The syntax-morphology interface problem from the Minimalist view

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The problem

Even if targets behave similarly (agreeing or not agreeing), there are still complexities in the syntax-morphology interaction. Thus targets may have more than one agreement slot. In Archi, many targets mark agreement in two places, some in three, and a few in four.

1. Background. In generative syntax, AGREE establishes relations between probes (~targets) and goals (~controllers). The main condition on the establishment of such relations is that the probe and the goal be in a local configuration. Cross-linguistically, violations of locality in agreement are quite rare and are also subject to principled constraints, i.e., do not fall all over the place. Therefore, before we expand the scope of agreement phenomena in such a way that would make Archi look very exotic, it is important to investigate whether Archi really has any contexts where agreement with more than one argument takes place in the same local domain.

Several approaches capture the relation between syntax and morphology (i.e., surface representation). Distributed Morphology (DM) assumes that the input to morphology is a syntactic derivation. This means that syntax is the source of grammatical features and determines, in a principled way, how such features are arranged (Halle & Marantz 1993, Harley & Noyer 1999, Bobaljik 2012)[1]. The following assumptions are particularly important for DM:

(i) elements within syntax and elements within morphology enter into the same types of constituent structures (such structures can be diagrammed through binary branching trees); these elements (both in syntax and in morphology) are understood as discrete units (Syntactic Hierarchical Structure All the Way Down)

(ii) morphology operates on the output of syntactic derivation; the latter consists of abstract morpho-syntactic features devoid of phonological content

(iii) phonological expressions, called Vocabulary Items, are inserted in a process called Spell-Out, which happens <u>after syntax</u> (Late Insertion); null exponents are recognized as possible.

Given the DM assumptions, each morpheme corresponds to one functional head in syntax (cf. (ii) and (iii)).[2] Under these assumptions, there is no problem of multiple exponence: there are simply several functional heads involved in syntactic agreement.

2. Monoclausal structures. The example in (1) shows standard Archi agreement with the absolutive. The verb agrees with the absolutive object and there is only one agreement marker per for, one on the non-finite form (*b-a‹r›carši*), the other on the auxiliary (*d-i*).

(1) tor-mi   χˤon   b-a‹r›ca-r-ši   b-i
    that.II.SG-ERG   cow(III)[SG.ABS]   III.SG-‹IPFV›milk-IPFV-NON-FIN   III.SG-be.PRS
    'She is milking the cow.'

In (2), the tense is different, and the agreement shows up in what seems like two occurrences on the same predicate. To reiterate, functional heads are responsible for agreement. The double agreement we see in (2) is consistent with the presence of a complex predicate: one functional head that is responsible for agreement is *v* (the light verb)*,* the other one is a higher functional head (Asp). In what
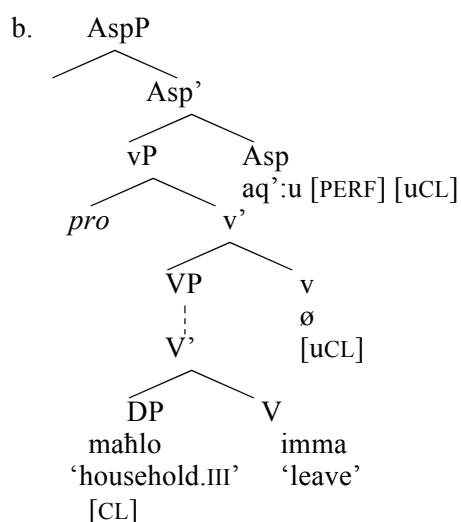
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[1] For the diagram illustrating the architecture of grammar under DM, see Appendix 1.
[2] For treatment of portmanteau morphemes see Appendix 2.

follows, we will not be distinguishing between perfective and imperfective (for lack of data); however it is quite possible that the imperfective would be more complex than the perfective.
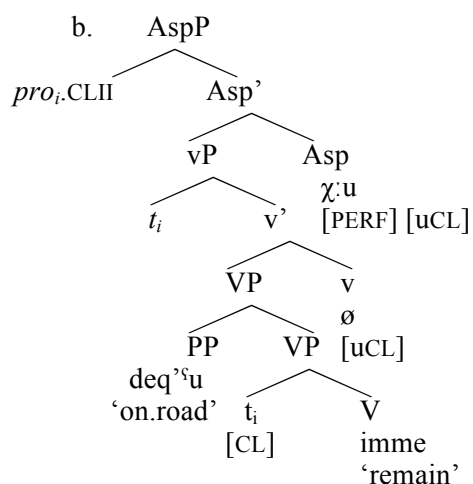
The head *v* introduces the lexical verb, the head Asp introduces aspectual (or maybe temporal) features. The two functional heads (*v* and Asp) both have the unvalued feature [CL], which we show as [uCL] (u for 'unvalued'). To value the unvalued feature, each head probes for this feature. The probing reaches the closest goal within the clause (the absolutive argument with such a feature). Agreement is registered on each head once.

