

Rescue by PF Deletion and the Intervention vs. Truncation Debate

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1. Background

It is well known that central adverbial clauses as well as a subset of complement clauses resist so-called 'main clause phenomena'. In this paper, we will consider only the type of main clause phenomena that are derived by the fronting operations illustrated in (1). Our discussion will initially focus on argument fronting, but will then be extended to VP fronting in English and TP fronting in modal sentences in French.

In English, argument fronting, which is available in root clauses and in a restricted set of complement clauses, is excluded from sentential complements to factive verbs. For example, as shown in (2), argument fronting is found in clauses complement to *tell*, but is excluded from complement clauses to factive verbs like *regret* and *realize*.

- (1)
- | | | |
|----|--|--------------------|
| a. | This book, Mary hasn't read. | ARGUMENT FRONTING |
| b. | Not a single proposal did we agree with. | NEGATIVE INVERSION |
| c. | In each hallway is/hangs/has long stood a large poster of Lincoln.
(Emonds 1976: 37, his (40)). | LOCATIVE INVERSION |
| d. | Present at the meeting were the company directors. | COPULAR INVERSION |
| e. | Fix the car, he will. | VP FRONTING |
- (2)
- | | |
|----|---|
| a. | She told me that that book, she hadn't read yet. |
| b. | (%)*John regrets [that this book, Mary read].
(Maki et al, 1999:3, their (2c)) |
| c. | *Nina realizes [that this book, Joe won't read]. |

To capture the absence of main clause phenomena in such domains, two syntactic accounts have been elaborated: the truncation account and the intervention account. The truncation account takes structural deficiency to be a primitive. It directly ascribes the restrictions on argument fronting to the lack of structural space needed for this type of operation to take place. The intervention account, on the other hand, hypothesizes that those domains that are incompatible with the fronting operations in (1) are themselves derived by movement and that this movement interferes with fronting operations. In other words, on this view, the 'truncation effect' is taken to be a by-product of locality considerations.

Empirically, these two accounts appear to be equivalent in that both approaches correctly predict that English argument fronting is banned in sentential complements to factive verbs and in central adverbial clauses. However, conceptually, the intervention account is superior because it appeals to constraints on locality that are independently motivated in other areas of the grammar, and it is therefore simpler and more general.

2. The truncation approach

The idea that structural truncation determines the distribution of main clause phenomena has been put forth in a number of works, including Kuroda (1992:350), Benincà and Poletto (2004), Grewendorf (2002:53), Emonds (2004), McCloskey (2006), Meinunger (2004), and Haegeman (2003, 2006). Haegeman's specific implementation for adverbial clauses was subsequently explored by Carrilho (2005:244-245, 2008), Munaro (2005), Hernanz (2007a,b), Bentzen et al (2007), Abels and Muriungi

(2008:693-694), Cardinaletti (2009), Wiklund et al (2009). Basse (2008) offers a Minimalist implementation according to which complements to factive verbs lack an edge feature, thus disallowing fronting.

As has been clear from the beginning of this line of research, however, clauses that disallow main clause phenomena cannot be assumed to lack a left periphery altogether. This is because such clause types manifest phenomena that are typically associated with the C-field such as Clitic Left Dislocation. This is illustrated for French in (3) and for Italian in (4).

- (3) a. Quand cette chanson, je l'ai entendue,
 when that song I it-have- 1SG hear-PART,
 j'ai pensé à mon premier amour.
 I have-1SG think-PART to my first love
 'When I heard that song, I thought of my first love.'
- b. Jean regrette que son texte, tu ne l'aies pas lu.
 Jean regret-3SG that his text you ne it have-SUBJ-2SG not read-PART.
 'Jean regrets that you haven't read his text.'
- (4) a. Se la stessa proposta la fa anche l'altro candidato,...
 if the same proposal it make3SG also the other candidate
 'If the other candidate also makes the same proposal,...'
 (Cardinaletti 2009: 6, (22a))
- b. Mi dispiace che questo problema gli studenti
 me displease-3SG that this problem the student-PL
 non l'abbiano potuto risolvere
 non it have-SUBJ-3PL can-PART solve
 'I am sorry that the students have not been able to solve this problem.'

