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Citation: Hartman, Jeremy. "The Semantic Uniformity of Traces: Evidence from Ellipsis Parallelism." *Linguistic Inquiry* 42 (2011): 367-388. Web. 19 Oct. 2011. © 2011 by the Massachusetts Institute of Technology

As Published: http://dx.doi.org/10.1162/LING_a_00050

Publisher: MIT Press

Persistent URL: <http://hdl.handle.net/1721.1/66500>

Version: Final published version: final published article, as it appeared in a journal, conference proceedings, or other formally published context

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The Semantic Uniformity of Traces: Evidence from Ellipsis Parallelism

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This article presents an argument from ellipsis parallelism that traces of all types of movement receive a bound variable interpretation at LF. MaxElide, a constraint on ellipsis, is used to probe the size of parallelism domains and detect the semantic contribution of a variety of traces. The data examined reveal a detailed interaction between *wh*-movement from various positions, T-to-C movement, and movement of subjects. I offer an analysis based on the overlapping variable-binder relationships created by these movements. The theoretical conclusion is that \bar{A} -, A-, and head movement all produce traces that feed interpretation. This conclusion argues directly against several proposals that deprive non- \bar{A} movements of (certain) semantic effects—for example, proposals that head movement occurs at PF, or that A-movement does not leave traces.

Keywords: ellipsis, movement, traces, sluicing, VP-ellipsis, MaxElide

A central question about the syntax-semantics interface concerns the interpretation of movement. While \bar{A} -movement has evident semantic consequences, the interpretive status of head movement and A-movement has been more controversial. Indeed, it has often been suggested that different types of movement provide fundamentally different inputs to the semantic component of the grammar. For instance, several authors (Chomsky 2000, Boeckx and Stjepanović 2001, Harley 2004) have claimed that head movement is ‘‘phonological’’ and hence does not affect interpretation at all. Others (Lasnik 1999, Omaki 2008) have proposed that A-movement and/or head movement simply do not leave traces.

This article presents evidence against such proposals, and in favor of the view that all types of movement leave traces that feed interpretation. Using the identity conditions on ellipsis as a diagnostic tool, I show that A-traces, \bar{A} -traces, and traces of head movement are all interpreted as bound variables. In addition to casting empirical doubt on previous proposals, this result has the appealing theoretical consequence that the interpretation of movement is, in an important

For valuable comments and discussion, I thank Danny Fox, Sabine Iatridou, Kyle Johnson, Jason Merchant, David Pesetsky, and Gary Thoms, as well as two anonymous *LJ* reviewers. I am indebted to Mohit Bhansali, Apurva Joshi, and Jim McCloskey for judgments. All remaining errors are mine.

respect, uniform. All varieties of syntactic movement give rise to variable-binding configurations at LF.¹

Merchant (2008; circulated 2001) was the first to suggest that ellipsis is subject to a constraint, *MaxElide*, that prefers a larger elided constituent over a smaller one, in particular environments. His proposal was subsequently refined and extended by Takahashi and Fox (2005), whose formulation I adopt here. *MaxElide* chooses the largest deletable constituent within a given domain of semantic parallelism, and its effects are visible whenever a variable inside the elided constituent is bound from outside the elided constituent. By examining the role of traces in various positions and of various movement types, I bring to light an expanded *MaxElide* paradigm and show that it is explained if all types of traces are interpreted as bound variables.

The article is organized as follows. In section 1, I give a brief overview of *MaxElide*, its theoretical background, and the types of data that fall within its purview. In section 2, I formulate and confirm a series of predictions regarding the varied location of \bar{A} -traces. I present new data involving extraction from embedded clauses, as well as higher versus lower positions inside the main clause. In section 3, I turn to the role of non- \bar{A} traces, examining the interaction among *wh*-adverbials, T-to-C movement, and subject movement. I summarize the data in the article and then present the analysis. In sections 4 and 5, I conclude by discussing various implications and extensions of the analysis and speculating on directions for further inquiry.

1 *MaxElide*: Background

1.1 *Preliminary Data and Account*

It has been observed (Merchant 2001, 2008; cf. Sag 1976:63–65) that VP-ellipsis is often disallowed when sluicing in the same clause is possible. The effect is illustrated in (1).

- (1) a. Mary was kissing someone, but I don't know who (*she was).
- b. John borrowed a book. Guess which book (*he did).
- c. You play a wind instrument? Which one (*do you)?
- d. *Speaker A*: John has broken something.
 Speaker B: What (*has he)?
- e. Mary was reading. The question is: what (*was she)?
- f. *Speaker A*: Susan will talk to a professor.
 Speaker B: Did you hear which one (*she will)?
- g. Fred likes chocolates. Does anyone know what kind (*he does)?
- h. Anna was afraid. But God only knows of what (*she was).
- i. You admire a woman in this room. Tell me who (*you do).

¹ A qualification is necessary here. I am not including, and have not investigated, the kinds of overt rightward movement operations that are sometimes taken to apply in cases such as heavy NP shift, clausal extraposition, and scrambling. One natural extension of the present investigation would be to see whether the parallelism tests in this article can be extended to these movements, and with what results. (Another potential qualification concerns reconstructed movement, which I address briefly in footnote 17.)

Takahashi and Fox (2005) propose an account of this effect that is based on the theory of ellipsis parallelism developed by Rooth (1992) and Heim (1997). A version of this theory is given in (2)–(3), from Takahashi and Fox 2005:229, followed by a brief explication of an important consequence.

- (2) For ellipsis of EC [elided constituent] to be licensed, there must exist a constituent, which reflexively dominates EC², and satisfies the parallelism condition in (3). [Call this constituent the *parallelism domain (PD)*.]
- (3) *Parallelism*
 PD satisfies the parallelism condition if PD is *semantically identical to another constituent AC, modulo focus-marked constituents*.³

Note that the definition in (2) leaves the size of the PD unfixed; in principle, the PD may be the elided constituent itself, or larger. The condition in (3), however, entails that there is one particular scenario in which the PD *must* be larger than the elided constituent. This scenario occurs when the elided constituent contains a variable whose binder lies outside the elided constituent. In this configuration, which Takahashi and Fox term *rebinding*, the semantic condition in (3) will require the PD to be large enough to include the binder. If the PD did not include the binder, the PD would contain a free variable, rendering it semantically nonidentical to its antecedent.⁴

With these rebinding configurations in mind, Takahashi and Fox (2005:229) propose the following condition on deletion:

- (4) *MaxElide*
 Elide the biggest deletable constituent reflexively dominated by the PD.⁵

² XP reflexively dominates YP if XP dominates YP or XP = YP.

