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Subject-Auxiliary Inversion in comparatives and PF output constraints

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This paper establishes the novel generalization that Subject-Auxiliary Inversion (SAI) in comparative clauses requires the co-presence of VP-ellipsis, and argues that this peculiar fact follows from a disjunctive formulation of an ECP that applies at PF. The analysis relies crucially on the presence of an intermediate trace of the A'-moved comparative operator at the edge of VP, which is subject to the ECP at PF, and which interacts with the head movement involved in SAI. This trace is unlicensed in structures with I-to-C movement, but VP-ellipsis repairs the violation, providing further evidence that ellipsis can repair otherwise deviant structures.*

The object of this paper is to document and assay an explanation of a novel generalization concerning the co-occurrence of Subject-Auxiliary Inversion (SAI; analyzed here as I-to-C movement) and VP-ellipsis in comparative clauses. Although VP-ellipsis is usually optional, in comparative clauses in which I-to-C movement has occurred, it is obligatory. This generalization is stated in (1).

- (1) *Comparative SAI and VP-ellipsis generalization*¹
I-to-C movement in comparative clauses can occur only if VP-ellipsis has deleted the VP complement to I⁰.

While this peculiar fact would be easy to encode in grammar formalisms that make direct reference to constructions (such as Construction Grammar or some recent versions of Head-Driven Phrase Structure Grammar; see Goldberg 1995, Sag 1997, Kay and Fillmore 1999), presumably simply by stating the co-occurrence restriction on the type-hierarchies directly (e.g., {SAI} {comparative wh-movement} {non-VP-ellipsis} =), it poses a much more severe challenge for theories of grammar that attempt to reduce such apparently construction-specific phenomena to general principles that operate across the grammar without restriction. In this paper, I attempt to show that such a general account is possible, and that the seemingly parochial generalization in (1) does not provide evidence against grammatical theories that eschew reference to constructions (such as current work in Minimalism and Optimality Theory; see Chomsky 1995, Grimshaw 1997, Barbosa *et al.* 1998). In particular, I argue that the peculiar generalization in (1) finds its explanation in the interaction of the properties of head-movement involved in SAI with the licensing of traces of wh-movement, where the licensing in question must be formulated as a kind of ECP applying

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¹ This generalization was noted independently in Potts 2000.

at PF. This analysis lends new support both to the claim that wh-movement out of a VP proceeds via adjunction to that VP, and to the idea that certain types of constraints are operative as static, representational output constraints at the PF-interface.

1 Establishing the generalization

I begin by laying out the data that gives rise to the generalization in (1), and continue with a brief comparison to the more well-known case of SAI in matrix wh-questions.

1.1 Comparatives

In addition to the usual embedded word order seen in English comparative clauses (CPs selected by *than* or *as*), under certain circumstances the highest auxiliary can raise to C:²

- (2) a. Abby knows more languages than does her father.
(cf. Abby knows more languages than her father does.)
- b. Abby can play more instruments than can her father.
(cf. Abby can play more instruments than her father can.)
- c. Abby is taller than is her father.
(cf. Abby is taller than her father is.)

When I raises to C, however, the VP complement to I must be elided, as a comparison of (2a,b) with (3a,b) shows; when SAI does not take place, VP-ellipsis is not required, however, as shown in (4).

- (3) a. *Abby knows more languages than does her father know.
- b. *Abby can play more instruments than can her father play.
- (4) a. Abby knows more languages than her father knows.
- b. Abby can play more instruments than her father can play.

This can be seen clearly also in the contrastive data with stacked auxiliaries in (5)-(7) (a nominal amount comparative, an attributive adjectival comparative, and an adverbial comparative respectively):

- (5) a. Abby has been awarded more accolades than has her father (*been awarded).
- b. Abby has been awarded more accolades than her father has been awarded.
- (6) a. Abby has been awarded a more prestigious accolade than has her father (*been awarded).
- b. Abby has been awarded a more prestigious accolade than her father has (been awarded).
- (7) a. Abby has been playing piano longer than has her father (*been playing piano).

² What triggers this movement, and what determines the circumstances under which it can occur, are not germane to the issue that interests me here; see Pollard and Sag 1994:ch. 1, Pesetsky and Torrego 2001 for two recent approaches and references.

- b. Abby has been playing piano longer than her father has been playing piano.

It is not the case that SAI in comparatives is possible just in case some kind or other of VP-ellipsis occurs in the comparative clause — the target of VP deletion must be the highest VP, the complement to I. In (8a), for example, the lower VP headed by *awarded* has been deleted, leaving the higher VP headed by *been*. In each case, the result is ungrammatical. In the absence of SAI, however, VP-ellipsis is free to target the lower VP; this is shown in the control cases in (9).

- (8) a. *Abby has been awarded more accolades than has her father been.
 b. *Abby has been awarded a more prestigious accolade than has her father been.
 c. *Abby has been playing piano longer than has her father been.
- (9) a. Abby has been awarded more accolades than her father has been.
 b. Abby has been awarded a more prestigious accolade than her father has been.
 c. Abby has been playing piano longer than her father has been.

These data are supported by the results of two corpus searches. The first consisted of a search for SAI in comparative clauses using the AltaVista search engine, and was concluded on 29 October 1999, with the results given in Table 1. The search strings were *than does*, *than do*, and *than did* (other auxiliaries returned too high a rate of false hits to be useful). The number of hits (web pages that contained at least one occurrence of the search string) for each search string is given in column B. The AltaVista search engine, however, only makes available to the user a maximum of 200 web pages, reducing the actual available sample to 200 in each case (the criteria for the selection of the 200 is proprietary information of the AltaVista search engine). A random sample of ten percent of the available pages was examined for the search string. The number of occurrences of the search string that instantiated *than* with SAI (*N*) is given in column E (in some cases, a single webpage contained multiple instances of the search string). In each case, the context of the string was examined to determine whether or not VP-ellipsis was co-present, given as *V* in column F. The resulting percentage is reported in column G. No counterexamples to the generalization in (1) were found.