(2) a. maħlo-wu   **b**-imma‹**b**›aq:'u   *(=(1))*
      household(III)[SG.ABS]-and   III.SG-leave‹III.SG›PFV
      '... and left the household (to someone)'

b.
```
        AspP
        /  \
          Asp'
          /  \
        vP    Asp
       /  \   aq':u [PERF] [uCL]
     pro   v'
          /  \
        VP    v
        :     ø
        V'   [uCL]
       /  \
      DP    V
    maħlo   imma
'household.III' 'leave'
    [CL]
```

In the data presented here, there are several examples that illustrate multiple functional heads as in (2). All these examples show well-behaved agreement with the absolutive, occurring once on each head. In (3), the lexical verb is 'remain', which we assume to be unaccusative (therefore, its subject starts our as the internal argument, indicated by t_i in (3b)). The subject is expressed by the null pronominal whose class feature is II.

(3) a. χit:a deq'ʕu   **d**-imme‹**r**›χ:u   *(=(4))*
      then   road(IV)SG.LOC   II.SG-remain‹II.SG›.PFV
      'and then I stayed on the road'

b.
```
          AspP
          /  \
$pro_i$.CLII  Asp'
             /  \
           vP    Asp
          /  \   χ:u
        $t_i$  v' [PERF] [uCL]
             /  \
            VP    v
           /  \   ø
         PP   VP [uCL]
       deq'ʕu  /  \
     'on.road' $t_i$  V
        [CL]        imme
                  'remain'
```

Example (4), which includes what you call an adverb, may actually have another complex verb, something like 'to do for free' (*CL-allej-CL-u*), adjoined to 'work'. Therefore there are three verbs there, each agreeing with the absolutive subject. As in (3b), agreement is registered on each functional head once.

(4) tu-w   tej-me-s   **w**-allej‹**w**›u   w-irχʷni   *(=(3))*
     that.one-I.SG.ABS   that.one.OBL.PL-OBL.PL-DAT   I.SG-for.free‹I.SG›   I.SG-work.PFV
     'He worked for them for free.'

In the following examples, there are three monoclausal structures, two of which are probably adjuncts: 'he took her as wife for himself' (adjunct clause), 'did a wedding' (adjunct clause), and 'settled down'. Within each clause, the predicate agrees with the absolutive. All the three clauses have null pronominal subjects, and these subjects are not identical, which is typical under adjunction. In the example below they are indicated as *pro* with subscripts. The absolutive goals below are capitalized and underlined.

(A side note: We doubt that the first two clauses (5a), (5b) are actually converbal adjunct clauses because in embedded clauses with a non-finite verb, the word order is normally verb-final; here we have preposed verbs. Given that converbs and evidentials are homophonous, it is more likely that the three clauses are paratactically connected. This does not change the points made here with respect to agreement.)

(5) o‹r›ka-li   ju-w-mu   ja-r   ł:onnol-ši   žu-s:a‹r›u   *(=(12))*
     ‹IISG›take.PFV-CVB   this-I-SG.ERG   this-II[SG.ABS]   woman-ADVZ   LOGOPH.OBL.ISG-DAT.PCL‹II.SG›
     ow-li   o:q-u   q'eˤ‹b›di-li
     [IVSG]do.PFV-CVB   wedding(IV)[SG.ABS]-and   ‹I/IIPL›sit.down.PFV-EVID
     'Then he married her (took her as a wife for himself), they had a wedding and settled down.'
     [T5:31]

a. o‹r›ka-li   ju-w-mu   <u>JA-R_J</u>   ł:onnol-ši   žu-s:a‹r›u
    <II.SG>take.PFV-CVB   this-I-SG.ERG   <u>THIS-II[SG.ABS]</u>   woman-ADVZ   LOGOPH.OBL.ISGDAT.PCL‹II.SG›[3]
   'he took her as his wife'

b. *pro_{i/?i+j}*   ow-li   <u>O:Q-U</u>
              [IVSG]do.PFV-EVID   <u>wedding(IV)[SG.ABS]</u>-and
    'he/they [the ergative could be either *pro_i* or *pro_{i+j}*] had a wedding'

c. <u>*pro_{i+j}*</u>   q'eˤ‹b›di-li
              ‹I/IIPL›sit.down.PFV-EVID
    'they settled down'

Examples (5a)—(5c) are monoclausal, and the agreement facts within each clause are consistent with what we have established earlier: one agreement per functional head.

3. Biclausal structures.

3.1. Converb: Adjunct clause.

The example in (6) has to be biclausal, because the matrix verb 'be' cannot license the ergative. Since the lower clause is a converb the most likely structure is the one where the embedded clause is an adjunct and the matrix clause has a null pronoun coreferential with 'the horse'. That straightforwardly accounts for the agreement on both verbs. The English equivalent in (6b) presents a rough translation of what the structure may be like.

