

Argument Contained Ellipsis Revisited*

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This paper investigates an unusual identity constraint on English verb phrase ellipsis which imposes the following requirement: when an elliptical relation holds between two verb phrases A and B such that A is contained in an argument b of B, then the corresponding argument a of A must be identical to b . The paper argues that this is due to two factors: 1) the licensing conditions on ellipsis, which require logical equivalence between a deleted constituent and its antecedent (Sag 1976; Williams 1977), and 2) the interpretation of variable binding structures, which involves adding assignments to the assignment function, rather than reassigning values to previously used variables.

1 Argument Contained Ellipsis

1.1 *The facts*

Wasow (1972) notes the impossibility of verb phrase ellipsis in sentences such as (1a-b):

- (1) a. *A proof that God exists doesn't \emptyset .
- b. *Your proof that my proof is valid isn't \emptyset .

Wasow accounts for these and similar sentences with a constraint that prohibits an elided VP from finding an antecedent within its subject.

The contrasts in (2) and (3) (originally observed by Jorge Hankamer) shows that this constraint is too strong: ellipsis is allowed in this configura-

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tion, but only if the subject of the elided VP is identical to the subject of its antecedent.

- (2) a. Everyone who wants to eat some fugu should \emptyset .
 b. *Everyone who wants Jason to eat some fugu should \emptyset .
- (3) a. The woman who said she would buy the tuna did \emptyset .
 b. *The woman who said Kim would buy the tuna did \emptyset .

It's important to observe that this is a constraint on *ellipsis*: the unelided (but deaccented) counterparts of the unacceptable examples above are OK:

- (4) a. A proof that God exists doesn't exist.
 b. The belief that I am mistaken is mistaken.
 c. Everyone who wants Jason to eat some fugu should eat some fugu.
 d. The woman who said Kim would buy the tuna bought it/the tuna.

These generalizations hold for other types of subjects as well. The sentential subject in (5) is analogous to Wasow's example:

- (5) *That you think that these facts are surprising isn't \emptyset .

Examples with free relative subjects behave like Hankamer's examples:

- (6) a. What you think is surprising isn't \emptyset .
 b. *What convinced you that this fact is surprising isn't \emptyset .
- (7) What convinced you that this fact is surprising isn't surprising.

In Kennedy 1994, I claimed that judgments are the same regardless of whether the elided VP is the embedded or the matrix VP, though I'm actually not sure about this anymore: (8b) and (9b) are worse than the (a) examples, but seem better than the examples above.

- (8) a. Everyone who wants to \emptyset should eat some fugu.
 b. ?Everyone who wants Jason to \emptyset should eat some fugu.
- (9) a. The woman who said she would \emptyset bought the tuna
 b. ?The woman who said Kim would \emptyset bought the tuna.

It should also be acknowledged that the judgments on all of these examples vary, and in particular, for many speakers, addition of *too* or *instead* to the end of the ungrammatical examples tends to make them more acceptable:

- (10) a. ??Everyone who wants Jason to eat fugu should \emptyset too.

b. ??The woman who said Kim would buy the tuna did \emptyset instead.

There doesn't seem to be the same degree of improvement in acceptability of the Wasow examples, however:

- (11) a. *A proof that God exists does \emptyset too.
 b. *Your proof that my proof is valid is \emptyset as well.

There are two possible explanations for the improvement in acceptability of examples like (10a-b). On the one hand, it may be the case that these sorts of constructions actually aren't ill-formed, just somehow infelicitous (hard to interpret, etc.), and the addition of *too*, *instead*, etc. improves their felicity (interpretability, etc.). On the other hand, it is possible that these sorts of constructions are basically ill-formed, but the addition of these particles somehow makes it easier for the hearer to assign an interpretation to them, giving the illusion of well-formedness. In Kennedy 1994, I assumed the latter was the case, and at the risk of generating a bit of confusion, I will continue to make this assumption for the moment, since it is assumed by two of the three analyses of this phenomenon that I will discuss. At the end of the paper, though, I will revisit this assumption in light of some additional theoretical and empirical considerations, and argue that the former position is in fact the correct one.

Moving to non-subjects, Kennedy 1994 shows that this sort of contrast is even stronger when we consider argument (non-)identity in ACD configurations. (12)-(13) involve canonical cases of ACD with direct objects.

- (12) a. Polly visited every town Erik did \emptyset .
 b. *Polly visited every town located in a country Erik did \emptyset .
 c. Polly visited every town located in a country Erik visited.
- (13) a. Max fooled none of the senators that Hector will \emptyset .
 b. *Max fooled none of the aides of the senators that Hector will \emptyset .
 c. Max fooled none of the aides of the senators that Hector will fool.

The interpretation of (12b) that is unavailable is illustrated in (14a). If the relative clause can be construed as just modifying *town* (which is somewhat difficult in this example), as in (14b), then ellipsis is OK.

- (14) a. For every x, y s.t. x is a town and y is a country and x is in y and Erik visited y , Polly visited x
 b. For every x, y s.t. x is a town and Erik visited x and y is a country and x is in y , Polly visited x

(15) involves an indirect object, and (16) an embedded subject.

- (15) a. Erik sent letters to every senator Polly did \emptyset .
 b. *Erik sent letters to every aide who worked for a senator Polly did \emptyset .
 c. Eric sent letters to every aide who worked for a senator Polly sent letters to.
- (16) a. Mona wants the candidates that Jack does \emptyset to be successful.
 b. *Mona wants the rivals of the candidates that Jack does \emptyset to be successful.
 c. Mona wants the rivals of every candidate that Jack wants to be successful to be successful.

The facts lead to the descriptive generalization in (17) (Kennedy 1994, p. 2).

- (17) *Argument Contained Ellipsis*
 Ellipsis between VP_1 and VP_2 , VP_1 contained in an argument A_2 of VP_2 , is licensed only if A_2 is identical to the parallel argument A_1 of VP_1 .

Our task is to figure out why this constraint should hold. Note that even if we decide that the subject-contained cases don't deserve a grammatical explanation, we still have the antecedent-contained cases to deal with.

1.2 The problem of ACE

Let's take as our starting point the hypothesis that ellipsis is licensed by semantic identity between VPs (XPs), as has been recently championed by Merchant (2001). In particular, let's adopt the hypothesis in (18), which is a revised version of Sag 1976; Williams 1977. (The following discussion is modeled after Heim 1997, though essentially the same points are made in Kennedy 1994.)

