

Sorting out Relative Clauses: A Reply to Bhatt*

Sarah Hulsey and Uli Sauerland

MIT and Universität Tübingen/University of Massachusetts

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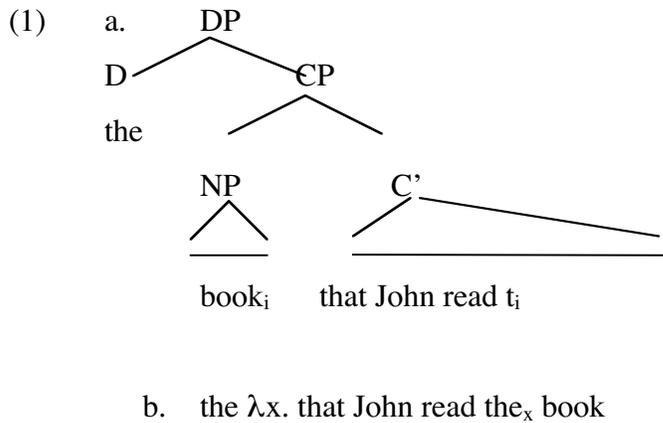
1. Introduction

Recent evidence from interpretation has led to progress in our understanding of the structure of restrictive relative clauses. The general picture that has emerged from several studies is that relative clauses are ambiguous as originally proposed by Carlson (1977) and developed further in Heim (1987) and Sauerland (1998, 2000, 2002). The ambiguity concerns the position in which the head NP of the relative clause is interpreted. In some cases, the head must be interpreted in a position internal to the relative clause. In others, it appears that the head must be interpreted external to the relative clause. These two kinds of facts have been used to show that we need both an analysis in which the relative clause is purely internally headed and also one in which the relative clause is externally headed. In his recent paper Bhatt reviews some of the evidence for this ambiguity and presents new evidence for this ambiguity. In this paper, we discuss Bhatt's argument and some further evidence for the ambiguity hypothesis.

The two structures of restrictive relative clauses we argue for, Sauerland (1998, 2000, 2002) and Bhatt (2002) call the raising and the matching structure. In the raising structure, the head NP is interpreted only in the relative clause internal trace position.

* This paper puts together ideas we came up with independently, but that seem to us to form a cohesive paper. Responsibility for section 2 lies with Sarah Hulsey, while responsibility for sections 3 and 4 lies with Uli Sauerland. We are grateful to Meredith Landman and Winfried Lechner for useful feedback on the first draft of this paper. This work was made possible by financial support of the German Science Foundation (DFG Grant SA 925/1-1 to Uli Sauerland).

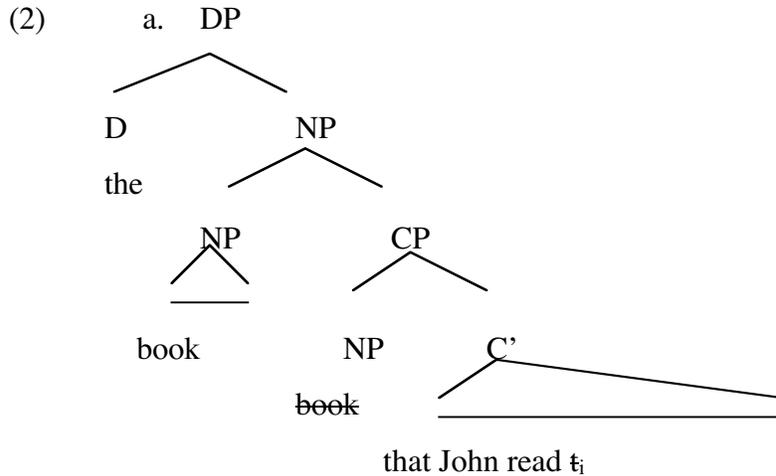
For the DP *the book John read*, the representation of the raising structure is given in (1a) and the LF-representation in (1b).



For the interpretation of this structure, *the_x book* can be interpreted as $g(x)$ with a presupposition that $g(x)$ is a book. The notation *the_x book* may be understood as a shorthand for "the λy . ($x=y$ and book(y))" (Fox 1998).¹

In the matching structure, the head NP is interpreted outside of the relative clause. Furthermore an elided NP is interpreted inside the relative clause that must be similar enough to the head NP for the purposes of ellipsis licensing. The matching structure is illustrated in (2a) with the LF-representation in (2b).

¹ A property of this account of traces is that the variable x must be of the type of individuals. It is unclear at present whether this account is sufficient for functional questions as first discussed by Engdahl (1980). Sauerland (1998) therefore assumes that the variable left unbound in a trace must be of a higher type than that of individuals which raises problems of its own though. For our purposes in this paper, the simple account works very well, hence we adopt it.



b. the book λx . John read the_xbook

A third logical possibility that has been proposed is one in which externally headed structures are purely externally headed and have no elided copy of the NP inside the relative clause. However, Safir (1999) and Sauerland (1998) argue that such a structure must be unavailable for restrictive relative clauses, and that even in cases in which the head NP is present external to the relative clause, it is necessary to also interpret a copy internally. Therefore, we will assume a matching analysis as the only externally headed structure.

As far as we know, two cases provide clear evidence for the raising analysis: the interpretation of idioms (Brame 1968, Schachter 1973) the binding of variables (Schachter 1973, Vergnaud 1974). Bhatt (2002) discusses an ambiguity that arises with superlatives which he claims provide a new argument for the raising analysis. We show in section 3.1 that, if Bhatt's facts are given a raising analysis, his argument is actually only another instantiation of the argument from the binding of variables.

An example of how idiom interpretation requires the raising structure is (3a). If the idiomatic reading of *headway* is available only if *headway* appears inside the complement of *make*, (3a) requires the raising analysis in (3b).

(3) a. John was satisfied by the amount of headway that Mary made.

- b. John was satisfied by the λx Mary made the e_x amount of headway

An example where binding requires the raising structure is (4). Binding of the reflexive *himself* requires the matching analysis in (4b).²

- (4) a. Mary liked the picture of himself that John sent.
- b. Mary liked the λx John sent the e_x picture of himself_x

In example (5a), the interpretation of the superlative indicates that it is necessary to interpret the relative clause head in a relative clause internal position similar to its overt position in the paraphrase in (5b). Bhatt claims that this interpretation of (5a) arises from the raising analysis.

