Parasitic Gaps and the Heterogeneity of Dependency Formation in STAG

Dennis Ryan Storoshenko
Department of Linguistics, Languages and Cultures
The University of Calgary
dstorosh@ucalgary.ca

Robert Frank
Department of Linguistics
Yale University
bob.frank@yale.edu

Abstract

This paper presents an account of parasitic gaps in Synchronous TAG, making use of the more flexible semantic derivations that derive from the proposal in Frank and Storoshenko (2012) to add separate scope components to all predicates. We model parasitic gaps as deriving from a TAG analog of sidewards movement (Nunes, 2004), where the licensing wh-phrase combines first with the domain containing the parasitic gap, which then combines with the main clause domain via tree-local multi-component combination. Such tree-local derivations are possible only because of the manipulations of scope available in the semantics. The phenomenon explored here not only shows the continued role of the syntax in constraining syntactic dependencies, but also demonstrates the potential for derivations which are syntactically well-formed, but are rendered impossible due to the improper binding of the parasitic gap variable.

1 Overt and Covert Dependencies in TAG

Frank and Storoshenko (2012) propose a new conception of the semantic side of a synchronous TAG. Following proposals beginning with Kallmeyer and Joshi (1999), where the representation of quantifiers in TAG consists of a multi-component set including both a scope component and a variable component, Frank and Storoshenko advocate a similar division for the trees headed by lexical predicates. Specifically, they propose that the semantics of each lexical head includes a predicate component, in which each of the predicate's arguments is saturated by a variable, and a scope component, in which each of the variables introduced in the predicate component is lambda bound and the operator is saturated by a substitution node. It is substitution into the scope component, then, which accomplishes the saturation of the arguments of the predicate. Examples of such representations for the transitive verb *criticize* and the preposition *at* are given in Figure 1.

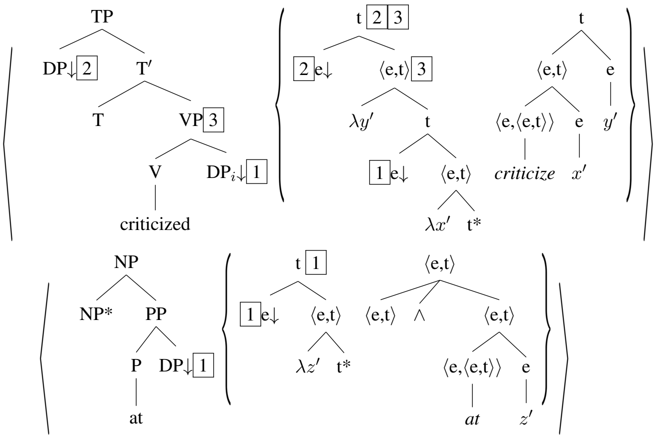

Figure 1: STAG elementary tree pairs following Frank and Storoshenko (2012).

The inclusion of a quantifier-like scope component in the elementary semantic object associated with a lexical predicate has a number of salutary consequences. It predicts, for instance, that lexical predicates can themselves introduce quantificational force over their arguments. We see this in cases of passivization, where the suppressed subject is existentially quantified. That such a subject must be present in the semantics is supported by its capacity to control into purpose clauses:

(1) The boat was sunk [PRO to collect the insurance]

In a number of languages, including ASL (Petronio, 1995), Gun-djeyhmi, and Warlpiri (Evans,

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1995), affixes on the verb can impose collective or distributive interpretations over certain arguments, suggesting the presence of a quantifier in the scope component that quantifies over that argument. In English, a similar phenomenon is found with "stubbornly distributive predicates": a plural subject of such a predicate must receive a distributive interpretation, so that (2) can only mean that each of the boxes is large, and not that the collection of boxes is large.

(2) The boxes are large.

Again, this interpretational requirement can be represented through the presence of a universal quantifier in the scope component of predicates like *large* which takes the semantics of the subject to delimit its domain of quantification.

What motivated Frank and Storoshenko to make this proposal, however, was the fact that the scope-predicate conception of semantic tree sets allows for tree-local MCTAG derivations of cases of scopal interpretations such as (3), in which the quantifier scopes out of an adjunct.