- (18) *The Sag/Williams theory of ellipsis*
 Delete a VP_e at PF only if there is a VP_a in the surrounding discourse such that for all variable assignments g , $\llbracket VP_e \rrbracket^g = \llbracket VP_a \rrbracket^g$.

At first glance, this looks like a good basis for an account of the ACE facts (and in the end, I will say that it does in fact do the trick). The minimal set of assumptions we need to get the contrasts above are the following:

- (19) *Initial assumptions*
- i. For $\alpha = pro/t$, $\llbracket \alpha_i \rrbracket^g = g(i)$
 - ii. The VP-internal subject hypothesis
 - iii. A relative pronoun and the categories it binds share the same index as the DP modified by the relative clause and the categories it binds
 - iv. ‘Semantically distinct’ DPs and the categories they bind bear distinct indices.

Let’s take the subject case first:

- (20) a. $[_{DP} \text{ everyone who}_1 \text{ wants PRO}_1 \text{ to } [_{VP_a} t_1 \text{ eat some fugu}]]_1 \text{ should } \underline{[_{VP_e} t_1 \text{ eat some fugu}]}$
- b. * $[_{DP} \text{ everyone who}_1 \text{ wants Jason}_2 \text{ to } [_{VP_a} t_2 \text{ eat some fugu}]]_1 \text{ should } \underline{[_{VP_e} t_1 \text{ eat some fugu}]}$

The crucial difference between these structures is the indices on the VP-internal subject traces: they are identical in (20a), thus (21a) holds and (18) is satisfied; they are distinct in (20b), thus (21a) holds and (18) is violated.

- (21) a. For all assignments g : $\llbracket [_{VP_a} t_1 \text{ eat some fugu}] \rrbracket^g = \llbracket \underline{[_{VP_e} t_1 \text{ eat some fugu}]} \rrbracket^g$
- b. \neg For all assignments g : $\llbracket [_{VP_a} t_1 \text{ eat some fugu}] \rrbracket^g = \llbracket \underline{[_{VP_e} t_2 \text{ eat some fugu}]} \rrbracket^g$

We’re going to get a similar result in the ACD cases. Ignoring the VP-internal subjects for the moment, here are the LFs of the relevant examples:

- (22) a. $[_{DP} \text{ every town } wh_1 \text{ Erik did } \underline{[_{VP_e} \text{ visit } t_1]}]_1 \text{ Polly PAST } [_{VP_a} \text{ visit } t_1]$
- b. * $[_{DP} \text{ every town } wh_1 t_1 \text{ located in } [_{DP} \text{ a country } wh_2 \text{ Erik did } \underline{[_{VP_e} \text{ visit } t_2}]]_2]_1 \text{ Polly PAST } [_{VP_a} \text{ visit } t_1]$

Here again the logical equivalence condition is satisfied for (22a) but not for (22b), because of the (non-)identity of indexical values on the traces.

- (23) a. For all assignments g : $\llbracket [_{VP_a} \text{ visit } t_1] \rrbracket^g = \llbracket \underline{[_{VP_e} \text{ visit } t_1]} \rrbracket^g$
- b. \neg For all assignments g : $\llbracket [_{VP_a} \text{ visit } t_1] \rrbracket^g = \llbracket \underline{[_{VP_e} \text{ visit } t_2]} \rrbracket^g$

The problem with this approach, however, as documented by Heim 1997, is that when we take into account the indices on the subjects in ordinary cases of ACD, as well as indices on subjects in simple cases of conjoined ellipsis,

we make the wrong predictions. In particular, since assumption (iv) of (19) posits non-coindexing for ‘semantically distinct’ DPs, we rule out (24) (as well as (22a)) for the same reason that we rule out the bad ACE cases with non-subject identity.

(24) Satoshi ate fugu, but Jason didn’t.

Assumption (iv) requires us to posit (25a) as the representation of (24); if we could posit (25b), we’d be OK, but this will also let in the bad ACE cases.

(25) a. Satoshi₁ PAST [VP_a t₁ eat fugu] but Jason₂ PAST NOT [~~VP_e t₂~~
eat fugu]
b. Satoshi₁ PAST [VP_a t₁ eat fugu] but Jason₁ PAST NOT [~~VP_e t₁~~
eat fugu]

Even if we give up the VP-internal subject hypothesis — essentially saying that the subject identity cases fall under a different generalization from the ACD cases (which is what I will end up arguing at the end of this paper) — we would still have a problem (if we maintain assumption (iv) of (19)). Examples like the following show that ellipsis tolerates different objects in constructions that don’t involve argument containment:

(26) a. Peanuts, I like; walnuts, I don’t.
b. The problems you can see are easier to deal with than the ones you can’t.
c. I know which books you read and which articles you did too.

According to the non-coindexing assumption (iv), (26a) should have only the LF in (27a), which doesn’t license ellipsis, not the one in (27b), which does.

(27) a. Peanuts₁ I PRES [VP_a like t₁], walnuts₂ I PRES NOT [~~VP_e like t₂~~]
b. Peanuts₁ I PRES [VP_a like t₁], walnuts₁ I PRES NOT [~~VP_e like t₁~~]

So, it is clear that something is wrong with our initial set of assumptions; the strategy now is to figure out what needs to be changed. Two obvious alternatives present themselves. The first option is to maintain the ‘logical equivalence’ analysis of ellipsis and change our assumptions about indexing. The second option is to maintain our assumptions about indexing and change our assumptions about ellipsis.

Of course, there are many other options as well, but I want to focus here on different versions of these two approaches to the problem, since 1) all of the approaches (to the ACD subcases of ACE, at least) currently on

the market fall into these two categories, and 2) on the whole, the set of assumptions I have laid out form the basis for a quite general framework for semantic interpretation and ellipsis licensing that has been shown to do a lot of work for us in other contexts. It is worth keeping in mind, however, that at the end of the day it may turn out that ACE is really telling us that we need to think about some more radical alternatives to the ‘standard’ set of assumptions.

2 Approaches to ACE

2.1 Kennedy 1994

2.1.1 The proposal

The analysis of ACE presented in Kennedy 1994 is essentially a version of option 1 above: VP-deletion requires logical equivalence of VPs, but semantically distinct DPs are not prohibited from bearing identical indices. The crucial assumptions are listed in (28).

