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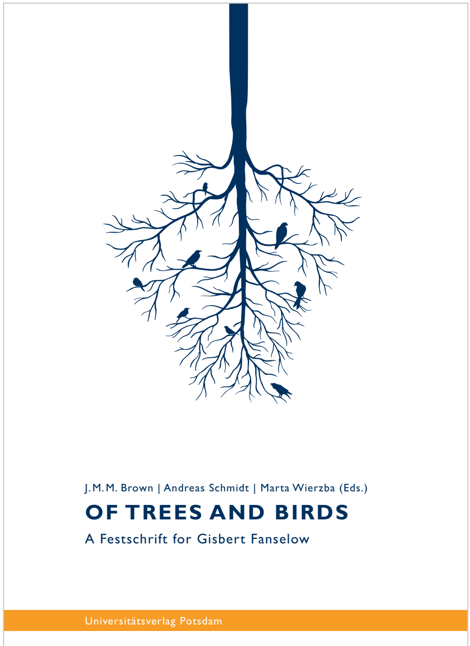

Intermediate reflexes of movement: A problem for TAG?

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1 Introduction

A major topic in syntax has been the nature and modeling of non-local (i.e. cross-clausal) dependencies. Unsurprisingly, this is also a topic that Gisbert Fanselow has always had a strong interest in, both from an empirical as well as a formal perspective, in particular with respect to long-distance wh-movement in German. Consider the examples in (1) ((1b) is taken from Fanselow & Mahajan 2000: 219, see also Fanselow 2006):

(1) a. What do you think that the kingfisher saw last night in Potsdam?

b. Wen denkst du wen sie meint wen Harald liebt?
who think you who she believes who Harald loves
'Who do you think that she believes that Harald loves?'

The wh-pronoun *wen/what* that occurs at the beginning of the matrix clauses is interpreted as the object of the verbs *saw* and *love*, respectively, but these verbs are part of embedded clauses. The dependency between the thematic position of *wen/what* and its surface position is thus non-local. Since the 1970s, more and more empirical evidence has been accumulated for the hypothesis that such seemingly non-local dependencies are in fact the result of a sequence of smaller step (Chomsky 1973), i.e. a moving wh-XP makes intermediate stop-overs on the way to its terminal landing site. The empirical evidence for this hypothesis comes from 'visible traces' of these hypothetical intermediate movement steps, also called reflexes of movement. These are morphosyntactic/phonological changes in the embedded clauses along the path of movement, as well as reconstruction effects into intermediate landing sites or spell-out of (parts of) intermediate copies. In fact, (1b) instantiates the latter type of reflex: The wh-pronoun *wen* is not only pronounced in its terminal position but also in lower (underscored) positions that do not constitute its thematic position. The common interpretation (in GB/Minimalist syntax) is that this pattern arises because the copies of *wen* in intermediate landing sites can also be phonologically realized (in some contexts in some languages), see a.o. Fanselow & Mahajan (2000), Felser (2004) on German wh-copying. Which positions constitute intermediate landing sites is still debated, but most syntacticians nowadays agree on SpecC and Specv (see Abels 2012, van Urk 2018 for discussion and recent overviews of the debate).

Taking into account the vast literature on reflexes of movement that has been published since the 1970s, we can establish a typology of reflexes (see a.o. Lahne 2008, Abels 2012, Zentz 2013, Georgi 2014, van Urk 2015, van Urk 2018): There are (a) reflexes that occur on the heads of the phrases through whose specifier the wh-element has passed (taken to be the result of agreement between the head H and the XP moving through SpecH), and (b) reflexes in intermediate landing sites. Spell-out of (parts of) intermediate copies as in (1b) would be an instance of (b) (see van Urk 2015: ch.6 on copy spell-out); so are semantic reflexes where a moved XP is interpreted in an intermediate landing sites (examples will be provided below). The (a) pattern is illustrated with data from Irish wh-movement in (2):

(2) *go/aL-alternation in Irish (McCloskey 1979: 54, McCloskey 2001: 67)*:

a. Deir said **gu**-r ghoid na síogaí í
   say they *go*-PST stole the fairies her
   'They say that the fairies stole her away.' *declarative*

b. [$_{CP_1}$ [cén t-úrscéal]$_1$ **a** mheas mé [$_{CP_2}$ **a** dúirt sé
   which novel *aL* thought I *aL* said he
   [$_{CP_3}$ **a** thuig sé ___$_1$]]]
   aL understood he
   'Which novel did I think he said he understood?'
   long wh-movement