- (5) a. the longest book that John said Tolstoy ever wrote
- b. the thing such that John said it is the longest book Tolstoy ever wrote

One argument for the existence of the matching structure in addition to the raising structure comes from the distribution of Condition C effects (Sauerland 1998, 2000, 2002). Consider (6a) which in contrast to the wh-movement example (6b) allows coreference between *John* and *he*.

- (6) a. Which is the picture of John_i that he_i likes?
- b. *Which picture of John_i does he_i like?

² In examples like (i) where the binder in the relative clause is a quantifier further assumptions about the interpretation must be made. We address this issue in section 3.

- (i) Mary liked the picture of himself that every boy sent.

While the raising structure (7a) would predict a Condition C effect for (6a), the absence of a Condition C effect is predicted by the matching structure.

- (7)
- a. the λx . he₁ likes the_x picture of John₁
 - b. the picture of John₁ λx . he₁ likes the_x picture of him₁

Further arguments for the matching analysis are given by Sauerland (1998, 2000, 2002) and Bhatt (2002) (see also Doron 1982), but these will not play a role in the present paper.

In section 2 of this paper, we present another argument for the matching analysis. We show that extraposed relative clauses only allow the matching structure. In section 3, we discuss the semantics of examples where the relative clause contains a variable which is bound only in a relative clause internal position. Section 4 concludes the paper.

2. Extraposed Relative Clauses

2.1 Extraposition blocks Raising

In each of the three cases of forced raising mentioned above, extraposition of the relative clause past a right-adjoined VP adverb is not possible, as first noted for the idiom and variable binding cases in Hulsey (2001).

One such structure that forces raising has part of an idiom in the head NP and part inside the relative clause as in (8). Under the assumption that an idiom must be interpreted as a constituent (Marantz 1984, Chomsky 1993), this requires the relative clause to be internally headed.

- (8)
- a. Mary praised the headway that John made.
 - b. I was shocked by the advantage that she took of her mother.

These relative clauses cannot be extraposed past a temporal adverb (9). Here and below we assume that a temporal adverb marks the right edge of the VP.

- (9) a. *Mary praised the headway last year that John made.
 b. *I was shocked by the advantage yesterday that she took of her mother.

Both (9a) and (9b) are ungrammatical, though near-minimal pairs that do not contain idioms can be extraposed quite easily.

- (10) a. Mary praised the pot roast yesterday that John made.
 b. I was shocked by the garish dress yesterday that she took from her mother.

The RCs in (10) do not force a raising analysis and allow extraposition. Additionally, extra lexical material intervening between the two halves of the idiom is perfectly fine, as long as it is within the relative clause itself and does not indicate extraposition.

- (11) a. Mary praised the headway that as of yesterday John had made.
 b. I was shocked by the advantage that as of yesterday she had taken of her mother.

The ungrammaticality of (9) thus appears to come from an incompatibility of extraposition with idiomatically interpreted relative clauses.

Another case that forces a raising structure is one in which there is an anaphor in the relative clause head NP, which is bound by something inside the relative clause as in (12).

- (12) a. I saw the picture of himself that John liked.
 b. Mary discovered the book about himself that Bob wrote.

When we try to extrapose the RCs in (12), the resulting sentences are ungrammatical (13).

- (13) a. *I saw the picture of himself_i yesterday that John_i liked.
b. *Mary discovered the book about himself_i yesterday that Bob_i wrote.

Related sentences that do not force a raising analysis permit extraposition here:

- (14) a. I saw the picture of Clinton yesterday that John liked.
b. Mary discovered the book about Rome yesterday that Bob wrote.

In (14), nothing forces a raising structure for the relative clause, and extraposition is permitted. There is nothing wrong in principle with a reflexive in an NP that heads an extraposed relative clause, as long as the binder is not within the relative clause:

- (15) a. I saw the picture of myself yesterday that John liked.
b. Mary discovered the book about herself that her father (secretly) wrote.

Examples (13)–(15) show that extraposition is also incompatible with the second case of forced raising: relative clauses in which an anaphor in the relative clause head is bound by an NP within of the relative clause.

Bhatt shows in his paper that low readings of adjectival modifiers of a relative clause's head NP also force a raising analysis. (16) is ambiguous between a high and a low reading for the adjectival modifier *first*. The two readings are paraphrased in (17) and (18).

(16) I read (last night) the first book that John said that Tolstoy wrote.

(17) *paraphrase of the high reading for (16)*

the first book about which John said that Tolstoy had written it.

(18) *paraphrase of the low reading for (13)*

the x s.t. John said that the first book that Tolstoy had written was x.

The low reading is incompatible with extraposition past R-adjoined *last night*, as (19) shows. Here we include the NPI *ever*, following Bhatt, since its licensing conditions force the low reading when placed within the *written* clause.

(19) *I read the first novel last night that John said Tolstoy ever wrote.

In contrast, the high reading permits extraposition. Again, we have placed the NPI in such a way as to force the high reading.

(20) I read the first novel last night that John ever said Tolstoy wrote.

Bhatt analyzes the high reading as being compatible with either a matching or a raising analysis. As we will see in section 2.2, extraposition is not only incompatible with certain instances of raising structures, it forces a matching structure. In this section we have shown that none of the three relative clause environments that are generally thought to require a raising structure permit extraposition of the relative clause.

2.2 Why Extraposition should force Matching

Fox and Nissenbaum's (2000) analysis of extraposition predicts that extraposition of a relative clause is only possible with the matching structure. Their analysis stems from some puzzling facts about extraposition: first, in extraposition of complements but not of adjuncts, the extraposed constituent can be shown to have undergone movement; secondly, in adjunct extraposition but not in complement extraposition, the source NP can be shown to have undergone (covert) movement. In their paper, they show that these facts can be accounted for by extending Lebeaux's (1988) (later modified by Chomsky (1993)) proposal about counter-cyclic merger of adjuncts.