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[3] We will come back to the analysis of *ł:onnol-ši žu-s:a‹r›u* in section 3.2.

(6)   zari   noʕš   darc'lirši e‹**b**›t'ni-li   **b**-i   *(=(5))*
        1SG.ERG horse(III)[SG.ABS] to.post   ‹III.SG›tie.PFV-CVB   III.SG-be.PRS
        'I tied horse to the post.' (based on Kibrik 1977: 195)

        a. [$_{TP}$ [$_{CP}$ zari noʕš darc'lirši$_i$ e‹**b**›t'ni-li] *pro$_i$*   **b**-i]
        b. "as I have tied the horse to the post, (so) (it) was"

(6a) allows us to make several predictions:

- the converb and *bi* can be separated by intervening lexical material
- there should be separate adverbial modification for each of the clauses (this can be tested using the adverb like *again*, which could be repetitive vs. restitutive)
- whatever the grammar of converb clauses is for Archi, the lower clause in (6a) should conform to it, for example:
  - *zari, noʕš*, and *darc'lirši* may not be able to appear after *e‹b›t'ni-li* (assuming Archi embedded clauses are predicate-final)
  - *zari, noʕš*, and *darc'lirši* may not be able to scramble out of the converb clause (assuming Archi adjunct clauses are islands)

The other examples involving converbs are structured in a similar manner. In (7), we again find the matrix verb 'be' which cannot license the dative; the dative and the absolutive 1sg are licensed in the converbal adjunct clause, which is adjoined to the matrix clause.

(7)   [d-ez$_i$ zon-a‹**r**›u   d-aku-r-ši]   *(=(11))*
        II.SG-1SG.DAT 1SG.ABS-PCL‹II.SG› II.SG-see-IPFV-CVB
        pro$_i$ d-i   daχon-n-a
             II.SG-be.PRS   mirror(IV)-OBL.SG-IN.ESS
       'I [woman speaking] see myself in the mirror.' ("(I) am in the mirror as/while I see myself")
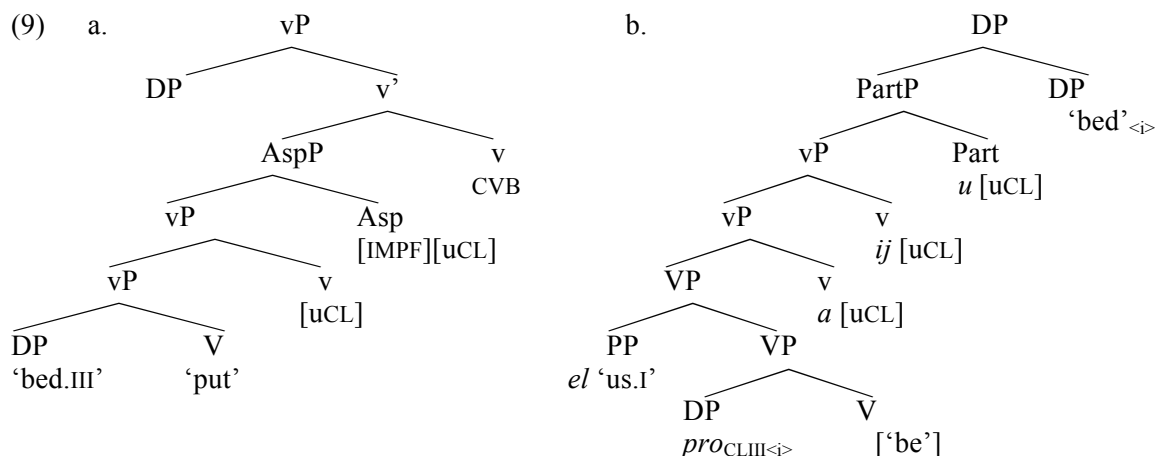
In (8), there are probably three or four clauses: the adjunct clause 'when (they) went to lie down' (which may include the purpose clause 'to lie down'—there is simply no way to tell), the converbal clause 'having made the bed for ourselves', and the matrix clause with the verb 'be', which agrees with 'bed':

(8)   a‹**b**›χa-so   ‹**b**›qʕa-mχur   **b**-el-a‹**b**›-ij‹**b**›u   *(=(13))*
        ‹I/IIPL›lie.down-FIN   ‹I/IIPL›go.PFV-WHEN   III.SG-1PL.EXCL.DAT-PCL‹III.SG›-EMPH‹III.SG›
        mas:-u   b-a‹**r**›ča-r-ši   e‹**b**›di
        bed(III)[SG.ABS]-AND IIISG-‹IPF›put-iPFV-CVB   ‹IIISG›be.PST
       'Only once shepherds were gone to sleep, could we make our own beds.' [T31:6]

  a. a‹**b**›χa-s   *pro*   o‹b›qʕa-mχur
       ‹I/IIPL›lie.down-FIN   ‹I/IIPL›go.PFV-WHEN
       (the null pronominal corresponds to the shepherds)

  b. **b**-el-a‹**b**›-ij‹**b**›u   mas:-u$_i$ b-a‹**r**›ča-r-ši
       III.SG-1PL.EXCL.DAT- PCL‹III.SG›-EMPH‹III.SG› bed(III)[SG.ABS]-AND IIISG-‹IPF›put-IPFV-CVB

  c. *pro$_i$* e‹b›di
           ‹IIISG›be.PST
   (the null pronominal is co-indexed with 'bed')

