

A PF-interface condition on syntactic computation Riny Huybregts

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Introduction. Modern generative research has shown convincingly that syntactic operations in natural language are computational in nature, triggered by formal properties of morpho-syntax and applying “blindly” to linguistic objects. In particular, they are typically insensitive to phonological and semantic conditions. However, there may be related phonological or semantic effects, a different matter altogether. In this sense, syntax is autonomous but interacts with interpretive systems such as the semantic and phonological components that are external to “narrow syntax” *per se*. Furthermore, recent research in the minimalist program suggests that syntax is well-designed to meet legibility conditions imposed by the external systems it interacts with. Interestingly, this characterization of syntax, an optimal way of recursively linking the interface conditions, appears to be contradicted, sometimes at least, by intriguing empirical fact (see Chomsky’s minimalist account of *Holmberg’s Generalization*, a non-trivial syntactic regularity involving both phonological and informational properties, in his *Derivation by Phase* (Chomsky, 2001a)).^{*}

The empirical and conceptual problem. In this article we discuss a curious phenomenon in Khoekhoe, a Central Khoisan language, which poses an apparent problem for the autonomy of syntax as understood above. Khoekhoe is a surface OV language with a clause-initial complementizer C that agrees with the subject of its TP complement. Here we simplify and assume that the C-system is not split up into a finer-grained set of functional projections with Agreement heading its own functional projection as may be the case in German and Dutch, languages with left-edge properties not unlike those of Khoekhoe.¹

(1)a. neetse-p ke ‘áo-p-à tará-s-à kò #aí
today-3.sg.m C man-sg.m-Case woman-sg.f-Case RcPast call
 (“the man just called the woman today”)

b. ‘áo-p-à-s ke tará-s-à neetse kò #aí
man-3.sg.m-Case-3.sg.f C woman-3.sg.f-Case today RcPast call
 (“the woman just called the man today”)

The agreeing inflection marks person, number and gender features and is identical to the “determiner” inflection that is an obligatory part of Khoekhoe (pro)nominals. In addition to establishing an agreement relation, agreement inflection also attracts some constituent to its specifier position (EPP-effect). Khoekhoe has therefore all the properties of a V-2nd language like German or Dutch with a focus element at the left-edge of the clause except that the second position is not filled with a verb but with a subject-agreement morpheme that is phonologically merged to the focussed constituent, which, incidentally, could be V (more precisely, remnant VP).

Normally the tense morpheme is expressed in front of V but if V is “initialized” (as the single surviving element of the residual VP) and moved to the left-edge position of CP then T can not stay stranded. Precisely under these conditions “orphanaged” T moves to a position between C and subject DP. Move T, a *syntactic operation*, applies only when T is sentence-final, a *PF-condition*. But phonological considerations should not affect rule applicability in narrow syntax. Hence the problem.²

- (2)a. * #aí-*p* ke 'áo-*p*-à tará-s-à neetse **kò**
 call-3.sg.m C man-3.sg.m-Case woman-3.sg.f-Case today RcPast
 ("the man just called the woman today")
- b. #aí-*p* ke **kò** 'áo-*p*-à tará-s-à neetse
 call-3.sg.m C RcPast man-3.sg.m-Case woman-3.sg.f-Case today
 ("the man just called the woman today")

On the assumption that Khoekhoe is underlyingly SVO with O being internally merged to the containing light verb projection, the strong phase vP, movement of T apparently depends on the prior initialization of (remnant) VP. But given the computational, cyclic and compositional nature of syntactic processes this conclusion is unacceptable. Several questions arise. If T can not support itself why does it move only when it is clause-final? Furthermore, why does it move to a post-complementizer position? And finally, movement of T seems to have counter-cyclic properties, applying to the complement of C after merging of some focus XP to CP has taken place. More precisely, when the computation reaches the strong phase CP, the complement of the head of the next lower strong phase vP will no longer be accessible to computation. Consequently, establishing whether T is clause-final will in effect violate the *Phase Impenetrability Condition* (PIC), a general condition of computational complexity, since the complement of light verb *v* must be inspected for right-edge elements.³

Khoekhoe also seems to contradict some well-known language universals of verbal systems. SOV languages universally tend to have their auxiliary verbs follow their main verbs, and their tense categories follow their auxiliary verbs. However, Khoekhoe runs counter to these universal tendencies (as, incidentally, does Dutch, to a greater, or German, to a lesser extent). In fact, the "universal" constituent order "V Aux T" of OV languages (3a) is ruled out in Khoekhoe. Instead we find the "marked" word order in (3b).⁴

- (3)a. S O V (AUX) T
 b. S O T V (AUX)

Assuming underlying "VO" and "T(Aux)V" word orders with internal merge of object DP and (auxiliary) verbs, verb-raising of V to Aux and subsequent raising of the amalgam to T would give rise to the word order sequence "V(Aux)T," other things being equal. And just as in the case of verb initialization we would predict cliticization of T to C to be the only option. But the sentence is ill-formed and only the derivation leading to (1) gives a well-formed outcome.