A	B	C	D	E	F	G
Search string	Number of hits	Sample available	Sample inspected	Number of <i>than</i> + SAI (<i>N</i>)	Number of <i>N</i> containing VP-ellipsis (<i>V</i>)	<i>V</i> as a percentage of <i>N</i>
<i>than does</i>	45,581	200	20	26	26	100 %
<i>than do</i>	68,627	200	20	22	22	100 %
<i>than did</i>	46,086	200	20	21	21	100 %

TABLE 1: AltaVista search for SAI with VP-ellipsis in comparatives

The second corpus search was a search for the same strings in J. Hoeksema's 16 million word database of texts. The number of hits were as follows: 24 occurrences of *than*

does, 26 occurrences of *than do*, and 28 occurrences of *than did*. And again the results were identical: in all cases, SAI in a comparative clause was accompanied by VP-ellipsis.

1.2 Matrix wh-questions

The connection between SAI and VP-ellipsis seen in comparatives contrasts with the state of affairs found in the most common environment for SAI in English: matrix wh-interrogatives, where SAI is obligatory. Here, the restriction noted above for comparatives does not hold — no VP-ellipsis is necessary:

- (10) a. How many languages does Abby know?
b. How many instruments can Abby play?
c. How many accolades has Abby been awarded?
d. How prestigious an accolade has Abby been awarded?
e. How long has Abby been playing the piano?

There are several other environments in which SAI occurs in standard English, but comparison with such cases is less illuminating, for reasons we will see directly. Consideration of such cases will thus be postponed until below, and I will concentrate first on the asymmetry between the constraints on SAI in comparatives vs. matrix wh-questions.

2 Intermediate wh-traces and the Empty Category Principle at PF

We are now in a position to confront the analytical challenge presented by the data above. First, why is VP-ellipsis necessary in comparatives with SAI, and second, why does SAI in matrix wh-questions not have a similar effect? Let us begin by answering the first question. In essence, it seems that the VP deletion is saving an otherwise illicit structure; VP-ellipsis repairs some kind of defect brought about by SAI.

I would like to suggest that this defect is the ill-formedness of the intermediate trace of wh-movement that occurs in the comparative clause. A number of lines of evidence indicate that wh-extraction out of a VP proceeds via adjunction to that VP (see Chomsky 1986, Fox 1999, López and Winkler 2002; cf. also Koster 1978). If this is so, a regular comparative clause such as that in (4b), repeated here in (11a), will have the representation in (11b).

- (11) a. Abby can play more instruments than her father can play.
b. ... than [_{CP} *Op*₁ her father can [_{VP} *t*₁' [_{VP} *t*_{SU} play *t*₁]]]

In this structure, the comparative operator (here represented simply as *Op*; see Lechner 1998, Kennedy 2002 for refinements) has been extracted from the object position of *play*, marked by *t*₁, and has moved to specCP by first adjoining to the VP, marked by *t*₁'.

The intermediate trace *t*₁' will be subject to general well-formedness conditions on traces, in particular, it will be subject to the Empty Category Principle (ECP). I modify here the disjunctive approach to the ECP advocated in Chomsky 1981, 1986 and much other work. Crucially, however, this condition applies at PF, and is independent of any condition that may apply at LF as well, about which I will have nothing to say here. Conceptually, this

approach is reminiscent especially of the proposal in Aoun *et al.* 1987 (also Rizzi 1990:39 for proper head-government, and cf. Jaeggli 1982), who argue that part of the ECP applies at PF, though the details differ substantially.

(12) *The Empty Category Principle at PF* (ECP_{PF}):

At PF, a trace of A'-movement must either be

- i. PF-head-governed, or
- ii. PF-antecedent-governed

Both disjuncts contain versions of familiar notions, here applied to PF representations. These PF versions of head-government and antecedent-government are defined below; the (i) clauses follow the definitions in Rizzi 1990 in essentials — the innovations are the additional (PF) requirements imposed by the (ii) clauses. I begin with the definition of PF-head-government, given in (13).

(13) *PF-head-governs* iff

- i. a. is a head, and
 - b. c-commands , and
 - c. respects Relativized Minimality wrt , and
- ii. is PF-active

(14) A link i in a chain $\langle \dots, i, \dots \rangle$ is *PF-active* iff i is the link at which lexical insertion occurs

The idea in the definition in (14) is that the PF interface privileges one copy — i — of a moved element for lexical insertion (in the sense of Halle and Marantz 1993) over other links in the chain formed by movement (the notion ‘chain’ being only a derivative one, presumably reducible to a consequence of the definition of Move); the features of i are said to be active at PF (note that this does not entail that this element will be pronounced, given the existence of null lexical items such as null operators, null I⁰, null D⁰, etc.). How this computation is effected is not relevant here (but see Richards to appear for one theory of this selection); in general, i in (14) will be the head of the chain in the cases of present interest.³

The definition of PF-antecedent-government is given in (15).

(15) *PF-antecedent-governs* iff

- i. a. and are co-indexed, and
 - b. c-commands , and
 - c. respects Relativized Minimality wrt , and
- ii. is PF-visible

³ The notion of PF-active bears some similarity to Aoun *et al.*'s (1987) notion of ‘PF-visible’, though their definition picks out a slightly different class of elements, those that either are pronounced or bear certain kinds of indices (see Aoun *et al.* 1987: 539, 546). Cf. also Chung's 1991:120 definition of ‘strong’ head governors (those that either are pronounced or are an element of {V, A, Infl}).

(16) An expression is *PF-visible* iff it has phonetic exponents

I understand having phonetic exponents as meaning that the element in question is pronounced (cf. the equivalent notion of having a phonetic matrix). In the present cases of interest, wh-operators, the notion corresponds exactly to the traditional distinction between overt and empty (or null) operators; only overt operators can satisfy clause (ii) or the ECP_{PF} .⁴

In an example such as (11) above, then, these definitions will have the following consequences. In (11b), the lower trace of wh-movement t_1 is PF-head-governed by *plays*: *plays* is a head, c-commands t_1 , no other head intervenes, and at PF, it forms a single-membered chain, and lexical insertion targets it. The intermediate trace of movement, t_1' , is PF-head-governed by the modal *can* in I^0 : *can* is a head, c-commands t_1' , no other head intervenes, and lexical insertion targets it at PF. Therefore, both traces in (11b) satisfy the ECP_{PF} , by virtue of satisfying clause (i) of (12).⁵

Consider now what happens when SAI occurs, as in (3b), repeated here in (17a).

