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E-type A′-traces under Sluicing

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One of the most puzzling aspects of the investigation of elliptical structures has been the fact that the interpretation of an ellipsis site seems to be able to deviate from the interpretation of its antecedent. The working hypothesis of most researchers has been that the interpretations are in fact identical at the relevant level of structure (as in the classic Sag-Williams analysis of 'sloppy' identity facts). This paper uncovers another aspect of the 'deviance from identity' that is attested in ellipsis, under sluicing, and argues that certain problems that arise for the standard accounts of sluicing can be resolved if syntactic variables (A'-traces) are allowed to form an equivalence class with pronominals under ellipsis. These 'pronominal' variables can be interpreted using an E-type strategy.

Section 1 presents a very brief review of the main relevant points of the account of sluicing assumed here, section 2 introduces and explains the problem, and section 3 offers my solution.

1   Background on sluicing

Sluicing is an IP-level elliptical phenomenon first discussed (and named) in Ross 1969, and subsequently investigated by a number of researchers (Rosen 1976, Levin 1982, Chao 1987, Lobeck 1991, 1995, Ginzburg 1992, Chung Ladusaw and McCloskey [CLM] 1995, Reinhart 1995, Ramos-Santacruz 1996, Romero 1997, among others). (1) collapses a number of examples. The structure for the embedded interrogative clause prior to LF is given in (2) (see especially Chao 1987, Lobeck 1995, and Merchant 1996 for support for this structure).

(1)   a.   Jack bought a flag, but I don't know where/how/why/
              when/for who(m)/on what day.
        b.   Mark baked a cake for someone—guess for who!

(2)   CP
        ╱╲
    XP$_{[wh]}$ C'
              ╱╲
          C°   IP
          [+●] |
                    |
                    e
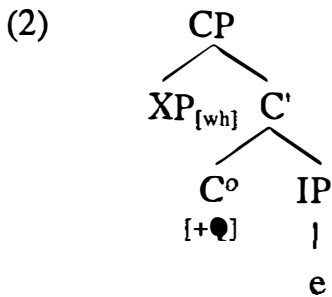
The general analytical question posed by the interpretation of (2) is that posed by all elliptical constructions—how do we get something from nothing? I will follow CLM's answer here in assuming that the interpretation is generated by 'recycling' an IP present in the discourse. Specifically, the null IP is replaced at LF by means of an operation of IP-copy (see also Reinhart 1991 and Hazout 1995), the clause-level equivalent to VP-copy assumed in many approaches to VP-ellipsis. (I will sidestep the issue of deletion vs. reconstruction/copying approaches to ellipsis here, and follow CLM in assuming a copying account for ease of exposition, though nothing rests on this; see especially Winkler 1997 for a recent comparison.) IP-copy will yield the LFs in (3) and (4), corresponding to (1a) type examples with adjunct wh-phrases and (1b) type with arguments, respectively.

(3)   ... [$_{CP}$ where/how/... [$_{IP}$ Jack bought a flag]]

(4)   ... [$_{CP}$ for who [$_{IP}$ Mark baked a cake for someone]]

        The question of how to associate the wh-phrases with an appropriate bindee internal to the elliptical IP is the property of sluicing that has occupied most researchers, but since the solution to this is orthogonal to the problem I will present below, I will not discuss it further here.

2 The problem: A'-traces under sluicing

The problem, given IP-copy or its equivalent mechanism in a PF-deletion or higher-order unification approach, arises quite simply: IPs which contain A'-traces are themselves licit targets of IP-copy. Such IPs can provide the necessary antecedent IP to resolve a sluice. Constructed examples are given in (5), and some attested ones are in (6)-(8).

(5)　a.　The report details what IBM did and why.

　　　b.　Who did the suspect call and when?

　　　c.　We know which families bought houses on this block, but we don't know which (houses), yet.

　　　d.　It was clear which families had mowed their lawns, but we can only guess with which brands of lawnmower.

　　　e.　The judge had records of which divers had been searching the wreck, but not of how long.

　　　f.　The hospital spokeswoman told us which patients had died, but she wouldn't say when.

　　　g.　The Guiness Book records how long some alligators can hold their breaths, but not which (ones).

　　　h.　Though Abby eventually told us who she saw that night, she never revealed where.