The complex form in (8b) is comprised of multiple light verbs which all show agreement with the absolutive. The agreement is local and there is one-to-one correspondence between each agreement exponent and each functional head.

The dative pronoun in (8) presents another interesting case: it has multiple class agreement exponents along with what seems like two emphatic markers. We hypothesize that the dative pronoun is part of the participial clause modifying *mas:-u* 'bed', with the null argument in the participial clause corresponding to 'bed'. In (9a), we see the general structure of the converbal clause, and (9b) shows the internal structure of *b-el-a‹b›-ij‹b›u mas:-u*. The agreement with 'bed' in noun class is due to presence of the null pronoun of class III in the participial clause, co-indexed with the head noun (the coindexation is shown by <i> on the relevant nouns). The light v heads are some kinds of emphatic verbs whose semantics is not yet fully understood.

(9) a.

vP
DP   v'
AspP   v
CVB
vP   Asp
[IMPF][uCL]
vP   v
[uCL]
DP   V
'bed.III'   'put'

b.

DP
PartP   DP
'bed'<i>
vP   Part
u [uCL]
vP   v
ij [uCL]
VP   v
a [uCL]
PP   VP
el 'us.I'
DP   V
pro_CLIII<i>   ['be']

3.2 Participial agreement

So far we have mainly discussed clausal agreement. In addition, there is DP-internal agreement when AGREE connects a nominal head with its modifiers (one could think of that as concord). Concord is just a sub-case of the operation AGREE, establishing a relation between the participle (attributive form in your notation, ATTR) and the noun phrase it modifies. Under concord, the unvalued gender features of the participle are matched against the corresponding valued features of the noun. Thus:

(10)

DP
PtcpP   DP
[CL]
V   Ptcp
[uCL]   CONCORD
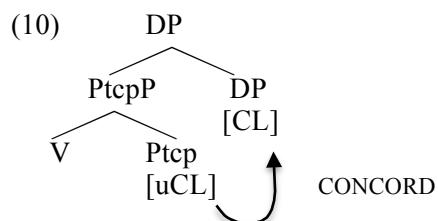
The head noun can be null, in which case its identity is recovered from the agreement on the participle; this is similar to the English 'the chosen', 'the recovering', etc., where the head noun is also unexpressed but the determiner shows that it is implied.

Depending on their structural complexity, participial modifiers can be divided into lexical (as shown in (10)), phrasal, or clausal. A nice example of the lexical participle is *c'abu-t:u-t ł:an* 'drunk water' (from example (12)), where the concord is between *c'abu-t:u* and *ł:an*. In terms of the surface position, it seems that clausal agreement is expressed prefixally, and concord is expressed suffixally.

If the participial modifier is clausal, then the material in the clause embedded under the Ptcp head (*t:u*) has clausal agreement, where the predicate agrees with the absolutive in its local domain; this is standard monoclausal agreement, as discussed in section 2 above.
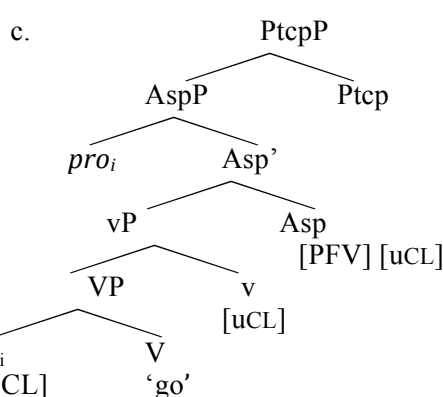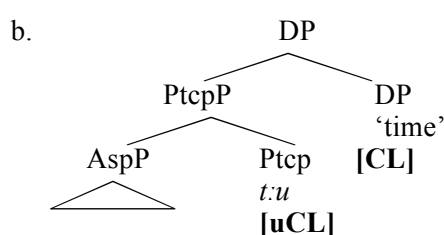
If we now consider the examples provided in the handout, they fall into two subsets: examples of DPs with modifying participle and examples of full clauses that include such DPs.