- (17) a. *Abby can play more instruments than can her father play.
b. ... than [_{CP} *Op*₁ can [_{IP} her father t_{can} [_{VP} t_1' [_{VP} *t_{SU}* play t_1]]]]

This example has the structure in (17b), parallel to (11b) above except for the presence of I-to-C movement. I-to-C movement in the comparative clause moves the modal *can* out of the IP, forming the chain $\langle can, t_{can} \rangle$ (again, presumably independent principles determine that the higher copy is pronounced in this structure, and that the lower copy remains unpronounced, signalled here with the traditional *t*). While the lower trace t_1 satisfies the ECP_{PF} as above, the I-to-C movement changes the licensing status of the intermediate trace t_1' : the lower copy of *can*, t_{can} in I^0 , does not PF-head-govern t_1' because it is not PF-active (the higher copy is, in C). This means that the ECP_{PF} in (12) cannot be satisfied via clause (i) as it was in (11).

The other possibility for satisfying the ECP_{PF} is via clause (ii) of (12), which requires PF-antecedent-government. While *Op* in specCP does antecedent-govern t_1' , it does not satisfy the crucial PF-requirement in (15ii): *Op* is not PF-visible, that is, pronounced (perhaps for substantive reasons, as explored in Lechner 1998 and Kennedy 2002). Thus the intermediate trace of *Op* violates the ECP_{PF} and (17a) is correctly ruled out.

We are now in a position to account for the otherwise puzzling generalization that SAI is possible in comparatives just in case VP-ellipsis has targeted the VP sister to I^0 , as established in section 1.1. I assume that ellipsis is deletion of a constituent at PF (see Merchant 2001 for extensive discussion and references); for VP-ellipsis, this means that a VP is deleted in the derivation from Spell-Out to the PF representation. For a non-comparative

⁴ The notions of PF-visibility and PF-activeness clearly have much in common; whether they could be collapsed entirely, at least for case of heads, depends on details of the analysis of Affix-hopping and complementizer 'deletion' phenomena that go beyond the bounds of the present paper.

⁵ Similarly, presumably, when I^0 has no pronounced content, as in (4a), where no *do*-support is necessary; exactly how lexical insertion spells out the information in I^0 on the verb in such cases is a topic of much debate (see e.g. Bobaljik 1995). The present cases are incompatible with literal I-to-V lowering analyses — what is clear is that in these cases I^0 must not move, so it is the features of I^0 , though not necessarily pronounced in I^0 , that are active at the PF interface, and operate in the desired manner for purposes of the ECP_{PF} .

example such as (18a), this deletion is represented as in (18b), where strikethrough indicates deleted material, inactive at PF.

- (18) a. Abby can play the piano, but her father can't.
 b. Abby can play the piano, but her father can't [_{VP} ~~*t_{SU}* play the piano~~].

Consider now what effect such deletion will have in comparatives in which SAI has occurred, such as (2b), repeated here.

- (19) Abby can play more instruments than can her father.

In such an example, wh-movement leaves an intermediate trace adjoined to the highest VP, as we have seen. But in addition, VP-ellipsis has applied, deleting the highest VP segment. The resulting PF structure is given in (20).

- (20) ... than [_{CP} *Op*₁ can [_{IP} her father *t_{can}* [_{VP} *t₁'* [_{VP} ~~*t_{SU}* play *t₁*~~]]]]

Because VP-ellipsis has deleted the intermediate trace *t₁'* contained in the deleted VP, *t₁'* will not violate the ECP_{PF}; deletion removes the offending trace from the PF-object considered by the ECP_{PF}, since the ECP_{PF} is a well-formedness condition applying at the PF interface. The logic here is very similar, then, to the logic applied to other PF violations voided by ellipsis as discussed in Lasnik 1995, 1999, Kennedy and Merchant 2000, and Merchant 2001.

This explanation extends as well to the data in (5)-(8) above; as we saw there, VP-ellipsis must target the highest VP. The deletion of a lower VP does not suffice to rescue the structure.⁶ Under the proposed analysis, this is the expected result, assuming as before that the wh-movement targets (at least) the highest VP.⁷ In (8a), repeated here, for example, the deletion of the VP headed by *awarded* does not remove the intermediate trace *t₁'* adjoined to the VP headed by *been* from the PF structure submitted to the PF well-formedness requirements — as such, *t₁'* remains at PF and violates the ECP_{PF}.

- (21) a. *Abby has been awarded more accolades than has her father been.
 b. ... than [_{CP} *Op*₁ has [_{IP} her father *t_{has}* [_{VP} *t₁'* [_{VP} *been* [_{VP} ~~*t_{SU}* awarded *t₁*~~]]]]]

Let us now reconsider the case of SAI in matrix wh-questions, where VP-ellipsis is not required, such as in (22), repeated from (10b) above.

- (22) How many instruments can Abby play?

⁶ This fact shows that simply stating a type-hierarchy co-occurrence restriction like [{SAI} {comparative wh-movement} {non-VP-ellipsis} =], as considered at the beginning of this paper for Construction Grammar or some versions of HPSG, is too facile: somehow, the VP-ellipsis must also be restricted to occurring in a certain position. I am unsure whether such additional requirements pose a difficulty for construction-sensitive theories as currently formulated.

⁷ Whether every VP in stacked VP structures must be targeted by wh-movement cannot be decided on the basis of the SAI facts alone: putative intermediate traces adjoined to lower VPs would satisfy the ECP_{PF} in any case. See section 3.3 below for more discussion.

This has the structure given in (23).

(23) [CP How many instruments₁ can [IP Abby *t_{can}* [VP *t₁'* [VP *t_{SU}* play *t₁*]]]] ?

As in (17) above, *t₁'* does not satisfy clause (i) of the ECP_{PF}. However, unlike in (17), *t₁'* here satisfies clause (ii): the operator *How many instruments* is PF-visible, and PF-antecedent-governs *t₁'*. Because of this, there is no similar requirement for VP-ellipsis in matrix wh-questions.⁸

At this point, it is important to examine the generality of the analysis presented thus far. While it is successful in handling for an otherwise puzzling and until now unaccounted-for generalization, one may wonder whether it has undesired consequences in domains other than the two examined so far. In particular, it makes the claim that there will be no instance of wh-movement out of VP co-occurring with I-to-C movement in which the operator is not PF-visible (in traditional terms, which involves an empty operator). This claim is fairly simple to check, since the environments in which I-to-C movement in English occur are quite limited, which we can consider in two groups.