(6)　a.　That's a gazebo. But I don't know who built it or why. [overheard conversation]

　　　b.　A ride-along with an officer shows who gets ticketed, and why. [SJ Mercury News 8/9/96]

　　　c.　A chronology was the first step in piecing together what had happened—which had to precede figuring out why. [K.S. Robinson Green Mars p. 222]

　　　d.　They didn't have any clear idea of what they were going to try to do, or why. [K.S. Robinson Green Mars p. 535]

　　　e.　What's proposed and why. [SJ Mercury News headline 11/28/96]

(7)　a.　[The Smart Toilet] is a paperless device that not only accommodates calls of nature, but also 'knows' who's using it and how. [SJ Mercury News 8/6/96]

　　　b.　What interveners are able to 'get out of the way', and how? [Szabolcsi & Zwarts 1993: 14]

　　　c.　Investigators want to know who is supplying the drugs—and how—since Kevorkian's medical liccnsc was suspended in 1991. [SJ Mercury News 8/17/96]

(8)   a.   [The police asked] who'd seen him last and where. [D. Tartt
              The Secret History p. 294]

        b.   But R.C. Lahoti, a High Court judge appointed to lead the investigation of the accident, must decide who will decode the recorders and where. [SJ Mercury News 11/30/96]

        c.   He only wanted to know whom they had met, and where. [K.S. Robinson Red Mars p. 515]

Even multiple wh-phrases may be in the antecedent IP:

(9)   a.   We need to know who saw what, and when.

        b.   [He] makes no empirical claims concerning what domain will be opaque for what relations, [or] why. [Szabolcsi & Zwarts 1993 fn. 4]

        c.   You know exactly who will laugh at which particular kind of joke, and for how long. [slightly altered ex. from L. de Bernières Corelli's Mandolin p. 33]

Traces of QRed constituents in the antecedent IP can also give rise to the same effect.

(10)   a.   The suspect phoned everyone on this list, but we don't know when.

         b.   Most gangs will be at the rumble, though it's not clear why.

         c.   Every boy scout helped, though most didn't know why.

         d.   (Only a) Few boats looked for survivors, though it's not clear why.

         e.   At least five guerrillas survived the raids, but no-one could figure out how.

         f.   The duke hid exactly six of the jewels, and even Holmes didn't know where.

After IP-copy, we will have the representative LFs in (11), where the material in bold has been copied in. These LFs have the glaring defect that the wh-trace in the second conjunct, which has been copied along internal to the IP, is now unbound. Under normal circumstances we'd expect an unbound trace to give rise to spectacular ungrammaticality—but these examples show that it doesn't.

(11)   a.   ... [$_{CP}$ what$_1$ [$_{IP}$ IBM did t$_1$]] and [$_{CP}$ why [$_{IP}$ **IBM did t$_1$**]]

        b.   [$_{CP}$ who$_2$ did [$_{IP}$ the suspect call t$_2$]] and [$_{CP}$ when [$_{IP}$ **the suspect call t$_2$**]]

I suggest that the key to explaining these examples' acceptability is the fact that they have interpretations parallel to the sentences in (12), which contain

overt pronouns anaphoric to preceding non-c-commanding wh-phrases, but no ellipsis.

(12) a. The report details what$_1$ IBM did and why IBM did it$_1$.
    b. Who$_2$ did the suspect call and when did the suspect call him$_2$?
    c. Most gangs$_3$ will be at the rumble, though it's not clear why they$_3$'ll be there.
    d. Every boy scout$_4$ helped, though most$_5$ didn't know why they$_{4/5}$ helped.