3.2.1. Examples of DPs with modifying participle

We already saw a possible instance in of a participial clause in (9b) but it is obscured by a number of silent elements, and also we are not quite sure what the emphatic heads are. If we look at the other examples provided, the simplest case is probably (11), where the participial phrase agrees (via concord) with the noun 'time'. Inside the participial phrase, the verb agrees with the (understood) first person subject pronoun, which is class II (referring to a woman). Thus, there are two agreement sets:

(i)　　agreement (concord) between the participle and the noun it modifies (11b); together they form a DP (the relevant class features are shown in bold)

(ii)　　agreement between 'go' and the first person pronoun (11c): it is the standard clausal agreement such as discussed above
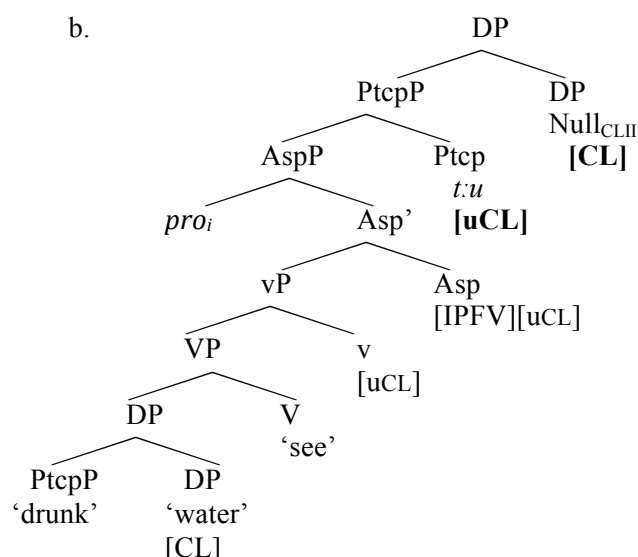
(11) a.　jamu-t　　　　　o‹r›qˤa-tːu-**t**　　　　　　saʕat-li-t　　　　　　　　　　　*(=(9))*
　　　　　this-IV.SG　　‹II.SG›go.PFV-ATTR-IV.SG　time(IV)-SG.OBL-SUPESS
　　　　　'at the time of my going'

b.

$$
\begin{array}{c}
\text{DP} \\
\text{PtcpP} \quad \text{DP 'time'} \\
\text{AspP} \quad \text{Ptcp} \; [\mathbf{CL}] \\
\quad tːu \\
\quad [\mathbf{uCL}]
\end{array}
$$

c.

$$
\begin{array}{c}
\text{PtcpP} \\
\text{AspP} \quad \text{Ptcp} \\
pro_i \quad \text{Asp'} \\
\text{vP} \quad \text{Asp} \; [\text{PFV}][\text{uCL}] \\
\text{VP} \quad \text{v} \; [\text{uCL}] \\
t_i \; [\text{CL}] \quad \text{V 'go'}
\end{array}
$$

The difference between (11) and several other examples in the data is that in (11), the head noun is overt, and in the other examples, it is null. Null nominal heads modified by a participle are observed in the following examples: (12)-(17).

Let us consider (12) in more detail. As in (11), (12) shows the dissociation between clausal agreement (agreement that takes place in the clause embedded under the participial head) and the noun-modifier concord. The only difference is that the head noun is null; judging by the class registered on the participle, it refers to a female. Note that the interpretation 'her throat' as referring to that female's throat is due to co-indexation, not to a syntactic relation.

(12) a.　c'abu-tːu-t　　　　　　ɬːan　　　　　　hanqː'-a-χut　　　　　 akːu-r-tːu-**r**　　　　*(=(8))*
　　　　drink.PFV-ATTR-IV.SG　water(IV)[SG.ABS]　throat(IV)-IN-TRANS　[IV.SG]see-IPFV-ATTR-II.SG
　　　　'Consumed water can be seen through her throat'. [T1:6]

b.
```
                              DP
                    ┌──────────┴──────────┐
                 PtcpP                    DP
            ┌──────┴──────┐            Null_CLII
          AspP           Ptcp            [CL]
      ┌────┴────┐         t:u
    pro_i      Asp'      [uCL]
          ┌────┴────┐
         vP        Asp
     ┌────┴────┐  [IPFV][uCL]
    VP         v
 ┌───┴───┐   [uCL]
DP        V
      ┌───┴───┐  'see'
   PtcpP     DP
  'drunk'  'water'
            [CL]
```

Examples (13) and (14) similarly have null DPs modified by participial phrases. Example (13) has additional structure inside the participial phrase (possibly a control complement, although it is hard to tell without more data).
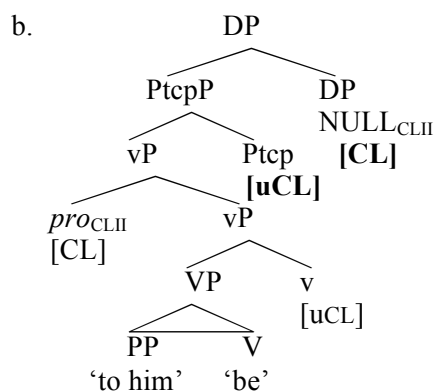
(13) [_DP_ [_PartP_ [_CP_ lagi   a:c'a-l-kan]   kummul-u   kunne-t'u-t:u] **Ø_CLII_-r]** *(=(7))*
        stomach(IV)[SG.ABS] [IV.SG]fill-FIN-TEMP food(IV)[SG.ABS]-and IV.SG.eat.PFV-NEG-ATTR-II.SG
        '(who) never ate to the full' [= 'the one that didn't eat food to fill her stomach']