In Irish, the default form of the declarative complementizer (C) is *go*, see (2a); if, however, C is crossed by Ā-movement, it obligatorily changes to a form glossed as *aL*, see (2b). Crucially, under long-distance movement, this change to *aL* happens in each clause of the dependency, also in those CPs where the moving XP does not have its terminal landing site (see CP_2 and CP_3 in (2b)). The standard analysis for this pattern is that the wh-XP makes stop-overs in each SpecC position on the way to its terminal position, and the form of C reflects this intermediate movement step (either due to agreement with the moving XP or due to C's feature content that enables an intermediate movement step of the wh-XP, see McCloskey 2002 for discussion of the Irish data). Languages with reflexes on heads differ in the distribution of reflexes across clauses. Next to the Irish pattern where (i) each CP along the movement path exhibits the reflex, there are also languages in which (ii) only the clause that hosts the terminal landing site of the wh-XP shows the reflex (CP_1 in (2b)), (iii) the reflex only surfaces in clauses that are crossed by movement but do not host the terminal landing site (CP_2 and CP_3 in (2b)), and (iv) only the clause in which the wh-XP originates contains the reflex (CP_3 in (2b)); see Georgi (2014, 2017) for examples and a discussion of analyses of these patterns.

Given our knowledge of the various types of reflexes of movement in the languages of the world, we can use the patterns to differentiate between various approaches to long-distance displacement dependencies. The question is which of the existing approaches can capture all attested reflex patterns and excludes the non-attested patterns. Van Urk (2018) takes up this question and compares the slash feature percolation approach as pursued in HPSG (where each projection between the base and the terminal position of a moving XP is affected by percolation) with Minimalist movement approaches that postulate either feature-driven or non-feature-driven intermediate movement steps to certain positions. Van Urk concludes that the approach that postulates feature-driven intermediate movement to SpecC and Specv best captures the attested variation. In this paper, I will extend van Urk's work by investigating another influential approach to long displacement dependencies that he did not consider: Tree Adjoining Grammar (TAG). I will first provide a brief introduction of TAG, focusing especially on how long-distance dependencies are treated in this formalism. This overview will make it clear that reflexes of movement in intermediate positions are potentially problematic for TAG. I will then go through some reflex patterns and discuss whether and how they could be accounted for in TAG, and why some of the previous proposals that try to cover these challenging patterns in TAG cannot be upheld. I conclude that at least the reflex patterns that involve spell-out of / reconstruction into intermediate landing sites remain a challenge for TAG.

2 Long dependencies in TAG

Tree Adjoining Grammar (TAG) is a grammar formalism first presented in Joshi et al. (1975) and further developed mainly at UPenn in the subsequent decades. The following description of its basic properties (especially those relevant for the modeling of long-distance dependencies) is based on Kroch & Joshi (1985), Kroch (1987), Frank & Kroch (1995), Frank (2002); see these references for further details and applications of the formalism. Rather than expanding a single phrase marker by recursively (and potentially infinitely) adding elements to its root node (as in current Minimalism), TAG assumes a finite basic set of *elementary tree*s (ETs) that are combined with each other to form more complex structures; in this respect, TAG is similar to Chomsky's (1957) generalized transformations. ETs represent (maximally) a single clause, i.e. a CP. Following Frank (2002), I take these CPs to be built by the basic operations postulated in Minimalism (but nothing hinges on this), including Merge, which combines two elements to form a new constituent. Crucially, all basic operations in TAG are confined to ETs, i.e. there are no cross-clausal dependencies in TAG (= *the fundamental TAG hypothesis*). In order to account for the various seemingly long-distance dependencies in natural language such as long wh-movement as in (1), TAG provides the operation Adjoin that connects ETs. In particular, Adjoin inserts a special class of ETs, the *auxiliary trees* (ATs), into non-auxilary ETs (also called *initial trees* (IT)) by "splitting up" the IT. ATs have the property of being recursive in the sense that their root node must be identical to one of its terminal nodes. ITs are ETs that do not have this property. An AT that is recursive on the node N rewrites (viz. is inserted into) the corresponding node N in an IT. The example in (1) is derived as follows (ignoring the adjuncts):