The first group consists of yes-no questions (24), literary counterfactuals and concessives (25), non-wh-exclamatives (26), and imperatives and hortatives (27).

- (24) a. Can she play the piano?
b. Does he know many languages?
- (25) a. Had he been on time, we might have made it.
b. Be it ever so humble, there's no place like home.
- (26) a. Man, can she play the piano!
b. Am I ever glad to see you!
- (27) a. Don't everybody get up at once!
b. May he be a joy to you forever!

These various constructions have in common that there is no overt operator in specCP, and indeed no reason to assume that there has been wh-movement out of the VP at all (though it is sometimes argued that there is some kind of null operator present in specCP for various reasons, this operator is not usually assumed to originate within the clause; see McCloskey 1991:295, Potsdam 1996, and Bennis 1998). These constructions are thus irrelevant to our present concerns.

The second group consists of affective inversion structures (28), and *no sooner-* (29a), *little-* (29b), *so-* (30), and *as-* constructions (31).

⁸ Likewise for the trace of the A-moved subject, if the ECP_{PF} is generalized to A-traces as well, a possible extension outside the scope of this paper; because the subject is overt, it will satisfy clause (ii) of the ECP_{PF}. In general, I do not consider subjects here for this reason; wh-moved subjects of comparatives (such as *More people can sing than can play the piano*) will not be relevant in any case, since in these cases, no SAI is found (see Aoun *et al.* 1987:567-568, Rizzi 1990:40-41, and Grimshaw 1997 for various explanations of this fact).

- (28) Rarely have I ever been so surprised.
 (29) a. No sooner had he arrived than it started to rain.
 b. Little did he suspect that he had already been betrayed.
 (30) Abby can swim a mile, and so can Ben.
 (31) Abby got the Nobel Prize, as did her father.

In these cases, some element does precede the moved auxiliary in C⁰. For affective inversion structures (see Liberman 1974), it has been argued in Haegeman and Zanuttini 1991 that the extracted operator (*rarely* in (28)) is in specNegP, but the exact location of this specifier and its head (into which I⁰ moves) does not matter: in either case, since the operator is overt, the ECP_{PF} will be satisfied by clause (ii) of (12). Similar remarks apply to (29) and (30), though it is even less clear that any extraction has occurred (though VP-ellipsis may be highly preferred with *so*, it apparently does not have the same categorical status that the comparative examples above do; see Chomsky and Lasnik 1993 and Quirk *et al.* 1985:882 for examples of *so* with SAI without VP-ellipsis⁹).

This leaves the case of *as*. This case bears the strongest resemblance to the comparative data considered above, since VP-ellipsis is required as well (compare (31) with **Abby got the Nobel Prize, as did her father get the Nobel Prize*). This state of affairs can be accounted for if the *as*-construction involves some kind of extraction of an operator to specCP, an assumption strongly supported by island-sensitivity and other evidence (see Postal 1998 and Potts 2000). In particular, it supports the idea that *as* is not itself the extractee (since in that case, it would be an overt operator, and should not require VP-ellipsis with SAI), but rather that *as* is a head that co-occurs with a null operator (as with the equative *as* in *Abby speaks as many languages as does her father (*speak)* etc.).¹⁰ The intermediate trace of this null operator, then, will be subject to the ECP_{PF} as above, with the expected results.

Thus it appears that the present analysis achieves sufficient generality, applying equally well to other cases in which SAI occurs. Similarly, the vast majority of constructions in which wh-movement takes place (including relative clauses, clefts, pseudoclefts, ‘topicalizations’, free relatives, and embedded wh-questions) will not be relevant to

⁹ As E. Potsdam reminds me, for many speakers, VP-ellipsis is obligatory with *so*. For such speakers, we must assume that *so* is like *as* in selecting a CP whose specifier is filled by an empty operator, presumably an extracted VP (see Potts 2000 in particular for justification that such *so*-clauses involve extraction of a VP-operator). For speakers who share the judgments of Chomsky, Lasnik, and Quirk *et al.*, *so* is presumably in specCP. Another possibility, suggested to me by S. Winkler, is that the construction with *so* simply doesn’t involve ellipsis at all, *so* being itself the (moved) predicate, as in López 1995, and hence irrelevant here.

¹⁰ This is supported as well by that fact that *as* can be used as a complementizer in some dialects, equivalent to *that* in standard English (occurring in selected complement clauses and in headed relative clauses, for example). The data in (i) and (ii) illustrate these uses of *as* respectively, taken from the lower class British speech of the characters of Dorothy Sayers:

- (i) a. She was quite ready to believe as she done wrong. [D. Sayers, *Unnatural Death*, 1927, p. 109]
 b. I don’t know as I ought to tell you. [*loc. cit.*]
 (ii) This is Mr. Murbles, as put in that unfortunite advertisement, as I truly believes was the beginnin’ of it all. [*op. cit.* p. 104]

distinguishing the effects of the ECP_{PF} from those of the traditional ECP applying only at LF, since in none of these cases do we find concomitant I-to-C movement.¹¹

3 Further considerations

At this point, we have seen that the ECP_{PF} can successfully account for the generalization given in (1), and have been led to an interesting view of the kinds of constraints that can operate at the PF interface, an issue that I return to in the Conclusion below. Before concluding however, three further points are worth briefly exploring: comparatives with overt operators, pseudogapping, and V-to-I movement, which will be taken up in the following three sections in turn.

3.1 Comparatives with PF-visible operators

The first point is an intriguing prediction of sorts that the analysis makes, which as it turns out is unfortunately difficult to test for independent reasons. We have seen that in standard English comparatives, in which the operator in specCP is nonovert, SAI is impossible without concomitant VP-ellipsis. But the account given leads us to expect that if the operator were overt, SAI should be possible even without VP-ellipsis. There are varieties of American English that permit an overt operator, namely the invariant *what*, in some comparatives (see Hankamer 1973). Although it is somewhat difficult to find speakers for whom judgments involving such comparatives are absolutely secure, due to prescriptive prohibitions against the overt operator, it appears that the kind of example we would expect to find are nevertheless ungrammatical:

- (32) a. *Abby can sing more songs than what can her dad sing.
b. *Abby knows more languages than what does her father know.