Example (14) shows a complex DP similar to the one presented in (9b) above, with the emphatic segment representing a separate head. We do not have enough data to analyze it conclusively, so the structure we propose needs more verification, but we hypothesize that the participial clause includes a silent verb 'be':

(14) [_DP_ [_PtcpP_ d-as:a-a‹r›u-ej‹r›u-t:u] **Ø_CLII_-r]**
        II.SG-of.myself-‹II.SG›PCL-‹II.SG›EMPH-ATTR-II.SG
        'my own [female]' (Kibrik 1977: 127-30 via Corbett 1998: 196)

The constituent *ł:onnol-ši žu-s:a‹r›u*, which was mentioned above (see ex. (5)), probably has the same structure as (14), also with a silent verb 'be'. The null head noun and the participle show agreement (concord) in class II; the verb in the participial clause agrees with the silent absolutive pronoun ('she'). If this analysis is on the right track, the silent elements should be replaceable with overt ones within the same structure.

(15) a. ł:onnol-ši žu-s:a‹r›u
         woman-as LOGOPH.OBL.ISGDAT.PCL‹II.SG›

b.
```
                         DP
                ┌─────────┴─────────┐
             PtcpP                  DP
         ┌─────┴─────┐          NULL_CLII
        vP          Ptcp          [CL]
     ┌───┴───┐     [uCL]
  pro_CLII    vP
   [CL]    ┌───┴───┐
          VP        v
       ┌───┴───┐  [uCL]
      PP        V
    'to him'   'be'
```

3.2.2. Examples of clauses that include DPs accompanied by modifying participles
Two examples in the data show full clauses, which also include DPs of the type discussed in the previous subsection. In both examples we find a null DP modified by the participial expression.

In (16), we find a simple equative construction of the form 'X is Y' (*John is a linguist; You are the one without sin*), where we will refer to the underlined portion as the Predicate Phrase. The subject is 'the girl' and the predicate phrase is "be one having cunning". In the PredP, the verb *i* 'be' trivially agrees with the absolute subject *jar lo* 'this girl'. The nominal part of the PredP includes a null DP (as in the examples above) and the modifying participial phrase. The participial head agrees with the silent noun it modifies, 'girl', in class II. The embedded verb 'be' agrees with the absolutive 'cunning'. Throughout this example, we find only class II agreement, but it is important to bear in mind that the sources of this agreement are different for different constituents.
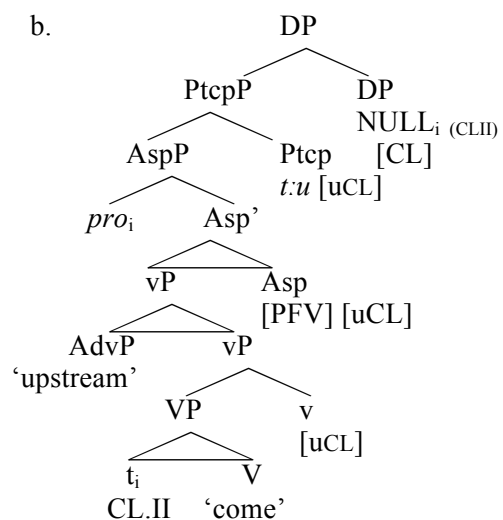
(16) a. ja-r   lo   s:iħru   **b**-i-t:u-**r**   d-i   *(=(11))*
    this-II.SG child(II)[SG.ABS] cunning(III)[SG.ABS] **III.SG**-be.PRS-ATTR-**II.SG** II.SG-be.PRS
    'This girl is cunning.' (literally 'this female child is (one) who is with cunning')

    b.