(3) Donald criticized three groups from every state. ($\forall > 3, 3 > \forall$)

Such examples had been taken by Nesson and Shieber (2008) to motivate the adoption of more powerful regimens of TAG derivation. Without the separate scope component, the tree local introduction of a quantifier *every state* into *from*'s elementary tree would leave the quantifier stranded inside of the modifier's semantics. With the revised representation, however, the quantifier can be tree-locally adjoined into the scope component. The two components of the preposition can then adjoin into the scope component of the quantifier *three groups*, with the location of the adjoining determining the relative scope of the two quantifiers. To complete the derivation, the two components of the object quantifier can adjoin into the scope component of *criticized*, which we assume will combine with its own predicate component.

Given the increased derivational flexibility offered by this new conception of semantic elementary trees, one might wonder whether it undermines previous work in TAG that derives locality in movement from constraints on how trees can combine. Starting with Kroch and Joshi (1985) and continuing to Frank (2002) and beyond, it has been argued that the impossibility of extraction from syntactic islands such as (4) derives from the nature of elementary trees coupled with the way in which TAG derivations proceed.

(4) *Which state did Donald criticize the man who was from t?

Roughly speaking, this example is blocked because there is no way for the wh-phrase *which state* to end up at the front of the clause if it is inserted into the elementary tree representing the relative clause of which it is an argument. Could the flexibility afforded by scope-predicate semantic trees somehow undermine these results?

An easy, but ultimately less than satisfying, response to this question asserts that such flexibility doesn't arise for overt syntactic movement because there is no compelling motivation for the split of syntactic elementary trees on par with that which has been proposed for semantic elementary trees. Yet, even if such a split were in fact desirable for the syntax, it turns out that examples like (4) would still be blocked. To derive (4) in a massively multi-component syntax, *which state* could be inserted into an upper component associated with the relative clause. At the next step in the derivation, where the relative clause is attached to the elementary tree associated with the nominal *man*, the lower component of the relative must attach directly to the lower component of the nominal, since that is its surface position. By tree-locality, this would force the higher component of the relative, containing the wh-phrase *which state*, into the DP structure as opposed to a putative higher component of the DP, leaving it unable to reach the left peripheral position of the clause. Similar arguments can be constructed for the other "strong islands" that have been shown to derive from the TAG derivation. In short, the creation of overt syntactic dependencies are more constrained than their covert counterparts because the fact that the derivation needs to produce the correct ordering of phonological material constrains the derivation to involve the lower components.

In the remainder of this paper, we will examine another class of syntactic dependencies, involving parasitic gaps, which have not be widely explored in the TAG literature (but cf. Frank (1991)). These gaps are interesting because while they are licensed by an overt syntactic dependency, the parasitic gap does not, we claim, involve the displacement of any element in the syntax (cf. Chomsky (1982)), and is instead modulated through dependencies formed on the semantic side of the derivation. As a result, parasitic gaps permit greater derivational flexibility than the dependencies found in usual cases of overt wh-movement.

2 Parasitic Gaps

Parasitic Gap (PG) constructions are broadly defined as a set of sentences in which one trace or gap left behind by an A′ extraction is only licit when another such gap exists in the sentence (Engdahl, 1983). An example of this appears in (5):

(5) **Which papers** did Bill file ___ without Carl reading $\_\_\__p$?

In this example, extraction from the object position of *file* is independently well-formed, though it is not possible to extract the object of *reading* in the adjunct clause on its own.

(6) *? **Which papers** did Bill file the grades without Carl reading $\_\_\__p$?

PGs can also occur inside infinitival adjuncts, as in (7), where the arguments of the matrix and adjunct clauses are identified.

(7) **Which papers** did Carl file ___ without reading $\_\_\__p$?

As has been widely discussed, PGs are able to be able to occur in other (strong) island contexts, such subject islands, so long as there is an additional, independently well-formed instance of extraction.

(8) a. **Which boy** did [Mary's talking to $\_\_\__p$] bother ___?

b. **What car** did [the attempt to repair $\_\_\__p$] ultimately break ___?