³ In Takahashi and Fox's formulation (2005:229), "PD is semantically identical to AC modulo focus-marked constituents if there is a focus alternative to PD, PD_{Alt}, such that for every assignment function g , $\llbracket \text{PD}_{\text{Alt}} \rrbracket^g = \llbracket \text{AC} \rrbracket^g$. PD_{Alt} is an alternative to PD if PD_{Alt} can be derived from PD by replacing focus-marked constituents with their alternatives." The exception for focused material will not be central to our argument, but it is necessary so that parallelism can be established in examples like those in section 1.2. See Rooth 1992 for discussion.

⁴ As Takahashi and Fox (2005:230–231) note, we must also assume Heim's (1997) ban on "meaningless coindexation" to ensure that the variable that is free within the elided constituent and the variable that is free within the antecedent constituent are not "accidentally" assigned the same index.

(i) If an LF contains an occurrence of a variable v that is bound by a node α , then all occurrences of v in this LF must be bound by the same node α .
 (Heim 1997:202)

⁵ The original formulation that Merchant (2008:141) proposed is as follows:

(i) Let XP be an elided constituent containing an \bar{A} -trace
 Let YP be a possible target for deletion
 YP must not properly contain XP

As we will see, there is good reason to disprefer a formulation that explicitly restricts MaxElide to \bar{A} -traces. See also Takahashi and Fox 2005:225, where examples from Sag 1976 and Williams 1977 are used to show that the effects of MaxElide extend to bound variable *pronouns*, which are not traces at all. Specifically, in cases of "sloppy identity" where a pronoun is bound from a higher clause, ellipsis of the larger VP is possible, but ellipsis of the embedded VP is impossible.

Assuming that *wh*-traces are interpreted as bound variables, MaxElide explains the effect illustrated in (1). To see this, consider (1a), repeated in (5), with the LF representation shown.⁶

- (5) Mary was kissing someone, but I don't know who (*she was).
 someone $\underbrace{[\lambda y. \text{Mary was } [_{VP} \text{kissing } y]]}_{AC} \dots \text{who } \underbrace{[\lambda x. \text{she was } [_{VP} \text{kissing } x]]}_{PD}$

This structure instantiates the rebinding scenario described above. VP itself is not a possible choice of PD, since it contains a rebound variable. This variable requires the PD to be at least as large as the constituent immediately dominating the binder, λx . MaxElide applies to this larger PD, and the biggest deletable constituent it contains is the constituent targeted by sluicing. Deletion of VP, a smaller constituent, will violate MaxElide.

It is important to bear in mind that MaxElide does *not* force selection of the largest PD. It allows selection of *any* PD that satisfies the parallelism condition in (3), and then it forces selection of the largest deletable constituent within that PD. The application of MaxElide can thus be represented with the “two-step” template in (6), which I will employ throughout this article.

- (6) 1. Select a possible PD
 2. Apply MaxElide to that PD

Yields ellipsis possibilities

Note that in the absence of a rebound variable, the possibility of a larger elided constituent does not rule out ellipsis of a smaller constituent, since nothing prevents the smaller elided constituent from being a PD. MaxElide can thus apply to either a larger or a smaller PD, yielding a different elided constituent depending on which PD is selected. This is the case in (7), where ellipsis of either the higher or the lower VP is an option.

-
- (ii) a. John said Mary hit him, and BILL also did $\langle \lambda x. x \text{ say Mary hit } x \rangle$
 b. *John said Mary hit him, and BILL also $\lambda x. x$ said she did $\langle \lambda y. y \text{ hit } x \rangle$
- (iii) a. John is proud that there are pictures of him there, and BILL is $\langle \lambda x. x \text{ proud that there are pictures of } x \text{ there} \rangle$, too
 b. *John is proud that there are pictures of him there, and BILL is $\lambda x. x$ proud that there are $\langle \text{pictures of } x \text{ there} \rangle$, too
 (Takahashi and Fox's (5) and (6), adapted from Sag 1976 and Williams 1977, respectively)

Since sloppy identity here requires the pronoun to be bound from the matrix clause, the PD must be as large as the constituent immediately dominating this binder. MaxElide will therefore rule out ellipsis of the embedded VP, since it is not the largest deletable constituent in the PD. (Note that strict identity *is* possible here, because it does not require a rebinding configuration, and is thus compatible with a smaller PD.)

⁶ Covert quantifier raising creates the binding structure in the AC, just as overt *wh*-movement does in the EC. In both cases, I assume that the binder is a λ -operator adjoined to the scope of the moved element. See section 4.3 for discussion of the importance of this assumption.

(7) Mary said you would leave, and Sue also [_{VP1} said you would [_{VP2} leave]].

- | | | |
|-------------------------------|--------------|--------------|
| 1. Possible PDs: ⁷ | VP1 | VP2 |
| 2. MaxElide chooses: | VP1-ellipsis | VP2-ellipsis |
-

Mary said you would leave, and Sue also did.

Mary said you would leave, and Sue also said you would.

Again, in the rebinding cases, only a larger PD is possible, so the template looks like this:

(8) Mary was kissing someone, but I don't know who [λx . she was [_{VP} kissing x]].

- | | |
|----------------------|--|
| 1. Possible PD: | “ λxP ” (i.e., the constituent immediately dominating λx) |
| 2. MaxElide chooses: | sluicing |
-

Mary was kissing someone, but I don't know who.

*Mary was kissing someone, but I don't know who she was.

1.2 A Note on Intervening Focus

When focused material intervenes between two potential elided constituents, deletion of the smaller one is possible, as illustrated in (9)–(11). This, too, is predicted by MaxElide, as Takahashi and Fox (2005) note. Since focused material cannot be deleted, the largest *deletable* constituent in these examples will be VP, and MaxElide is satisfied.

(9) Mary doesn't know who we can invite, but she can tell you who we CANNOT.

(Takahashi and Fox 2005:(9))

(10) I don't know which puppy you should agree to adopt, but I know which one you should REFUSE to.

(Takahashi and Fox 2005:(33))

(11) I don't know who JOHN will kiss, but I know who SUSAN will.

2 The Position of \bar{A} -Traces

2.1 Wh-Adverbials and MaxElide

The above examples have dealt exclusively with argument *wh*-words. In this section, I show that the behavior of *wh*-adverbials provides a new window onto the workings of MaxElide, confirming the role of the trace position in determining possible PDs, and eventually in section 3 revealing an important interaction with head movement and A-movement.

Let us begin with the fact (observed in Schuyler 2001) that *wh*-adverbials often do not yield MaxElide violations with VP-ellipsis.