    c.
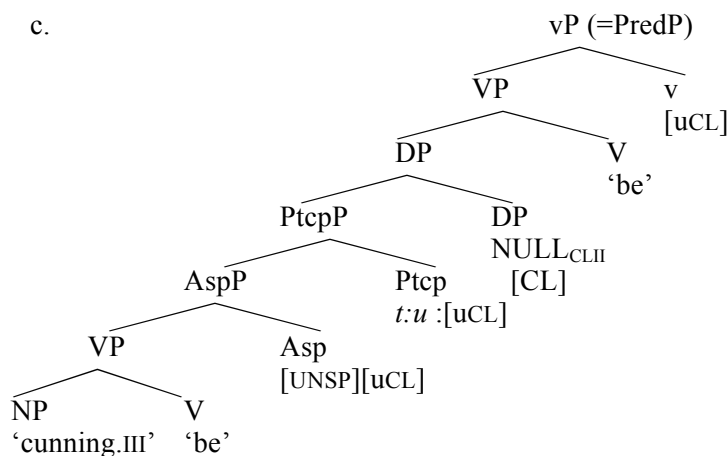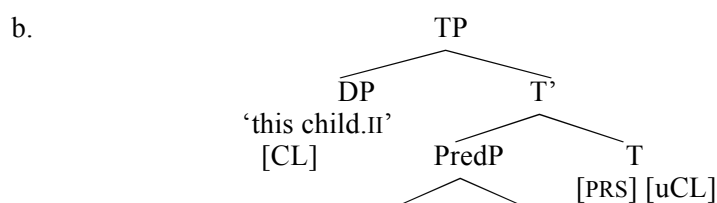
In (17), the absolute subject of the embedded clause is coreferential with the unexpressed head noun of the participial expression. Again, they match in class but they are different entities as far as agreement is concerned; the agreement inside the participial clause is with the absolutive argument (the silent pronoun assigned class II based on the gender of the interlocutor), and the agreement (concord) between the participle and the null head is in class II as well. The conidexation between the null head and the null pronominal inside the participial clause is simply accidental—compare a very similar structure in (16b) where the null head is also in class II, but there is no coindexation with the participial clause material. (17b) below shows the relevant part of the representation:

(17) a. duχij   **d**-aqˤa-t:u-**r**?   *(=(6))*
    upstream   II.SG-come.PFV-ATTR-II.SG
    'You were coming back?'

b.

```
                      DP
          PtcpP              DP
                          NULLᵢ (CLII)
     AspP        Ptcp    [CL]
                 t:u [uCL]
  proᵢ      Asp'
        vP        Asp
                  [PFV] [uCL]
   AdvP      vP
'upstream'
       VP        v
                 [uCL]
    tᵢ      V
  CL.II    'come'
```
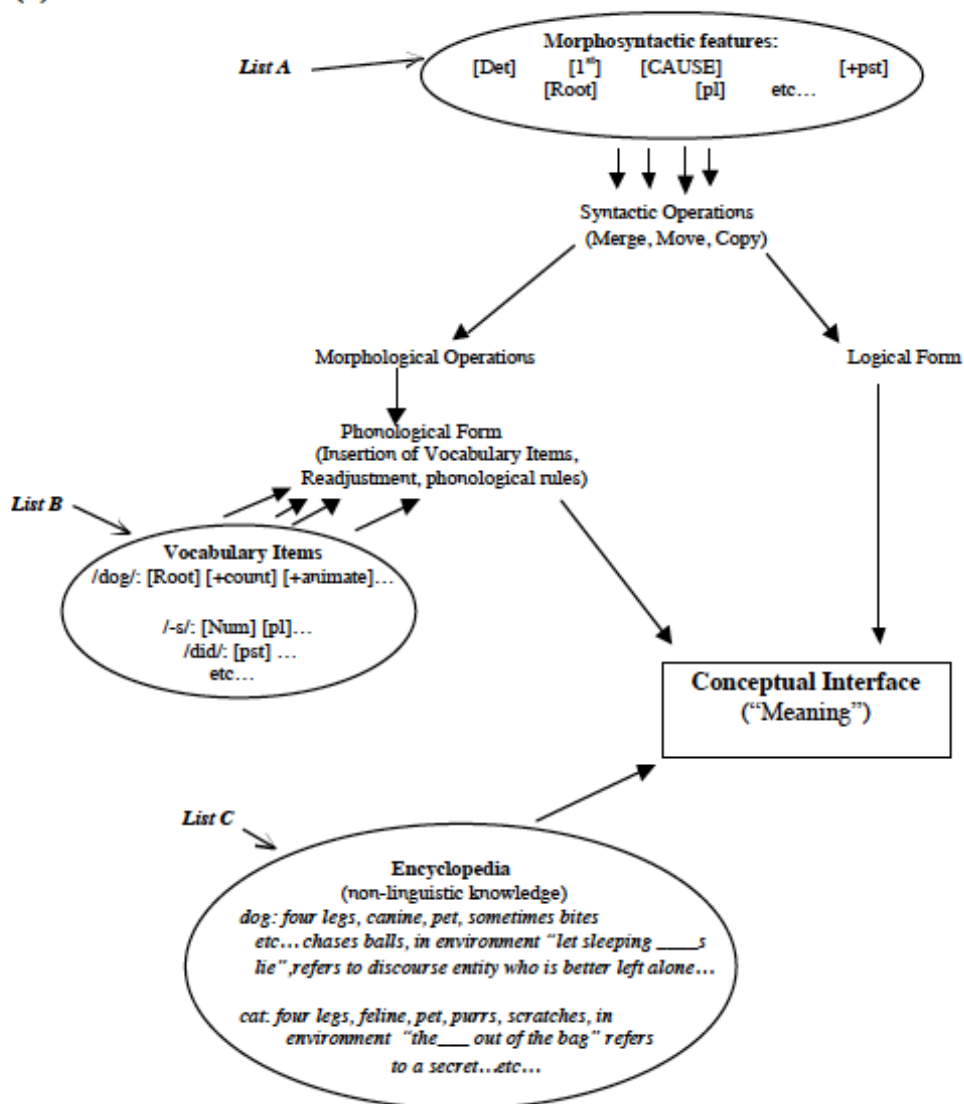
In sum, what looks like agreement with two controllers is simply due to the presence of two local domains: the clausal domain for the participle and agreement inside the noun phrase between the attributive marker (participle) and the head noun.