Despite first, worrisome appearances, these data in fact shed no light on the account given above, because SAI in comparatives is unacceptable in these varieties even *with* VP-ellipsis:

- (33) a. *Abby can sing more songs than what can her dad.
b. *Abby knows more languages than what does her father.

Thus it is clear that the source of the judgments in (32) lies elsewhere, and does not have to do with the ECP_{PF} . One possibility is that the examples in both (32) and (33) are judged unacceptable because they involve a fatal register clash: while use of the overt operator *what* in comparatives is colloquial and belongs to a very low, informal spoken register, the use of SAI in comparatives belongs to an extremely high, formal register of English. In other words, no single register's grammar can produce these two in a single sentence (barring intentional

¹¹ We are of course left with the intriguing residual question of why the observed difference should exist between the ability of overt (PF-visible) and empty (not PF-visible) operators to license intermediate traces. Clearly this fact should find its place in a general theory of how these kinds of operators differ, presumably relating to more general considerations of recoverability and identification; see in particular Grosu 1994 for extensive discussion.

register mixing).¹² Another possibility, suggested to me by E. Potsdam, is that the syntax of the *what*-clauses in (32) and (33) is essentially that of (free) relatives, an analysis made plausible by other evidence as well (animacy restrictions, the unrestricted interpretations found in attributive comparatives, etc.); see den Besten 1978 for extensive discussion. If this is the case, then we do not expect to find SAI in any case, since SAI is excluded in (free) relatives in general.

3.2 SAI, VP-ellipsis, and pseudogapping

The second point worth exploring is the interaction of the present cases with pseudogapping. Pseudogapping as in (34a) is most widely analyzed as consisting of adjunction of a remnant XP to VP followed by VP-ellipsis (see Kuno 1981, Jayaseelan 1990, Kennedy and Merchant 2000, Johnson 2001; see Lasnik 1995 for a related but differing viewpoint), represented in (34b) as left-adjunction for convenience.

- (34) a. I eat meat, but I don't seafood.
 b. ... I don't [_{VP} seafood [_{VP} ~~eat~~]]

Pseudogapping is compatible with SAI, as the examples in (35) show (from Sag 1976a and Kempson *et al.* 1999:282 fn 43, respectively), though as Levin 1986 points out, such examples are somewhat marked.

- (35) a. A: Hey! I've never seen you on campus before. B: Nor have I you!
 b. John didn't give a nickel to Mary, nor did I a dime to Sue.

Pseudogapping also occurs in comparative clauses, as in (36); in fact, the best examples of pseudogapping are precisely in comparatives, as Levin 1986 observes.

- (36) Abby plays the flute better than her father does the trumpet.

Given Levin's observation, it is particularly surprising that pseudogapping with SAI in comparatives is impossible, as (37) shows.¹³

¹² A parallel to this situation might be found with pied-piping of prepositions and the use of the archaic form *whom*: many speakers reject examples with pied-piping of *who*, since the latter, bare, form belongs to a more colloquial register that prohibits pied-piping in favor of preposition stranding; cf. ®**With who did he speak?* (where ®* indicates a register clash) vs. the prescriptively correct *With whom did he speak?*. See Lasnik and Sobin 2000 for discussion.

¹³ Levin also observes that the level of acceptability of examples of pseudogapping deteriorates with unlike subjects (as with SAI); this fact alone may account for some of the unacceptability of the examples in this section. I am operating on the assumption that this fact itself is in need of an explanation, and in any case, Levin's observations are more of a general nature, and not meant as an absolute measure — she herself notes several examples where these conditions are not met, but pseudogapping remains possible. The pseudogapping examples in this section use unlike subjects because SAI in comparatives prohibits like subjects in any case: *Abby_i is taller now than was {her father / *she_i} last year* vs. *Abby_i is taller now than {her father / she_i} was last year* (see also Potts 2000:11-12 for discussion with respect to *as* as well; Potts points out that inversion creates an anti-pronominal context in the sense of Postal 1998, following the observation made in Quirk *et al.* 1985:1382).

(37) *Abby plays the flute better than does her father the trumpet.

We can make sense of this fact if wh-extraction out of a VP must target the highest VP-segment. In this case, an example like (37) will have the structure in (38). In (38), VP-ellipsis has deleted the VP segment below the adjoined remnant *the trumpet*, leaving the intermediate trace t_1' intact at PF, where it violates the ECP_{PF}.

(38) ... than Op_1 does her father t_{does} [_{VP} t_1' [_{VP} the trumpet [_{VP} ~~t_{SU} play t_{OB} t_1~~]]]

Crucially, a derivation in which wh-extraction targets VP first, followed by remnant adjunction, followed by VP-ellipsis must be ruled out, as this would lead to the PF representation in (39), where t_1' can be deleted along with the intermediate VP segment (see Sag 1976b, Merchant 2000 for discussion of VP segments as targets of deletion).

(39) ... than Op_1 does her father t_{does} [_{VP} the trumpet [_{VP} ~~t_1' [_{VP} ~~t_{SU} play t_{OB} t_1~~]]]]~~

There is in fact independent indication that such a restriction on the ordering of multiple A'-movement is in force (see Fox 1999), which presumably should be derived (see Chomsky 2001's notion of 'phases' and extractions from them). If (38) represents the only licit derivation, then, the absence of pseudogapping with SAI in comparatives also falls out from the analysis proposed above.