- (28) Kennedy’s analysis of ACE
- i. *The Sag/Williams theory of ellipsis*
Delete a VP_e at PF only if there is a VP_a in the surrounding discourse such that for all variable assignments g , $[[VP_e]]^g = [[VP_a]]^g$.
 - ii. *The Reinhart 1983 theory of coindexation*
The interpretation of coindexation is semantic binding.
 - iii. *The *i*-within-*i* constraint*
 $*[\alpha \dots i \dots]_i$ when α -internal i is not bound by α .
 - iv. The VP-internal subject hypothesis

A consequence of (28ii) is that there is no general prohibition on semantically distinct DPs bearing the same index. In particular, DPs in distinct clauses can bear identical indices with no problem. (29a) and (30a) can therefore have the LFs in (29b) and (30b), respectively, which satisfy the identity condition on ellipsis since the VP-internal variables will get the same value for all assignments.

- (29) a. Satoshi ate fugu, but Jason didn’t.
b. Satoshi₁ PAST [VP_a t_1 eat fugu] but Jason₁ PAST NOT [VP_e t_1 eat fugu]
- (30) a. Peanuts, I like; walnuts, I don’t.
b. Peanuts₁ I PRES [VP_a like t_1], walnuts₁ I PRES NOT [VP_e like t_1]

On this analysis, the strategy is to ensure that ACE constructions are not assigned representations that satisfy the identity condition on ellipsis. That is, it should be the case that only the (a) LFs for (31) and (32), which don't license ellipsis, are possible LFs. The ones in (b), which would satisfy the identity condition on ellipsis, need to be ruled out.

- (31) a. $[\text{DP everyone who}_1 \text{ wants Jason}_2 \text{ to } [\text{VP}_a t_2 \text{ eat some fugu}]]_1 \text{ should } [\text{VP}_e t_1 \text{ eat some fugu}]$
 b. $[\text{DP everyone who}_1 \text{ wants Jason}_1 \text{ to } [\text{VP}_a t_1 \text{ eat some fugu}]]_1 \text{ should } [\text{VP}_e t_1 \text{ eat some fugu}]$
- (32) a. $[\text{DP every town } [\text{CP } wh_1 t_1 \text{ located in } [\text{DP a country } [\text{CP } wh_2 \text{ Erik did } [\text{VP}_e \text{ visit } t_2]]]_2]]_1 \text{ Polly PAST } [\text{VP}_a \text{ visit } t_1]$
 b. $[\text{DP every town } [\text{CP } wh_1 t_1 \text{ located in } [\text{DP a country } [\text{CP } wh_1 \text{ Erik did } [\text{VP}_e \text{ visit } t_1]]]_2]]_1 \text{ Polly PAST } [\text{VP}_a \text{ visit } t_1]$

In Kennedy 1994, I ruled out the (b) representations in a “principled” way by appealing to principles of referential circularity. The contrasts in (33) show that there are configurations in which an expression inside a DP that ends up being interpreted as a bound variable cannot bear the same index as the DP itself — these are so-called *i-within-i* violations.

- (33) a. $*[\text{Every proof } [\text{CP that it}_1 \text{ is correct}]]_1 \text{ is bound to be circular.}$
 b. $[\text{Every proof } [\text{CP } wh_1 \text{ that convinces us that it}_1 \text{ is correct}]]_1 \text{ is elegant.}$

Roughly speaking, unless a pronoun can be bound inside DP (in (33b), by the relative operator), it cannot end up being interpreted as bound by the DP (or more properly, by the determiner) (see in particular Jacobson 1977; Higginbotham 1983; Haik 1985, 1987). I claimed that the (b) representations above violate this constraint because the occurrence of the index 1 inside the relative clauses is bound by a distinct DP, not by the relative operator of the bigger DP.

2.1.2 The problems

The problem with this proposal is that if we really think through the principles underlying *i-within-i* effects, the result we want to derive doesn't actually follow from anything. For example, one way to derive *i-within-i* effects would be to adopt the assumptions about variables and binding in (34):

- (34) (Modified) Heim and Kratzer 1998 semantics for variables and binding
- i. For $\alpha = pro/t$, $\llbracket \alpha_i \rrbracket^g = g(i)$
 - ii. For $\alpha \neq pro/t$, $\llbracket [\gamma \ \alpha_i \ \beta] \rrbracket^g =$
 - a. $\lambda x. \llbracket \beta \rrbracket^{g[x/i]}(\llbracket \alpha \rrbracket^g)$ or
 - b. $\llbracket \alpha \rrbracket^g(\lambda x. \llbracket \beta \rrbracket^{g[x/i]})$,
 depending on the semantic type of α .
 - iii. A context c is appropriate for a LF ϕ only if c determines a variable assignment g_c whose domain includes every index that has a free occurrence in ϕ .

These assumptions conspire to ensure that pronouns and empty categories are interpreted as bound variables only if they are c-commanded by a coindexed expression at LF. If this configuration is not met, a bound interpretation is unavailable, and pro/t_i is interpretable only if i is in the domain of g_c .

In constructions like (33b), the pronoun is interpreted as a bound variable by virtue of being coindexed with the relative pronoun. First, assume that $\llbracket wh^{rel} \rrbracket^g = \lambda f_{\langle e,t \rangle}. f$. Then:

$$(35) \quad \llbracket [CP wh_1^{rel} [\text{that } t_1 \text{ convinces us that it}_1 \text{ is correct}]] \rrbracket^g = \\ \llbracket wh^{rel} \rrbracket^g(\lambda x. \llbracket [\text{that } t_1 \text{ convinces us that it}_1 \text{ is correct}] \rrbracket^{g[x/1]}) = \\ \lambda x. x \text{ convinces us that } x \text{ is correct}$$

In constructions like (33a), however, in which the pronoun it_1 is contained within a clausal complement of the noun, there will be nothing to bind it inside the DP. Only those expressions contained inside the complement of the whole DP will be interpreted as bound:

$$(36) \quad \llbracket [\gamma [\text{every proof that it}_1 \text{ is correct}]_1 \ \beta] \rrbracket^g = \\ \llbracket [\text{every proof that it}_1 \text{ is correct}] \rrbracket^g(\lambda x. \llbracket \beta \rrbracket^{g[i/x]})$$

As a result, the pronoun will be interpretable only if 1 is in the domain of the contextual assignment, which means that it is (at best) free, not bound.