Lebeaux explains the availability of (21) by the ability of adjuncts to merge with the NP that they modify after WH-movement, (22).

- (21) Which examinations near John_i did he_i peak at?
(22) a. he_i peaked at which examinations — move- α →
b. [which examinations] did he peak at — adjoin α →
c. [which examinations [near John_i]] did he_i peak at?

(Lebeaux 1988, 53)

According to Lebeaux's analysis, the adjunct [near John] is merged after WH-movement of [which examinations], thus obviating Condition C. A similar analysis, as in (23), is not available for complements because the Projection Principle requires all thematic relations to be satisfied at all levels of the derivation.

- (23) *Which pictures of John_i does he_i like <which pictures>?

Structure (23) violates the Projection Principle because it lacks a copy of the complement at the base-generated site of the WH-phrase. (24) satisfies the Projection Principle, but has a Condition C violation.

- (24) *Which pictures of John_i does he_i like <which pictures of John_i>?

Lebeaux's analysis thus accounts for the difference in grammaticality between (21) and (24) by showing that adjuncts can be merged counter-cyclically after WH-movement but that complements cannot be.

Fox and Nissenbaum extend the Lebeaux picture of counter-cyclic adjuncts merger to cover the puzzling facts about extraposition. They argue that adjuncts can be counter-cyclically adjoined after Quantifier Raising, as well, which can account for the differences between extraposition of adjuncts and extraposition of complements. Their analysis of extraposition of an adjunct is:

(25) We saw a painting yesterday by John.

a. We_i [_{VP} t_i [saw a painting] yesterday]

—QR(‘covert’)→

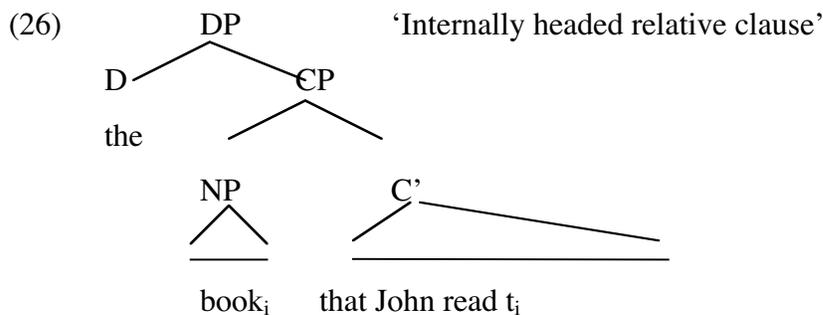
b. We_i [[_{VP} t_i [saw a painting] yesterday] <a painting>]

—adjunct merger (‘overt’)→

c. We_i [[_{VP} t_i [saw a painting] yesterday] <a painting> by John]

In (25) the adjunct is merged to the (unpronounced) head of the QR chain. A similar story is not available for complement extraposition for the same reasons as in the Lebeaux analysis: the PP requires the complement be merged before any movement takes place. So, according to Fox and Nissenbaum, complement extraposition takes place by movement of the extraposed constituent from the base-generated complement of NP position to its surface position. Adjunct extraposition takes place by merger of the adjunct to the post-QR position of the source DP (ex, [a painting] above). Their arguments for this come from tests that show that in complement extraposition (but not adjunct extraposition) the extraposed constituent has moved and that in adjunct extraposition (but not complement extraposition), the source DP has undergone (covert) movement.

This analysis of extraposition gives a ready explanation for why it is not possible to extrapose a relative clause modifier that has the raising structure (26):

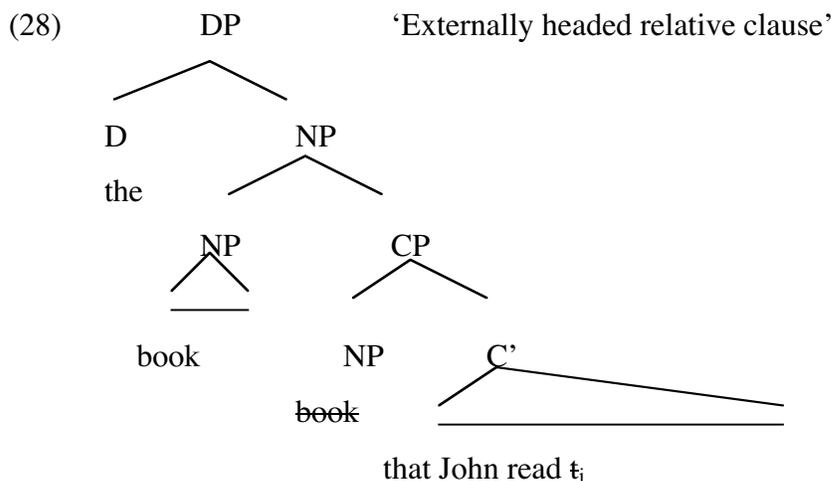


Since the head NP is itself a part of the relative clause CP, there is no adjunct available to undergo Fox and Nissenbaum's adjunct extraposition to give (27):

(27) I found the book yesterday that John read.

The relevant extraposed constituent [that John read] is not an adjunct in the structure (26). QR of the source NP followed by late merger of [that John read] is not possible not only because [that John read] is not an adjunct but also because [book] is first merged *inside* the relative clause—by the time [book] is moved into the specifier of CP in (26)(from where it would undergo QR, as we know by the word order of (27)), the entire CP has already been merged: later merger is not possible. Additionally, [that John read] in (26) is not a complement: it is a C', a constituent that cannot move on its own, so complement extraposition is likewise not possible. Fox and Nissenbaum's analysis of extraposition thus does not allow for either adjunct extraposition or complement extraposition of the relative clause in a raising structure.

On the other hand, it is perfectly possible for a relative clause with a matching structure (28) to undergo Fox and Nissenbaum's adjunct extraposition. Here the CP is an adjunct to NP and can adjoin counter-cyclically to the head of a QR-chain of the DP, giving the word order in (27).



In this case, the NP [book] undergoes QR past the adverb [last year]. Then the CP [that John wrote] adjoins to it. One environment that is generally agreed to force a matching structure is that in which there is an R-expression in the relative clause's head-NP that is co-referential with something inside the relative clause head. Extraposition is possible in these cases, as in (29).

