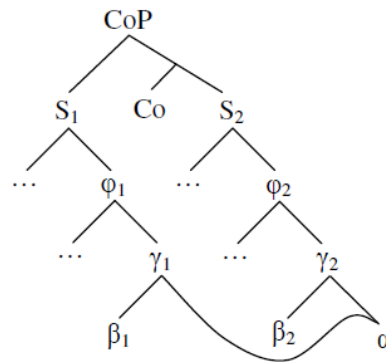
In the same vein (1) and (2) are probably also coordinated structures. For instance, (1) can be reformulated as follows: "He carries the suitcase and the cage, and he does not need the suitcase, so he throws it away." The question remains whether this is indeed syntactic coordination. There are no overt markers of coordination in this sequence, but RSL generally does not use any overt coordinative signs. Maybe the combination of clauses in (1) and (2) is actually a discourse-level phenomenon. However, the whole sequence in (1) and (2) must be the input to the linearization procedure – otherwise the generation of weak hand holds would be impossible. Does this mean that parts of discourse and not just sentences can be the input to the linearization procedure? If so, this should be also applicable to spoken languages: discourse-level coordination should be handled by similar mechanisms.

5.4 Parentheticals

Having established the rules of linearization for External Remerge, it is necessary to discuss parentheticals, too. Note that in spoken languages no special rules for linearization of parentheticals are necessary, because Parenthetical Merge does not create multitdominance (22).

(22) *Parenthetical Merge* (De Vries 2011)
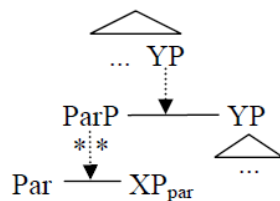
par-Merge (Par, XP_{par}) → ParP
Merge (ParP, YP) → YP

However, it appears that SLs and RSL in particular do have a separate rule of linearization for Parenthetical Merge, because parentheticals are often linearized on the second tier, while the first tier turns into a weak hand hold (23).

(23)   H1   STREET--
         H2   STREET GORKIY EARLIER STREET BITTER EARLIER RIGHT
         'Gorkiy Street (earlier it was called Gorkiy, right)…'

In (23) the parenthetical phrase is realized on the one hand, while the other hand contains a weak hand hold of the element belonging to the main clause[6]. The rule for linearization of parenthetical merge can be formulated as in (24). Note that the phonological constraint in (20) predicts the realization of the last element of the main sentence as a hold.

(24)   *Spell-Out of Parenthetically Remerged Nodes in RSL*
         Spell out the Parenthetical Phrase on the second tier.

There is a crucial difference between the rules of linearization for External Remerge and for parentheticals. In the former case, the rule concerns one node, which is realized on the second tier as a weak hand hold. In the latter case, the rule concerns the whole parenthetical phrase, which is realized as a normal phrase, creating a hold on the other tier due to the phonological constraint. This difference also results in the difference in alignment: in the case of External remerge there is a full alignment of the utterances on the two tiers, while in the case of parentheticals the second tier becomes de-activated immediately when the parenthetical phrase ends (25).

(25)   a.   *Alignment of tiers with External Remerge in RSL*
              H1   [main clause--------------------]$_{utterance}$
              H2   [hold----------------------------]$_{utterance}$
         b.   *Alignment of tiers with Parenthetical Merge in RSL*
              H1   [main clause--[hold----------]------------]$_{utterance}$
              H2   [parenthetical]$_{utterance}$

Finally, the current analysis makes no clear predictions for the amalgams which contain both a shared node created by External Remerge and a parenthetical, because it is impossible to satisfy the rules of realization for both in the same structure. One possibility is that amalgams are just not realizable in RSL, but another possibility is that one of the linearization rules (16) and (24) will override the other. Further research is needed.

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[6] The beginning of the hold (over the sign GORKIY) is a syntactic hold: the head of the noun phrase spreads across the dependent, which then turns into a hold accompanying a parenthetical.

The most important theoretical consequence of this subsection is that RSL shows an overt distinct realization of Parenthetical Merge which confirms the status of this operation as distinct from other kinds of Merge.

6 Discussion

In the previous sections a multidominant analysis of weak hand holds in RSL has been proposed. So far the analysis aimed to achieve the descriptive adequacy. However, this analysis also makes some predictions that could be tested in future.

If the analysis is correct, then effects parallel to those in spoken languages should be observed in RSL as well. For instance, island effects should be absent in cases like (8), and parentheticals should be insensitive to c-command. In the corpus analyzed here there were no clear examples confirming these expectations, so it is to be tested in future research.

Most importantly, the current analysis predicts the constraints on the use of weak hand holds. Leaving aside phonetically motivated holds, all multi-dominant and parenthetical structures and only they should produce holds in RSL. Again, the limited corpus size does not allow testing this prediction fully. However, examples similar to Right Node Raising, appositives and non-restrictive relative clauses can easily be constructed in RSL involving a weak hand hold.

Another prediction concerns the ordering of elements: it is expected to be different in RSL than in spoken languages. For instance, a translation of (6), which is an example of Right Node Raising, into RSL is likely to look like (26). Since linearization rules are different for RSL, the shared node is not expected to appear in the right-most position, but only on the second tier.

(26)   H1: BILL------------   ADMIRE   JILL HATE
       H2:   BUSH IX------------------------------
                'Bill admires, but Jill hates Bush'

RSL also has some other weak hand holds that have not been discussed here. For instance, RSL, as many other SLs, uses the so-called list buoys (Liddell 2003), when the fingers of the weak hands are used to list referents. It is possible to analyze this case as an instance of multidominance as well: the list buoy can be an overt realization of the shared scene-setting topic. This is also an argument in favor of the structure proposed for (1).

Another very common type of weak hand holds is a hold to mark background in locative construction. Pfau & Aboh (2012) analyze this kind of hold as prosodic, but this might be another instance of a multidominant structure as well. As for the syntactic holds, mentioned in section 2, it does not look likely that they can be analyzed as involving multidominant structures. Further research is needed here.

Finally, note that the linearization rule in (16) only handles structures that result from External Remerge. It is interesting to see in future whether Internal

Remerge can lead to the activation of the second tier, too. It has been claimed that wh-words are sometimes realized as weak hand holds (Conlin et al. 2003). If this is true, the rule in (16) has to be revised in order to include both types of remerge.

One important theoretical consequence of the analysis proposed here is that the modality difference between SLs and spoken languages is fully localized in the linearization procedure and further prosodic alignment rules, while the syntactic analysis is equally applicable to both modalities. This is a desired result, because differences in linearization are unavoidable given the different articulators, while differences in syntax are less expected.

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