The problem for the Kennedy 1994 analysis of ACE is that nothing really goes wrong in the cases we're interested in: the rules in (34) (or any other set of assumptions that derives *i-within-i* effects; see e.g. Jacobson 2000) don't have any problem interpreting a structure like (37) in just the right way: at the point of interpretation of CP_2 , the index 1 can be reassigned, as shown in (38b).

$$(37) \quad [_{DP} \text{ every town } [_{CP_1} wh_1 [_{IP_1} t_1 \text{ located in } [_{DP} \text{ a country } [_{CP_2} wh_1 [_{IP_2} \\ \text{Erik did } [_{VP_e} \text{ visit } t_1]]]]]]]_1 [_{Polly PAST} [_{VP_a} \text{ visit } t_1]]$$

- (38) a. $\llbracket CP_1 \rrbracket^g = \llbracket wh \rrbracket^g(\lambda x. \llbracket IP_1 \rrbracket^{g[x/1]})$
 b. $\llbracket CP_2 \rrbracket^{g[x/1]} = \llbracket wh \rrbracket^{g[x/1]}(\lambda z. \llbracket IP_2 \rrbracket^{g[x/1][z/1]})$

At the end of the day, the best we can say is that the bad representations are ruled out by a syntactic constraint on the distribution of indices. We might hypothesize that this is a generalization of what the semantics derives, but this is a ‘patch’ at best.

2.2 Heim 1997

2.2.1 The story

The analysis of ACE developed in Heim 1997 is a version of the second option discussed above: Heim maintains the assumption that semantically distinct DPs have to bear distinct indices, but jettisons the Sag/Williams analysis of ellipsis in favor of the focus-based approach advocated in Rooth 1992. The crucial assumptions are given in (39).

- (39) Heim’s analysis of ACE
- i. *Rooth’s (1992) analysis of ellipsis*
 - a. A deleted VP and its antecedent must have the same lexical material up to indexical values on traces, pronouns, etc.
 - b. A deleted VP must be contained in a phrase that contrasts appropriately with some phrase that contains the antecedent VP.
 - ii. *No Meaningless Coindexing*
 If a 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 .
 - iii. *The VP-internal subject hypothesis*

The notion of ‘appropriate contrast’ appealed to here is the same one that is relevant for the licensing of focus/deaccenting in Rooth’s theory:

- (40) A constituent ϕ contrasts appropriately with a constituent ψ iff:
- a. ϕ and ψ don’t overlap, and
 - b. for all assignments g , the regular semantic value of ψ w.r.t. g is an element of the focus value of ϕ with respect to g .

Heim’s claim about ACE is that the problem comes from the appropriate contrast condition: essentially, it is not possible to satisfy the ‘identity’ component

of this condition (40b) without violating the ‘no overlap’ component (40a).

Let’s take the subject case first. (41a-b) are potential LFs for the good and bad examples, respectively. Note that in (41b), the indices on the subjects of VP_a and VP_e are distinct, in accord with the ‘No meaningless coindexing’ constraint.

- (41) a. [everyone who wants PRO_1 to [VP_a t_1 eat *fugu*]]₁ should [~~VP_e t_1 eat *fugu*~~]
 b. *[everyone who wants $Jason_1$ to [VP_a t_1 eat *fugu*]]₂ should [~~VP_e t_2 eat *fugu*~~]

The analysis runs like this:

1. In both (41a) and (41b), the syntactic identity requirement on deletion is met.
2. In (41a), the appropriate contrast condition is also met:
 - (a) Let $\phi = [\text{~~VP}_e \text{ } t_1 \text{ eat fugu}]~~$ and $\psi = [VP_a \text{ } t_1 \text{ eat fugu}]$: the focus value of VP_e for any g is the unit set containing the proposition $g(1)$ *eat fugu*, which is the same as the regular value of VP_a for any g .
 - (b) **NB**: this is possible precisely because the subject traces inside the two VPs can (in fact, must) be coindexed here.
3. In (41b), however, there is no way to satisfy the appropriate contrast condition.
 - (a) This won’t work for $\phi = [\text{~~VP}_e \text{ } t_2 \text{ eat fugu}]~~$: thanks to ‘no meaningless coindexing’, there is no phrase that in the representation that expresses $g(2)$ *eat fugu*.
 - (b) This won’t work for $\phi = [\text{should } [\text{~~VP}_e \text{ } t_2 \text{ eat fugu}]]~~$, because the focus value of this for any g is $\{f(g(2) \text{ eat fugu}) \mid f \text{ is an alternative to the meaning of } \textit{should}\}$, but there is nothing in the representation whose meaning will be an element of this set either.
 - (c) Finally, this won’t work for $\phi = [\text{the whole sentence}]$, because this would violate the ‘no overlap’ condition.

Essentially the same story is told for cases of ACE-ACD, the only difference being that we are looking at LFs in which the QP containing the elided VP has undergone QR. However, the basic problem will be the same: the ‘no overlap’ condition and the ‘no meaningless coindexing’ condition will conspire

to ensure that all of the potential focus values for various choices of ϕ will be assignment-dependent.

So the two absolutely crucial components of Heim's analysis are the 'no overlap' component of the appropriate contrast condition and the 'no meaningless coindexing' assumption. The former can arguably be made to follow from more general principles (maybe *i-within-i*, in which case the Kennedy and Heim analyses share a crucial property, or maybe Condition C of the binding theory, which is evidently what Root argues).

The latter is not so obviously justified, however: given the assumptions about the interpretation of binding/coindexation in (34), this does not follow. In fact, Heim's analysis would be compatible with a slightly different version of this constraint that allowed coindexing *except in argument-containment configurations*. I will return to this point below.

2.2.2 New predictions

A very positive result of Heim's analysis is that it has broader empirical coverage than Kennedy's. In particular, it rules out (42b), which Kennedy's analysis does not cover:

- (42) a. Satoshi₁ wants PRO₁ to [_{VP_a} *t*₁ eat fugu], and will [~~VP_e *t*₁ eat fugu~~] (too).
 b. *Satoshi₁ wants Jason₂ to [_{VP_a} *t*₂ eat fugu], and will [~~VP_e *t*₁ eat fugu~~] (too).
 c. Satoshi₁ wants Jason₂ to [_{VP_a} *t*₂ eat fugu], and he₁ will [~~VP_e *t*₁ eat fugu~~] (too).