(3) a. step1: building the IT, wh-movement of the wh-subject to the minimal SpecC:
ET: [$_{CP}$ What$_1$ [$\boxed{_{C'}}$ that the kingfisher saw _$_1$]]

b. step2: creating the AT that is recursive on C′:
[$_{\mathbf{C'}}$ *do you* [$_{VP}$ *think* **C′**]]

c. step3: Adjoining AT to IT at $\boxed{C'}$:
[$_{CP}$ What [$_{\mathbf{C'}}$ *do you* [$_{VP}$ *think* [$_{\mathbf{C'}}$ that the kingfisher saw _$_1$]]]]

Thus, wh-movement to SpecC is clause-bound, it takes place in the IT in (3a) but cannot leave it. The impression that is has moved out of the IT is created by adjoining the AT in (3b) to IT's C′-node, see (3c). The C′-node is thus split up by the AT. As a result, the wh-element is further away from the rest (viz. the TP-material) of its IT than before, but it never moved out of the IT. Long-distance dependencies are thus *an illusion* in TAG, created by Adjoining trees to other trees. In even more complex dependencies that span more than one clause-boundary, as in (4a), there are two ATs recursive on C′, see (4c). Importantly, in order to derive (4a) the two ATs are first combined with each other before the newly created complex AT is adjoined to and thus expands the IT at C′ (Frank 2002: 179), see (4d).

(4) a. What did Gisbert say that you think that the kingfisher saw (last night is Potsdam)?

b. IT: [$_{CP}$ What$_1$ [$\boxed{_{C'}}$ that the kingfisher saw _$_1$]]

c. ATs: (α) [$_{C'}$ did Gisbert [$_{VP}$ say C′]],
(β) [$_{C'}$ that you [$_{VP}$ think C′]]

d. order of operations: (i) AT(α) adjoins to AT(β); (ii) the result of (i) adjoins to $\boxed{C'}$ of the IT

In fact, the alternative view on apparent long-distance dependencies in TAG derives a number of properties of such dependencies, e.g. (some) island phenomena. What I will concentrate on in this paper, however, is TAG's potential to deal with reflexes of movement in intermediate positions. It is crucial to note that since there is no cross-clausal movement in TAG, there is also nothing like successive-cyclic movement from one CP into another. The AT that adjoins to an IT is never affected by operations that take place inside the IT. There are no intermediate movement steps into a higher clause. In this respect "long" dependencies in TAG are fundamentally different from the GB/Minimalist analysis of long movement, where the wh-element moves out of the minimal CP and makes stop-overs in the specifier of (at least) every intervening CP on its way to the terminal landing site. The obvious question is thus how intermediate reflexes of movement can be handled in TAG if all syntactic dependencies are strictly clause-bound and never affect higher clauses. In the following section, I discuss challenges and possibilities for modeling some reflexes of movement in TAG.

3 Reflexes of movement in TAG

I will address reflexes of movement on heads first, as illustrated for Irish in (2). Since there cannot be agreement with the moving XP in an intermediate landing site in TAG, languages that exhibit reflexes on heads in clauses in which the XP does not have its terminal landing site are potentially problematic. This does not only hold for languages with the Irish pattern, but also for those mentioned in section 2 in which the reflex only occurs in clauses crossed by movement (but not in the clause that hosts the terminal landing site). Similarly, it is not immediately obvious how TAG accounts for languages that exhibit a reflex of movement only in the clause in which the moved XP has its terminal landing site; this would be Irish′ where the special form of the complementizer only occurs in CP_1, as is the case e.g. in Chamorro (Chung 1998). There are ways to handle the Chamorro pattern in TAG without violating the fundamental TAG hypothesis as long as the reflex occurs on the C-head: The wh-XP moves to SpecC within the IT and agrees with C from this position (Spec-head Agree); if we assume that C's features percolate to C′ (which seems reasonable), they are present on the node that is later "split up" by Adjoin. Thus, when the AT adjoins to C′ of IT, it is possible either to retain the feature of C′ (percolated from C) at the upper part of the split C′, or to have a copy of the feature on C′ present on each subpart of the split C′ node. In either way, the agreement features of the wh-XP would end up on the C′ node of the matrix clause. If we allow them to percolate or to be handed down to C (in syntax or in a postsyntactic morphological component), we get the desired pattern with the reflex of movement occurring only in the clause where the wh-XP surfaces. More challenging are languages like Duala (Epée 1975): the reflex also occurs only in the clause where the wh-XP has its terminal landing site, but it surfaces on a lower head than C, viz. in the TP-domain. If the T-head agrees with the wh-XP inside the IT and then an AT is adjoined to C′ of that IT, the agreement features of the wh-XP should end up in the lower clause of the dependency, not in the highest one where we see them. Technically, we could say that these reflexes are derived in TAG similar to the one Chamorro: Agreement actually happens between the wh-XP in IT's SpecC position and the C-head + percolation of this information to C′. Later, after Adjoin took place, the information is handed down from the C′-node that ends up in the matrix clause even further down, viz. to the T-domain. Something like this seems necessary anyway because the reflex of movement that shows up lower than in the CP-domain of the terminal clause of the dependency (as in Duala), is never triggered by A-movement (targeting SpecT). Thus, it is obviously triggered by wh-movement to SpecC. Hence, there are ways to handle reflexes on heads that only occur in the highest clause of the dependency in TAG. What is, in fact, expected in TAG are languages with the opposite pattern, viz. languages in which the reflex of occurs only in the clause in which the wh-XP originates, as e.g. in French in (5) where participle agreement (in gender and number) with the preposed object DP of the verb 'repaint' can only occur in the clause in which this DP has its θ-position:

(5)

$[_{CP}$	[Quelles	chaises	$]_1$	as-tu	dit	/	*dit-es	
	which.FEM.PL	chairs(FEM.PL)		have-you	said	/	said-FEM.PL	

$[_{CP}$	qu'	il	a	*repeint	/	repeint-**es**	$\_\_\__1$	]]
	that	he	has	repainted	/	repainted-FEM.PL		

'Which chairs did you say that he repainted?' Branigan (1992)

This follows if the participle / v head in the IT 'Which chairs that he repainted?' agrees with the wh-XP (either in-situ or after movement); after Adjoin of the AT 'did you say that' to IT's C′-node took place, the v-head that agreed with the object is in the lower clause of the dependency – the only position of IT that ends up in the matrix clause is SpecC (and potentially a part of C′, see the discussion above). Interestingly, this French type of reflex is rather challenging for the GB/Minimalist view of reflexes of movement (see Georgi 2014: sec. 4.3 for discussion). Thus, reflexes on heads that occur either only in the top-most or only in the lowest clause of a long dependency can be handled more or less straightforwardly in TAG. What remains is the question how reflexes in intermediate clauses can be accounted for (viz. reflexes in C_2 and C_3 as in Irish in (2)). The aforementioned mechanisms are not sufficient to derive reflexes in these positions. Zentz (2013) discusses this issue for Kinande, another language in which reflexes of movement occur on heads in intermediate clauses. In Kinande, the complementizer exhibits agreement in noun class with an Ā-moved XP, and this is possible in every clause of the dependency (see the C-head *kyo* agreeing in class 7 with the wh-XP in (6), Schneider-Zioga 2009: 47).

(6)

$[_{CP_1}$	ekihi	**kyo**	Kambale	asi	$[_{CP_2}$	nga	**kyo**	Yosefu
	7.what	7.WH	1.Kambale	1.know		if	7.WH	1.Yosefu

akalengekanaya	$[_{CP_3}$	**kyo**	Maty	akahuka	]]]
1.thinks		if	1.Marya	1.cooks	

'What did Kambale know that Yosefu thinks that Mary is cooking (for dinner)?'

Zentz, following ideas in Frank (1992, 2002), proposes a feature-percolation / matching algorithm to account for such reflexes: As postulated above, the wh-XP moves to SpecC of the IT and agrees with the C-head in a Spec-head-configuration; these features also percolate to C′ of the IT. As a consequence, the C′-node that will be 'split' by Adjoin bears the relevant features of the wh-XP. By assumption, the features of the C′-nodes of the AT that is adjoined to the IT's C′-node must match. Thus, only an AT that also bears class information on its C′-root node (projected from C^0) can adjoin to the IT with a wh-XP in SpecC in Kinande. The features on C′ of the AT cannot be the result of agreement with the wh-XP, of course (the wh-XP is not present in the AT); rather, they can be added freely in the AT. However, Adjoin will only be successful if the features of the C′-nodes in the IT and the AT match. To summarize, if we assume feature percolation and matching requirements on Adjoin, it is possible to derive all attested patterns of movement reflexes on heads in TAG without violating the fundamental TAG hypothesis (all operations are strictly clause-bound). Let me briefly discuss an older proposal for how to capture intermediate reflexes on heads from the literature: Kroch & Joshi (1985) discuss how stylistic inversion (SI) in French can be analyzed in TAG. SI involves (optional) inversion of the subject and the finite verb of a clause. In a nutshell, it applies in clauses along the path of Ā-movement (see Kayne & Pollock 1978 for details); in (7) SI occurs in the matrix and the embedded clause (inverted elements are underlined):