(29) I saw the picture of John_i yesterday that he_i likes³.

This is expected, since we have seen that the Fox & Nissenbaum account of extraposition is only compatible with a matching structure. Extraposition can be used as another test to see whether a relative clause has a matching or a raising structure.

Now consider again the high readings of adjectival modifiers discussed by Bhatt. As we saw in the last section, in these sentences extraposition is possible as in (30) (repeated from (21))

(30) I read the first novel last night that John ever said Tolstoy wrote.

As we have seen, extraposition of adjuncts is compatible with externally headed, matching RCs, but not with purely internally headed ones. We can conclude, therefore, that (18), which has the high reading, also has a matching structure. The evidence from extraposition thus supports the analysis of the high reading as a having a matching structure.

³We assume that the relative clause-internal NP can undergo Fiengo and May's (1994) Vehicle Change as in (i), and that is why there is no Condition C effect within the relative clause (see also Section 3.1 below):

(i) I saw the picture of John_i [~~picture of him_i~~]_j that he_i likes t_j]

3. The Interpretation of Raising and Matching Relative Clauses

For the semantics of relative clauses, examples like (31) constitute the most interesting case. In (31), *himself* seems to be interpreted as a variable bound by the quantifier *everybody*.

(31) The picture of himself that everybody sent in annoyed the teacher.

The evidence in the previous section and also other arguments in Sauerland (1998, 2002) show that (31) must have the raising analysis. Consider the raising structure in (32).

(32) [the λx . everybody λy . y send in the_x picture of y] annoyed the teacher

In (32), the predicate created by λx is only true of an individual which is, for everybody, a picture of that person. Therefore, (32) presupposes there to be a single picture that shows every student. However, the sentence (31) can also be true in a situation where each person sent in a picture that only shows a single person, namely himself. Therefore, structure (32) cannot be the only LF of (31).

We propose that (33) is also a possible LF-structure of (31). In (33), *everybody* has moved out of the relative clause to attach to the matrix clause.

(33) everybody λy . the λx . y send in the_x picture of y] annoyed the teacher

The possibility of QR out of a relative clause to account for examples like (31) is first discussed by Doron (1982) and Sharvit (1996, 1999). Sharvit, however, rejects the QR analysis because this hypothetical movement seems syntactically implausible to her as relative clauses are usually islands for movement. Therefore Sharvit takes (31) to motivate a richer set of assumptions about the semantics which we address in more detail below. Bhatt (p. 52) claims that the binding data are possibly compatible with the

matching analysis, and claims that his new data involving superlatives provide a cleaner argument for the raising analysis.

In the following, we first address that Bhatt's data from the ambiguity of superlatives. We show that Bhatt's account of these data on the raising analysis needs to be revised, and that properly understood within the raising/matching ambiguity, Bhatt's data cannot be understood as a scope ambiguity as he claims, but rather as a binding ambiguity largely analogous to (31). In the second subsection, we discuss a small difference between the two cases of binding and argue that this difference provides evidence for the QR analysis of (31).

3.1 The Ambiguity of Superlatives Reconsidered

The main contribution of Bhatt's paper is a discussion of an ambiguity in DPs like (34).

(34) the longest book John said Tolstoy wrote (Bhatt's (20))

The DP (34) can either refer to the longest book amongst those books which John said that Tolstoy wrote or of the book such that John said it is Tolstoy's longest. Bhatt calls these two readings the *High* and the *Low Reading* of the superlative *longest*.

Bhatt claims that this ambiguity can be understood as a scope ambiguity on the raising analysis, and furthermore that the matching analysis predicts a wrong interpretation for (34). We, however, couldn't understand Bhatt's argumentation for these points. In the following, we show the predictions we believe are correct for (34). In particular, we show that the ambiguity in (34) is an ambiguity of binding of a world variable argument, and the matching analysis predicts only actually attested interpretations of (34).

We assume the matching analysis argued for in Sauerland (1998, 2000, 2002). On this analysis, crucially, the relationship between the internal head and the external head is the relationship always required for the licensing of phonological deletion. The deletion licensing condition is mainly motivated by work on VP-ellipsis, but there's no a priori

reason to assume that deletion licensing should work differently depending on the category targeted. Some technical details of the deletion licensing condition are still controversial (Rooth 1992, Fox 1999), and probably further revisions of the deletion licensing condition will be made in the future. Our claim is that exactly the same deletion licensing condition motivated by research on VP-ellipsis and other deletion phenomena also applies in the licensing of deletion of the lower head in matching relatives.

For the convenience of the reader we restate the deletion licensing condition of Rooth (1992) here with some adjustment of the notations. We assume that there is a syntactic feature Δ that renders a phrase unpronounced. Δ must be licensed by occurring in the argument of an operator \sim in the way stated in (35a). \sim in turn presupposes the presence of a discourse antecedent as stated in (35b).⁴

- (35) a. ΔX is licensed iff there is a node Y that is identical to or dominates X and that bears the feature \sim and such that for no terminal node X dominated by X there's any focus mark that dominates X and is dominated by Y
- b. $\llbracket \sim X \rrbracket_f^g(\alpha)$ is defined iff $\alpha(h) \in \llbracket X \rrbracket_f^h$ for all assignment functions h. Where defined $\llbracket \sim X \rrbracket_f^g(\alpha) = \llbracket X \rrbracket_f^g$ for any g and α ,

The argument α of \sim must be of the same type as that of X: a function from partial assignment functions to entities of the semantic type of X. We assume that α must be a silent pronominal element of this type and that usually there is an overt antecedent of α . This requires that there be also variables of this type and an operator that ensures that the value of such a variable be identical to the interpretation of some constituent overtly occurring in the discourse. Therefore, we define a new operator, σ_n as follows:⁵

⁴ We use the notation $\llbracket - \rrbracket_f^g$ for Rooth's focus semantic value of a constituent under assignment g.

⁵ The assumption that values of assignment functions can take assignment functions as arguments raises the potential to define a versions of Russell's paradox: the assignment function g for which g(1) is defined for all assignment functions h for which h(1) isn't defined for h. However, the paradox can hopefully be avoided by restricting the class of assignment functions suitably (cf. Sternefeld 2002).