Assuming that the ATB-moved subject cannot be reconstructed in (42b), the only constituent that would be big enough to use as ϕ in the appropriate contrast condition would be the whole sentence, which would violate 'no overlap'. In contrast, in (42a), the elided VP is big enough, and in (42c), the second conjunct will work (assuming focus on the subject pronoun).

2.2.3 The problems

Heim's analysis also runs into some empirical problems. The first may actually not be a problem: it predicts that deleting the subject-contained VP in the subject-ACE cases should be OK:

- (43) [Everyone who wants Jason₂ to [~~VP_e *t*₂ eat fugu~~]]₁ should [_{VP_a} *t*₁ eat fugu]

Here we let ϕ be [Jason_{2,F} to ~~[VP_e t₂ eat fugu]]], the focus value of which will include $g(1)$ *eat fugu* for any g . But as I mentioned at the beginning, I'm no longer so sure about the facts here: if this sort of example is well-formed, then Heim's analysis scores a point.~~

The second problem is a bigger one. Since all the work here is being done by the focus component of Rooth's theory of ellipsis, and since 'no meaningless coindexing' applies everywhere, the analysis predicts that we should get ACE violations in deaccenting. This is not true, however, as shown by (44a-b), where smaller type represents deaccenting.

- (44) a. Everyone who wants Jason to eat fugu should eat fugu/it.
 b. Polly visited every town located in a country Erik visited.

If VP_d in the LFs of these examples is subject to the same licensing conditions as VP_e in their ellipsis counterparts, then these should be just as bad.

- (45) a. [everyone who wants Jason₁ to [VP_a t₁ eat fugu]]₂ should [VP_d t₂ eat fugu]
 b. [a country *wh*₁ Erik [VP_d visited t₁]] [every town located in t₁]₂
 [Polly PAST [VP_a visit t₂]]

Finally, there is (in my opinion) a major conceptual/theoretical problem with this analysis: why should the 'no meaningless coindexing' constraint hold? This should follow from something, but as far as I can tell, the simplest initial assumptions about the syntactic representation of binding configurations shouldn't care about coindexation of variables bound by distinct binders. (Though I will qualify this statement below.)

2.3 Sauerland 1998, 2002

2.3.1 The story

Sauerland (1998, to appear) develops an analysis of ACE that is in some ways quite different from the Kennedy and Heim analyses, though roughly speaking it is an instance of an approach that says our assumptions about indexing need to be revised. The crucial bit of Sauerland's analysis is his analysis of the interpretation of \bar{A} chains, stated in (46). I think that Sauerland's analysis could in principle be implemented in either the Sag/Williams theory of ellipsis or a Rooth-style approach, so to keep things simple I will assume the former. (Sauerland himself adopts the extension of Rooth's approach advocated in Fox 1999a.)

- (46) Sauerland's analysis of \bar{A} -chains
- a. The trace of \bar{A} -movement contains a copy of the head of the moved XP.
 - b. $[[\langle nom_i \rangle]]^g = g(i)$ if $[[nom]]^g(g(i)) = 1$, otherwise undefined (see Fox 1999b).

On this analysis, the contrast in (47) is straightforwardly explained.

- (47) a. Polly visited every town Erik did.
 b. *Polly visited every town located in a country Erik did.

These examples have the LFs in (48). Here I assume that like-indexing on bound expressions is OK, and doesn't violate any constraint.

- (48) a. [every town [_{CP} ~~town~~₁ Erik did [_{VP_e} visit ~~$\langle town_1 \rangle$~~]]]₁ [Polly PAST [_{VP_a} visit $\langle town_1 \rangle$]]
 b. [every town [_{CP} ~~town~~₁ located in a country [_{CP} ~~country~~₁ Erik did [_{VP_e} visit ~~$\langle country_1 \rangle$~~]]]]₁ [Polly PAST [_{VP_a} visit $\langle town_1 \rangle$]]

(48a) is unremarkable: VP_a and VP_e have the same denotations for all assignments:

- (49) For all assignments g , $[[[VP_a \text{ visit } \langle town_1 \rangle]]]^g = [[[VP_e \text{ visit } \langle town_1 \rangle]]]^g$

The problem with (49b) is not in the indexical values — I am assuming that reassignment of the index 1 is taken care of when the relative operator composes with its scope — but at the level of interpretation of the trace. Since the trace have distinct lexical content, they will be interpreted differently and logical equivalence will not hold.

- (50) \neg For all assignments g , $[[[VP_a \text{ visit } \langle town_1 \rangle]]]^g = [[[VP_e \text{ visit } \langle country_1 \rangle]]]^g$

2.3.2 Problems

This analysis predicts that we should not see ACE effects when the distinct arguments in ACE configurations have the same lexical content, and this is indeed what Sauerland claims. He presents data like (51)-(52) as evidence (these are Sauerland's judgments):

- (51) a. *Polly visited every town that's near the lake Erik did.
 b. Polly visited every town that's near the town Erik did.
 c. Polly visited every town that's near the one Erik did.

- (52) a. *Satoshi ordered a drink that was more expensive than the dish Jason did.
 b. Satoshi ordered a drink that was more expensive than the drink Jason did.
 c. Satoshi ordered a drink that was more expensive than the one Jason did.

My own judgments differ: I find the (b) examples above ungrammatical, but I agree that the (c) examples are significantly more acceptable. The empirical difficulty here is that both my judgments and Sauerland's judgments are shared by other native speakers. At the UCSC Ellipsis Workshop (January 2003), the majority of native speakers agreed with my claims about the data, but some speakers agreed with Sauerland's claims. One thing that everyone agreed on is that if the second DP is indefinite (in Sauerland's examples above, it is always definite), the examples are worse:

- (53) a. *Polly visited every town that's near a town that Erik did.
 b. *Satoshi ordered every drink that was more expensive than a drink Jason did.

In contrast, the unelided counterparts are OK:

- (54) a. Polly visited every town that's near a town that Erik visited.
 b. Satoshi ordered every drink that was more expensive than a drink Jason ordered.