References

Bobaljik, Jonathan David. 2012. *Universals in Comparative Morphology*. Cambridge, MA: MIT Press.

Halle, Morris. 1997. Distributed Morphology: Impoverishment and Fission. *MIT Working papers in linguistics 30: Papers at the Interface.* p. 425-449.

Halle, Morris and Alec Marantz. 1993. Distributed morphology and the pieces of inflection. In K. Hale and S.J. Keyser (eds.), *The View from Building 20*, Chapter 3, pp. 116-176. Cambridge, MA: MIT Press.

Harley, Heidi and Rolf Noyer. 1999. State-of-the-art-article: Distributed Morphology. *GLOT International* 4.4:3-9.

Radkevich, Nina. 2010. *On location: the structure of case and adpositions*. Ph.D. thesis. University of Connecticut.

Appendix 1: DM Model (Harley and Noyer 1999)

(1)

Morphosyntactic features:

[Det]   [1ˢᵗ]   [CAUSE]   [+pst]
[Root]   [pl]   etc…

Syntactic Operations
(Merge, Move, Copy)

Morphological Operations   Logical Form

Phonological Form
(Insertion of Vocabulary Items,
Readjustment, phonological rules)

List B

Vocabulary Items
/dog/: [Root] [+count] [+animate]…

/-s/: [Num] [pl]…
/did/: [pst] …
etc…

Conceptual Interface
("Meaning")

List C

Encyclopedia
(non-linguistic knowledge)
*dog: four legs, canine, pet, sometimes bites
etc…chases balls, in environment "let sleeping ____s
lie",refers to discourse entity who is better left alone…*

*cat: four legs, feline, pet, purrs, scratches, in
environment "the___ out of the bag" refers
to a secret…etc…*

List A

Appendix 2: Portmanteau Morphemes in DM

PORTMANTEAU MORPHEMES= a single vocabulary item for 2 or more terminal nodes

Distributed Morphology principles:
- Vocabulary Insertion targets terminal nodes (the Subset Principle)
- post-syntactic operation of Fusion (Halle and Marantz 1993, Harley and Noyer 1999)
- two-sister nodes are fused into a single node (2)
- a new node inherits all the feature of the two original nodes

(1) **The Subset Principle (Halle 1997):**
The phonological exponent of a vocabulary item is inserted into a position if the item matches all or a subset of the features specified in that position. Insertion does not take place if the vocabulary item contains features not present in the morpheme. Where several vocabulary items meet the conditions for insertion, the item matching the greatest number of features specified in the terminal morpheme must be chosen.
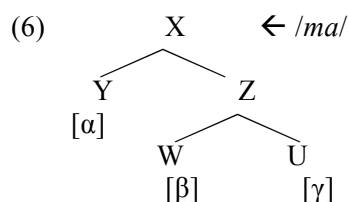
(2) Fusion

a.

```
        A
       / \
      A   \
         / \
        B   C
       [x] [y]
```

b.

```
      A   B/C
       \ /  [x; y]
```
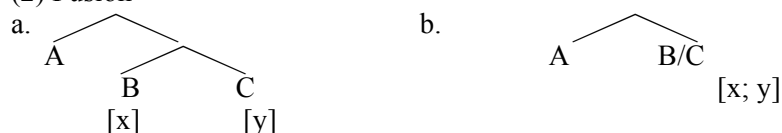
Alternative:

(3)   THE VOCABULARY INSERTION PRINCIPLE[4] (Radkevich 2010)
The phonological exponent of a vocabulary item is inserted at the minimal node dominating all the features for which the exponent is specified.

(4)

```
            X
           / \
          Y   Z
         [α]  / \
             W   U
            [β] [γ]
```

(5)   /ma/ ⇔ [α, β, γ]
        /ba/ ⇔ [β]
        /ca/ ⇔ [γ]

(6)

```
        X       ← /ma/
       / \
      Y   Z
     [α]  / \
         W   U
        [β] [γ]
```

---

[4] A node X minimally dominates [α] iff:
(1) X dominates [α] and
(2) there is no node Z such that Z dominates [α] and X dominates Z.