While no analysis has ever been proposed for sentences like those in (5)-(10), ones like those in (12a,b) were discussed in Bolinger's seminal 1978 paper and more recently in Comorovski 1996. Comorovski only mentions them in passing, since her main interests lie elsewhere, and attributes the possibility of an anaphoric link of the observed kind to the existential presuppositions of wh-questions. Whether or not this is the correct approach to the feasibility of such anaphoric links in the first place, this observation obviously doesn't solve the problem raised by the elliptical sentences in (5)-(10).

    Note especially that none of these examples is plausibly the result of some novel, mysterious application of across-the-board (ATB) movement of the first wh-phrase out of both conjuncts. Such an ATB account would obviously run into numerous problem (phrase-structural, to begin with, as well as island violations); in addition, there are many examples which are not coordinate structures of the kind necessary for ATB extraction (see the appendix for additional examples).

3   The solution: Vehicle change and E-type pronouns

The solution I will suggest in effect assimilates sluices to their nonelided counterparts above. I propose that the LFs of copied IPs like those in (11) are in fact fully parallel in the relevant respects to the LFs of sentences like (12)—specifically, that wh-traces (and traces of QR) can be treated as equivalent to pronouns under this kind of ellipsis (namely, when not bound by another operator). Fiengo and May 1994 propose and defend a mechanism for capturing exactly this kind of syntactic sleight of hand: vehicle change (see also van den Wyngaerd and Zwart 1991, Brody 1995, Giannakidou and Merchant 1998, Kennedy 1997, Merchant and Kennedy to appear). Vehicle change in essence defines certain equivalence classes under ellipsis; this is given in its general form in (13). For our purposes, the relevant instantiation of vehicle change is the one given schematically in (14), which states that nonpronominals may be treated as pronominals under ellipsis. Specifically, a variable like a wh-trace can be treated as a

pronominal—its 'pronominal correlate', in Fiengo and May's term, as in (15).

(13) *Vehicle change* (Fiengo and May 1994:218ff.)
Nominals can be treated as nondistinct with respect to their pronominal status under ellipsis.

(14) [-pronominal] $=_e$ [+pronominal]   (where $=_e$ means 'forms an equivalence class under ellipsis with')

(15) [-a, -p] (variable or name) $=_e$ [-a, +p] (*pronominal correlate* $= {}^p$e)

Fiengo and May take pains to argue that vehicle change is syntactic, and has syntactic effects, and is not simply relevant at some more abstract level of semantic equivalence (as in property-anaphora treatments of ellipsis). They show that the pronominal correlates of names and wh-traces under VP-ellipsis do not trigger Principle C violations, do trigger Principle B, and do not respect islands, all of which they assume are syntactic phenomena. Though their discussion is limited exclusively to VP-ellipsis, the first and third of these properties can be observed under sluicing as well.

3.1   Vehicle change under sluicing

Let us begin with the Binding Theory effect, namely the disappearance of Principle C effects. (16) presents a standard case of a Principle C violation with a name. If the trace of a moved wh-phrase is copied under a co-indexed c-commanding pronoun as in (17a), however, no deviance arises, contrary to naive expectation, since featurally names and wh-traces are indistinct. Vehicle change, however, can convert the trace into its pronominal correlate, as in the LF given in (17b), in which the variable t_4 is realized as its pronominal correlate ${}^p e_4$; ${}^p e_4$, being [+pronominal], is no longer subject to Principle C.

(16)   *The detectives wanted to know whether they$_3$ knew why Sue hated the Thompsons$_3$.

(17)   a.   The detectives wanted to know who$_4$ [Sue hated t$_4$] and whether they$_4$ knew why.

       b.   ... they$_4$ knew why [**Sue hated ^{p}e$_4$**]

Principle B is not testable, since in sluicing an entire IP is elided, so no example with a clause-mate c-commanding pronoun can be constructed.