Crucially, this restriction holds only for multiple (A'-) *extractions* out of VP, utilizing adjunction to VP as a landing site, and does not hold of base-generated VP-adjuncts such as adverbials. As Potts 2000 points out, the restriction regarding pseudogapping does not extend to what are presumably VP adjuncts:

(40) Klaus would be happier in the north than would Chuck in the south. (Potts 2000:15 (61a))

Fully exploring the contrast between examples like (40) and that in (37) would take us beyond the scope of the present inquiry, but several lines of analysis are open to us. First, one might wonder whether in these case the attested adverbials are in fact adjoined to VP, and not to some higher projection (I', IP); determining the exact adjunction site of right-adjoined adverbials is notoriously difficult, and is complicated by the fact that they can undergo rightward movement as well (in this regard it is important to note that the remnant of pseudogapping must precede such adverbials: cf. *I'd build a house in the north before I would a cabin in the south* vs. **I'd build a house in the north before I would in the south a cabin*; see Sobin 1981 for contrasting data from gapping, for instance). A second possibility, assuming *in the south* in (40) is in fact right-adjoined to VP, would be to explore whether the directionality of adjunction might make a difference: if it could be shown that the remnant of pseudogapping, presumably like wh-movement, left-adjoins to VP, one might pursue an account of the differences between such remnants and adjuncts based on this fact. Third, one might claim simply that adverbial elements don't factor in the computation at PF in a relevant way, as proposed for other reasons by Bobaljik 1995; here, we might assume that VP-ellipsis

can target the highest VP segment, eliminating the illicit trace in the way discussed, but not necessarily delete a right-adjoined adverbial (following in essence Sag's 1976b proposal).

Finally, one might claim, if the attested restriction on extraction ordering is to be derived from phase-edge effects following Chomsky 2001, that merger of adjuncts at the VP doesn't affect the computation of the edge, allowing a moved element below the merged adjunct to still qualify as at the phase-edge (allowing further extraction), whereas multiple movements to the VP edge (as in the pseudogapping cases) does affect this computation. Essentially, we would claim that only one moved element, the highest one, counts as being at the phase-edge (this must be related in some manner to the differing features driving the movements involved, since multiple wh-extraction is permitted, of course; I leave open the many questions that arise). If this latter line of analysis is on the right track, the following picture emerges: when both the comparative operator and a pseudogapped remnant are moved, the resulting VP structure is that in (41a), where underlining indicates elements at the edge of the VP-phase — because the wh-operator must be extracted further, to specCP, it must be on the edge of the phase, as discussed above. But Merge targeting a VP that has a comparative operator adjoined to it by previous movement, adjoining a VP adjunct (represented as left-adjoined in (41b) for ease of comparison with (41a)), does not alter the status of the moved XP at the edge, resulting in either an expanded edge, as indicated with underlining in (41b), or perhaps simply not affecting the edge computation at all.¹⁴

- (41) a. ... than *Op*₁ does her father *t*_{does} [VP *t*₁' [VP the trumpet [~~VP~~ *t*_{SU} ~~play~~ *t*_{OB} *t*₁]]]
 b. ... than *Op*₁ would Chuck *t*_{would} [VP in the south [VP *t*₁' [~~VP~~ *t*_{SU} ~~be~~ *t*₁]]]

If this analysis is on the right track, the contrast between base-generated adjuncts and remnants of pseudogapping for blocking further wh-movement of the comparative operator falls out from the independent computation of phase-edges. Because the intermediate landing site of the comparative operator in (41b) is below the adjunct, but still on the edge, the operator can be extracted to specCP, and the VP to which *t*₁' is adjoined can be deleted as indicated, saving the structure from an ECP_{PF} violation as in (20) above.

It is thus clear that there are various analytical options available to us to account for the contrast between (37) and (40), though deciding between them should ideally be done on the basis of evidence unrelated to the data from comparatives; since doing so is not material to my present purposes, such an expanded investigation can safely await further research.

Pseudogapping raises another interesting issue, however. In such examples, the object of comparison can be an attributive adjective originating in the remnant of pseudogapping, as in (42a). Following Kennedy and Merchant 2000, I assume that such examples involve movement of the comparative operator (here, a DegP) out of the DP *a concerto*, followed by movement of *a concerto* to VP, followed by VP-ellipsis (here obligatory, for reasons discussed in detail in Kennedy and Merchant 2000); this derivation results in the structure in (42b).

¹⁴ Such a conclusion is needed independently to allow wh-extraction in the presence of VP-adjuncts in any case (or VP-internal subjects, for that matter).

- (42) a. Abby played a longer sonata than her father did a concerto.
 b. ... than Op_2 her father did $[_{VP} t_2'' [_{VP} [a t_2 concerto]_1 \text{play} [_{FP} t_2' [_{F} E^0 t_1]]]]$]]

Given the analysis developed so far, we expect that in such cases, SAI will be impossible, since t_2'' in (42b) will violate the ECP_{PF} . This prediction is correct:

- (43) *Abby played a longer sonata than did her father a concerto.

Further, it is interesting to note that the remnant of pseudogapping can itself be the object of comparison, in nominal amount comparatives such as (44) (here, VP-ellipsis is only optional, as noted in Kennedy and Merchant 2000:101 fn 10).

- (44) Abby can play more sonatas than her father can concertos.

In these cases, as with attributive comparatives, SAI and pseudogapping are incompatible:

- (45) *Abby can play more sonatas than can her father concertos.

This follows under the present account if such nominal subdeletions involve movement of an empty operator to specCP, as is usually assumed (see Chomsky 1977, Kayne 1981:98-99, Grimshaw 1987, Corver 1993, and Izvorksi 1995), an analysis suggested especially by the fact that nominal subdeletions are sensitive to the availability in a given language of preposition-stranding (see Milner 1978, Kayne 1981).¹⁵

Finally, note that SAI is not found in predicative adjectival subdeletion structures either:

- (46) *Abby is taller than is her father short.

This fact is again expected under the present analysis if these structures involve movement of an empty operator from a VP-adjoined position (as mooted by Izvorski 1995 in particular) or a VP-internal one (a possibility supported by the fact that attributive adjectival subdeletion is impossible in general, reducible to a Left Branch effect if the operator moves from the DegP inside the DP).

3.3 V-to-I movement

The last point worth examining here is the interaction of V-to-I movement with the ECP_{PF} , with a particular view to seeing what light the present analysis can shed on the nature of this movement, especially *vis-à-vis* I-to-C movement. The question that arises is whether V-to-I movement has the same effect on the licensing of wh-traces as I-to-C movement has. The answer is no, as we will see immediately. This fact raises a substantive issue: is this non-parallel behavior of head movement to be traced somehow to the differing nature of V-to-I vs.