(7) [$_{PP}$ Avec qui]$_1$ *a* *prétendu* *Marie* [$_{CP}$ *que* sortirait
with whom has claimed Marie that would.leave
Jean __$_1$]]?
Jean
'With whom did Marie claim that Jean would leave?'
(Kayne & Pollock 1978: 604)

Kroch & Joshi (1985: 81) state that "[...] French must contain a constraint that makes the appearance of an inverted subject dependent on the appearance of a wh- in the COMP of the same simplex sentence." However, in the TAG-formalism the wh-element *qui* (pied-piping the preposition *avec*) has never been in COMP (=SpecC) of the embedded clause at any stage of the derivation. The elements in italics in (7) constitute the AT that is adjoined to C′ of the IT. So how can SI be triggered in embedded clauses of long Ā-dependencies in TAG? Kroch and Joshi propose the following solution: Inversion is possible in ATs (but not enforced); in addition, there is a constraint "imposed on the adjoining of an inverted auxiliary tree to an initial tree. If the initial tree contains a fronted wh-, the inverted auxiliary tree will be adjoinable to the right of the wh-COMP. Otherwise, it will not be." In other words, while inversion is freely available in ATs, it must be licensed by the presence of a wh-element in the local COMP via adjoining; if the context for inversion is not met within the AT, it must be met after adjoining the AT to the IT. Indeed, this is the case in (7): The inversion in the AT is licensed by the fact that after adjoining there is a wh-element in the now local c-commanding SpecC. If we adopt such constraints on well-formedness and the condition that they can also be met in the output structure, examples as in (7) with a reflex of movement in an embedded clause of a long Ā-dependency can indeed be modeled in TAG. However, this is not the end of the story. Long-distance dependencies can span several clauses, not just two as in (7). If there is just one more level of embedding, SI can apply in the most deeply embedded CP, see (8) (Kayne & Pollock 1978: 606; SI may or may not apply to higher clauses as well, but this is irrelevant here):[1]

(8)

$[_{CP}$	Les	filles	$[_{CP}$	[avec	qui	$]_1$	tu	disais	$[_{CP}$ que
	the	girls		with	whom		you	say.PST	that

prétendait	cette	pauvre	femme	$[_{CP}$	que	sortirait	son
claimed	this	poor	woman		that	would.go.out	her

mari	$\_\_{}_1$	]]]	sont	toutes	là	]
husband			are	all	here	

Recall that in order to derive such an example, the two ATs that correspond to the strings *tu disais que* (AT1) and *prétendait cette pauvre femme que* (AT2) must first be combined before the resulting structure is adjoined to the C′-node of the IT *avec qui sortirait son mari* (which is itself combined with another tree representing the matrix clause). In

1. Kayne and Pollock argue that the somewhat degraded grammaticality of (8) is not due to the application of SI in CP3, because the example improves once the subject of this CP is made "heavier" and undergoes extraposition.

this derivation, the most deeply embedded AT2 (= CP3) exhibits SI, but it is not licensed by Kroch and Joshi's condition on well-formedness of SI: It is not licensed by a wh-element (here, a relative operator) in the local SpecC when it first combines with AT1 since there is no such element in AT1; it is also not licensed by the relative operator in the IT after adjoining [AT1+AT2] to the IT: though there is such an element in COMP of the IT, it is not local to AT2 (the more deeply embedded of the two ATs). The relation between elements in AT2 and the material inside the IT (above C′) would be non-local and thus impossible to state in TAG. The only way to circumvent this problem would be to first adjoin AT2 to IT, and then to adjoin AT1 to [IT+AT2]. After the first step, AT2 is local to the operator in COMP of IT and SI is thus licensed; SI is also well-formed in AT1 since it is also local to the same COMP after adjoing to IT + AT2. However, such a derivation is explicitly excluded in TAG. Thus, Kroch and Joshi's analysis of this reflex of movement cannot be a generally viable solution to reflexes of movement in intermediate clauses of long Ā-dependencies. A feature percolation/matching algorithm along the lines of Zentz (2013) may provide the required mechanism, though. See also Frank (2002: ch.4) and Frank (2006: sec.5) on a similar feature percolation-based TAG-conform analysis of (apparant) long-distance agreement.