I think this is fairly systematic. Consider the following examples, describing the results of some sort of cognitive psychology experiment in which the task is for a child to reproduce the actions of another child when faced with rows and columns of different shapes (circles, squares, triangles).

- (55) a. *Nicholas touched every circle above a circle Julian did.
 b. *Nicholas touched every circle above some circles Julian did.
 c. *?Nicholas touched every circle above some of the circles Julian did.
 d. ?Nicholas touched every circle above the one Julian did.

In general, the less definite the second DP, the less acceptable the ellipsis. Again, the unelided counterparts of these examples are perfect:

- (56) a. Nicholas touched every circle above a circle Julian touched.
 b. Nicholas touched every circle above some circles Julian touched.
 c. Nicholas touched every circle above some of the circles Julian

touched.

- d. Nicholas touched every circle above the one Julian touched.

The bottom line here is evidently that there is some effect of lexical identity/definiteness, but it is not yet clear just what this effect is, how systematic it is, and how much we want to base a general explanation of ACE on it. At the very least, more experimentation needs to be done to decide what is going on here before we draw any conclusions.¹

Setting these cases aside, there are other examples that are more clearly problematic for Sauerland's proposal. Recall from the initial discussion of the facts in section 1.1 that free relatives show ACE effects:

- (57) a. What you think is surprising isn't.
 b. *What convinced me that what you think is surprising isn't.
 c. What convinced me that what you think is surprising isn't surprising.

These involve subjects, which are not covered by Sauerland's analysis anyway, since it is strictly geared towards \bar{A} movement constructions. However, we see the same effects with free relatives in ACD configurations:

- (58) a. I'll order what(ever) Jason does.
 b. *I'll order whatever goes well with what(ever) Jason does.
 c. I'll order whatever goes well with what(ever) Jason orders.
- (59) a. Kim always votes for whoever Lee does.
 b. *Kim always votes for whoever is competing against whoever Lee does.
 c. Kim always votes for whoever is competing against whoever Lee votes for.

Sauerland's analysis predicts examples like (59b) and (58b) to be OK, since there is no mismatch of lexical content here. So even if Sauerland turns out to be right about the interpretation of chains, we will need to say more to

¹Polly Jacobson (p.c.) suggests that the improvement observed in the examples with definite DPs may somehow stem from the fact that use of the definite sets up a presupposition that there are pairs of objects and individuals connected by some salient relation, in these cases, the relation expressed by the overt verb. If something like this is correct, then it may be possible to analyze ellipsis as being licensed not literally by the matrix VP, but rather by these presuppositions. Crucially, this would allow the indexical values on the variables inside the elided VP to differ from those inside the antecedent, as long as we use the same variables in the representation of the meaning of the presupposed information. Whether this hypothesis can actually be implemented remains to be seen.

account for these cases.²

A final point to make is that (as noted above) since Sauerland's proposals apply to \bar{A} -traces only, the analysis says nothing about cases of subject-ACE. I will end up arguing below that this is in fact the result we want, so this is actually a positive result of the proposal.

2.4 Scorecard

Here's where things stand:

- Kennedy (1994): accounts for all the ACE facts (subject-ACE and ACD-ACE), but relies on a stipulation about the distribution of indices that doesn't really follow from anything.
- Heim (1997): accounts the ACE facts and makes correct predictions about additional cases, but relies on a stipulation about the distribution of indices that doesn't really follow from anything.
- Sauerland (1998, to appear): only accounts for ACD-ACE (potentially a good result), but for some speakers at least, the lexical identity constraint appears too strong, and the analysis clearly overgenerates in the case of free relatives). (The analysis may also undergenerate for non-ACE configurations involving \bar{A} -movement out of an elided VP; see note 2.)

The Kennedy/Heim analyses have the same basic theoretical problem, but potentially better empirical coverage than the Sauerland analysis, suggesting that a new and improved analysis of ACE can be found by focusing on the representation and interpretation of binding configurations.³

² Another potential problem for Sauerland's analysis is that it is possible to have non-identity of lexical content of \bar{A} -traces in non-ACE configurations, namely in the sorts of examples that were shown to be problematic for the 'vanilla' Sag/Williams analysis:

- (i) a. I know which cities Polly visited, but I don't know which lakes she did.
 b. The cities Polly visited are near the lakes that Erik did.

Sauerland addresses this problem in Sauerland (to appear), and proposes (different) ways of handling examples like (ia) and (ib). I need to study this work in more detail in order to decide whether these examples can be dealt with in a principled way or whether they represent fundamental problems with the proposal.

³Actually, two other relevant works need to be considered before the analysis developed below can be accepted. The first is the analysis of subject-ACE in Hardt and Asher 1997, which seeks to explain the facts in terms of discourse-level effects. My hope is that once we give up trying to explain these cases in terms of LF-representations, which is what I will

3 A new proposal: No local variable reassignment

As noted above, even though Heim adopts the ‘no meaningless coindexing’ constraint, really all that is crucial is that ‘meaningless’ coindexing is ruled out in ACE configurations — we wouldn’t make the wrong predictions if bound variables in distinct sentences were allowed to have the same indices. This result is the mirror image of what is required in Kennedy’s analysis: the only place we need to *disallow* coindexing of bound variables is in ACE configurations. This means that if the grammar included the constraint in (60), both analyses would account for the facts of ACE without having to make unjustified stipulations about the distribution of indices.

- (60) *No local variable reassignment*
 In $[\alpha \dots v_i \dots]$, if $[[\alpha]]^{g[x/i]}$, then $*[[v_i]]^{g[z/i]}$ for $z \neq x$

The purpose of this constraint is to rule out variable reassignment within a constituent: once the value of a particular i has been fixed by the composition principles that handle the interpretation of (bound) variables, it cannot be reassigned. Note that this is not what the rules for interpreting variables presented in (34) above stated: those principles (from Heim and Kratzer 1998) explicitly allowed reassignment (as is standard practice)

The hypothesis that (60) is meant to capture is the following. The assignment function with respect to which a LF is evaluated is *partial*: it includes only assignments to free variables; it does not include in its range any bound variables in a LF-representation. In the course of interpreting a constituent, however, new (bound) variables may be assigned values in accord with the composition principles (to be redefined below), but this may happen only once: there is no reassignment of values. Once the interpretation procedure moves on to a new constituent, however, the new additions to the assignment are ‘erased’, and we can start reusing variable names for the interpretations of subsequent occurrences of bound variables.

suggest below, the Hardt-Asher proposal will fill in the gaps.