So, rather than claiming that there is no left periphery at all, 'positional' accounts of the incompatibility of some clausal domains with argument fronting postulate that such domains are characterized by a reduced or 'truncated' left peripheral space. Thus, while (5a) corresponds to Rizzi's original articulated CP, (5b) represents the reduced left periphery assumed by Haegeman (2003, 2006) to be available in adverbial clauses and in complements to factive verbs. Haegeman further argues that the projection ForceP exclusively encodes illocutionary force, and that the subordinating conjunction is hosted by a distinct head 'Sub'. Presupposed domains such as central adverbial clauses and complements to factive verbs are then assumed to lack illocutionary force, hence ForceP is absent.

In addition, Haegeman assumes that the higher TopP and FocP, but not the lower TopP, are dependent on ForceP. As a result, in reduced domains, FocP and the higher TopP are absent, *de facto* ruling out argument fronting in English, although the lower TopP remains available. This lower TopP is only 'active' in Romance, where it hosts Clitic Left Dislocated constituents. The same lower TopP in English cannot host argument fronting, as (5c) shows. Finally, to accommodate adjuncts that may appear in the left periphery in English central adverbial clauses, as in (5d), Haegeman postulates a specialized projection ModP.

- (5) a. (SubP) > ForceP > (TopP) > (FocP) > ModP > TopP > FinP
 b. SubP > ~~ForceP~~ > ~~(TopP)~~ > ~~(FocP)~~ > ModP > TopP > FinP
 c. *When [that song] we heard, . . .
 d. When [last year] she started to work for the UN, she suddenly became much more relaxed.

There is, however, a serious objection that one may raise with respect to the truncation account; which is that it ignores the fact that the patterns observed in the left periphery of reduced clauses are replicated in other domains in which they have standardly been accounted for in terms of intervention. As is well known, the domains with restricted argument fronting operations display a double asymmetry. First, while argument fronting is unavailable in English, adjuncts can appear in the left periphery, as shown in (5d). Second, while argument fronting is unavailable in English, Clitic Left Dislocation is available in Romance. Interestingly, similar asymmetries have also been reported for

domains such as embedded *wh*-questions, as in (6), relative clauses, as in (7), and embedded clauses in the context of long extraction, as in (8).

- (6) a. *Robin knows where, the birdseed, you are going to put.
(Culicover 1991:5, (6c))
- b. Lee forgot which dishes, under normal circumstances, you would put on the table.
(Culicover 1991:9, (17d))
- c. It. Non so proprio chi,
non know-1SG honestly who
questo libro, potrebbe recensirlo.
this book can-COND-3SG review-it
'I honestly don't know who could review this book.'
- (7) a. *These are the students to whom, your book, we will recommend next spring.
b. These are the students to whom, next spring, we will recommend your book.
- c. It. ?Ecco lo studente a cui, il tuo libro,
this is the student to whom the your book
lo darò domani.
it give-FUT-1SG tomorrow
- (8) a. *Who did you say that to Sue, Bill introduced?
(Boeckx & Jeong 2004, (3))
- b. Which book did Leslie say that for all intents and purposes, John co-authored with Mary?
(Bošković 2011:34, n. 34, (i), from Culicover 1991)
- c. It. ?Non so a chi pensi che, tuo fratello,
non know-1SG to whom think-2SG that your brother
lo potremmo affidare.
him can-COND-1PL entrust
'I don't know to whom you think that, your brother, we could entrust.'
(Rizzi 2004, (64a))

Now, the patterns in (6) through (8) are not usually dealt with in terms of truncation. Rather, it is standardly assumed that fronted arguments are interveners for *wh*-movement, while adjuncts and Clitic Left Dislocated constituents in the left periphery are not. The precise formalization of the locality constraints on movement depends, of course, on the theory of intervention adopted, and implementations vary. Additionally, we note that a fronted argument is marginally compatible with an adjunct to its right, as shown in (9a); multiple argument fronting is excluded, as shown in (9b), and multiple adjuncts, as in (9c), and multiple Clitic Left Dislocations, as in (9d), are possible in the left periphery. These facts also seem to call for an intervention account in which one fronted argument blocks the movement of another but a left-peripheral adjunct does not block the fronting of another.