⁷ Technically, there are many more possible PDs than indicated. Here and elsewhere, I show only the minimal PD that licenses each syntactically deletable constituent. For example, the constituent *would leave* is a possible PD but, for syntactic reasons, is not itself a deletable constituent (see, e.g., Lobeck 1995).

- (12) a. Mary was trying to kiss someone, but I have no idea why (she was).
 b. *Speaker A*: John's leaving.
 Speaker B: Do you know when (he is)?
 c. John knows the prisoners escaped, but he doesn't know how (they did).
 d. You say you'll pay me back, but you haven't told me when (you will).
 e. Susan practices her violin. I'm just not sure how frequently (she does).
 f. *Speaker A*: Tom baked a cake.
 Speaker B: I wonder why (he did).

The contrast with the examples in (1) is striking. Recall that with *wh*-objects, sluicing was available, but VP-ellipsis was unacceptable. With the *wh*-adverbials in (12), sluicing is still available; the difference is that now VP-ellipsis is available as well. Following one of Schuyler's (2001) insights, I propose that a smaller PD is in fact possible in (12), if the *wh*-adverbials can be merged outside the VP. Much evidence has accumulated in the literature for the availability of VP-external adjunction sites for adverbial phrases (see Baltin 2007 and references therein).⁸ Let us take this VP-external merger to be adjunction to TP, as illustrated in (13b).⁹

- (13) I don't know . . .
 a. [_{CP} who [_{TP} John will [_{VP} leave ~~wh~~θ]]].
 b. [_{CP} when [_{TP} ~~when~~ [_{TP} John will [_{VP} leave]]]].

If the structure in (13b) is available for *wh*-adverbials but not for *wh*-objects, then it is clear why *wh*-adverbials, unlike *wh*-objects, do not trigger MaxElide violations with VP-ellipsis: they need not leave a trace in the elided VP. This is illustrated in (14).

- (14) . . . I don't know when λz. [_{TP} ~~when~~_z [_{TP} John will [_{VP} leave]]]
- | | | |
|----------------------|----------|-------------|
| 1. Possible PDs: | λzP | VP |
| 2. MaxElide chooses: | sluicing | VP-ellipsis |

John will leave, but I don't know when.
 John will leave, but I don't know when he will.

⁸ Further evidence for the availability of the VP-external adjunction structure comes from the fact that *wh*-adverbials, unlike *wh*-objects, can escape deletion in VP-ellipsis constructions. (For speakers who liberally accept imperfect instances of pseudogapping, the (b) sentences may be marginally acceptable because of this independent derivation.)

- (i) a. John called today, so he doesn't have to tomorrow.
 b. *John called Mary, so he doesn't have to Susan.
 (ii) a. We won't succeed today. But we will someday.
 b. *We won't hire John. But we will someone.

⁹ Although this assumption is reasonably common in the syntactic literature (see, e.g., Hornstein and Weinberg 1981), an anonymous reviewer points out that it may create a problem for some semantic analyses of tense. For instance, on von Stechow's (2009) analysis, temporal adverbials contain a covert time variable that must be *under* the scope of existential quantification introduced by Tense morphology. Therefore, temporal adverbials adjoined to TP would be too high to be bound. The conflict might be avoided if quantification over times is introduced not by Tense morphology itself, but by covert existential closure of the time variable higher in the structure (or if temporal adverbials are simple modifiers of event predicates, without covert time variables).

Since the VP here contains no rebound variables, it is a possible PD. MaxElide can apply to this PD, and VP will be the largest deletable constituent. Alternatively, it remains an option to select a sufficiently larger PD. This will yield sluicing.

2.2 *Embedded Clauses*

The preceding explanation for the lack of MaxElide violations with *wh*-adverbials relies on the fact that *wh*-adverbials can originate above the elided VP. This explanation thus makes a straightforward prediction: if we have a structure in which the *wh*-adverbial originates *below* the elided VP, then VP-ellipsis should once again be ruled out by MaxElide. One way of testing this prediction is to add an embedded clause and examine the possibility of embedded construal of the *wh*-adverbial. The two interpretations of sentences like (15) correspond to two different origin sites of the *wh*-adverbial.

- (15) I forget when he said Mary left.
- a. I forget [_{CP} when [_{TP} ~~when~~ [_{TP} he [_{VP} said [_{CP}[_{TP} Mary left]]]]]]
(Matrix reading)
 - b. I forget [_{CP} when [_{TP} he [_{VP} said [_{CP} ~~when~~ [_{TP} ~~when~~ [_{TP} Mary left]]]]]]
(Embedded reading)

The embedded reading diagnoses a structure where the *wh*-adverbial originates below the matrix VP. The prediction, then, is that if we construct examples like those in (12), except that the elided constituent now includes an embedded clause, we should once again observe MaxElide's signature contrast between sluicing and VP-ellipsis. Specifically, the VP-ellipsis cases should allow a reading where the *wh*-adverbial modifies the matrix clause, but not a reading where it modifies the embedded clause. The sluicing cases should allow both readings. This prediction is in fact borne out.

- (16) a. John said Mary would leave, but I forget when.
√Matrix reading / √Embedded reading
- b. John said Mary would leave, but I forget when he did.
√Matrix reading / *Embedded reading
- (17) a. Mary is telling John to object, but I'm not sure how forcefully.
√Matrix reading / √Embedded reading
- b. Mary is telling John to object, but I'm not sure how forcefully she is.
√Matrix reading / *Embedded reading
- (18) a. Susan asked John to return. Guess when.
√Matrix reading / √Embedded reading
- b. Susan asked John to return. Guess when she did.
√Matrix reading / *Embedded reading
- (19) a. Tom learned to play the "Minute Waltz," but I'm not sure how quickly.
√Matrix reading / √Embedded reading

- b. Tom learned to play the ‘‘Minute Waltz,’’ but I’m not sure how quickly he did.
 ✓Matrix reading / *Embedded reading¹⁰

In the structure corresponding to the matrix readings, the PD can be as small as the matrix VP, or larger. Both sluicing and VP-ellipsis are thus possible, as shown in (20).

- (20) I forget when λz . [_{TP} ~~when_z~~ [_{TP} John said Mary [_{VP} left]]]
 (Matrix reading)

- | | | |
|----------------------|--------------|-------------|
| 1. Possible PDs: | λzP | VP |
| 2. MaxElide chooses: | sluicing | VP-ellipsis |
-

John said Mary would leave, but I forget when.
 John said Mary would leave, but I forget when he did.