- (36) $\llbracket \sigma_n X \rrbracket^g$ is defined if and only if $g(n)(h) = \llbracket X \rrbracket^h$ for any assignment function h for which $\llbracket X \rrbracket^h$ is defined.
If defined, $\llbracket \sigma_n X \rrbracket = \llbracket X \rrbracket$.

Consider example (37) for an illustration of these concepts.

- (37) John's coach approved of his contract and Bill did Δ too.

The strict interpretation of (37) is licensed as in (38a) (In (38) and in the following, we use variable symbol α_n for variables of the same type as constituent meanings). If $g(x)$ was John, (38a) would require that both John's coach and Bill approve of John's contract. (38b) shows how one sloppy interpretation is licensed. The resulting interpretation requires that John's coach's contract be approved of by John's coach and Bill's contract be approved of by Bill. (38c) is a representation where ellipsis cannot be licensed because there is no suitable antecedent for ellipsis licensing.

- (38) a. John's coach σ_1 (approved of x 's contract) and
Bill $\alpha_1 \sim$ (did Δ (approved of x 's contract))
b. John's coach $\sigma_1(\lambda x. x$ approved of x 's contract) and
Bill $\alpha_1 \sim(\lambda y. y$ did Δ (approve of y 's contract))
c. *John $\lambda x. x$'s coach approved of x 's contract and
Bill $\lambda y. y$ did Δ (approve of y 's contract)

Rooth (1992) and Fox (1999) argue that sometimes the external argument of \sim , the silent pro α , itself doesn't satisfy condition (35b), but an entailment of α does (i.e. there is a β such $\alpha(h)$ entails $\beta(h)$ and $\beta(h) \in \llbracket X \rrbracket^h$ for all assignment functions h). But, if ellipsis is licensed via an entailment, the content of Δ must be subject to an additional restriction. Rooth and Fox develop intricate accounts of this restriction. For reasons of space, we assume the condition in (39), which is possibly too simple, but sufficient for our purposes.

- (39) The lexical content of the phrase dominated by Δ must be the unique most salient completion of ellipsis site considering the position of the \sim licensing Δ , the external argument of \sim , and the material in the scope of \sim , but not Δ .

This condition is illustrated by (40): The elided VP in (40a) is neither the unique nor the most salient completion for this elided VP position, and therefore ellipsis licensing via an entailment is blocked. In (40b), on the other hand, ellipsis can be licensed via the entailment from not having a red cent entails to not having some money, because the absence of negation in the second conjunct blocks the otherwise more salient completion "have a red cent".

- (40) a. *I have read every book, and Kai has too (Δ = read some books)
 b. I don't have a red cent, but Kazuko might. (Δ = have some money)

On Rooth's account, deletion of the constituent marked with Δ can be licensed by a semantic condition satisfied by a constituent containing Δ —the one that bears the feature \sim . \sim must sit on a different constituent than Δ to license sloppy readings as in (38b). However, it is useful to note that, if a sloppy reading isn't targeted, condition (35) is equivalent to (41) where the two licensing features occur on the same constituent. (41) is satisfied if and only if the meaning of the deleted phrase is identical to that of its antecedent α , except for the possibility of entailment.

- (41) $\llbracket \Delta \sim X \rrbracket^g(\alpha)$ is defined iff $\alpha(h) = \llbracket X \rrbracket^h$ for all assignment functions h
 where defined $\llbracket \Delta \sim X \rrbracket^g(\alpha) = \llbracket X \rrbracket^g$ for any g and α

Consider now the differences between VP-ellipsis and deletion in matching relatives. We follow Sauerland (1998, 2000, 2002) in assuming that deletion of the lower head in matching relative clauses is different from VP-ellipsis in two regards: deletion is obligatory and the antecedent licensing ellipsis must be the external head. VP-ellipsis, on the other hand, is not obligatory and the antecedent of deletion licensing isn't

unequivocally determined by the position of the deleted VP. As pointed out in Sauerland (2000) and Kennedy (2000), deletion in matching relative clauses shares these two properties with the analysis of comparative deletion of Bresnan (1975) argued for most recently by Lechner (1999). Kennedy (2000) suggests the general term *Movement Deletion*, which we will adopt in the following.

It is well motivated that in movement deletion, the antecedent licensing deletion must be determined unequivocally by the position of the deleted phrase (Williams 1977, Kennedy 1997 on comparatives, Sauerland 1998, 2000, 2002 on relatives). However, the requirement is difficult to state on the account of deletion licensing we assume because the antecedent argument is taken by \sim not by Δ . This difficulty, though, must be faced since movement deletion allows sloppy readings as shown by (42): Ellipsis licensing in (42) requires the structure in (43) where \sim occurs on not on the phrase targeted by movement deletion, but a bigger phrase.

(42) John is more proud of himself than Bill is.

(43) more \sim [$\lambda d'$ Bill λy .y is $d'-\Delta$ (proud of y))] λd [John λx .x is $d-\Delta$ (proud of x)]

We suggest the following account: We enforce a new licensing condition that requires semantic identity except for the indexing between the phrase targeted by movement deletion and the antecedent it must take. The technical implementation is done by the operator μ_i in (44) that like σ_i presupposes semantic identity of the value of its index and its argument except for the indexation of unbound variables.

(44) $\llbracket \mu_i(XP) \rrbracket^g$ is defined iff. $\exists h: \llbracket XP \rrbracket^g = g(i)(h)$ and $\exists h': \llbracket XP \rrbracket^{h'} = g(i)(g)$
 where defined $\mu_i = \text{id}$

For example (42), we suggest that two coindexed μ -operators are inserted in the two positions as shown in (45):

(45) more \sim [$\lambda d'$ Bill λy .y is $d'-\mu_1$ (proud of y))] λd [John λx .x is $d-\Delta(\mu_1$ (proud of x))]

More generally, we can define the process of movement deletion as follows:

- (46) *Movement deletion*: For two phrases XP and YP where XP c-commands YP applying movement deletion is defined as:
- (i) affix μ_i to XP (where i is an index that doesn't occur anywhere else except as inserted by (ii))
 - (ii) affix Δ and μ_i to YP

The feature Δ triggers obligatory deletion of YP. Moreover Δ must be licensed and thereby enforces the presence of a \sim -operator dominating YP. The two coindexed μ -operators not only force XP and YP to be identical in meaning except for the indices of free variables, but also requires the antecedent of \sim licensing the Δ on YP to be the corresponding constituent containing XP, since only XP and YP bear a μ -operator with the same index.