- (9) a. ?This book, around Christmas, you should buy.
(Rizzi 1997:331, n 26, (i))
- b. *This book, to Robin, we gave.
(Culicover 1991:36, (117a)).
*Bill, that house, she took to for the weekend.
(Emonds 2004:95 (27b))
- c. Last week, in Paris, after a hard day's work, he met his agent again.
Deep down, as we grew up, we rued the fact we hadn't taken that path.
(*Guardian* 05.05.2009, page 2, col. 5)
- d. Il libro, a Gianni, glielo darò senz'altro.
the book to Gianni him-it give-FUT-1SG without doubt
'I will give Gianni the book without doubt.'
(Rizzi 1997:290, (21))

3. Movement and intervention

Although space considerations prevent us from demonstrating this in detail here, a feature-based theory of intervention, such as the one proposed by Haegeman and Ürögdi (2010), can capture the double asymmetry in (8) and the patterns in (9). (It is important to note, additionally, that the arguments put forth in sections 4 and 5 of the present paper go through regardless of the specific implementation of locality one adopts.) The same double asymmetry arises in adverbial clauses: The paradigm in (10) shows that in temporal *when* clauses, argument fronting is unavailable in English while Clitic Left Dislocation remains possible in Romance.

- (10) a. *When this song we heard, ...
 b. Quand cette chanson, je l'ai entendue...
 when this song I it have-1SG heard

The asymmetry between English argument fronting and Romance Clitic Left Dislocation in (10) is parallel to that displayed in interrogative *when* clauses, as the paradigm in (11) shows.

- (11) a. *I wonder when [this song] we heard.
 b. Je me demande quand [cette chanson], je l'ai entendue
 I myself ask-1SG when this song I it-have-1SG heard

Given that the asymmetry displayed in (11) is, by hypothesis, determined by the locality effects discussed so far, we must also assess the plausibility of such an approach in the context of (10).

We follow Geis (1970) and Haegeman (2007) in assuming that adverbial clauses are derived by *wh*-movement of an operator. Argument fronting in the interrogative *when* clause in (11a) is standardly ruled out by locality conditions on movement. If temporal *when* clauses are derived by operator movement, then the same conditions on locality will account for the unavailability of argument fronting in English (10a). Since, as previously mentioned, Clitic Left Dislocation does not block *wh*-movement, we also expect (10b) to be grammatical for the same reason (11b) is. Thus, while it may appear that in adverbial clauses, TopP and FocP are not projected, what, in fact, happens is that any fronted constituent FocP or TopP might host will act as an intervener with respect to the movement of *when* and the derivation of the adverbial clause will fail to converge. In other words, FocP and TopP can be projected as long as they do not host any interveners for movement.

4. Intervention, fronting and ellipsis

We now turn to an asymmetry between the distribution of English VP fronting, another instantiation of main clause phenomena, and that of VP ellipsis. We will first explore Johnson's (2001) analysis of VP ellipsis, according to which VP ellipsis is derived by VP fronting followed by ellipsis of the fronted VP. Such an analysis receives indirect support from the fact that VP ellipsis is only possible if the elided VP has a discourse antecedent, hence is in some way discourse given, or 'topical'. We will show that there are, however, some interesting distributional differences between VP fronting and VP ellipsis. The ultimate goal of our discussion will be to argue that Authier's (2011) implementation of Johnson's thesis not only accounts for the observed distributional differences between VP fronting and VP ellipsis, but also presupposes the intervention account of main clause phenomena.

4.1. English VP ellipsis as "VP fronting and silence"

As is well known, VP ellipsis must be licensed by a finite auxiliary or by infinitival *to*. This is illustrated in (12).

- (12) a. Jane doesn't eat grapefruit and Holly doesn't \emptyset either.
 b. Jane wouldn't eat grapefruit and Holly wouldn't \emptyset either.
 c. Jane hasn't eaten any grapefruit and Holly hasn't \emptyset either.

- (12) d. Mag Wildwood wants to read Fred's story, and I also want to \emptyset .
(Johnson 2001:440, (5d))
- e. John wants to go on vacation, but he doesn't know when to \emptyset .
(Johnson 2001:441, (9a))
- f. I can't believe Holly won't eat grapefruit. We can't believe Fred *(won't) \emptyset , either.
(Johnson 2001:439, (4))
- g. Sally Tomato started running down the street, but only after José started *(to) \emptyset .
(Johnson 2001:440, (7))

As shown in (13), VP fronting also must be licensed by a finite auxiliary or by infinitival *to*.