In the structure corresponding to the embedded readings, the *wh*-adverbial originates below the matrix VP. Here, the matrix VP *cannot* be a PD, since it contains a rebound variable. Sluicing is possible, but matrix VP-ellipsis violates MaxElide, as shown in (21).¹¹

- (21) I forget when λz . [_{TP} he [_{VP} said [_{CP} ~~when_z~~ λy . [_{TP} ~~when_y~~ [_{TP} Mary left]]]]]]]
 (Embedded reading)

- | | |
|----------------------|--------------|
| 1. Possible PDs: | λzP |
| 2. MaxElide chooses: | sluicing |
-

John said Mary would leave, but I forget when.
 *John said Mary would leave, but I forget when he did.

2.3 Subjects Extracted from Embedded Clauses

The same effect can be shown for *wh*-subjects, which have been observed (Lasnik 2001, Merchant 2008) not to trigger MaxElide violations in the simplest cases.¹²

¹⁰ It is at least worth considering another, less intuitive possibility: perhaps in the (a) examples, what appears to be an embedded reading is in fact produced by omitting the higher clause entirely. For example, (16a) could be derived from *I forget when* _{EC} *Mary will leave* _t. This idea must be rejected. The distinct embedded reading can easily be made salient in examples like (i).

(i) That crazy cult wants Moses to return to earth, but I don’t know when.

In this case, the second clause clearly means ‘I don’t know when they want him to return to earth’, not ‘I don’t know when he will return to earth’.

¹¹ Ellipsis of the lower VP is fine, as expected, on both the matrix and the embedded readings (*John said Mary would leave, but I forget when he said she would*). I am indebted to an anonymous reviewer for pointing out that, in this regard, the analysis straightforwardly predicts what would otherwise be a very unintuitive three-way contrast: the embedded reading is available under either the smallest ellipsis option (embedded VP-ellipsis) or the largest ellipsis option (matrix sluicing), but not under the intermediate option of matrix VP-ellipsis. Furthermore, this prediction is made only if *wh*-movement is successive-cyclic and each movement introduces a new binder. See also section 4.2 for a similar argument about A-movement.

¹² I defer the analysis of these examples until section 3. Given the discussion so far, however, it would be fair to ask *why wh*-subjects do not trigger MaxElide violations. Assuming that subjects originate inside the VP, we might expect them to pattern with objects rather than with adjuncts. (Indeed, the behavior of *wh*-subjects was part of Merchant’s (2008)

- (22) a. Someone kissed Susan, but I don't know who (did).
 b. One of the professors will give the talk, but I'm not sure which one (will).
 c. *Speaker A*: Someone solved the problem.
 Speaker B: Who (did)?
 (Merchant 2008:(37))
 d. *Speaker A*: Someone here has been to Paris.
 Speaker B: Really? Who (has)?

In keeping with the prediction, though, subjects *do* in fact trigger MaxElide violations when extracted from an embedded clause.

- (23) a. John wants someone to kiss Susan, but I don't know who (*he does).
 b. Mary said a certain girl would come, but I forget which girl (*she did).
 c. *Speaker A*: Mary was hoping one of her friends would win.
 Speaker B: Really? Which one (*was she)?
 d. Tom thinks one of the professors will talk. I forget which one (*he does).
 e. *Speaker A*: I expect a few of the students to fail the test.
 Speaker B: Which students (*do you)?

As in the *wh*-adverbial cases, the embedded reading indicates a structure where the *wh*-word originates below the matrix VP. In this structure, the matrix VP cannot be a PD, since it contains a rebound variable. When we select a PD large enough to contain a binder for that variable, MaxElide will choose sluicing, ruling out VP-ellipsis.

In this section and the previous one, we have examined the behavior of *wh*-adverbials and *wh*-subjects, compared with *wh*-objects. The findings can be summarized with the following generalization:

- (24) With regard to MaxElide, both *wh*-subjects and *wh*-adverbials behave differently from *wh*-objects. The exception is *wh*-subjects and *wh*-adverbials extracted from lower clauses, which behave like *wh*-objects.

motivation for restricting his original version of MaxElide to \bar{A} -traces; he noted that in examples like (22a–d), VP-ellipsis is allowed “since the elided VP does not contain a *wh*-trace” (p. 143), only the trace of subject movement.)

I am indebted to an anonymous reviewer for making clear what we may conclude from (22a–d) at this point in the discussion: at the very least, (the output of) subject movement *can* be visible at LF. That is, a structure like (i), where the VP-internal trace is bound only by the *wh*-operator, cannot be the only LF representation for a subject-extracted *wh*-question.

- (i) [_{CP} who λx . [_{TP} will [_{VP} x leave]]]

We are left with two options: either subject movement leaves no interpreted VP-internal trace, or (anticipating the analysis to come) the VP-internal trace is bound by an intermediate operator—that is, subject movement creates its own λ -abstractor.

In other words, we have confirmed that it is truly *the location of the wh-trace*, rather than the grammatical function of the *wh*-word, that is relevant for predicting the effects of MaxElide.

2.4 “Low” Adverbial Interpretation

In the previous sections, we have examined *wh*-adverbials and *wh*-subjects that originate in an embedded clause. In this section, I present a related phenomenon inside a single clause. The data involve two cases of “low” (VP-level) adverbs.¹³ In both cases, the basic argument remains the same: the lower interpretation of the adverb corresponds to a trace inside the elided VP, thus producing a MaxElide violation.

2.4.1 *Low Temporal Adverbials and the Perfect* Consider the ambiguous sentence in (25).

- (25) John has been in Boston for two months.
- a. John is in Boston now, and has been there for the past two months.
 “U-(niversal) Perfect”: Perfect level-adverb
 - b. There was a two-month period that John spent in Boston (say, back in 1983).
 “E-(xperiential) Perfect”: Eventuality-level adverb

Iatridou, Anagnostopoulou, and Izvorski (2003) suggest that the first reading is associated with a structure in which the adverbial is adjoined higher in the clause, and the second reading is associated with a structure in which the adverbial adjoins internal to the VP domain. Let us take the higher location to be TP-adjunction (26a).

- (26) a. [_{TP}[_{TP} John has [_{VP} been in Boston]] for two months].
 b. [_{TP} John has [_{VP} been in Boston for two months]].