The approach taken here doesn't seek to establish lexical identity between the deleted XP and its antecedent in movement deletion. That this is the right approach is shown by the presence of so-called vehicle change effects in movement deletion (cf. Sauerland 2000, 2002). Consider the analysis of (47a) in (47b). It's unclear how the idiomatic interpretation of *headway* would be licensed in the relative clause internal trace position. Hence, we suggest that the non-idiomatic noun *progress* occurs in the trace position. Because *headway* and *progress* mean the same thing, movement deletion is licensed in (47).

- (47) a. Bill made the amount of headway that Mary demanded.
b. Bill made the $x=\mu_1(\text{amount of headway}) \lambda x$. Mary demanded
the_x $\sim\Delta\mu_1(\text{amount of progress})$.

Now consider again Bhatt's example *the longest book John said Tolstoy had written*. Consider first Bhatt's account of the high reading. Bhatt gives the structure in (48) (the example Bhatt actually considers at this point is with *first* in the place of *longest*.)

(48) the λx longest [book, x] [longest [book, x] [John said that Tolstoy had written x] (Bhatt 2002: (24a))

We quote this structure literally from Bhatt's paper, because we don't understand it. We don't think structure (49) is intended by Bhatt, because Bhatt assumes that if the superlative morpheme doesn't move out of NP only the absolute reading is available.

(49) the [longest book] [λx . [the_x longest book] λy . John said that Tolstoy had written y]

Recall that superlatives often seem to allow two readings: the absolute and the comparative reading as illustrated in (50) (see Sharvit and Stateva 2002 for a recent discussion).

(50) Tolstoy wrote the longest book.
absolute reading: 'The book that is longer than all other books currently under consideration was written by Tolstoy.'
comparative reading: 'Of the authors currently under consideration, the book Tolstoy wrote is longer than the book of any of the other authors.'

Bhatt adopts the account of Szabolcsi (1986) and others claiming that the absolute and comparative reading correspond to the two different LF-representations in (51a) and (51b). The LF-structures in (51) assume the lexical entry for -est in (52).

(51) Tolstoy wrote the longest book
a. Tolstoy wrote the -est(K) λd . d-long book
b. Tolstoy -est(K) λd . wrote the d-long book.

$$(52) \quad \llbracket \text{-est} \rrbracket (K)(P)(x) = 1 \text{ iff.} \\ \forall y \in K \setminus \{x\}: \max \{d | P(x)(d) = 1\} > \max \{d | P(y)(d) = 1\}$$

On Szabolcsi's assumptions, the structure (49) should allow only the absolute reading which requires that Tolstoy wrote the longest book. This isn't the high reading of Bhatt's example.

Could the intent of Bhatt's structure (48) be a representation where *-est* is moved? If it is the intent, we believe that then movement deletion would not be licensed. Consider one candidate for a structure where *-est* has been moved, namely the following structure.

$$(53) \quad \text{-est } \lambda d' \text{ the } [d' \text{-long book}] [\lambda x. \text{-est } \lambda d \text{ [the}_x \text{ d-long book]} \lambda y. \text{John said} \\ \text{that Tolstoy had written } y]$$

In (53), *-est* doesn't take an external argument. Hence, the lexical entry (52) wouldn't be appropriate for (53). Bhatt ((83), p. 87) adopts a lexical entry that would render (53) interpretable. We discuss this proposal further in (55).

There is, however, another problem with (53). Namely, movement deletion would not be licensed in (53): The deleted phrase contains the variable *d* while the antecedent contains the variable *d'* in the corresponding position. Hence, the semantic deletion licensing feature \sim must be on a constituent that includes the binder of *d*. Any antecedent of such a phrase would at least have to include the binder $\lambda d'$ of the variable corresponding to *d* in the antecedent. But even the smallest phrase containing $\lambda d'$ contains also the relative clause that the deleted phrase is a part of. Hence, movement deletion couldn't be licensed.

A general problem that is also raised by (53) is that Bhatt's analysis of the superlative morpheme *-est* is as far as we can tell incomplete. Consider Bhatt's discussion of a structure like (54), which appears in (38d) in Bhatt's paper (except for our use of the notation the_x).

(54) -est λd : Tolstoy wrote the_x d-long book

Following unpublished work of Heim's (1995), Bhatt assumes that the superlative morpheme has the semantics in (55), where the value of the contextual restriction C is determined by context.

(55) $\llbracket \text{-est} \rrbracket (C)(P) = 1$ iff. $\exists d [P(d) \wedge \forall Q \in C \setminus \{P\} \neg Q(d)]$

Bhatt ((39), page 65) gives the value of C for (54) as in (56) (again we use the notation *the_i* but otherwise quote from Bhatt's paper).

(56) $C = \{ \lambda d$: Tolstoy wrote the_x d-long book,
 λd : Tolstoy wrote the_y d-long book, ...
 λd : Tolstoy wrote the_z d-long book }

However, the formulas in (56) mix up object and meta language since x is a variable in the object language in (54). We assume that x in (56) is a shorthand for g(x), where g is the assignment function. But still, we don't understand (56): Is the intent then that C depends on the values the assignment g yields for x, y, z, and other variables?

In an appendix to his paper, Bhatt creates the impression that the process forming C follows from a proposal Heim makes in unpublished work. The proposal he attributes to Heim (1995) Bhatt illustrates by means of the example (55). In this example, the two strategies in (56) are available to determine C.

(55) John is angriest at Mary
LF: est(C) λd [John is d-angry at Mary]

(56) Depending on the context (and associated focus marking), C can be:
(a) the set of degree properties of the form $\lambda d[x$ is d-angry at Mary]
(b) the set of degree properties of the form $\lambda d[\text{John is d-angry at } x]$

The strategies illustrated in (56), however, would as far as we can tell only derive the comparison set (57) for (54). (57) doesn't predict the right interpretation, though.