- (13) She claimed that...
- a. eat grapefruit, Holly didn't.
- b. eat grapefruit, Holly wouldn't.
- c. eaten grapefruit, Holly hasn't.
- d. eat grapefruit, Holly wants *(to).
(Johnson 2001:444, (17))
- e. ?* eating grapefruit, Holly started.
(Johnson 2001:444, (18))

Assuming that VP ellipsis is VP fronting minus the PF spell-out of the head of the chain created by VP fronting, the parallelism in judgments illustrated in (14) through (16) below is immediately accounted for. While VP fronting out of an infinitival clause complement to a tensed verb is licit, as is its 'silent' VP ellipsis counterpart, both VP ellipsis and VP fronting are illicit in (15) and (16) because extraction out of infinitival adjuncts, infinitivals embedded within an NP, and *wh*-islands is impossible.

- (14) a. Mag Wildwood wants to read Fred's story, and we also want to \emptyset .
b. Mag Wildwood wants to read Fred's story, and [read Fred's story] we also want to.
- (15) a. *Mag Wildwood came [to read Fred's story], and we also came [to \emptyset].
b. ?*Madame Spanella questioned [Mag's desire to [eat rutabagas]], but only after we had questioned [Sally's desire to \emptyset].
c. ??Ron wanted to wear a tuxedo to the party, but Caspar couldn't decide [whether to \emptyset].
(Johnson 2001:445, (22c))
- (16) a. *Madame Spanella questioned [Mag's desire to [eat rutabagas]] and [eat plums] we questioned [Sally's desire to t].
b. ??Ron wanted to wear a tuxedo to the party, but [wear a tuxedo to the party] Caspar couldn't decide [whether to t].
(Johnson 2001:447, (29c))

4.2. French TP ellipsis as TP fronting

The parallelism between VP ellipsis and VP fronting in English is mirrored in French, as discussed in Authier (2011), who interprets the ellipsis of an infinitival complement to a modal verb in French as TP ellipsis. Authier further argues that TP ellipsis is licensed by TP fronting.

The French examples in (17) illustrate the fact that both TP fronting and TP ellipsis are licensed in the context of a class of modals that includes *pouvoir* 'be able', *devoir* 'must/should', *vouloir* 'want', *falloir* 'be necessary' and *avoir le droit* 'be allowed.' Note that in (17a), the fronted infinitival is directly linked to a gap in argument position and is therefore an instance of English-style Topicalization rather than Clitic Left Dislocation.

- (17) a. Je veux pas laver tes chaussettes,
 I want not wash your socks
 mais [nettoyer l'évier], je veux bien.
 but to-clean the-sink I want well
 'I don't want to wash your socks, but clean the sink, I'm willing to.'
 (Authier 2011:198 (44c))
- b. A: Peux-tu nettoyer l'évier? B: Je veux bien Ø.
 can-you to-clean the-sink I want well

Authier shows that, in contrast, infinitivals embedded by epistemic modals are incompatible with both TP ellipsis and TP fronting. In (18a) and (18c), *devoir* 'must' and *pouvoir* 'may/be able' can only have a deontic reading. In (18b), the context forces an epistemic reading of *pouvoir* and TP fronting is impossible.

- (18) a. La police doit arriver dans cinq minutes
 the police must arrive in five minutes
 et l'ambulance doit aussi Ø.
 and the-ambulance must too
 (Authier 2011:193, (26))
- b. *Arriver d'un moment à l'autre, la police peut,
 to-arrive of-a moment to another the police may
 alors accélère!
 so hurry-up
 'The police may arrive at any moment, so hurry up.'
- c. Partir en vacances, tu peux pas.
 to-leave for holidays you can not.

Further, as (19) shows, both TP ellipsis and TP fronting are illicit in infinitival adjuncts. This is because French fronted infinitival TPs, just like English fronted VPs, must be able to find a finite clause to land in and that the fronted clause in (19a), being contained in an island to extraction, cannot do so.