From this proposal it follows that, in *wh*-movement contexts, the E-Perfect reading indicates a structure with a VP-internal trace and thus provides another testing ground for MaxElide effects. Specifically, the prediction is that the sluicing cases should allow both the U-Perfect and the E-Perfect, while the VP-ellipsis cases should allow only the U-Perfect. The following examples show that this prediction holds:

- (27) a. John’s been in Boston, but I don’t know for how long.
 √U-Perfect / √E-Perfect
 b. John’s been in Boston, but I don’t know for how long he has.
 √U-Perfect / ??/*E-Perfect
- (28) a. Mary’s been on a diet, but I’m not sure for how many months.
 √U-Perfect / √E-Perfect
 b. Mary’s been on a diet, but I’m not sure for how many months she has.
 √U-Perfect / ??/*E-Perfect

¹³ The ideas for these two arguments originated in discussions with Sabine Iatridou and Jeroen van Craenenbroeck, respectively. For yet another example of “low” adverbials, Mark Baltin (pers. comm.) points out that subcategorized adverbials, which are plausibly VP-internal, predictably pattern like *wh*-objects with respect to MaxElide.

(i) Mary became angry, but we don’t know how angry (*she did).

2.4.2 *Low Reason Adverbials and Negation* Consider now the sentence in (29), which is ambiguous between a “high” reading (adverbial adjoined above negation, to TP) and a “low” reading (adverbial adjoined below negation, to VP).

- (29) John’s not getting married for that reason.
 a. *John*: “I’m never getting married. I’m just too attached to my bachelor lifestyle.”
 (High reading)
 b. *John*: “I’m eager to get married. But one thing I’m definitely not doing is getting married for money.”
 (Low reading)

The prediction is that the sluicing cases should allow both the high and the low readings, while the VP-ellipsis cases should allow only the high reading. The following examples show that the prediction holds:

- (30) a. John’s not getting married for a certain reason, but I forget why.
 ✓High reading / ✓Low reading
 b. John’s not getting married for a certain reason, but I forget why he’s not.
 ✓High reading / ??/*Low reading

2.5 Conclusion

This section explored the behavior of *wh*-adverbials and *wh*-subjects with respect to MaxElide and demonstrated an important interaction with embedded construal and other types of “low” interpretation. The next section begins with a revealing contrast that is only observable through the behavior of *wh*-adverbials. I present an account of the newly expanded MaxElide paradigm and highlight its implications for the semantic representation of non- \bar{A} traces.

3 T-to-C Movement, A-Movement, and the Full MaxElide Paradigm

The goal of this section is (a) to present a data paradigm that features an interaction between *wh*-adverbials and T-to-C movement in the context of ellipsis, and (b) to show that this interaction is only accounted for by a combination of A-movement and head movement that demonstrates the ability of both these types of traces to expand PDs.

3.1 Interaction of Wh-Adverbials with T-to-C Movement

Let us begin with a revealing asymmetry. We saw in (12) that *wh*-adverbials do not trigger MaxElide violations in embedded questions. But in main (root) questions, the violations resurface.¹⁴

¹⁴ As expected, focusing the auxiliary renders these examples acceptable—but see the puzzle in section 4.4.

- (31) a. *Speaker A*: The guests left already.
 Speaker B: Really? When (*did they)?
- b. *Speaker A*: I'm depressed.
 Speaker B: Why (*are you)?
- c. John and Mary play the drums? How loudly (*do they)?
- d. *Speaker A*: Susan practices yoga.
 Speaker B: Where (*does she)?
- e. *Speaker A*: Bill met the queen of England.
 Speaker B: How (*did he)?
- f. The prisoners escaped. But how (*did they)?
- g. We know Anna is going to resign. The only question is: when (*is she)?
- h. *Speaker A*: The workers have gone on strike.
 Speaker B: For what reason (*have they)?

The explanation of this asymmetry will be central to the analysis that follows. Before looking at the proposal, let us take stock of the previous generalizations and summarize the data we have seen so far.

VP-ellipsis with an extracted *wh*-object triggers a MaxElide violation in both main and embedded questions. VP-ellipsis with an extracted *wh*-subject does not trigger a MaxElide violation in either main or embedded questions. The contrast between main and embedded questions is visible only in the extraction of *wh*-adverbials, where VP-ellipsis triggers a MaxElide violation in main questions but not embedded questions.

The full MaxElide paradigm to be explained, then, is shown in table 1, where “√” stands for the possibility of VP-ellipsis (= no MaxElide violation), and “X” stands for the impossibility of VP-ellipsis (= MaxElide violation). Recall also the principled exception to this summary, given in (24): subjects and adverbials, when extracted from lower clauses, behave just like objects ((16)–(19), (23)).

3.2 Analysis

I suggest that the data set summarized above is evidence for the claim that all traces count toward the calculation of PDs. This includes \bar{A} -traces, A-traces, and traces of head movement. Specifically, this claim entails that the trace of T-to-C movement is a semantic variable that forces the choice of a PD large enough to include its binder, and the same is true of the trace of A-

Table 1
 Full MaxElide paradigm

	Embedded questions	Main questions
<i>Wh</i> -objects	X (1a,b,f–i)	X (1c–e)
<i>Wh</i> -adverbials	√ (12a–f)	X (31a–h)
<i>Wh</i> -subjects	√ (22a–b)	√ (22c–d)

movement (including, crucially, movement from a VP-internal subject position). Let us see how these claims account for the MaxElide paradigm in table 1.

In (32), I show simplified LF representations for each of the six cases in the table.¹⁵ The underlined portion of the representation is the (smallest) PD.¹⁶ Recall that although VP-ellipsis relies on a PD small enough that VP is its largest deletable constituent, selection of a larger PD is always possible; this is why sluicing is acceptable in all the cases.

- (32) a. [_{CP} what λx . [_{TP} she λy . will [_{VP} y eat x]]] (Obj. Emb.)
 b. [_{CP} What λx . will λz . [_{TP} she λy . z [_{VP} y eat x]]] (Obj. Main)
 c. [_{CP} when λx . [_{TP} x [_{TP} she λy . will [_{VP} y leave]]]] (Adv. Emb.)
 d. [_{CP} When λx . will λz . [_{TP} x [_{TP} she λy . z [_{VP} y leave]]]] (Adv. Main)
 e. [_{CP} who λx . [_{TP} x λy . will [_{VP} y leave]]] (Subj. Emb.)
 f. [_{CP} Who λx . [_{TP} x λy . will [_{VP} y leave]]] (Subj. Main)

Note that in (32f) I adopt the standard assumption (e.g., Den Besten 1983, Koopman 1983, Pesetsky and Torrego 2001) that extraction of *wh*-subjects in main clauses does not trigger T-to-C movement; this is evidenced by the lack of *do*-support. I now examine each of these six structures in turn, showing how in each case, the ellipsis possibilities summarized in table 1 follow from the treatment of all traces as bound variables.