Second, we find that the normal binding relation between a wh-phrase and its bound trace, which is constrained by islands, is relaxed under this type of sluicing as well. In other words, the pronominal correlate of a reconstructed trace can find its antecedent outside of an island. This is indeed trivially true under sluicing, since sluicing involves wh-islands to begin

with, but even embedding the CP immediately dominating the sluiced IP inside another island does not affect the status of these examples. Again, normal binding could not be expected to hold in the first place, since the wh-phrase does not even c-command the pronominal correlate.

The following example is structured as follows. The (a) example is simply a control, showing the ungrammaticality of extraction from the island (here, a subject; see the appendix for this kind of sluice inside 24 other kinds of islands as well). The (b) example shows that a wh-link into a non-elided IP is impossible. The (c) example gives a version with no ellipsis, but with a pronoun linked to the wh-antecedent. This link from a pronominal element is what makes the sluiced version in the (d) example (and those in the appendix) grammatical, as its LF in (e) shows.

(18) subject island

    a.   *Which crime$_4$ did the FBI admit that <solving t$_4$> will prove difficult?

    b.   *The FBI knows which truck$_4$ was rented, but <figuring out from where t$_4$ was rented> has proven difficult.

    c.   The FBI knows which truck$_4$ was rented, but <figuring out from where it$_4$ was rented> has proven difficult.

    d.   The FBI knows which truck$_4$ was rented, but <figuring out from where> has proven difficult.

    e.   ... figuring out from where [^{P}e$_4$ **was rented**] has proven difficult.

3.2   *Interpreting the result of vehicle change: E-type wh-traces*

An account of the anaphoric link between the pronominal correlate and its antecedent must distinguish them from regular bound wh-traces or bound pronouns. Once the syntactic mechanism of vehicle change has played its role, the semantics can treat these pronominal correlates exactly as it does their overt pronominal counterparts. These are essentially a subspecies of donkey pronouns: anaphoric on a preceding quantificational expression, yet not bound by it.

Let us take as our working example (19a) and its associated LF after vehicle change, and its unelided counterpart in (20):

(19)   a.   Which suspect did Abby call, and when?

      b.   [$_{CP}$ which suspect$_2$ did [$_{IP}$ Abby call t$_2$]] and [$_{CP}$ when [$_{IP}$ **Abby call** ^{P}e$_2$]]

(20)   Which suspect did Abby call, and when did she call him?

The pronominal correlate is indistinguishable for purposes of interpretation from the pronoun in (20); both are interpreted as donkey pronouns. For simplicity, I will assume a functional analysis of donkey pronouns as E-type pronouns, following essentially Lappin and Francez 1994 (see also Heim 1990, Neale 1990, and Chierchia 1995; see Tomioka 1994 for VP-ellipsis). Nothing hinges on the particulars of this analysis of donkey anaphora, and I will return to the dynamic binding approach in section 3.3.

(21) $[^{P}\mathbf{e}\,] = f(x)$

Using a Karttunen-style semantics for questions, the interpretation of the conjoined questions will be that in (22).

(22) $[\,(19b)\,] = \lambda p[\exists x.\mathbf{suspect}(x) \wedge {}^{\vee}p \wedge p = {}^{\wedge}[\mathbf{call}(\mathbf{abby},\,x)]] \wedge$
$\lambda p[\exists t \wedge {}^{\vee}p \wedge p = {}^{\wedge}[\mathbf{call}(\mathbf{abby},\,f(x),\,\mathbf{at}\;t)]]$

        This formula is interesting because it makes clear that the interpretation of the antecedent IP (here, $^{\wedge}[\mathbf{call}(\mathbf{abby},\,x)]$) is not identical to that of the elliptical IP, even ignoring the results of the binding association necessary to interpret the wh-XP (without this, we have $^{\wedge}[\mathbf{call}(\mathbf{abby},\,f(x)]$). This shows that a purely semantic account of ellipsis would have to countenance a deviance from identity at that level as well; here, a bound pronoun translates as a variable, while an E-type pronoun as a function.

        Note that the conjunction in (22) is not trivial (as Bolinger 1978 suggests)—(19a) does not mean what a multiple question does:

(23)   Which suspect did Abby call when?