¹⁵ I will have to leave it open how these facts could be reconciled with the account of subdeletion proposed in Kennedy 2002.

I-to-C movement, or does it derive from independent properties of the resulting structures? This in turn raises an analytical issue: is it possible to reformulate the definitions given above to retain the advantages of the account constructed thus far without faltering on V-to-I movement, and if so, what is the best way to do this? The evidence bearing on these questions is at times quite subtle, and to a great extent dependent on considerations of a more global nature than I have been concerned with here. Before tackling these questions, let me lay out what the relevant data will be.

V-to-I movement occurs in the most widely spoken varieties of English only with inflected forms of the verb *be* and the auxiliary *have* (modals being base-generated in I^0 , and other auxiliaries being quite marginal). There are two kinds of cases that will be of interest here: first, where the operator involved originates as the complement to *be*, as in (47), and second, where the operator extracts from a series of VPs selected by a verb that raises into I^0 , as in (48).

- (47) a. I didn't know how fast she was.
 b. He's not the man he was.
- (48) a. They asked what instruments she had been playing.
 b. Abby has been playing the same instruments her father has been.
 c. The Nobel is the only prize (which) Abby hasn't been awarded.

For the first set of cases, the relevant portion of the structure is given in (49).

- (49) a. ... [CP how fast₁ [IP she was [VP t₁' [VP t_{was} t₁]]]]
 b. ... [CP Op₂ [IP he was [VP t₂' [VP t_{was} t₂]]]]

The problem that emerges here is how the lower traces (t_1 and t_2 , respectively) satisfy the ECP_{PF}. (The higher, VP-adjoined traces will be licensed by clause (i) of the ECP_{PF} as we have seen.) In (49a), t_1 does not satisfy clause (i) of the ECP_{PF} as formulated in (12) because its head-governor, the trace of *was*, is not PF-active as required for PF-head-government in (13); *was* in I^0 itself is prevented from being the head-governor by Relativized Minimality (necessarily so, since if all moved heads could govern through their traces, the I-to-C movement effects would remain a mystery). This leaves the possibility that the ECP_{PF} is satisfied via PF-antecedent-government. But this possibility also fails: the closest antecedent-governor for t_1 is t_1' , by Relativized Minimality, and this trace is not PF-visible as required for PF-antecedent-government. So t_1 in (49a) fails to be either PF-head-governed or PF-antecedent-governed, and the structure should violate the ECP_{PF}, a conclusion in conflict with its status as perfectly grammatical. Precisely the same reasoning applies to (49b).

The examples in (48) present a different *prima facie* difficulty, if we assume that wh-movement proceeds cyclically by adjunction to every VP in stacked VP structures. If this is so, these examples will have the structures in (50), where only the traces of interest are given.

- (50) a. ... [CP what instruments₁ [IP she had [VP t₁'' [VP t_{had} [VP t₁' [VP been playing t₁]]]]]]
 b. ... [CP Op₂ [IP her father has [VP t₂'' [VP t_{has} [VP t₂' [VP been [VP playing t₂]]]]]]]]
 c. ... [CP (which)₃ [IP she hasn't [VP t₃'' [VP t_{has} [VP t₃' [VP been [VP awarded t₃]]]]]]]]]]

The difficulty comes from the trace which is adjoined to the VP complement of the base position of the raised verb: t_1' , t_2' , and t_3' in (50a), (b), and (c), respectively. Here we face a similar situation to the one just described for complements of moved *be*: t_1' in (50a) is neither PF-antecedent-governed (since the closest antecedent-governor is t_1'' , which is not PF-visible) nor PF-head-governed (since t_{had} is not PF-active). Of course, this kind of example only poses a difficulty if wh-extraction proceeds via adjunction to every VP: if, on the other hand, extraction proceeds only via adjunction to the highest VP in such stacked VP structures, nothing more need be said, since a trace adjoined to this VP is PF-head-governed by the raised verb in I^0 . Although it has not been settled in the literature whether such cyclic adjunction is necessary, I will proceed on the assumption that under the system generally used here, extraction will result in such intermediate adjoined traces.

I take it that the difficulty in these two kinds of examples can be traced back to the same source and that, since the difficulty cuts across the distinction between overt and null operators, this source is to be located in the nature of PF-head-government. In some fashion, and counter the naive expectation raised by the case of I-to-C movement, the structures in (49) and (50) manage to satisfy the ECP_{PF} despite the attested verb movement: for some reason, V-to-I movement does not have the effect of disrupting PF-head-government of traces that would have been PF-head-governed from the original position of the moved V. The question that must be answered, then, is why this should be so.

There are two possible answers to this question. The first takes as its starting point the idea that the traces of the moved verbs are PF-head-governors despite that fact that they are not, under our current definitions, PF-active; in other words, why is it that a trace of a verb (t_V) raised to I^0 qualifies as a PF-head-governor, but the trace of I (t_I) raised to C^0 does not?

Posing the question this way leads us to search for a principled distinction between the kinds of movement involved, considering especially properties of the moved elements and the positions they are moved from. Indeed, it is not difficult to find discussions of the quite different nature of the inherent governing properties of V vs. I: much of the literature on the nature of (especially proper) head-government has stressed exactly the defective nature of I^0 , in contrast to the more durable ability of V^0 to properly head-govern, accounting especially for subject-object extraction asymmetries in these terms. Following this line of thought, we could revise the definition of PF-active in (14) to be sensitive to these differences: in terms of the theory of Chomsky 1986, for example, where V L-marks its complement but I does not (Chomsky 1986:79), we can redefine PF-active as follows:

- (51) A link α_i in a chain $\langle \alpha_1, \dots, \alpha_n \rangle$ is *PF-active* iff α_i is the link at which lexical insertion or L-marking occurs.

Under this definition, the lowest position in a chain of verb movement is always a PF-head-governor, since it is from this position (α_n) that L-marking proceeds (i.e., a verb V L-marks its complement when V is in the position α_n , not in any other, derived, position). Viewed from the perspective of positions in the tree, this kind of solution claims essentially that the position I is defective with respect to PF-head-government, and must be targeted by lexical

insertion in order to qualify as a PF-head-governor, whereas V always qualifies as such, regardless of whether it is the position targeted by lexical insertion or not.