(57) $C = \{ \llbracket \lambda d [y \text{ wrote the}_x \text{ d-long book}] \rrbracket^{\text{g}} \mid y \text{ is the name of an individual} \}$

We believe Bhatt actually must assume a new mechanism for determining the restrictor of -est. (58) yields the right context set for (54).

(58) C is the set of all degree properties $\llbracket \lambda d. \text{Tolstoy wrote the}_x \text{ d-long book} \rrbracket^{\text{g}}[x/a]$ for all individuals a for which there is a degree d such that $\llbracket \lambda d. \text{Tolstoy wrote the}_x \text{ d-long book} \rrbracket^{\text{g}(x/a)}(d)$ is true.

However, it isn't clear to us how to properly generalize (58): We show now that, in example (59), a seemingly analogous procedure leads to an unattested interpretation.

(59) John read her longest book

Assuming the LF-representation (60a), the comparison set in (60b) seems analogous to (58).

(60) a. $\text{-est}(C) \lambda d. \text{John read } x\text{'s d-long book.}$
 b. $C =$ the set of degree properties $\llbracket \lambda d. \text{John read } x\text{'s d-long book} \rrbracket^{\text{g}(x/a)}$ for all individuals for which there is degree d such that $\llbracket \lambda d. \text{John read } x\text{'s d-long book} \rrbracket^{\text{g}(x/a)}(d)$ is true

However, the interpretation that arises from this comparison set can be paraphrased as (61). Clearly, this isn't an interpretation we would want to predict.

(61) John read the book by her and it is the longest book he ever read by any author.

Example (34) doesn't have a reading where *-est* is part of the relative clause head. We see why this should be so when we spell out the meaning of such a representation. The definite would refer to the longest book of some comparison class and furthermore presuppose that John said that Tolstoy wrote this book. On this interpretation, the relative clause head is a property that is true of only one individual, and therefore the relative clause cannot restrict this property any further, or else the existence presupposition of the definite wouldn't be satisfied. This interpretation is pragmatically ill-formed because the relative clause isn't actually restricting the head noun.

In example (65), *-est* can take scope inside the relative clause head. On this reading, (60) refers to the set of all books x with the following two properties: there is an author such that x is the longest book that author wrote and John read x . We suggest that this interpretation arises from the representation (60b).

- (65) a. the longest books of an author that John read
 b. the an author λx *-est* [λd d-long book of x] λy John read the $_y$ *-est* d-long book of x

Now consider the Bhatt's low reading. This reading is most clearly present in a scenario where John made false claims about the length of Tolstoy's books. Hence the reading must involve a comparison of the lengths that Tolstoy's books have in possible worlds that are compatible with what John had said, and not the lengths of Tolstoy's books in the actual world. The binding relationship the low reading involves is as sketched in (66).

- (66) the longest book in w' John said $\lambda w'$ Tolstoy wrote

Binding of the occurrence of w' in the relative clause head in (66) is only possible if the head is only interpreted in a relative clause internal position. In this way, Bhatt's argument for the raising analysis reduces to one familiar since Schachter's 1973 paper: there are occurrences of variables in the relative clause head that can only be bound in a relative clause internal position. Specifically, one way to derive the low reading with the analysis of superlatives argued for by Sharvit and Stateva (2002) is the following:

(67) the λx John said that Tolstoy wrote the λd $\text{-est}(C(w'))$ λd d-long book in w'

On this analysis, the value of the contextual restriction C must be a function from worlds to sets of individuals, namely the one in (68).

(68) $C(w')$ is the set of books that Tolstoy wrote in w'

The way the contextual restriction is determined is dissatisfying, and we offer (67) here only to demonstrate that the matching analysis indeed makes an account of the low reading possible. We sketch a better analysis of the low reading in section 4.

It is worth pointing out at this point that the availability of low readings isn't restricted to superlatives: The interpretation of example (69) is one where the book talked about is 50-pages long only in the worlds compatible with the teachers claims, not the actual world.

(69) We discovered that the 50-page book that the teacher said Tolstoy wrote has 500 pages.

The presence of a low reading in (69) shows that it is correct to understand low readings in terms of world variable binding, rather than scope.

3.2 Binding into the Relative Clause Head

We observed above by means of (70a) (repeated from (31)) the interpretation the raising analysis predicts if a quantifier inside the relative clause binds a variable in the head of the relative clause. Recall that the interpretation of (70) presupposes the existence of a single picture that shows everybody.

(70) a. The picture of himself that every send annoyed his mother.
b. [the λx . everybody λy . y send in the λx picture of y] annoyed the teacher

While (70) cannot be the only interpretation available for (32), in examples with world variable binding only the structures analogous to (70) and their corresponding interpretations seem to be available. This is evidenced by Bhatt's (p.66) discussion of (71) (Bhatt's (4)).

(71) The longest books that John said Tolstoy wrote

Bhatt considers a scenario where John claimed at some time that *War and Peace* was Tolstoy's longest work and then changed his mind to claim that *Anna Karenina* was Tolstoy's longest opus. Bhatt claims that in such a scenario (71) leads to a presupposition failure. Actually, it is more interesting to consider the singular variant of (71) in Bhatt's scenario since (70a) also has singular morphology. The singular version in (72) also leads to a presupposition failure in Bhatt's scenario, except if it appears as an argument in a copula sentence. Hence, (72a) is odd in Bhatt's scenario, but (72b) is acceptable.

- (72) a. The longest book that John said Tolstoy wrote annoyed me.
b. The longest book that John said Tolstoy wrote are always different.

We assume that the argument positions of a copula are special in that functions can be the arguments of the copula, but not in the case of other verbs. Doron (1982) and Sharvit (1996, 1999) have argued that the copula case is different.

If we accept that the copula case is special, there is an interesting difference between binding of a pronoun by a quantifier in (70a) and the binding of a world variable argument in (72a). Namely, (72a) results in a presupposition failure as expected. (70a), however, doesn't result in a presupposition failure even though this is predicted for LF-representation (70b).