There are three main analytical puzzles posed by PGs. First, how does a single wh-phrase bind multiple gaps? Second, how is the appearance of the PG dependent on the occurrence of another? Finally, how does the existence of one well-formed filler-gap dependency license another one that crosses an island boundary. In the following sections, we present an analysis of PG constructions in STAG, that provides an solution to both of these puzzles. We demonstrate that the distribution of well-formed parasitic gaps is determinable by a combination of syntactic factors and constraints on the semantic derivation of the PG which are only made possible once the scope trees introduced in the previous section are used. In doing so, we also show that our analysis accounts for a number of previously observed properties of PGs.

3 An Analysis of PGs

Before proceeding with the analysis of PGs, we will first sketch our assumptions concerning the analysis of of wh-movement. The elementary tree sets required are given in Figure 2. We represent local *wh*-extraction in the matrix clause as a tree-internal movement on the syntax side. We assume a syntactic constraint on the moved substitution site at the specifier of CP requiring a *wh*-phrase. However, there is no semantic consequence associated with this movement: the semantic components of the matrix clause are as expected under the split scope tree analysis: arguments are substituted into a scope component that includes lambda operators that bind variables in the argument position of the predicate.[1] The semantic effect of *wh*-extraction derives from the tree set associated with the wh-phrase, which has the same basic form as a generalized quantifier. For the proper names, we are using simple type e intepretations in the interests of space, though nothing crucially hinges on avoiding a GQ analysis of these nominals as well. To derive a simple case of clause-bound wh-movement, such as *Which papers did Bill file?*, on the syntax side of the derivation, the DP *Bill* will substitute into the specifier of TP subject position, and the wh-phrase *which papers* will substitute into the specifier of CP. The semantic side will proceed as is standard for sentences involving quantifiers: the wh-phrase's tree set will substitute and adjoin into the scope component of the *file* set, while the e-type tree associated with *Bill* will substitute into the higher substitution site. This will yield a two part derived tree set, which combines together at the conclusion of the derivation.

To derive a PG-containing sentence, such as (5), we will make use of a synchronous multi-component tree set for the adjunct clause shown on the bottom of Figure 2. This tree set has two complications relative to the split-scope adjunct represented shown above in Figure 1. On the syntax side, because this sentence involves extraction, the object position of the verb in the adjunct clause is filled by a trace. However, because the antecedent for this trace is not within this elementary tree, we represent the antecedent via a "degenerate" DP tree, into which the filler of this gap will ultimately

[1]Note that the VP-adjoined adverbial modifier is constrained via link [3] to take a scope position above the abstractor for the object, but below the subject. We return to the reason for this assumption below.