In both (32a) and (32b), VP cannot be a PD since it contains two rebound variables: the trace of the subject and the trace of the extracted *wh*-object. The smallest PD that contains binders for both of these variables is the constituent immediately dominating λx (call it “ λxP ”). MaxElide applies to this PD and chooses the largest deletable constituent, the sluiced constituent. VP-ellipsis violates MaxElide.

- (33) [_{CP} what λx . [_{TP} she λy . will [_{VP} y eat x]]] (Obj. Emb.)
 [_{CP} What λx . will λz . [_{TP} she λy . z [_{VP} y eat x]]] (Obj. Main)
 1. Possible PDs: λxP
 2. MaxElide chooses: sluicing

Mary will eat something, but I don't know what (*she will).

Speaker A: Mary will eat something.

Speaker B: What (*will she)?

¹⁵ I use the variable names *x*, *y*, *z* merely for convenience. I make no claim about the semantic type of head movement traces and traces of *wh*-adverbials, or about the denotations of the associated moved elements. These are important questions, but they do not bear directly on the present argument. (For compositional analyses of head movement chains, see Lechner 2007 and Shimada 2007.) All that matters for the purposes of this analysis is that the traces are variables of *some* type at LF.

¹⁶ I abstract away from the possibility of an intermediate Spec,vP landing site for *wh*-extracted objects. As the reader can verify, this does not affect the predictions. For instance, in the structure in (i), the smallest available PD is still the sister of *what*.

(i) [_{CP} what λz . [_{TP} she λy . will z λx . [_{VP} y eat x]]]

In (32c), VP cannot be a PD since it contains one rebound variable, the trace of the subject. The smallest PD that contains a binder for this trace is the constituent immediately dominating λy . This PD *does not* dominate the potentially sluiced constituent, so when MaxElide applies, the largest deletable constituent will be VP, and VP-ellipsis is grammatical.

(34) [_{CP} when λx . [_{TP} x [_{TP} she λy . will [_{VP} y leave]]]] (Adv. Emb.)

- | | | |
|----------------------|--------------|--------------|
| 1. Possible PDs: | λxP | λyP |
| 2. MaxElide chooses: | sluicing | VP-ellipsis |

Mary will leave, but I don't know when (she will).

In (32d), VP cannot be a PD, since it contains one rebound variable, the trace of the subject.

(35) [_{CP} When λx . will λz . [_{TP} x [_{TP} she λy . z [_{VP} y leave]]]] (Not possible)

The smallest constituent that contains a binder for this trace is the constituent immediately dominating λy .

(36) [_{CP} When λx . will λz . [_{TP} x [_{TP} she λy . z [_{VP} y leave]]]] (Not possible)

But crucially, this constituent is not a possible PD either, since it now contains a new rebound variable. By expanding the PD, we “catch” the trace of T-to-C movement. The smallest constituent containing a binder for *this* trace is the constituent immediately dominating λz .

(37) [_{CP} When λx . will λz . [_{TP} x [_{TP} she λy . z [_{VP} y leave]]]] (Not possible)

Crucially again, this constituent is not a possible PD since it “catches” yet another rebound variable, the trace of the *wh*-adverbial. Thus, it is necessary to expand once more, to include a binder for this variable.

(38) [_{CP} When λx . will λz . [_{TP} x [_{TP} she λy . z [_{VP} y leave]]]] (Possible!)

The resultant PD will be the constituent immediately dominating λx . MaxElide applies to this PD and chooses the largest deletable constituent, which is the sluiced constituent. VP-ellipsis will violate MaxElide.

(39) [_{CP} When λx . will λz . [_{TP} x [_{TP} she λy . z [_{VP} y leave]]]] (Adv. Main)

- | | |
|----------------------|--------------|
| 1. Possible PDs: | λxP |
| 2. MaxElide chooses: | sluicing |

Speaker A: Mary will leave.

Speaker B: When (*will she)?

In (32e) and (32f), VP cannot be a PD since it contains the rebound trace of the subject. The smallest PD that includes the binder for this trace is the constituent immediately dominating λy . MaxElide applies to this PD, and the largest deletable constituent will be VP, so VP-ellipsis is grammatical.

- (40) [_{CP} who λx. [_{TP} x λy. will [_{VP} y leave]]] (Subj. Emb.)
 [_{CP} Who λx. [_{TP} x λy. will [_{VP} y leave]]] (Subj. Main)

1. Possible PDs: λxP λyP
 2. MaxElide chooses: sluicing VP-ellipsis

Someone will leave, but I don't know who (will).

Speaker A: Someone will leave.

Speaker B: Who (will)?

Now that we have worked through the account of the full MaxElide paradigm in table 1, note that the interpreted traces of both T-to-C movement (head movement) and subject movement (A-movement) are essential to the analysis: if we ignored either one, we would lose the contrast between (32c) and (32d). In the latter example, if we did not count the trace of T-to-C movement, we would not be forced to expand the PD beyond λyP. If we did not count the trace of subject movement, we would not be forced to expand the PD beyond VP. Either way, we would wrongly predict VP-ellipsis to be available in (32d) as well as (32c). Further corroboration and discussion of the role of head movement and A-movement traces are provided in sections 3.3 and 4.2, respectively.

At this point, the full range of data presented so far—the distinct behaviors of *wh*-objects, *wh*-subjects, and *wh*-adverbials; the exceptions regarding the last two when extracted from lower positions; the existence of a MaxElide asymmetry in main versus embedded questions; the fact that this asymmetry surfaces only with *wh*-adverbials—is accounted for by the existing theory of parallelism, along with the new claim that all types of traces are interpreted as bound variables.

3.3 Head Movement Is Implicated: Evidence from Two Nonstandard Englishes

We have just seen that the semantic contribution of head movement traces offers a successful account for the main/embedded asymmetry with *wh*-adverbials. It is of course possible that this asymmetry is actually due to some independent property of main versus embedded questions and that the correlation with T-to-C movement is an epiphenomenon, not an explanation. Here, I present data from two nonstandard varieties of English that strongly implicate T-to-C movement as the cause of the main/embedded asymmetry discussed above.

Indian Vernacular English (IVE; Bhatt 2000) is the mirror image of Standard English with regard to subject-auxiliary inversion. Bhatt (2000) shows that IVE has T-to-C movement in embedded questions but lacks it in main questions. The following examples illustrate:

- (41) a. What he has eaten?
 b. What you want?
 c. How much interest they charged you?
 d. How long ago that was?
 e. Why you look worried?