This approach bears most similarity to the approach to defining head governors advocated in Chung 1991, who restricts head governors to those heads that either belong to a given set (among which V), or else are phonetically overt (Chung 1991:120). Though the class picked out there is slightly different from the one required here, the similarity is otherwise close: lexical heads are ‘prototypical head governors’ (Chung 1991:107) whose head-government properties are invariant, while more defective functional heads like D must be phonetically overt to qualify as head governors (see also Chung 1998:276-322 for extensive recent discussion). The approach also bears a similarity to the definition of ‘PF-visible’ advocated in Aoun *et al.* 1987, who propose that a head H will qualify as a PF-head-governor either if H is phonetically overt or if H has acquired an ‘index through the application of grammatical processes like a syntactic movement rule...’ (Aoun *et al.* 1987:539). They leave it somewhat open what may count as a qualifying ‘grammatical process’; if V-to-I movement, but not I-to-C movement, were posited to pass on an index in their system, the distinction necessary here could be made as well (a distinction that may well be derivable from independent factors, if V-to-I movement occurs in the syntax before Spell-Out, but I-to-C at PF).¹⁶

Such an analysis, though perfectly adequate and consistent with previous theoretical work, suffers primarily from the need to posit a disjunction in the definition of PF-active; as Rizzi 1990:76-77 points out, disjunctive statements sometimes point to a deficient understanding of the underlying properties at issue, though they may be productive and useful research vehicles nonetheless. This metatheoretical concern is essentially the only objection one could bring to the redefinition of PF-active in terms sensitive either to lexical insertion or L-marking (or its equivalent) in (51).

The second possible answer to the question of why V-to-I and I-to-C movement have the variable effects seen in English explores the possibility of imposing a PF-adjacency requirement on PF-head-government, as Aoun *et al.* 1987:573-575 do (cf. also Kayne 1981:98). The simplest way to do this is to alter the definition of PF-head-government in (13) above by replacing clause (i.c) (the Relativized Minimality requirement) by a clause requiring that be *PF-adjacent* to . Two elements can then be defined as PF-adjacent iff no PF-visible head or specifier separates them.¹⁷

This additional requirement draws the desired distinctions, as a brief consideration of the relevant cases shows. In the case of I-to-C movement, the subject will intervene between I in C and the VP-adjoined wh-trace, blocking PF-adjacency, with the results of the analysis

¹⁶ In fact, Aoun *et al.* are somewhat unclear on whether head movement leaves an indexed trace: on p. 539 they assume that ‘rules moving ... nonphrasal categories do not leave ... indices’, while on p. 546, they claim that ‘the trace of a moved verb ... is indexed’, in order to account for V2 effects in Dutch; they further point out that the literature on the question is equivocal, citing Torrego 1984 and Bouchard 1985 for conflicting claims regarding the ability of moved verbs to count as governors for the purposes of the ECP.

¹⁷ For purposes of adjacency, adjoined elements such as adverbs do not count, either for the reasons posited by Bobaljik 1995, or, at least for the cases in (48), simply because the option of adjoining the adverbs below the wh-trace has been taken. In this regard, it is also interesting to note that negation does not count, as (48c) above indicates (while in the computation relevant for *do*-support, negation destroys adjacency; I conclude from this fact that ‘affix-hopping’ is not dependent on PF-head-government as defined here).

In sum, the facts of V-to-I movement are compatible with the present analysis under two different and equally viable minor redefinitions of PF-head-government. The first builds upon a posited difference between V-to-I and I-to-C movement related to the lexical nature of the base position V, while the second capitalizes on the fact that subjects in English appear between I and C and disrupt PF-adjacency. In either case, we have a workable adaptation of the above analysis of the fact that I^0 moving into C^0 causes a disruption of PF-head-government in the manner we have seen, while verbs moving into I^0 have the ability to satisfy the ECP_{PF} via, or in spite of, their traces.

Conclusion

The analysis presented here rests on three elements: first, that wh-movement of the comparative operator proceeds via adjunction to the VP sister of I^0 ; second, that the resulting intermediate trace is subject to an ECP operating at the PF interface; and third, that I-to-C movement destroys the possibility that this ECP can be satisfied by head-government by I^0 . These three elements have the result that in comparatives, where the extracted operator is nonovert, structures in which I-to-C movement has applied will always be accompanied by VP-ellipsis. The result is an internally coherent analysis of the surprising and subtle generalization that opened this paper, an analysis which furthermore is compatible with all other instances of subject-auxiliary inversion in English, and which does not rely on construction-specific statements or restrictions.

The theoretical import of the present analysis is not merely that there must be a licensing condition on traces that applies at PF, and that this condition must have the disjunctive character of Chomsky's 1981, 1986 ECP (not the conjunctive character of Rizzi 1990, for example), but *simpliciter* that there must be such a licensing condition at all. This is a conclusion some recent work has attempted to avoid, instead building the traditional representational well-formedness conditions such as the ECP into the well-formedness conditions on the movement operation itself. If the analysis presented here is correct however, such efforts cannot suffice to account for the full range of data a static ECP_{PF} can: presumably no derivational version of the ECP can be devised that would have the ability to look ahead to the output of PF deletion, and license the intermediate traces in question just in case such a later PF operation were to apply. Since it is exactly VP deletion that rescues otherwise ill-formed structures, and since this deletion happens in the mapping from Spell-Out to PF, no derivational constraint applying (stepwise or otherwise) before Spell-Out will be able to take this deletion into account. A static well-formedness condition such as the ECP_{PF} pursued here, on the other hand, will apply only after all deletion operations have, at the PF interface itself, and will be sensitive to exactly this kind of information, with the results we have seen.

Indeed, if Chomsky 1995 and others are correct in analyzing I-to-C movement itself as a kind of movement that takes place on the PF side of the derivation (though see Zwart 2001 for important qualifications), then we have no recourse but to look to conditions on that side of the derivation to account for the generalization established here, since it is only in

movement only co-occur in matrix clauses with overt operators, given Reis 2000's convincing re-analysis of the purported cases of embedded V2 as a special kind of parenthetical.)

structures in which SAI has occurred that such VP-ellipsis is required. Putting these considerations together, we find all the more reason to posit well-formedness constraints such as the ECP_{PF} that operate exclusively at the PF interface.

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