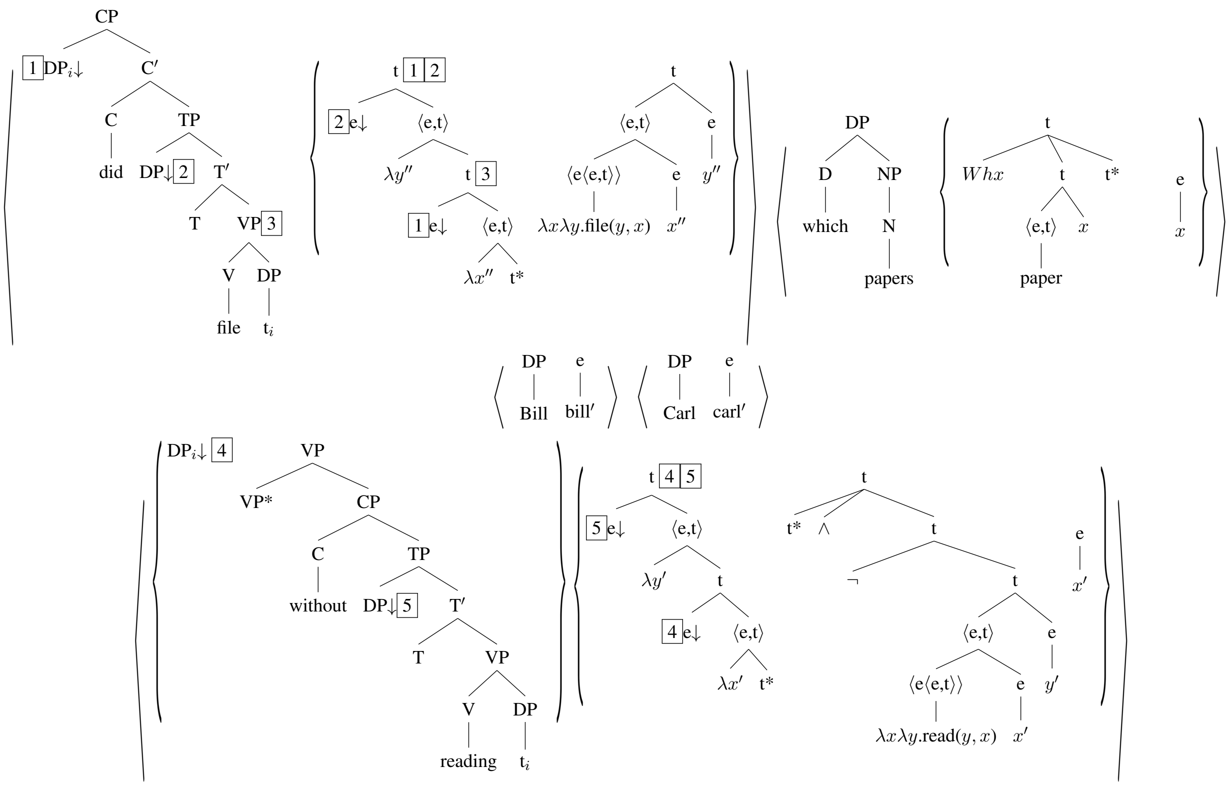

Figure 2: Elementary trees for (5)

substitute. On the semantic side, we follow the assumption made in the previous paragraph concerning the semantics of wh-movement, namely that it is not encoded in the tree of the predicate taking the wh-argument. In this case, however, the antecedent of the gap is not present in the same syntactic elementary tree, and consequently is not syntactically local. We take this to be an indication that this extraction can only be licensed in the context of another licensing gap. We encode that requirement semantically, by introducing an additional e-type variable in the semantic tree set, which will need to combine in the same domain as the adjunct.

To derive (5), we follow an analysis that is reminiscent of the sideward movement analysis in Hornstein and Nunes (2002) and Nunes (2004). Under this analysis, the *wh*-phrase originates in the adjunct (island) clause, moves to the argument position of the matrix predicate, and then on to the canonical position for wh-phrases, specifier of CP. This analysis directly accounts for the first of the PG puzzles mentioned above: a single wh-phrase can bind multiple gaps, since that phrase moves through both gap positions. Under the TAG version of this idea, we begin by combining the *without reading* adjunct tree set with both of its arguments: the *Carl* DP, which substitutes into the subject position, and the wh-phrase *which papers*, which substitutes into the degenerate DP component. In the semantics, the unique e component of *Carl* will substitute into the higher substitution site of the scope tree; the components of the *wh*-phrase will combine tree-locally into the same adjunct scope tree, the scope component adjoining to the root of the adjunct's scope tree, and the e component substituting into the lower substitution position. The derived tree set is shown in Figure 3.

This derived MCS now combines tree-locally with the matrix predicate's elementary tree, not only modifying the predicate, but also filling the argument position of the moved DP in the syntax, and saturating its e-type substitution node in the semantics. This semantic combination is fully tree-local with all components of the adjunct combining into the scope tree for the matrix predicate, bringing along the binder of the *wh*-variable. Following the constraint that the two t-recursive components of the adjunct MCS must combine at the interior t node of the matrix clause scope tree, there is only one possible result where all variables are properly bound, shown in Figure 4.

As noted above, our analysis is similar to the sideward movement analysis in Minimalism, treat-