This difference corroborates the claim that (70a) allows a second LF-representation where the binder of the pronoun is moved by QR to a position above the relative clause head. The QR-account predicts that (72a) should result in a presupposition failure since the binder of the world variable argument cannot QR. Therefore, the difference between

(70a) and (72a) is predicted by the QR-analysis. Sharvit's (1999) alternative analysis of (70a), on the other hand, doesn't predict the difference: She proposes to explain (70a) on the basis of the functional reading also attested in the copula case. However, (72b) shows that a functional reading is also available in the world variable binding example, and therefore Sharvit's account of (70a) carries over directly to (72a). Hence, Sharvit's proposal would wrongly predict (72a) to be acceptable in the scenario described above.

It may seem that QR to a position outside of the relative clause should make the matching analysis shown in (73) possible, which would then incorrectly predict that extraposition should be possible.

(73) everybody λz [the[picture of y] [$\lambda x. z \lambda y. y$ sent in the _{x} picture of y]] annoyed the teacher

But, (73) violates the weak crossover condition.

Sharvit (1999) observes furthermore examples like (74) that initially seem to involve binding of *his* by the QR-ed quantifier *everybody* challenge our weak crossover account of (73).

(74) The picture of himself everybody sent in annoyed his mother.

However, *his* in (74) can be analyzed as the E-type pronoun *the person on x* , where x is bound by the DP the picture of himself similar to proposals for binding out of inverse linking constructions (Büring 2001).

Note that the matching structure (73) cannot be rescued in a similar way. The rescue would require replacing the occurrence of y in the external and internal head with an E-type description similar to the one for (74). But, this is blocked in (73) by the i-within-i condition.

4. Conclusion and Outlook

We have shown that the matching and raising ambiguity goes quite a long way towards explaining puzzling behavior of relative clauses. On the one hand, we have discussed two cases where reliably the raising structure is forced: One case is if there is a variable or anaphor in the relative clause head that is bound by a phrase in the relative clause. The other is when the relative clause head is part of an idiom the other parts of which only occur inside of the relative clause. On the other hand, we have also shown that there is one novel class of cases where the matching analysis is forced. We argued in section 2, that extraposition is expected to require the matching analysis if extraposition must be late adjunction of the relative clause as argued by Fox and Nissenbaum (2000). Further evidence for the matching analysis comes from the Condition C facts mentioned in (6) (Sauerland 1998, 2000, 2002), and the cases with pied-piping in the relative clause Bhatt discusses.

The major prediction of this picture is that any example is ungrammatical that contains an element that requires the matching analysis, but also contains an element that requires the raising analysis. In section 2, we have demonstrated that this prediction is borne out in the interaction of extraposition with binding into the relative clause head and idiom-parts as the relative clause head. Sauerland (1998, 2000, 2002) demonstrates the same prediction using Condition C instead of extraposition to force the matching analysis. In sum, the matching and raising ambiguity is well supported for relative clauses.

4.1 Speculation on three remaining problems

There are, however, some pieces of evidence suggesting that relatives clauses with an intermediate trace position internal to the relative clause allow a further structure for relative clauses. In fact, it seems likely to us that Bhatt's low reading of superlatives is better not analyzed as a plain raising structure after all. As we noted the low reading is

therefore (77c) should require the matching analysis. Therefore, a Condition C effect just as in (77a) is predicted to arise. But this is not what we find. Expanding Sauerland's suggestion that in (77c) matching may apply in an intermediate position of the the relative clause internal chain, we would like to suggest that (77c) allows a structure that has (78) as a part, where y is the variable bound by the *every senator* from a higher position.

(78) $\lambda x. y$ wanted [the_x (review of John_i's debate with y)] = something λz (him_i to read the_z thing)

We may paraphrase the scope of λx in (78) as in (79).

(79) y wanted that the review x of John's debate with y be something that he read

An interesting difference between (75) and (78) is that in (79) the relative clause head is interpreted in the pre-copular position of the cleft, while in (75) it's interpreted in the post-copular position. In both cases, however, the pre-copular position is bound by the relative clause operator. We leave this observation for future research.

The second problem Sauerland (1998:fn. 16) mentions arises from an interaction of ACD and binding in a relative clause internal position. First, consider Wold's (1995) observation that ACD conflicts with binding in the relative clause in examples like (80b) and (81b).

(80) a. Sue likes every picture of himself_i that John_i painted.
b. *Sue likes every picture of himself_i that John_i does.

(81) a. Sue likes every picture of himself_i that every boy_i painted.
b. *Sue likes every picture of himself_i that every boy_i does.

The facts in (80) and (81) are expected on the raising-matching ambiguity. For example, the assumption that ACD requires extraposition analyzed as late adjunction (Fox 2002) entails that ACD should force the matching analysis. Therefore, ACD is predicted to be incompatible with binding in a relative clause internal position.

A problem, though, is the acceptability of (82) (Danny Fox, personal communication). Here too, the matching analysis should be blocked by ACD. But then a different analysis is required to explain binding of *himself* by the quantifier *every boy*.

(82) Sue likes every picture of himself_i that every boy_i hoped she would.

We would like to suggest that (82) allows the structure in (83) where *y* be bound by *every boy* from a higher position.

(83) $\lambda x. y$ hoped [the_x picture of *y*] = something $\lambda z. she$ would like the_z thing

Again our proposed structure involves cleft-formation in the intermediate position. A cleft-sentence paraphrasing the scope of λx in (83) is (84).

(84) *y* hoped that the picture *x* of *y* be one that she would like

If the low relative clause $\lambda z. she$ would like the_z thing in (83) can be merged late, ACD in (82) is predicted to be possible.

At present, it is unclear to us how to formulate a generalization and an account for a treatment of intermediate trace positions in chains that would exactly predict the structures we hypothesize in this section and not make undesirable predictions in other cases. We hope, though, to have shown that it may be possible to retain the basic matching/raising ambiguity for simple cases and address the problems raised in this section by a more sophisticated treatment of intermediate trace positions in the relative clause internal chain (see also Sauerland (2001)).

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