- (4) * neetse-*p* ke **kò** 'áo-*p*-à tará-s-à #aí
 today-3.sg.m C RcPast man-3.sg.m-Case woman-3.sg.f-Case call
 ("the man just called the woman today")

At face value, T must be fronted when it occupies a right-edge position: it moves to a preverbal position if the verb is expressed in TP but to a post-complementizer position otherwise, thereby compounding the problem sketched above. These disjunctive properties are unprincipled and arbitrary. The question that arises is whether we can find a principled explanation, an "external" explanation that involves some interface condition or some general property of complex organic systems. We think that the PF-induced cliticization of T and the word order properties of the verbal domain are related phenomena, not just some quirky, disparate elements of the language. They will be shown to fall out as a consequence of independent verb raising properties of the Khoekhoe verbal system and their phonological expression in chains. We will propose an account of chain link expression that explains these unwelcome properties of orphanaged tense. There is therefore no rule of cliticization, it merely looks that way. We simply have a delusion of the senses by "externalized" language.

Only when we see the operations of the “internalized” language at work will we reach a better understanding of the illegitimately stranded tense in Khoekhoe and its word order properties.

Some descriptive detail. Khoekhoe has a nominal system that is richly inflected for person, number and gender. We may view this inflection as part of a determiner system. For the purposes of this article we need not discuss this system at length but to get some idea see the examples in (5) and (6).⁵

- (5)a. //ĩ-p (s)he-3.sg.m (“he”)
 b. //ĩ-s (s)he-3.sg.f (“she”)
 c. //ĩ-ku (s)he-3.pl.m (“they”)
 d. //ĩ-tì (s)he-3.pl.f (“they”)
- (6)a. kxòe-p person-3.sg.m (“the man”)
 b. kxòe-s person-3.sg.f (“the woman”)
 c. kxòe-ku person-3.pl.m (“the men”)
 d. kxòe-tì person-3.pl.f (“the women”)

Case morphology is invariant for subject and object with the single exception of the initialized subject of (declarative) clauses, which carries no case marking. This is illustrated by the sentences of (7), which all mean the same (“the men saw the woman”).

- (7)a. kxòe-ku ke kxòe-s-à kè mùũ
 person-3.pl.m C person-3.sg.f-Case Past see
- b. kxòe-s-à-ku ke kxòe-ku-à kè mùũ
 person-3.sg.f-Case C person-3.pl.m-Case Past see
- c. mùũ-ku ke kè kxòe-ku-à kxòe-s-à
 see-3.pl.m C Past person-3.pl.m-Case person-3.sg.f-Case

Person, number and gender are obligatorily expressed on nouns and pronouns. The verb may express these same phi-features under a number of syntactic conditions (i.e. verb initialization or object-agreement)

- (8)a. mùũ-p see-3.sg.m (“he sees” or “see him”)
 b. mùũ -s see-3.sg.f (“she sees” or “see her”)
 c. mùũ-ku see-3.pl.m (“they see” or “see them”)
 d. mùũ-tì see-3.pl.f (“they see” or “see them”)

In the case of verb initialization we get V-D agreeing with its N-D subject, a type of agreement system Khoekhoe shares with e.g. Siberian Yup’ik, Papuan Alambak and Iroquian Tuscarora. However, the inflection on the verb is not always present. Person, number and gender on the verb may be associated with subject or object. Subject agreement on the verb occurs in verb-initialized sentences only. Object agreement occurs in the verbal domain only.

- (9)a. mùũ-ku ke kò (//ĩ-ku-à) //ĩ-s-à
 see-3.pl.m C RcPast (s)he-3.pl.m-Case (s)he-3.sg.f-Case
 (“they just saw her”)
- b. //ĩ-s ke (*//ĩ-ku-à) kò mùũ-ku
 (s)he-3.sg.f C (s)he-3.pl.m-Case RcPast see-3.pl.m
 (“she just saw them”)

As (9) shows, there is a subject/object asymmetry involving the phonological expression of arguments: phi-marking on V allows “doubling” of subject (when V is initialized) but disallows “doubling” of object (when V is non-initialized).