The second is Jacobson 1998, which does not include an analysis of ACE *per se*, but does include a discussion of data that bears on the issues under consideration here, namely the well-formedness of examples like (i), which involve pied-piping:

- (i) a. Kim visited every country the capital of which Lee did.
 b. Pat voted for every candidate the rival of whom Jo did.

Superficially, it appears that these examples fall under the descriptive generalization in (17), since the arguments of the related VPs are not identical. How the analysis presented below will handle these facts is an issue that I will address in the next draft of this paper.

If such a principle is part of the grammar, it would derive the result I wanted to derive in Kennedy 1994: the LFs in (61) would be ruled out by this constraint, because they would involve reassigning the value of the index 1 inside a constituent where 1 is already assigned.

- (61) a. * $[\text{DP everyone who}_1 \text{ wants Jason}_1 \text{ to } [\text{VP}_a t_1 \text{ eat some fugu}]]_1 \text{ should } [\text{VP}_e t_1 \text{ eat some fugu}]$
 b. * $[\text{DP every town } wh_1 t_1 \text{ located in } [\text{DP a country } wh_1 \text{ Erik did } [\text{VP}_e \text{ visit } t_1]]_2]_1 \text{ Polly PAST } [\text{VP}_a \text{ visit } t_1]$

Representations that don't run afoul of (60), on the other hand, won't satisfy the identity conditions on ellipsis, so we correctly predict that ellipsis should be impossible in ACE configurations.

(60) would have similar consequences for Heim's analysis: it would preserve her basic account of ACE by maintaining the prohibition on representations like (61), but it would allow coindexing in coordinate structures, so we wouldn't have to stipulate 'no meaningless coindexing' as a general constraint on text-level LFs.

Of course, the 'no local variable reassignment' constraint in (60) is subject to the same criticisms as my original invocation of the *i-within-i* constraint if it can't be made to follow from anything. In this case, however, I think we are in better shape. Suppose that the rules of variable binding/interpretation are not as in (34) above, but rather as in (62). (This is a slightly modified version of the system suggested by Irene Heim in Heim & Kennedy's Fall 2002 Introduction to Semantics course at MIT.)

- (62) Semantics for variables and binding
- i. For $\alpha = pro/t$, $[[\alpha_i]]^g = g(i)$
 - ii. For $\alpha \neq pro/t$, $[[[\gamma \alpha_i \beta]]]^g =$
 - a. $\lambda x. [[\beta]]^{g \cup \{i \mapsto x\}} ([[\alpha]]^g)$ or
 - b. $[[\alpha]]^g (\lambda x. [[\beta]]^{g \cup \{i \mapsto x\}})$,
 depending on the semantic type of α .
 - iii. A context c is appropriate for a LF ϕ only if c determines a variable assignment g_c whose domain includes every index that has a free occurrence in ϕ .
 - iv. CONDITION: variable assignments are functions.

The crucial difference between this set of assumptions and the ones in (34) is that when a subtree of the form in (63)— a binder α_i and its scope — is interpreted, the new assignment to variables indexed i is added to the old assignment.

$$(63) \quad \begin{array}{c} \gamma \\ \wedge \\ \alpha_i \quad \beta \end{array}$$

This means that in order to satisfy clause (iv) of (62) — in order to ensure that the assignment function is a function — no subconstituent of β in (63) can introduce an assignment to the index 1 that gives it a different value from what it gets when γ is interpreted. The constraint in (60) is therefore a consequence of the assumptions in (62).

If we further assuming that at the root, the assignment function includes all and only the free variables in a LF representation in its range, and that composition rules require daughter nodes to have the same assignments as their mothers (except in the case of binding, as specified above in (62); cf. Heim and Kratzer 1998), we also derive the result that variable names can be freely reused outside of constituents in which they are introduced, as indicated schematically in (64).

$$(64) \quad \begin{array}{c} \llbracket \alpha \rrbracket^{g_c} \\ \swarrow \quad \searrow \\ \llbracket \beta \rrbracket^{g_c} \quad \llbracket \gamma \rrbracket^{g_c} \\ \swarrow \quad \searrow \quad \swarrow \quad \searrow \\ \llbracket DP_1 \rrbracket^{g_c} \quad \lambda x. \llbracket \phi \rrbracket^{g_c \cup [1 \rightarrow x]} \quad \llbracket DP_1 \rrbracket^{g_c} \quad \lambda x. \llbracket \psi \rrbracket^{g_c \cup [1 \rightarrow x]} \end{array}$$

Thus it is not exactly the case that assignments to bound variables are ‘erased’ when the interpretation moves to a new constituent (e.g., from β to γ in (64)), as stated above, rather those assignments are not there in the first place.

4 Consequences and refinements

4.1 The theory of ellipsis

If the proposals outlined in the previous section are correct, then it appears that either the Sag/Williams/Kennedy analysis or the Rooth/Heim analysis of ellipsis will account for the ACE facts. One potential argument for the former approach, however, is the fact discussed above that ACE effects really do seem to be about *ellipsis*, and not about ‘contrast’. As we saw, deaccenting is acceptable in the contexts where ellipsis is bad:

- (65) a. *Everyone who wants Jason to eat fugu should.
 b. Everyone who wants Jason to eat fugu should eat fugu/it.

- (66) a. *Polly visited every town located in a country Erik did.
 b. Polly visited every town located in a country Erik visited.

As noted above, Heim’s analysis predicts that we should see the same identity effects in ‘argument-contained deaccenting’, since it is the appropriate contrast part of Rooth’s theory of ellipsis, not the VP-identity part, that plays the crucial role in accounting for the data. Unless facts like (65a) and (66a) can be dealt with, then, we have an argument for separating ellipsis licensing from the theory of focus/deaccenting.

4.1.1 A positive result

Once we adopt the conventions for interpreting binding configurations proposed in (62) and derive the corresponding ‘no local variable reassignment’ effect, the Sag/Williams/Kennedy analysis can now derive (67a), which was accounted for by Heim (1997) but not by Kennedy 1994. This example must have to have the representation in (67b) to license ellipsis, but (67b) violates (60), because the index 1 is reassigned inside the VP headed by *want*.