- (19) a. *Paul a téléphoné [pour [obtenir son visa
 Paul has phoned in-order-to to-obtain his visa
 plus rapidement], pouvoir].
 more quickly to-be-able
 (Authier 2011:198, (46a))
- b. *Astrid voulait obtenir son visa plus rapidement
 Astrid wanted to-obtain her visa more quickly
 et elle a envoyé des fonds supplémentaires [pour pouvoir Ø].
 and she has sent funds extra to to-be-able
 (Authier 2011:201, (48f))

4.3. VP ellipsis vs. VP fronting

Attractive though the analysis of VP and TP ellipsis as movement and silence may be, a number of problems arise. One important issue discussed in Authier (2011) and in Aelbrecht and Haegeman (2012), is that VP fronting has a more restricted distribution than VP ellipsis.

4.3.1. (Lack of) sensitivity to islands

As illustrated in (20), like other types of extraction, VP fronting is sensitive to islands. On the other hand, VP ellipsis is fully grammatical in the same domains, as shown in (21). Under a movement account of VP ellipsis, this asymmetry is so far unexplained.

- (20) a. *I knew that some students presented this article in my class but [present the article] we couldn't recall [which of the students didn't t].
 b. *I know that some students presented this article in my class but [present the article] we can't recall [the students [who didn't t]].
- (21) a. I knew that some students presented this article in my class but we couldn't recall [which of the students didn't Ø].
 b. I know that some students presented this article in my class but we can't recall [the students [who didn't Ø]].

4.3.2. Topicalization within certain types of clauses

Similar asymmetries are also found with respect to French TP ellipsis and TP fronting, as shown in (22) and (23).

- (22) a. *Je parlerai avec qui [PRO parler], je veux t.
 I will-speak with who to-speak I want
 b. *Contacte les étudiants à qui on peut fournir cet article,
 contact the students to whom we can to-provide this article
 mais [PRO fournir cet article], ne contacte pas ceux [à qui
 but to-provide this article contact not those to whom
 on ne peut pas t]!
 we can not
- (23) a. Je parlerai avec qui je veux Ø.
 I will-speak with who I want
 b. Contacte les étudiants à qui on peut fournir cet article,
 contact the students to whom we can to-provide this article
 mais ne contacte pas ceux à qui on ne peut pas Ø.
 but contact not those to whom we can not

In a similar vein, (24a-b) show that VP fronting is incompatible with argument fronting, which can be seen as the result of a violation of locality conditions on movement. VP ellipsis, on the other hand, *is* compatible with argument fronting, as (24c) illustrates.

- (24) She doubted whether the new house might increase in value, ...
 a. *but [increase in value] the old house she was sure would.
 (Emonds 2004:95)
 b. *but the old house [increase in value] she was sure would.
 (Emonds 2004:95)
 c. but [the old house] she was sure would Ø.

Finally, as illustrated in (25) and (26), while VP fronting is excluded from central adverbial clauses, VP ellipsis is licit in the same context.

- (25) Mary wanted to move to London ...
 a. and [move to London] she did t.
 b. *and after [move to London] she did t, her life changed entirely.
 c. *and when [move to London] she did t, her life changed entirely.
- (26) Mary wanted to move to London, ...
 a. and eventually she did Ø.
 b. and after she did Ø, her life changed entirely.
 c. and when she did Ø, her life changed entirely.

4.4. An alternative view and its consequences

Given these asymmetries, Aelbrecht and Haegeman (2012) argue against the VP fronting derivation of VP ellipsis. However, Authier (2011) shows that, given certain assumptions about the place given to intervention in the architecture of the grammar and the interplay between ellipsis and intervention, Johnson's original movement analysis can actually be maintained. Our goal here will be to show that this account is relevant for the derivation of central adverbial clauses and has interesting consequences with respect to the choice between the truncation account and the intervention account outlined at the beginning of this talk. Specifically, we will show that the account developed by Authier crucially depends on a derivation of central adverbial clauses in terms of movement, and militates against the truncation account.

4.4.1. Repair by ellipsis

It has been pointed out that PF deletion can sometimes 'repair' violations that arise through extraction from an island. The original observation goes back to Ross (1969), who gives paradigms like the one in (27). The example in (27a) shows that illicit extraction from within a relative can be salvaged through an ellipsis operation that includes the island from which extraction has taken place.

- (27) a. She kissed a man who bit one of my friends, but Tom does not realize which one.
 b. *She kissed a man who bit one of my friends, but Tom does not realize which one of my friends she kissed [a man who bit t].