        If this is the correct analysis of the semantics of these expressions, we might expect to find them giving rise to effects prototypically associated with donkey anaphora, specifically in 'proportion problem' (after Kadmon 1987) environments. To the extent that such proportion problem effects can be discovered under sluicing, we have extremely suggestive supporting evidence for the treatment proposed here.

        In fact, these effects *can* be observed with sluicing, once the interaction of sluicing with quantificational variability effects (QVE) is brought into play (see Berman 1991, Lahiri 1991, and Ginzburg 1995 for discussions of QVE). Briefly, interrogative clauses embedded under certain predicates give rise to readings in which a quantificational adverb quantifies not over instances of the matrix predicate as expected, but rather over, loosely speaking, answers to the embedded question (the open sentence derived by lambda-abstracting over the wh-trace, in a Karttunen-style semantics). Thus (24a) has a reading given by (24b).

(24)   a.The sergeant {usually/for the most part} knows who has guard duty.
        b. $\mathbf{MOST}_x\,(\mathbf{has\text{-}guard\text{-}duty}(x))\,[\mathbf{know}(\mathbf{the\text{-}sergeant},\,\mathbf{that}\;x$
        $\mathbf{has\;guard\;duty})]$

Though this aspect of sluicing has never been investigated, it is unsurprising that QVEs arise in sluicing contexts as well. Thus the sluice in (25) shows the same ambiguity that (24a) did, as expected.

(25) Someone from Company D always has guard duty. The sergeant usually knows who.

Likewise, conjoined embedded interrogatives display QVE:

(26) The sergeant mostly knows who has guard duty and who has KP.

Although the interpretation of conjoined interrogatives has not been the subject of much investigation in the literature (though see Bolinger 1978 for some initial observations), I will assume that nothing special need be said beyond the semantics of coordination. For our purposes, it is enough to note that (26) has a reading which can be rendered by (27), where the open questions are conjoined in the restriction of the quantificational adverb.

(27) $\text{MOST}_{x,y}$ (has-guard-duty(x) $\wedge$ has-KP(y)) [know(the-sergeant, that x has guard duty $\wedge$ that y has KP)]

That is, in QVE under conjunction, there is quantification over n-tuples (here pairs).

It will come as no surprise, then, that QVE is retained under sluicing with traces in antecedent IP:

(28) The sergeant {usually, for the most part} knows who has guard duty, and when.

Though this has a symmetric reading[1], the most interesting property for our purposes is the availability of an asymmetric reading. Indeed, in (28), the subject asymmetric reading is highly preferred. Under this reading, the proportion problem emerges; (28) will be true in the situation sketched in (29):

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[1] This is reminiscent of the interpretation of QVE in multiple questions (mentioned in Berman 1991:209-210); a full exploration of these parallels will have to be postponed to future work, however. Here I note only that the interpretation of (28) in the text can be distinguished from that of an embedded multiple question like (i), which highly favors the symmetric reading given in (ii) (some speakers cannot get the asymmetric reading at all).

(i)   The sergeant usually knows who has guard duty when.
(ii) $\text{MOST}_{x,t}$ (has-guard-duty(x, at t)) [know(the-sergeant, that x has guard duty at t)]

Here quantification is over pairs of individuals and times. This is expected if all wh-phrases in multiple questions move to SpecCP at LF, where they all form the restriction of the quantificational adverb. The asymmetric readings discussed in the text for conjoined CPs seem to be available mostly when there is an donkey pronoun present in the second conjunct. This recalls the triggering influence of donkey pronouns in the standard examples as well, noted by Bäuerle and Egli 1985, though in neither case does the presence of such pronominals absolutely preclude other readings.

Again, these partial equivalences should presumably be derived from the correct account of the contribution of conjunction to the restriction in such environments.