(Bhatt 2000:74–75)

- (42) a. They know who has Vijay invited tonight.
 b. I wonder where does he work.
 c. I asked Ramesh what did he eat for breakfast.
 d. Do you know where is he going?
 (Bhatt 2000:75)

The predictions made by the present account are as follows. If the contrast between *wh*-adverbials in embedded questions ((12), (32c)) versus main questions ((31), (32d)) is due to the (non)occurrence of T-to-C movement, IVE should show the *opposite* contrast. That is, VP-ellipsis with *wh*-adverbials should be acceptable in main questions, but not in embedded questions. If the Standard English contrast were instead due to some independent property of main versus embedded questions, then IVE should show the same contrast, all else being equal. In fact, my informants indeed report the opposite contrast, as shown in (43).

- (43) a. *Mary will leave, but I don't know when will she. (IVE)
 b. *John's baking a cake, but I'm not sure why was he.
 c. *I fixed the car, but I can't remember how did I.
- (44) a. *Speaker A*: Mary will leave. (IVE)
 Speaker B: When she will?
 b. *Speaker A*: John was baking a cake.
 Speaker B: Why he was?
 c. *Speaker A*: I fixed the car.
 Speaker B: Really? How you did?

Furthermore, varieties of Irish English (McCloskey 1992, 2006, Henry 1995) allow subject-auxiliary inversion in embedded questions (though, unlike IVE, they do not lack inversion in main questions). These dialects thus provide *half* a testing ground. The prediction for embedded questions with subject-auxiliary inversion is that VP-ellipsis with *wh*-adverbials should be unacceptable. This is indeed the case, as shown in (45).

- (45) a. *Mary will leave, but I don't know when will she. (Irish E)
 b. *John's baking a cake, but I'm not sure why was he.
 c. *I fixed the car, but I can't remember how did I.

The facts from IVE and Irish English provide strong evidence that the matrix/embedded asymmetry with regard to *wh*-adverbials and VP-ellipsis is truly an effect of T-to-C movement, rather than an independent property of matrix versus embedded questions.

4 Implications of the Analysis

In the previous sections, I used MaxElide to detect the effects of various types of traces on the calculation of semantic identity. Successful analysis of the full MaxElide paradigm revealed that \bar{A} -movement, A-movement, and head movement all leave traces that behave like bound variables at LF. In this section, I discuss several consequences and extensions of this analysis, starting with the direct architectural implications for non- \bar{A} movements.

4.1 Architectural Implications

The derivational timing of syntactic operations has been investigated since the earliest days of linguistic theory. On the familiar ‘‘Y-model’’ of the derivation, the question of timing assumes an even greater importance: claims about a movement’s timing are claims about that movement’s capacity to affect semantic and phonological representations. For example, if a certain type of movement occurs on the phonological branch of the derivation, then it is impossible for it to affect LF representations. Contrapositively, if a movement affects LF representations, then it does not occur on the phonological branch.

The semantic contribution of head movement traces provides evidence that head movement can affect LF representations and thus argues directly against proposals that have assigned head movement to the PF wing of the grammar (Chomsky 2000, Boeckx and Stjepanović 2001; cf. Harley’s (2004) implementation involving phonological feature-passing). Such proposals have purported to explain the *absence* of observed semantic effects of head movement. However, as Matushansky (2006:102–105) emphasizes, the range of cases where we would even expect to observe semantic effects is quite limited. One promising scenario is the movement of quantificational heads (e.g., modal auxiliaries) over another scopal element; see Lechner 2007 for an argument along these lines. In this article, I have put forward another scenario, which relies not on the altered scope relations of a moved head but on the presence at LF of a bound variable in the trace position. The results are clear: head movement leaves semantically interpreted traces.

The evidence of interpreted traces also argues against two related proposals, according to which non- \bar{A} movements occur in the narrow syntax, but do not leave traces (Lasnik 1999 for A-movement, Omaki 2008 for head movement). If these movements did not leave a trace, the presence of a bound variable at the origin site would be unexpected, and the account of the full MaxElide paradigm would be lost. (See also the following section for a further point about the role of A-traces.)

Beyond casting doubt on previous proposals, the current results suggest that \bar{A} -, A-, and head movement share a basic uniformity: none of these movement types is categorically excluded from the narrow syntax, and all create variable-binding configurations at LF.¹⁷ Finally, it is worth noting that the uniform contribution of all types of movement in this respect is an obstacle for accounts that have sought to maintain the existence of *wh*-movement, but call the existence of A-movements into question (e.g., Bresnan 1978).

¹⁷ I leave open the possibility that these configurations can be altered by later LF operations (for discussion of such operations, see the extensive literature on ‘‘syntactic reconstruction’’—e.g., May 1977, Lebeaux 1995, Fox 1999, Lasnik 1999, Romero 1999). Though it is beyond the scope of this article, a natural extension of the present investigation would be to examine whether the parallelism tests that diagnose variable-binding configurations in fact distinguish ‘‘reconstructed’’ phrases (e.g., subjects and *wh*-phrases) from those that take surface scope. To the extent that they do make this distinction, we have evidence for syntactic accounts of reconstruction, on which the variable-binding configuration is nullified by a covert lowering operation, or a PF movement account of reconstruction (Sauerland and Elbourne 2002) on which the variable-binding configuration is not created in the first place. To the extent that such tests do *not* distinguish reconstructed phrases, this result could be taken as evidence for theories of ‘‘semantic reconstruction’’ (e.g., Sternefeld 2001), on which the binder-trace relationship is crucially preserved at LF, and the deviation from surface scope is achieved by interpreting the trace as a variable of a more complex type. I must leave this issue for future research.

4.2 An Argument for Successive-Cyclic A-Movement

The interpretation of A-traces as bound variables brings to light an argument for successive-cyclic A-movement, first alluded to by Takahashi and Fox (2005:235). Consider the pair of sentences in (46), which show that either higher VP-ellipsis or lower VP-ellipsis is possible.

- (46) a. John is likely to attend the party, and Mary is as well.
 b. John is likely to attend the party, and Mary is likely to as well.

Assuming that subject-to-subject raising proceeds successive-cyclically, the intermediate landing site will create a lower λ -abstractor, as in (47). Thus, a smaller PD will be possible. MaxElide can apply to this smaller PD and choose the lower VP-ellipsis.

- (47) a. . . . Mary λy is likely [_{TP} y λx to [_{VP} x attend the party]] as well
 b. . . . Mary λy is likely [_{TP} y λx to [_{VP} x attend the party]] as well

- | | | |
|----------------------|------------------|-----------------|
| 1. Possible PDs: | λyP | λxP |
| 2. MaxElide chooses: | High VP-ellipsis | Low VP-ellipsis |

John is likely to attend the party, and Mary is as well.