Now that we know how TAG can handle (intermediate) reflexes of movement on heads, I turn to reflexes in intermediate positions (XP positions). These involve scope reconstruction to intermediate positions and copy spell-out. Scope reconstruction in TAG is discussed in Frank & Kroch (1995: 15, fn.12). Consider the raising-to-subject example in (9), which is ambiguous:

(9) [$_{\text{TP}}$ A unicorn [$_{\text{T}'}$ T [$_{\text{VP}}$ *seems* [$_{\text{T}'}$ to be in the garden]]]]

The existential can have wide scope or narrow scope with respect to *seem*. The IT of the sentence is *A unicorn to be in the garden*; the AT *seem* (recursive on T′) is adjoined to the IT's T′-node. The wide scope reading follows since the existential in its derived position SpecT in the IT scopes over T′ of the IT, and this is the position to which the AT, containing *seem*, is adjoined. Low scope is derived if the subject starts out inside the VP (or vP) in the IT and then moves to SpecT: In the combined IT+AT, *seem* scopes over the trace of the existential inside the VP (which is part of the IT). Thus, the relevant scope can be reduced to two distinct positions of the existential in the IT — one is below the adjoining site and the other is above it, no non-local dependencies across IT/AT-boundary need to be postulated.[2] However, this analysis cannot cover all cases of reconstruction. Again, the approach breaks down once we consider more levels of embedding, e.g. as in (10), where the subject raises across two TP-boundaries:

(10) *Evidence for successive-cyclic A-movement (Castillo et al. 1999: 93)*:
[$_{\text{TP}_1}$ [John$_i$]$_1$ seems to Mary$_j$ [$_{\text{TP}_2}$ to appear to himself$_i$ [$_{\text{TP}_3}$ __$_1$ to be happy.]]]

Castillo et al. (1999) note that in this sentence the reflexive pronoun can be bound by *John*. However, *John* and the reflexive are not in the required structural condition to fulfill Principle A, neither when we consider *John* in its surface position (to far away from the anaphor, intervenor *Mary* should block binding), nor in its base position inside the most deeply embedded TP$_3$. According to Castillo et al., the only way to account for this binding possibility is to postulate an intermediate landing site of the raising subject *John* in SpecT$_2$. Thus, they take (10a) to provide evidence for successive-cyclic A-movement through every SpecT. As with SI in French, we thus have a reflex of movement in an intermediate clause, and the same problem arises: Unlike in (10), the attested scope of *John* cannot be attributed to the two positions *John* has in the IT *John*$_1$ *to be* __$_1$ *happy*: The upper one in SpecT corresponds to its surface position in (10a) (after adjoining of the two ATs *seems to Mary* and *to appear to himself* that are recursive on T′); the lower vP-internal one corresponds to its base position. But none corresponds to the inter-

2. Simple (IT) clauses with two quantifiers as in (i) also exhibit scope ambiguitiy.

(i) Some man loves every woman. $\forall \succ \exists, \exists \succ \forall$

Here, the two position of the existential (VP-internal and SpecT) are not sufficient to derive the ambiguity. But this kind of scope ambiguity can be derived by quantifier raising (QR) of the Q-XPs at LF. Since QR is clause-bound, QR-movement would in principle be compatible with TAG, it is a local, i.e. IT-bound operation.

mediate position at the edge of TP_2 that we need to get the binding facts in (10); *John* never moves into or establishes any relations with elements in the ATs.

The same abstract configuration — and thus the same problem for TAG — arises with reconstruction in Ā-dependencies that span more than two clauses. In the famous pit-stop reflexive configuration from Barss (1986), see (11), a reflexive contained in an Ā-moved XP cannot only be bound by the subject of the lowest clause CP_1 in which the XP has its base position, but also by the subject of CP_2:

(11) *Evidence for successive-cyclic Ā-movement: pit-stop reflexives (Barss 1986: 25)*:
[$_{CP_1}$ [$_{DP}$ Which pictures of himself$_i$]$_1$ did John$_i$ think [$_{CP_2}$ ___$_1$ Fred liked ___$_1$]]