Bošković (2011) proposes that locality violations incurred in syntax result in the marking of the element that is responsible for blocking movement. He does this concretely by marking this element with the diacritic *. With respect to illicit extraction from an island, he proposes that when a *w/h*-moved element crosses an island boundary, the island is *-marked. The presence of a * in the final PF representation of a derivation leads to a crash. However, such a violation is 'voided' if the *-marked element is deleted at PF. For example, if the offending *-marked nominal island is spelled out, as in (28a), the derivation crashes. If, on the other hand, the island fails to be spelled out through sluicing, as in (28b), the * is removed and the potential crash is avoided.

- (28) a. *She kissed a man who bit one of my friends, but Tom does not realize which one she kissed [_{DP*} a man who bit t].
 b. She kissed a man who bit one of my friends, but Tom does not realize which one she kissed [_{DP*} a man who bit t].

4.4.2. VP ellipsis

Bošković further extends his repair by ellipsis account to violations caused by an intervener. For example, when a moved *w/h*-element crosses over an intervener, leading to a potential intervention effect, the intervener is *-marked. As before, the presence of a * in the final PF representation leads to a crash but the crash is avoided if the *-marked element is deleted at PF. We illustrate this in (29) in relation to VP fronting and VP ellipsis.

- (29) a. *I know that some student presented this article in my class but we can't recall the student [who [_{VP*} present this article] did t].
 b. I know that some student presented this article in my class but we can't recall the student [who [_{VP*} present this article] did t].

As argued in detail in Authier (2011), repair by ellipsis combined with the assumption that intervention is a PF phenomenon, will allow the VP fronting account of VP ellipsis.

5. Consequences for the derivation of adverbial clauses

We can now explore the consequences that such assumptions hold for the derivation of adverbial clauses and for the syntactic account of main clause phenomena in general. Let us first briefly return to the core data. As shown in (30a-b) and (31a-b), VP and TP fronting are illicit in adverbial clauses, while VP ellipsis and TP ellipsis remain available in the same context.

- (30) Mary wanted to move to London, ...
- a. *and after [move to London]* she did t, her life changed entirely.
 - b. and after she did \emptyset , her life changed entirely.
 - c. and after [~~move to London~~]* she did t, her life changed entirely.
- (31) a. *Quand [PRO jouer au hockey]* je peux, ...
 when to-play at-the hockey I can
- b. Quand je peux \emptyset , je joue au hockey.
 when I can I play at-the hockey
 (Authier 2011:209-210, (59b), (60b))
 - c. Quand [~~PRO jouer au hockey~~]* je peux, ...

On the Authier/Bošković repair by ellipsis account, VP fronting in (30a) and TP fronting in (31a) lead to the assignment of a * to the fronted constituent. This results in ungrammaticality if this diacritic survives at PF, but if ellipsis applies, the diacritic is removed and the derivation converges, as shown in (30c) and (31c).

Interestingly, it turns out that there is an important proviso to this account. If (30a) and (31a) can be ‘rescued by ellipsis’, it must be the case that the offending constituent to be deleted can be identified as a starred intervener. For this to be possible, however, two conditions must obtain. First, the constituent must be an intervener with respect to another element that moves across it. Second, the constituent must be able to occupy a position in the left periphery of the clause that contains it, which means that there must be a landing site available to host it. The first condition leads to the conclusion that adverbial clauses must be derived by movement, since movement creates the precise context in which an intervention effect can arise. As for the second condition, while it is fully compatible with the movement derivation of adverbial clauses, it is far from clear how it can be reconciled with a truncation analysis. According to the truncation analysis, VP fronting is illicit in adverbial clauses because such clauses lack the appropriate landing site for VP fronting. If VP ellipsis is itself derived through VP fronting, it will follow that VP ellipsis should be excluded in those domains in which VP fronting is not possible. But this, of course, makes the wrong prediction: VP ellipsis is, in fact, compatible with what would be truncated domains.

At a more general level, it is worth pointing out that the theory of ellipsis advocated by Bošković and Authier presupposes that intervention effects are a PF phenomenon. Obviously the question arises as to whether accounts that take intervention to be a phenomenon of the narrow syntax can be devised to capture the VP ellipsis/VP fronting asymmetry while maintaining the VP ellipsis as VP fronting analysis. Another question that is far from trivial is how a feature-based account of intervention can be integrated into the repair by ellipsis account of VP ellipsis. We leave these as open questions for future work.

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