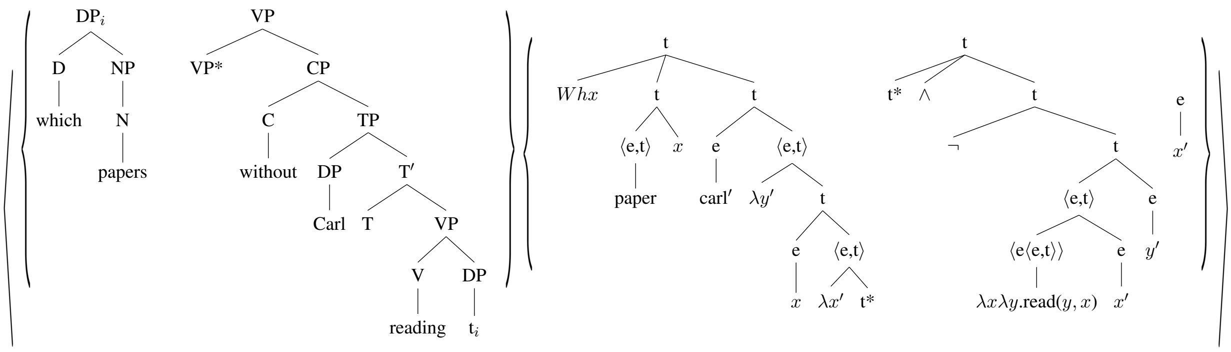

Figure 3: Derived tree set for adjunct clause in (5)

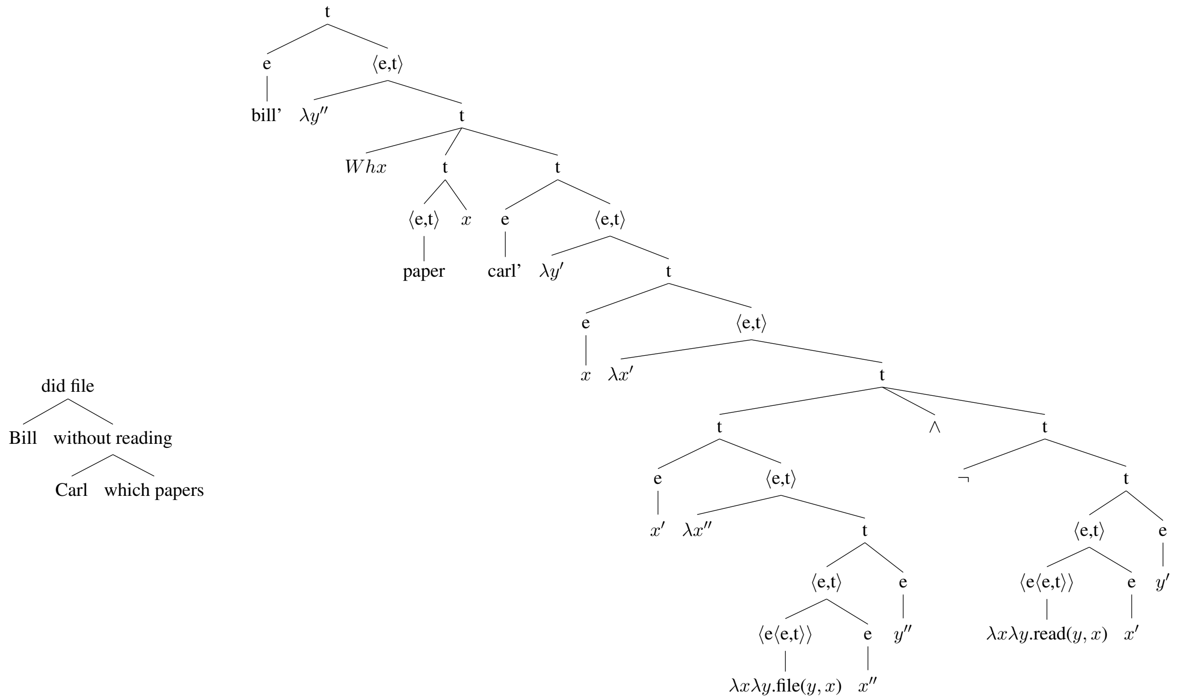

Figure 4: Derivation tree and derived semantic tree for (5)

ing the *wh*-phrase as combining directly with the adjunct, with the degenerate DP node in our syntactic MCS for the adjunct simulating the movement. However, the semantic form is quite simple, with the extra variable going from the adjunct to the matrix clause in reminiscent of the treatment of control into embedded clauses proposed by Nesson (2009), where one clause's elementary tree provides the arguments for another. Adopting this mechanism allows us to dispense with the need to posit null operators and the operation of chain composition, as proposed in Chomsky (1986) and widely assumed in more recent work on the topic. This flexibility is derived largely from the treatment of *wh*-dependencies as inherently quantificational, with no semantic effect on the predicates within which extraction takes place.