This example is derived in TAG by adjoining the C′-recursive AT *did John think (that)* to the IT *[$_{CP}$ [Which picture of himself]$_1$ [$_{C'}$ Fred liked __$_1$]]*. As with the long raising cases, the anaphor is bound by *John* neither in its base position in the IT, nor by its surface position in SpecC (there is a clause boundary between *John* and the anaphor that blocks binding). Frank & Kroch (1995) propose to solve this problem by claiming that binding by the matrix subject (here: *John*) is not the result of successive-cyclic movement of the wh-phrase through SpecC of the embedded clause, but rather comes about "by allowing a subject to bind into an element in [spec,cp] of its own clause, following Reinhart (1981)". This works for an example like (11), but again, problems may arise when we consider more levels of embedding:

(12) [$_{CP_1}$ [$_{DP}$ Which picture of himself$_i$]$_1$ did Peter believe [$_{CP_2}$ that John$_i$ thinks [$_{CP_3}$ Fred liked ___$_1$]]]

To the extent that *John* in (12) can still bind the anaphor in the fronted wh-XP, Frank & Kroch's (1995) solution does not work anymore, because the wh-XP that includes the reflexive is not contained in the same clause (CP) as *John*.[3] A similar problem arises for reflexes of movement

3. My native speaker informants have different opinions on this binding option, though.

that involve the spell-out of (parts of) intermediate copies as in example (1). Since there are no copies of moved XPs in intermediate clauses (corresponding to ATs) in TAG, spell-out of multiple copies is not an option in this framework. Given the solutions proposed for intermediate reflexes on heads outlined above, a way out would be to copy all features of the wh-XP to C' in the IT and to freely add them to C' in ATs; in addition, there must be a matching requirement for features on nodes targeted by Adjoin. In this way, ATs could be forced to bear features of wh-XPs. However, there is no XP position (SpecC) in the ATs that these features could be realized in. New XP positions would have to be created in the ATs counter-cyclically; and copying would have to involve the entire feature structure of the wh-XP present in the IT — this is not what well-known copying operations like agreement do, they only copy a small subset of features (e.g. phi-features) from one node to another. The copy mechanism that is needed here rather resembles total reduplication in morphology. But reduplication is a local process, while it would need to skip quite a lot of structure to create copies as in (1). Even if we can find a technical way of achieving doubling of the moved XP in ITs, the general question remains why this process (as well as the feature percolation mechanism discussed above) should apply. In HPSG and GB/Minimalism, the answer is clear: stop-overs / smaller steps, indicated by (intermediate) reflexes, apply for reasons of locality. But in TAG, where all operations are local (clause-bound) by definition, it is not obvious why a doubling of information across ETs is necessary in the first place. What do reflexes of movement encode instead, why are they useful? Imposing matching conditions on nodes that are subject to Adjoin (and thus 'shared' between ETs) is a technical possibility — there are a number of matching requirements in natural language; but why double information beyond those nodes that are the interfaces between elementary trees? I do not see any motivation for this in the TAG formalism.

More empirical work is needed to find out whether the binding indicated in (12) is indeed robustly available for speakers; if it is not, Frank and Kroch's analysis is sufficient.

4 Conclusion

In this paper, I have investigated how TAG, a formalism in which all operations are clause-bound, deals with reflexes of movement in intermediate positions, i.e. visible 'traces' of (seemingly) cross-clausal dependencies in between the base position and the landing site of a displaced XP. In HPSG or GB/Minimalism, these reflexes are taken to indicate smaller steps that are chained together to create a long dependency. Since there are no intermediate movement steps in TAG, these reflexes cannot be assumed to indicate intermediate stop-overs. I have shown that reflexes on intermediate heads can be accounted for if feature percolation and feature matching requirements are assumed, as proposed in the TAG-literature. Reflexes in intermediate XP positions (scope reconstruction, copy spell-out) are more challenging since the additional feature percolation mechanisms are not sufficient to describe these phenomena. The accounts proposed in the literature were shown to be untenable once more complex sentences are taken into account. The results thus corroborates van Urk's (2018) arguments for an approach that invokes true successive-cyclic transfer of information across clause-boundaries (as in approaches that postulate successive-cyclic movement). Similar problems for TAG also arise with other cross-clausal phenomena that are not addressed in this paper, e.g. raising to object, case switch, and case stacking. They are at least challenging for TAG, and it still needs to be shown whether and how they can be accounted for under the fundamental TAG hypothesis.

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