(29) Sergeant knows that: Private A has guard duty Mon.
                                 Private B has guard duty Tues.
                                 Private C has guard duty Wed.
      Sergeant is unaware that: Private D has guard duty Thur, Fri, Sat,
                                 and Sun.

In this situation, however, the symmetric interpretation, where quantification is over pairs of individuals and times, will predict (28) to be false. Instead, the correct interpretation of (28) under the subject asymmetric reading is given in (30), where quantification is over individuals alone.

(30) **MOST$_x$ (has-guard-duty(x)) [know(the-sergeant, when x has guard duty)]**

Here, the wh-phrase of the second conjunct remains in the nuclear scope of the quantifier.

Thus, there is considerable evidence that the approach advocated here is correct in its essentials, namely that these pronominal correlates are interpreted as E-type pronouns.

3.3 Eliminating vehicle change?

Having come this far, let us step back from the analysis presented and ask a more fundamental question: What is vehicle change? At this point in our understanding of the relevant phenomena, it is simply a stipulation—a bit of syntactic sleight of hand to get the right result, without any theory of why things can vary as observed, or why they are restricted to just this way. A more skeptical reader might say that it is little more than an artifact of a too slavish reliance on syntactic phrase markers. (It is indeed Fiengo and May 1994's factotum for mysteries: they put it to 13 different uses between pp. 219-230.)

Although space precludes a full working out of an alternative, I would like to sketch another view of the above phenomenon which relies on a dynamic binding approach to donkey anaphora (Groenendijk and Stokhof 1991, Chierchia 1995). Under this approach, dynamic definitions of $\exists$ and $\wedge$ allow the existential to bind variables outside its scope, and the occurrence of the variable x in the second conjunct in (31)—the translation of (19a)— would be licitly bound by the quantifier $\exists x$ in the first conjunct.

(31) $\lambda p[\exists x.\textbf{suspect}(x) \wedge {}^{\vee}p \wedge p = {}^{\wedge}[\textbf{call}(\textbf{abby}, x)]] \wedge$
       $\lambda p[\exists t \wedge {}^{\vee}p \wedge p = {}^{\wedge}[\textbf{call}(\textbf{abby}, x, \textbf{at } t)]]$

Of course, it will have to be established that it is not pernicious to allow dynamic conjunction with dynamic $\exists$ to scope through λ–operators, since these operators are generally static. However, some sort of scopal mechanism of this sort will be necessary in any case for examples like (32), where a regular indefinite scopes into a second question.

(32)   Where can I a buy a paper around here, and how much will it cost?

Under this approach to wh-traces under sluicing, a strict identity at a semantic level of interpretation (modulo the addition of a bindee for the sluiced wh-phrase) can be established, since the second conjunct will simply contain the same variable as the first conjunct does (^[**call(abby**, x)]).

The dynamic binding approach can be implemented just as successfully if we adopt the choice function analysis of indefinites (and sluicing) proposed by Reinhart 1995, 1997, and Winter 1997). Under this analysis, a wh-trace consists of the restriction and a choice function variable, as in the LF for (19a) given in (33).

(33)   [$_{CP}$ which suspect$_2$ did [$_{IP}$ Abby call f_2(suspect)]] and
       [$_{CP}$ when [$_{IP}$ **Abby call** f_2**(suspect)**]]

Now it is the choice function variable f that is the beneficiary of dynamic binding, as in (34).

(34) $\lambda p[\exists f.CH(f) \wedge {}^{\vee}p \wedge p = {}^{\wedge}[$**call(abby**, f**(suspect))**]] $\wedge$
       $\lambda p[\exists t \wedge {}^{\vee}p \wedge p = {}^{\wedge}[$**call(abby**, f**(suspect)**, at t)]]

Neither of these alternatives needs recourse to any mechanism like vehicle change, if the appropriate level for establishing equivalences for elliptical identity is semantic (for (31)) or LF (for (33)), since the relevant parts of the respective structures are truly identical. This does not show, of course, that vehicle change can be dispensed with in general, but it does make clear that vehicle change, in this case at least, is required only under one (widespread) view of the necessary components for resolution of ellipsis: syntactic phrase markers of a particular sort.