It is interesting to note that Nesson's treatment of control, which can be thought of as the inspiration for this this treatment of PGs, does not generalize to cases of adjunct control, as in examples like (7). The problem concerns the directionality of the derivation: if the adjunct adjoins into the matrix clause, the adjunct elementary tree set can provide arguments for the matrix, as it does in our PG analysis. However, the reverse cannot happen: the matrix clause cannot provide arguments which substitute into the adjunct.[2] To analyze adjunct control, then, we are forced to depart from an analysis where the two dependencies run in opposite directions, with control from the matrix into

[2]This might be possible if we relax constraints on TAG derivations, to permit flexible composition (Joshi et al., 2008; Chiang and Scheffler, 2008). We put this possibility aside here.

the adjunct for the subject but movement of the *wh*-object from the adjunct into the matrix clause. We see two possible resolutions of this conflict. On one of these, we would treat adjunct control in a manner similar to parasitic gaps, with the putative controller forming part of the adjunct clause's tree set. This would in essence involve an adoption of sidewards movement for adjunct control, as proposed by Hornstein (1999). Alternatively, we could embrace a semantic treatment of adjunct control. By taking the adverbial modifier's interpretation to be of type $\langle e,t \rangle$, with abstraction over the subject argument, combining such a predicate with the matrix VP, also of type $\langle e,t \rangle$, via predicate modification, we get the effect of subject control, as both predicates with be asserted to hold of the same entity.[3] We will not choose among these options in the remainder of the paper.

Before closing this section, we note that the present analysis accounts for another constraint on PG constructions, specifically their limitation to argument *wh*-words:

(9) a. * Why did you leave ___ when Bill walked in $\_\_\__p$?

b. ?* with whom did you drive to school ___ before going to the concert $\_\_\__p$??

While the sentence in (9a) may be understood as asking for the reason leaving at the time of Bill's arrival, there is no way to interpret it as including a PG, where the same reason would also hold for Bill's walking in. The same applies in (9b), where the question can ask about companions on the way to school, but not both going to the school and the concert. The contrast here follows because the adverbial clause tree set will not have the degenerate DP node into which the adjunct wh-phrase can substitute, as the position for such an adjunct is not licensed by the thematic structure of the verb in the adverbial.

4 Locality in Parasitic Gaps

The multi-component analysis set forth in the previous section allows extraction from an adjunct in a way that is not possible with non-multi-component TAG. Indeed, the impossibility of such extraction had been used to provide support for the TAG treatment of extraction, as it derives island constraints (Kroch, 1987; Frank, 2002). By granting ourselves this additional flexibility, we might worry that those results would fall away. Note, however, that there are substantial constraints on the use of such an island-violating derivation. First of all, the syntactic tree set containing the degenerate DP node will be constrained to substitute into an A′-position, as it is the host of a wh-phrase, meaning that it will be possible only in the presence of an instance of extraction. Furthermore, under the assumption that all multi-component combination is tree-local, we will ensure that the parasitic gap dependency is local to the licensing dependency. That is, the parasitic gap-containing adjunct must combine tree-locally with the clause inside of which the licensing extraction holds, in order for the substitution of the wh-phrase and adjunction of the modifier to take place in a tree-local fashion.

Note that this analysis does not prevent us from deriving examples in which the parasitic gap occurs within an embedded clause in the adjunct.

(10) Which papers did Bill file ___ [without believing that Carl had read $\_\_\__p$]?

To do so, we need only adjoin a C′-recursive tree headed by the verb *believe* into the adjunct tree, thereby "stretching" the PG dependency across the clausal boundary. If the PG is contained within an island (within the adjunct), no such derivation is possible. And indeed it has been known since Kayne (1983) that such instances of PGs are impossible:

(11) a. * Which papers did Bill file ___ without Carl meeting [the guy who wrote $\_\_\__p$?] (Complex NP)

b. * Which papers should we read ___ before [talking about $\_\_\__p$] becomes difficult ? (Subject Island)

Our analysis predicts this pattern exactly.