Analysis. So far we have assumed the equivalent of a “universal base” structure in a non-cyclic representational framework as the appropriate clausal structure of Khoekhoe.

(10) [CP ... C [TP ... T [VP ... V [VP V ...]]]]

(11) [CP XP [C [TP Subj [Obj [T [VP t_{OBJ} [t_{SUBJ} [V-v [VP t_V t_{OBJ}]]]]]]]]]]]]

In derivational terms, V merges with Object externally, projecting V. Next, light verb v merges with VP, projecting v and creating a strong phase vP. Next, V internally merges to vP adjoining to v; Subject merges externally with vP and Object does so internally (Case-Agreement system). Continuing, T merges with the vP projecting T. At the TP-level both Subject and Object merge to TP (as in the case of German and Dutch). Finally, after external merging of subject-agreeing C to TP, we have internal merge of some constituent of CP with the containing CP (again as in German or Dutch) in satisfaction of some interface condition. Specifically, focus expression at the left-edge serves the duality of semantics: the “surface structure interpretation” of informational structure is correlated with internal merge vs. the “deep structure interpretation” of theta structure is associated with external merge.⁶ Logical properties of the computational module possibly preadapt to requirements of external systems. The final result will be (11). So far everything is pretty common (apart from the iterative fronting of internal arguments to the left of T). XP may be Subject (Case and C-agreement unexpressed), Object (Case and C-agreement expressed) or, assuming that cyclic merge of vP obviates the need to merge v to T, remnant vP containing only V-v (C-agreement expressed). But if V-v initializes, T can not be left behind. Instead it shows up to the immediate right of C.

We will now attempt to account for this “right-edge phenomenon:” tense may not be expressed clause-finally. To do so we will first focus on TP. Khoekhoe has a number of Tense and Aspect structures. Punctual Aspect is expressed as in (12)

(12)a.	S	O	T	V	
b.			kè	V	remote past
c.			kò	V	recent past
d.			---	V	resent
e.			nìí	V	future
f.			kà	V	indefinite (conditional)

We may start wondering why the tense element invariably precedes the verb it is associated with. The answer is straightforward. If V merges with TP (adjoining to T) we would illicitly derive structure (13a), where T again shows up at phonological right edge.

(13) [TP XP [C [TP Subj [Obj V-T [VP t_{OBJ} [t_{SUBJ} [t_V [VP t_V t_{OBJ}]]]]]]]]]]

However, this way of phrasing the issue is fundamentally misguided. Delete is dissociated from Merge: the traces in (13) are actually full copies of moved categories. Therefore, it is only after “Delete copy” has applied to the lower copies of the chain-members that T in (13) shows up at the phonological right-edge. Other things being equal, we would assume Delete not to apply to the higher copy. Otherwise the distinction between overt and covert movement will be obliterated. But suppose now that we make expression of copies dependent on requirements of external systems. In the present case, this means that if

Subject and Object are expressed “upstairs” (i.e. the lower copies are deleted) then the partially interpreted PF-derivational product (14a) will be derived. (We assume that at the strong phase level “higher” chains are expressed first, maximizing expression of the “higher” copy as the unmarked case). The question of expressing T can now be resolved easily. Since there is an external PF-condition operative in Khoekhoe ruling out T at the phonological right-edge, the PF-operation of Delete must delete the “lower” copy of V, giving rise to the well-formed output (14b) and obviating the need for an ad-hoc rule of cliticization which adjoins T to C.⁷

- (14)a. [CP XP [C [TP Subj [Obj V-T [VP V]]]]]
 b. [CP XP [C [TP Subj [Obj T [VP V]]]]]

Alternatively, we may consider free ordering of Transfer and Merge. Ordering Merge prior to Transfer will give rise to overt movement of V. A phonologically illegitimate outcome results. Ordering Merge after Transfer yields covert movement of V with a well-formed result. Either way, the interaction between syntax and phonology does not violate autonomy.

We have argued that verb raising actually applies to Khoekhoe syntax. The underlying phasal unit conforms to the word order generalization “TV “ of VO languages, and the derived phasal unit after raising has applied conforms to the “universal” word order “VT” of OV languages (assuming unexpressed lower copies of moved elements). The marked order “TV” of Khoekhoe, an OV language, predictably results from an interface requirement ruling out the phonological expression of right-edge particles. The operation Delete adapts to this condition, forcing the expression of the higher copy.

Verb raising is independently motivated. Consider the Perfect Aspect system of Khoekhoe as illustrated in (15). Here the preverbal particles express tense while the postverbal element express perfective aspect.