4   Conclusions

The investigation of the behavior of A'-traces under sluicing has provided evidence for a number of conclusions. First, I argued that these wh-traces form an equivalence class with their pronominal correlates under sluicing, an extension of the notion introduced in Fiengo and May 1994 to capture a wide array of deviancies from identity long known to hold under VP-ellipsis. This equivalence class behavior was captured formally by the syntactic mechanism of vehicle change. The fact that these A'-traces are pronominals at LF explains the absence of effects associated with standard variables, namely that Principle C effects and island-sensitivity are voided. I further gave an interpretation of these pronominal correlates as E-type pronouns anaphoric on wh-phrases, parallel to E-type pronouns anaphoric on other non-binding quantifiers investigated in the literature on donkey anaphora, and showed a parallel to other donkey anaphora in giving rise to proportion problem effects. Finally, I speculated on an alternative using dynamic

binding and showed how this approach obviates the need for vehicle change to establish the requisite semantic identity, bringing these facts into line with the classic analyses of 'deviance from identity' under ellipsis.

Appendix: A quick tour of some other islands (adapted from Postal 1996):

(35) finite embedded interrogative clauses
We knew who the FBI had arrested, but we forgot to find out <when>.

(36) nonfinite embedded interrogative clauses
They told me who to call, but they didn't tell me <when>.

(37) complements of head nouns
Which books are being hidden, and do you believe <the claim that the librarian knows where>?

(38) conjuncts
We discovered which capacitors Mark had disabled, and that Lucy knew about it but <didn't reveal why>.

(39) nonfinite adjuncts
Who did Bob confess he had robbed <without admitting where>?

(40) finite adjuncts
What did Bob try to fix <before he knew how>?

(41) restrictive relative clauses
It was obvious which capacitors were to be connected, but I couldn't find anyone <who knew where>.

(42) embedded exclamatory clauses
I know what Mark bought, I just can't believe <for how little money>!

(43) right dislocated phrases
He explained which pieces were there, though he tried to avoid it, <our question about why>.

(44) non-wh nonrestrictive
We found out who Moriarty spoke to, though Holmes, <and I'm sure he even knew when>, said it wasn't enough.

(45) extraposed PPs
We were told which traps had been set off, and rewards were offered <for figuring out when>

(46) the finite complement of so
Which Pharaoh built the Sphinx? I don't know, but Mark will— he's so smart <that he'll probably even know in which year>.

(47) left-extracted constituents
      Mark knew what he had lost, though <how>, he couldn't imagine.
(48) exceptive phrases
      We knew everything about which items had been stolen <except how>.
(49) the pivot of pseudoclefts
      It's easy to see what was stolen—what is difficult is <to figure out how>.
(50) predicate nominals/clauses
      Who had left was obvious—the problem is <the question when>.
      Who had left was obvious—the problem is <that we don't know when>.
(51) *namely* and *that is* constituents
      Although she figured out who Jack bribed, Charlene still said she was unsuccessful, that is, <that she hadn't been able to discover with how much money>.
(52) the nonfinite complements of *too/enough*
      Mark told us what he found, but was too astute <to tell us where>.
(53) the nonfinite complements of object-raising triggers
      Mark told us what he found, but was hard <to persuade to tell us where>.
(54) *as* parentheticals
      What Frank had hidden was known, but, <as finding out where showed>, it wasn't easy to get him to reveal details of his crime.
(55) relative-like nonrestrictive clauses
      We need to find out what they filmed, and talk to Arthur, <who will know how.>
(56) the relative clause-like part of clefts
      We all knew who Lucy had had dinner with, but it was only Bert <who knew where>.
(57) either piece of *the more ... the more* comparatives
      We knew what kind of house Mark was planning to build, but the more <we started to realize where>, the more horrified we became.
(58) comparative clauses
      Mark told more people who he had seen <than he told where>.

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