There is however a kind of case that poses a potential difficulty for our analysis. This involves an example like (12), where an additional clause intervenes between the licensing gap and the surface position of the wh-phrase.

(12) **Which papers** did you predict that I would file ___ without reading $\_\_\__p$?

This example is ambiguous, with readings possible where *without* is modifying either *predict* or *reject*, and the PG is licensed in both cases. These

[3]Nissenbaum (1998) makes use of predicate modification in his semantic treatment of adjunct parasitic gaps, but uses it to ensure identity of the binders of the licensing gap and PG.

readings can be easily diagnosed by the controller of the adjunct clause: when it is *you*, attachment is high, and when it is *I*, attachment is low.[4]

Using the standard TAG analysis of successive cyclic wh-movement, the lower reading can be derived straightforwardly. As before, the adjunct-wh complex (corresponding to the lexical material *which papers* and *without reading*) is adjoined to the embedded clause's elementary tree (headed by *file*), as does the matrix clause (represented by the trees in Figure 5), at C′, thereby displacing the wh-phrase from its position at the edge of the embedded clause.

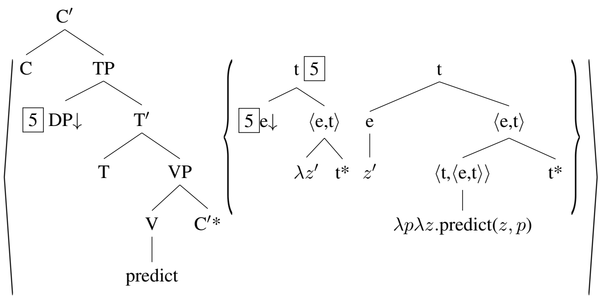

Figure 5: Elementary trees for *predict* (low attachment of adjunct)

Deriving the lower attachment of (12) is considerably less straightforward. Doing so using the same set of trees would require a non-local derivation: While the adjunct would need to be adjoined into the matrix clause's tree set, the wh-phrase, and associated variable in the semantics would need to composed into the embedded clause's tree set. In order to avoid such non-locality, we make use of the derivation of wh-extraction proposed in Kroch (1989) and Frank and Kroch (1995) to analyze cases of 'long movement' out of wh-islands. Specifically, we assume the alternative multi-component sets for the embedding predicate *predict*, shown in Figure 6. On the syntactic side, the tree is extended to a full CP (as opposed to C′), including a substitution site for the *wh*-phrase.

An immediate concern is that this substitution node appears to violate TAG version of the theta criterion (Frank, 2002), according to which all substitution nodes must be part of a chain that receives a θ-role. However, we note the exceptional nature of this position, as defined by the links in the tree. Unlike the case in Figure 2, where the adjunct is not required to fill the CP specifier (though it is able to do so), here the links are constructed such that it must do so (cf. the co-indexation of the specifier of CP and the VP). This means that the phrase substituting here must come from an adjunct in which it will already have received a role. Further constraints on the usage of this tree set are seen on the semantic side: the scope part of *predict* has been extended to provide a substitution site for the variable associated with the new DP, though instead of binding an argument of *predict*, the binder binds a type e tree in the new semantic MCS. On both the syntactic and semantic sides of the derivation, tree local combination into the *file* tree will complete the derivation. Because the *predict* tree set has an extra DP node and an extra variable, it will saturate an argument position in the clause it embeds, it guarantees a licensing gap for the PG it supports. As with the earlier cases, we see all variable dependencies moving in parallel through the derivation. The adjunct passes both the controlling subject and the *wh*-phrase through to the matrix clause via adjoining, and when the matrix clause adjoins into the embedded clause, it passes the *wh*-dependency on again.

As we already noted above, multi-component tree sets like the one in Figure 6 were first proposed in the analysis of extractions from (weak) wh-islands, and were taken to be the only path for such a derivation in a language like English where the lower CP could not host multiple wh-phrases in its specifier(s). If this is correct, our current analysis makes the prediction that instances of long movement will only permit the high attachment of the PG-containing adjunct. Frank and Kroch (1994) argued that this was correct for extraction out of DP, on the basis of examples like (13a), and we believe that it is also the case for extraction from (some) wh-islands:[5]

(13) a. Which building did the mayor$_i$ report on [Trump's$_j$ renovation of ___] [after

[4]We note that either of the treatments of control sketched above correctly capture this correlation between locus of attachment and controller.