- | | | | | | | |
|--------|---|-----|---|---|---------|--------------------------|
| (15)a. | S | O | T | V | Perf | |
| b. | | kè | | V | hàã 'íí | remote past |
| c. | | kò | | V | hàã 'íí | recent past |
| d. | | 0 | | V | hàã | present |
| e. | | nìí | | V | hàã hàã | future |
| f. | | kà | | V | hàã | indefinite (conditional) |

We continue to assume the underlying order to be T AUX V. Other things being equal, we would expect the linguistic computation to yield a derivational representation that would be phonologically interpreted, incorrectly, as (16a) rather than (16b), which is what we find.

- (16)a. S O V AUX T
 b. S O T V AUX

Applying verb raising cyclically, we first raise V to AUX. The result is V-AUX t_V . If the lower copy is left unexpressed and further raising is not considered, we get precisely the word orders of (15). We therefore have independent evidence for verb raising. But why shouldn't the verbal complex V-AUX raise to T? Suppose raising to T as well as to AUX is obligatory, forced to apply by some interface condition and implemented through uninterpretable features of activated Probe-Goal pairs. Then cyclic application of Merge will derive a structure as in (17) with copies of S and O distributed over the dotted lines (we will ignore these “traces” since they will be unexpressed, the higher copies getting spelled-out, the unmarked case).

- (17) S O [[V AUX] T] ... [V AUX] ... V ...

conditioning of syntactic derivations. To briefly illustrate, consider the following verb raising sequences in German (23) and Dutch (24).

- (23)a. lesen können wird V AUX T
 b. wird lesen können T V AUX
 c. * wird können lesen T AUX V
 will can read
 ("will be able to tread")
- (24)a. * lezen kunnen zal V AUX T
 b. * zal lezen kunnen T V AUX
 c. zal kunnen lezen T AUX V
 will can read
 ("will be able to read")

The alternative orderings in German and Dutch are complementary. Assuming "underlying" AUX-S-V-O order in the non-cyclic representation the derivational approach adopted here, we could claim that Dutch has no (overt) verb raising but German has. Or, we might assume that verb raising applies across the board and explain the different distributional facts independently of raising. The German case is particularly promising. Assume then that verb raising applies in Dutch as well as in German. Let us also assume there is basically one cycle, syntax, semantics and phonology operating in parallel phases. In particular, cyclic application of verb raising is combined with cyclic phonological interpretation in phasal units. Phasal derivation of phonology implies that the deepest verb will be interpreted as the most prominent verb (let us say an NSR-effect). Cyclic verb raising will give rise to an unordered linguistic object (defined by predicates such as "sister-of" and "immediately dominate") with the deepest verbal projection the most prominent element. Assume now that ordering in PF is free up to conditions imposed on these syntactic objects from the outside, viz. the PF-interface.

We propose that (25) is such a condition. Note that (25) roughly resembles the *Sound Pattern of English* formulation of the *Compound Stress Rule* (CSR), which accounts for the contrast between the left-branching compound [[**teachers** union] [president]] and the right-branching compound [[kitchen] [**towel** rack]]. (The most prominent element is in bold).

(25) In the configuration [X Y], X is prominent unless Y branches

The linguistic substructure composed by cyclic verb raising and phonological interpretation (PF-ordering and NSR in particular) will now give rise to the various orderings in (26), where primary relations (sisterhood and immediate containment) are preserved. (The most prominent element is in bold).

- (26)a. [[[lesen] [können]] [wird]]
 b. [[wird] [[lesen] [können]]]
 c. [[wird] [[können] [lesen]]]

Applying (25) to (26), we see that only (26c) gives an inconsistent result (*lesen* is NSR-prominent but is not CSR-prominent. The NSR-prominent verbs in (26a,b) occupy positions that interpreted as prominent by CSR as well. WE therefore seem to have a principled explanation of (23) involving an interface condition, viz. PF-condition (25).

It remains to account for Dutch. Assuming that verb raising applies obligatorily here as well, we may adopt (27), which always interprets the rightmost element in a binary structure as prominent.

(27) In the configuration [X Y], Y is prominent

Applying (27) to the PF-ordered structures (28) permitted by syntax gives a well-formed PF-interpretation in the case of (28c) only. The other structures have contradicting PF-properties (NSR-induced prominence does not coincide with prominence predicted by condition (27)).

- (28)a. [[[lezen] [kunnen]] [zal]]
 b. [[zal] [[lezen] [kunnen]]]
 c. [[zal] [[kunnen] [lezen]]]

In conclusion, we have seen that verb raising in Germanic is conditioned by properties of external systems which, though different from the Khoekhoe case, leave the autonomy of syntax untouched in each case.