- (67) a. *Satoshi wants Jason to eat fugu, and will (too).
 b. Satoshi₁ [_{VP} *t*₁ wants Jason₁ to [_{VP_a} *t*₁ eat fugu]], and will [~~_{VP_e} *t*₁ eat fugu~~] (too).

In contrast, in the good example (68a), we can assign an index to the subject of the second clause that is the same as the index on *Jason*, ensuring that the two VPs are logically equivalent, but is distinct from the subject of the first clause. This is shown in (68b).

- (68) a. *Satoshi wants Jason to eat fugu, and he will (too).
 b. Satoshi₁ [_{VP} *t*₁ wants Jason₂ to [_{VP_a} *t*₂ eat fugu]], and he₂ will [~~_{VP_e} *t*₂ eat fugu~~] (too).

4.2 Problems

On the potentially less positive side, the Sag/Williams/Kennedy analysis of ACE still predicts symmetrical (un-)acceptability for deletion of either the first or second VP, though, so if (69b) is really acceptable, then we have a problem.

- (69) a. *Everyone who wants Jason to eat fugu should.
 b. ?Everyone who wants Jason to should eat fugu.

Even worse, as far as I can tell, we no longer have an account of the Wasow examples! This is particularly embarrassing, since these are the most unacceptable cases of subject-ACE.

- (70) a. A proof that God exists doesn't.
 b. [A proof that God₁ [VP_A t₁ exists]]₁ PRES NOT [~~VP_E t₁ exist~~]

The problem here is that the clausal complement of the noun *proof* is not a constituent that is interpreted relative to the assignment of the index 1 introduced by interpretation of the whole subject DP and its sister. That is, this CP is not an instantiation of β in (63). If the larger picture is correct, then there must be something else going on here. We are therefore left in the somewhat unsatisfying situation of having explained all the derivative ACE facts, but not the single fact that started the whole investigation.

However, the biggest problem of all for the analysis is that it incorrectly predicts intra-sentential argument identity effects in certain cases of non-argument containment. (71), on the sloppy reading, is one such example:

- (71) Sam wants to report her findings before Lee does.

In order to derive the sloppy reading, *Sam* and *Lee* must bear the same indices. But if the *before*-clause is c-commanded by the matrix subject, the principles introduced in (62) should forbid this indexing.

- (72) [IP Sam₁ wants to [VP [VP_A t₁ report her₁ findings] [~~VP_E t₁ report her₁ findings~~]]]]

One way out would be to interpret the adjunct above the matrix subject. This would predict that we should only get *de re* interpretations of the adjunct, but this doesn't seem to be correct.

Another way out would be to allow double-indexing, as suggested in Heim 1993. If PRO could be indexed as in (73), where i in $i : j$ represents what it is bound by, and j what it binds, then we will get the right interpretation for this example and license ellipsis without running afoul of the 'no local variable reassignment' constraint.

- (73) [IP Sam₂ wants [[PRO_{2:1} to [VP_A t₁ report her₁ findings]] [before Lee₁ does [~~VP_E t₁ report her₁ findings~~]]]]]

Even if we could come up with a non-stipulative justification for this move, however, examples like the following show that the general problem we are trying to deal with here is much larger.

(74) Every boy thinks he is a genius because his mother does.

If the VP-internal subject trace plays a role in licensing ellipsis, as assumed by both Kennedy (1994) and Heim (1997) in order to account for subject-ACE, then (74) should have the LF-representation in (75), which is obviously incoherent.

(75) $[_{IP} [_{DP} \text{Every boy}]_1 [_{VP_A} t_1 \text{ thinks } [_{IP} \text{he}_1 \text{ is a genius}]]] \text{ because } [_{DP} \text{his}_1 \text{ mother}]_1 \text{ does } [_{VP_A} t_1 \text{ thinks } [_{IP} \text{he}_1 \text{ is a genius}]]]$

On the other hand, if we give up the idea that the VP-internal subject trace (and possibly A-traces more generally) is relevant to calculating identity in ellipsis, then all of the problems outlined here disappear. In other words, if we assume that A-traces are not bound variables, or that they are always bound inside (i.e., that VPs can always be analyzed as type $\langle e, t \rangle$, possibly by invoking the ‘Derived VP-Rule’), then the problems raised here will not arise.

The consequence of this move, however, will be to lose an analysis of subject-ACE — or at least to lose a single, general analysis of both the subject and ACD cases in terms of properties of LF representations. As I have mentioned at various points in this paper, however, this may in fact be the result we want. First, the judgments about the subject cases are the weakest and most variable, as noted at the outset. Second, some new data appears to provide further support that we do not want a representational analysis of subject-ACE. As shown by the examples in (76)-(77), when the subject-ACE configuration occurs in an embedded sentence, the result are almost perfectly acceptable sentences for Hankamer-style examples (76), and at least improved acceptability for Wasow-style examples (77).

(76) a. Jason said that everyone who wants him to eat fugu should.
b. I wish that the woman who said Kim caught a tuna had.

(77) a. ??History suggests that a proof that God exists never will.
b. ??I hope that my proof that your proof is invalid isn’t.

Of course, this still leaves open the question of what explains the (relative) unacceptability of matrix subject-ACE. My hope is that the discourse-based analysis proposed in Hardt and Asher 1997 (or something like it) will help us out here.

5 Conclusion

There's still a lot of work to do, but if the various problems identified in the previous section can be acceptably resolved, then at least the facts of ACD-ACE (the clearest cases to begin with) suggest the following conclusions:

- Ellipsis is licensed by semantic identity (Sag 1976; Williams 1977; Merchant 2001), not by the same principles that govern deaccenting.
- The interpretation of binding configurations adds new assignments to the assignment function, it does not modify previously existing assignments.
- Variables (or more properly, variable names) may not be reused within a constituent, but may be reused in non-overlapping constituents.

Of course, there are lots of issues to worry about, such as making sure that the proposal can account for the various (constraints on) strict/sloppy identity, explaining the interaction of ellipsis and focus/deaccenting (clearly these two 'modules' interact, even if the licensing conditions are not the same), and figuring out what is responsible for the 'Sauerland effects' (of definiteness/lexical identity in ACD-ACE). But if the ideas spelled out at the end of this paper are on the right track, then ACE has told us something new about ellipsis and the syntax and semantics of variable binding.

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