[5]Frank (1991) reaches a different conclusion concerning extraction from wh-islands, on the basis of examples like the following:

(1) Which car$_i$ did Bill$_j$ understand how the mechanic$_k$ had fixed ___ [without PRO$_{j/k}$ dismantling ___$_p$]

This example appears to permit the lower attachment interpretation to a considerably greater degree than (13b). We do not at present have an explanation for why the presence of an argument as opposed to adjunct wh-phrase in the embedded specifier of CP should lead to this difference. We leave this for future work.

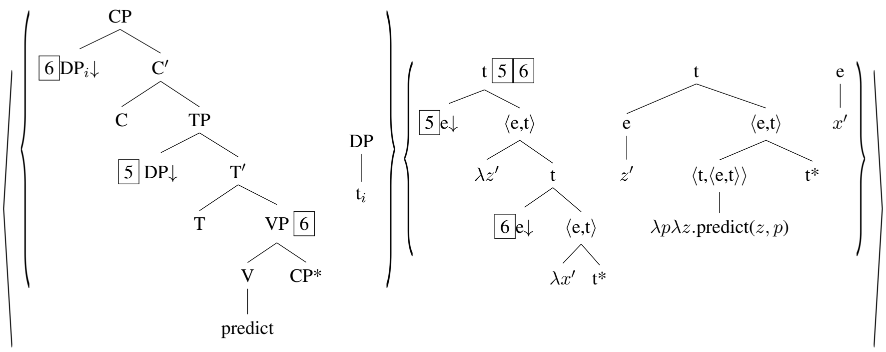

Figure 6: Elementary trees for *predict* (high attachment of adjunct)

PRO$_{i/*j}$ previously abandoning ___$_p$]?

b. Which car$_i$ did Bill$_j$ understand who$_k$ had fixed ___ [without PRO$_{j/*k}$ dismantling ___$_p$]

Such contrasts provide support for the treatment of high attachment we have provided, as well as for the analysis of PGs that we have presented.

5 Anti-C-Command and Beyond

We turn finally to another property that has been attributed to parasitic gap constructions. In the original paper on the topic, Engdahl contrasts cases like (7) with the anomalous (14).

(14) * **Which article** ___ got filed before Carl read ___$_p$?

Engdahl argues that the crucial distinction between these cases concerns the fact that the licensing gap in the well-formed case does not c-command the parasitic gap, whereas it does so in the ill-formed case. This anti-command condition has been widely assumed to be a restriction on parasitic gaps. Our present analysis captures this quite simply by forcing the adjunct's semantic content to adjoin into the matrix clause's scope tree at a position which can bind objects, but not subjects. Rather than building anti-c-command into the syntax, here we are deriving the same result from the semantics.

We also note that our approach captures another contrast relating to the use of PG constructions noted by Phillips (2006):

(15) a. **Which car** did the attempt to fix ___$_p$ ultimately destroy ___?

b. * **Which platform** did the reporter that criticized ___$_p$ ultimately endorse ___?

In neither case does the licensing gap c-command the PG, and yet there is a clear and strong contrast in judgments. While space prohibits a full analysis, the prior discussion provides the necessary insights. Though an STAG analysis of nominalizations is well outside the scope of this paper, it is plausible that *to fix* should be assimilable to the kind of infinitival adjunct present in (7). In contrast, in the case of the relative clause, our account is going to mirror the account for (4) where locality of the composition of the relative clause will be key. Of course, here we are dealing with a covert contrast not derived from overt movement, so the better analogy is to note that just as the relative clause is a scope island (versus the control case), the relative clause here remains a legitimate island for the parasitic gap.

In closing the paper with these examples, we note that parasitic gap constructions provide an ideal example of the theoretical possibilities afforded by STAG. The pairing of synchronized derivations does nothing to weaken the power of existing semantic constraints on a derivation, but does make it possible to allow semantics an equal opportunity to rule out syntactically well-formed derivations. This is a welcome result as it opens up new analyses for cases where seemingly well-formed syntactic derivations are ruled out based on a semantic contrast.

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