Additional verb raising in Khoisan. The case for verb raising in Khoekhoe can be strengthened by taking in consideration complement taking verbs of ability, volition and causation.

- (29)a. 'áo-p **ke** tará-s-à kè #ái //xáa
 man-3.sg.m C woman-3.sg.f-Case RmPast call can
 ("the man could call the woman")
- b. 'áo-p **ke** tará-s-à kè #ái #áo
 man-3.sg.m C woman-3.sg.f-Case RmPast call want
 ("the man wanted to call the woman")
- c. 'áo-p **ke** tará-s-à kè !xóé kái
 man-3.sg.m C woman-3.sg.f-Case RmPast run make
 ("the man made the woman run")

These sentences contain verbal structures that have all the properties of sentences discussed earlier. In particular, the verbs of ability (e.g. //xáa), volition (e.g. #áo) and causation (e.g. kái) have properties that are similar to those of perfective auxiliary verbs and therefore provide strong supporting evidence for the position that verb raising is operative in these constructions. In all these cases the complement verb is merged with the matrix verb. And precisely as in the case of auxiliary verbs of aspect, the complex verb resulting from verb raising will cyclically merge with Tense. However, PF-condition (20) will block expression of the T-adjoined verbal complex in its highest syntactic position. Only the lower copy can be expressed to satisfy the PF-interface condition.

There is interesting further evidence that verb raising occurs in Khoisan languages apart from Khoekhoe. Let us briefly discuss !Kung (!Xũ), a Northern Khoisan language. !Kung is a strict VO language with one curious exception. Whenever there is an adverb of a specific kind that need not concern us here, !Kung syntax licenses the exceptional word order "Adverb-O-V" in addition to "V-Adverb-O."⁸

- (30)a. !ae-kx'ao !hũ |ao
 hunter kill buffalo
 ("the hunter kills the buffalo")

b. !ae-kx'ao !hũ n||a-wa |ao (cf. **S V-T O S V O**)
 hunter kill adverb-prt buffalo
 ("the hunter kills the buffalo X-ly")

c. !ae-kx'ao n||a |ao !hũ (cf. **S V-T O S V O**)
 hunter adverb buffalo kill
 ("the hunter kills the buffalo X-ly")

Let us assume that the adverbial really is a tense element. The light verb complex agrees with the object, valuing its case feature, and forces movement of the object to its specifier position. This gives us the partial structure illustrated in (31).

- (31)a. S V-v O => O S V-v
 b. T O S V-v => V-v T O S => S V-v T O
 c. T O S V-v => S T O V-v

The verbal complex raises to T optionally. In older versions of the minimalist program we would attribute an optionally "strong" feature to T. Here we assume that the verb moves if the adverb has properties that makes it move. The inflectional suffix *-wa*, indicating compound morphology, is such a factor. In the absence of such a factor, V does not raise and we derive OV word order. (Free ordering of Merge and Transfer may give an alternative explanation: overt movement (30b) resulting from ordering Merge before Transfer, and covert movement (30c) resulting from the reversed order). In fact, the following !Kung sentence with a modal element provides further corroborating evidence.

(32) ha re |wa sì gumi ts' ao
 he Q not must cow milk
 ("mustn't he milk the cow ")

Conclusion. We have seen that Khoekhoe provides interesting evidence for the position that the operations of the computational module can be restricted to cyclic, compositional and recursive applications of Merge, both internal and external. External interface conditions, in particular the PF-condition that particles at the edge of strong phases can not be phonologically interpreted, will force the external rule Delete to apply to the higher rather than the lower copy in these cases. We therefore can preserve strong autonomy and hold on to the strong minimalist position that syntax is the perfect recursive linking of the interfaces (phonology and semantics feeding the sensory-motor and thought systems respectively).

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Notes

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¹ Cf. Huybregts (1998) and Washburn (2001)

² We heavily borrow from Hagman (1977) for the facts of Nama Hottentot (or Khoekhoe, the term preferred nowadays). Hagman (1977) states that sentences with sentence-final tense particles are “awkward” (though acceptable). We interpret this preference for tense movement as the optimal way of phonologically interpreting chains created by Move.

³ See Chomsky (2000, 2001a) for a discussion of *PIC*

⁴ V T AUX

⁵ Cf. Haacke (xxxx), and Hagman (1977)

⁶ See Chomsky (2001b, 2002)

⁷ See Bobaljik (1995) and Richards (1997) for (alternative) proposals and discussion of ways of expressing copies of moved elements.

⁸ Cf. Snyman (1970)