John is likely to attend the party, and Mary is likely to as well.

If, on the other hand, A-movement did not stop in the lower Spec,TP, then there would be no lower λ -abstractor, as in (48). Thus, only the larger PD would be possible, and one would expect the lower VP-ellipsis to be ruled out by MaxElide, contrary to fact.

- (48) Mary λy is likely [_{TP} to [_{VP} y attend the party]] as well

- | | |
|----------------------|------------------|
| 1. Possible PDs: | λyP |
| 2. MaxElide chooses: | High VP-ellipsis |

John is likely to attend the party, and Mary is as well.

4.3 Empirical Support for an Assumption about the Binding of Traces

Let me now highlight a crucial assumption that has underlain much of the argumentation in this article. The assumption—adopted, for example, by Heim and Kratzer (1998)—is that traces are not bound directly by the moved element itself; rather, they are bound by a λ -abstractor associated with the moved element. One consequence is that since each movement step creates its own binder-trace relation, the first link in a movement chain is sufficient to establish a PD with an internal binding structure.

The assumption becomes relevant in cases of successive-cyclic movement. To appreciate this point more concretely, consider (32e–f), repeated in (49). In these examples, a *wh*-extracted subject undergoes successive-cyclic movement from its V/vP-internal base position to Spec,TP, and then to Spec,CP. If traces were bound directly by moved elements, we would instead expect a structure like (50).

- (49) [_{CP} *who* λx . [_{TP} x λy . will [_{VP} y leave]]]

- (50) [_{CP} *who* _{x} [_{TP} x _{y} will [_{VP} y leave]]]

Table 2

Locus of the remaining puzzle

	Embedded questions	Main questions
<i>Wh</i> -objects	X (1a,b,f-i)	X (1c-e)
<i>Wh</i> -adverbials	✓ (12a-f)	X (31a-h)
<i>Wh</i> -subjects	✓ (22a-b)	✓ (22c-d)

Heim and Kratzer (1998:188) consider these two structures for successive-cyclic movement and observe, “These surely *look* different, but it is harder than one might think to come up with empirical evidence that would bear on the choice. To our knowledge the issue has not been investigated.”¹⁸ The effects of MaxElide provide us with precisely such empirical evidence. In the first structure, the lower λ -abstractor “closes off” a possible PD that excludes the intermediate trace. This is what allows VP-ellipsis. In the second structure, a smaller PD is impossible, since there is no constituent that includes the lower binder but excludes the intermediate trace. The PD in (50) must be as large as CP, in order to include the moved element itself, in its final landing site. With a PD this large, we would predict VP-ellipsis in these cases to be ruled out by MaxElide, contrary to fact.

Insofar as it succeeds, then, the analysis in this article offers new empirical support for variable-binding structures in which the binder forms a constituent with the scope of the moved element, to the exclusion of the moved element itself. Exactly how the creation of such structures should be integrated into the syntactic theory of movement remains an issue of considerable importance, but it is ultimately beyond the scope of this article.¹⁹

4.4 A Remaining Puzzle

This section describes a puzzle that I will not solve here. It concerns a further asymmetry between *wh*-objects and *wh*-adverbials in main questions. That is, I am “zooming in” on the circled portion of table 2. With *wh*-adverbials in main questions, intervening focus (see section 1.2) renders VP-ellipsis acceptable, even in rebinding contexts, as expected.

- (51) a. *Speaker A*: I didn’t want to come to the party.
 Speaker B: Then why DID you?
 b. If the prisoners can’t escape by breaking the lock, then how CAN they?
 c. Mary woke up at 7:00. When did JOHN?

¹⁸ Subsequently, the issue *has* been investigated. For empirical defenses of the binding structure in (49), see Nissenbaum 1998 and Nissenbaum and Schwarz 2009; the argument comes from parasitic gap licensing. For two theoretical perspectives, compare Sauerland 1998 and Barker 2007.

¹⁹ The traditional implementation (see, e.g., Heim and Kratzer 1998) is to have movement introduce an index, adjoined to the scope of the moved element. The trace of the moved element is then interpreted as a variable of the appropriate type, and the inserted index is interpreted as a λ -abstractor over this variable. Some version of this system is assumed, tacitly or explicitly, by many authors (Beck 2000, Meier 2003, Bhatt and Takahashi 2007), and it seems compatible with the arguments presented here.

The puzzle is why intervening focus does *not* save these examples with *wh*-objects:

- (52) a. *Speaker A*: I didn't kiss Mary.
 Speaker B: Then which girl DID you *(kiss)?
 b. If you aren't drinking water, then what ARE you *(drinking)?
 c. Mary will kiss Bill. Who will JOHN *(kiss)?

A striking clue that MaxElide seems to be involved comes from the principled exception in (24), restated in (53). Indeed, when we embed them, the *wh*-adverbials become like *wh*-objects with respect to this puzzle, as shown in (54).

- (53) With regard to MaxElide, *wh*-subjects and *wh*-adjuncts behave differently from *wh*-objects. But we can get them to behave like *wh*-objects by embedding them.
- (54) a. *If you don't think Mary's leaving because she's sick, then why DO you?
 b. *Speaker A*: I don't want Mary to dance quickly.
 Speaker B: *How DO you, then?
 c. *Speaker A*: John will ask Mary to leave at 5.
 Speaker B: When will TOM?
 √Matrix *Embedded

I have no solution to this puzzle to offer yet, and I leave it for further study.

5 Conclusion

This article has offered an argument that \bar{A} -movement, A-movement, and head movement share at least one semantic effect: their traces all enter into the calculation of semantic parallelism. MaxElide, a constraint on deletion that makes reference to domains of parallelism, was pressed into service to diagnose the size of these domains. The main results of the diagnosis were twofold.

First, we confirmed a detailed set of predictions regarding the location of \bar{A} -traces. Different ellipsis possibilities were observed for *wh*-extracted objects, adverbials, subjects, embedded adverbials and subjects, and two kinds of 'low' adverbials. The full range of contrasts was shown to follow from the location of the trace, the identity requirement on parallelism, and the application of MaxElide.

Second, we found that a rebound trace of *any movement type* was enough to spoil the semantic identity relation between constituents and force a larger domain of parallelism. This result constitutes evidence that traces of A-movement and head movement affect semantic representations—and provides an argument against models of grammar in which these movements do not feed interpretation, or in which they do not leave traces that can be interpreted as bound variables.

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