

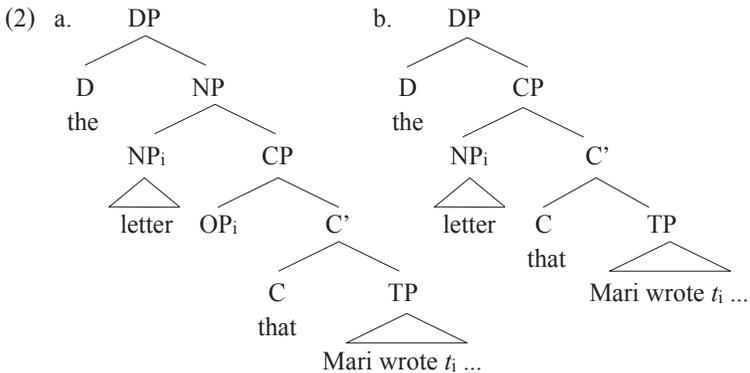
# On the Derivation of *That*-Relative Clauses and Reduced Relative Clauses\*

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## 1. Introduction

The derivation of relative clauses is a major concern of generative syntax. In the literature, two analyses have been proposed for the relative clause exemplified in (1). They are shown in (2a-b).

(1) She has [the letter that Mari wrote last night].



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The first analysis is the matching analysis (Chomsky (1977)), according to which the null operator moves to [Spec, CP] and then the relative clause CP adjoins to NP *letter* as in (2a). The null operator establishes the predication relation with *letter* (as indicated by the index *i*) so that *letter* is interpreted as the antecedent of the null operator.

The second analysis is the head raising analysis (Schachter (1973), Kayne (1994)). Under Kayne's (1994) head raising analysis, the relative clause head *letter* in (2b) is base-generated in the relative clause and moves to [Spec, CP], becoming the head of the relative clause. There has been controversy regarding which analysis is more adequate. In this paper, we deal with two types of relative clauses: *that*-relative clauses and reduced relative clauses. They are exemplified in (3a-b).

- (3) a. This is [the book that I bought yesterday].
- b. [The girl reading a book] is Mary.

We intend to demonstrate which of the two analyses is adequate for these relative clauses using two syntactic tests. The first is a familiar one: whether a part of an idiom can be the head of the relative clause. The second concerns whether the interrogative *wh*-phrases *whose NP* and *which NP* can be the head of the relative clause. Based on these two tests, we will show that both the matching analysis and the head raising analysis are available for *that*-relative clauses (Aoun and Li (2003), Hulsev and Sauerland (2006)), but only the head raising analysis is available for reduced relative clauses.

## 2. Theoretical Framework

We adopt Chomsky's (2008, 2013, 2015) labeling algorithm. Let us review the labeling algorithm. Chomsky (2013) assumes that the assignment of labels of constituents is based on minimal search, which is a third factor principle. Consider (4).



Given that the syntactic object (SO) consisting of H and XP is interpreted at the interfaces, the SO must be assigned its label. Therefore, minimal search for the lexical item locates the lexical item H so that H rather than XP is selected as the label of the constituent.

In pursuing the minimal-search-based label determination, we adopt Chomsky's (2008) labeling algorithm in (5), which is consistent with minimal search.

(5) In  $\{H, \alpha\}$ , H an LI, H is the label. (Chomsky 2008: 145)

(5) states that if H is a lexical item, the label of the constituent formed by H and  $\alpha$  is H. Thus, in (4) H becomes the label of the SO in accordance with (5) because it is a lexical item.

Let us turn to the case of the merger of two phrasal elements. Chomsky (2013) takes up the case of  $\{XP, YP\}$ , where neither XP nor YP is a head. In the structure  $[_\alpha XP YP]$ , the label of the SO is ambiguous between X and Y, since the heads (X and Y) are located by minimal search. This leads to label indeterminacy, which must be avoided. Here Chomsky (2013) proposes two ways for the SO to be labeled. They are shown in (6a-b).

- (6) a. The SO is modified so that only one head can be visible to labeling.
- b. The prominent features that XP and YP share become the label.

First, consider the case of (6a). Movement of either XP or YP leaves only one head visible to labeling. If XP undergoes movement, the label of  $\{XP, YP\}$  is Y as shown in (7).

(7) [ ... XP<sub>i</sub> ... [Y<sub>P</sub> XP<sub>i</sub> YP]]

The copy left by movement of  $XP$  does not count for the purpose of labeling. Then, only  $Y$  is visible to labeling so that the label of  $\{XP, YP\}$  is  $Y$  (for the purpose of exposition, we use the notation  $YP$  to represent the label of  $\{XP, YP\}$ ).

Next, let us consider the case of (6b). One example is the merger of  $DP$  and  $TP$  as in (8).

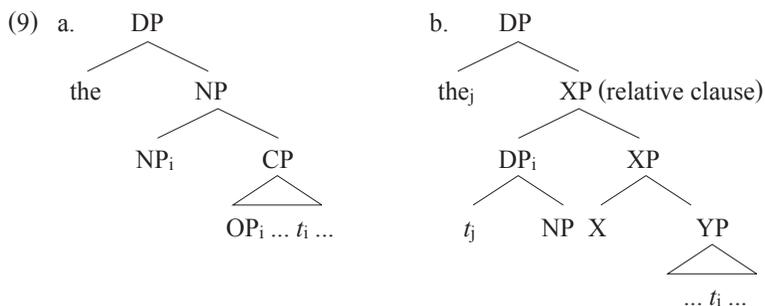
$$(8) \quad [_{<\varphi, \varphi>} [_{DP} [D \ \varphi]] [_{TP} [T \ \varphi] [ \dots ]]]$$

In (8),  $DP$  and  $TP$  share the prominent features,  $\varphi$ -features. Thus, the label of  $\{DP, TP\}$  is  $\varphi$ .

In the following sections, we discuss the derivation of relative clauses on the basis of the labeling algorithm.

### 3. A Proposal

We propose that the matching analysis and the head raising analysis are available for *that*-relative clauses, but only the head raising analysis is available for reduced relative clauses. Note that there are two strategies (the head raising strategy and the matching strategy) for the derivation of *that*-relative clauses. Although this appears redundant, there is a syntactic context where only one of them is available, as we will see in Section 4.2. In other words, the two strategies can be used separately; thus, there is no redundancy in the analysis of *that*-relative clauses. Now we are in a position to discuss the two analyses. We adopt the matching analysis shown in (2a), and then we present our head raising analysis. These analyses are shown in (9a-b).



Under the matching analysis in (9a), the relative clause CP containing the null operator in its edge adjoins to NP, as we have already seen. The null operator enters into the predication relation with NP, as a result of which NP is interpreted as the antecedent of the null operator. Under the head raising analysis in (9b), the relative clause head DP moves to the edge of the relative clause (XP). Note that the movement of DP yields the structure [ $\alpha$  DP, XP]. The label of  $\alpha$  then cannot be determined because neither DP nor XP is a head. We argue that the label indeterminacy is avoided by further movement of *the*. Specifically, *the* moves, leaving its copy behind.<sup>1</sup> The D head of {DP, XP} then becomes invisible to labeling because it is a copy, which leaves only the X head visible to labeling. As a result, the label of {DP, XP} is X. The D head *the* can become the label at the landing site because it is a head. In this way, the relative clause headed by D is derived.<sup>2</sup>

With the two analyses in mind, we analyze *that*-relative clauses and reduced relative clauses in detail in the next section.

## 4. An Analysis

### 4.1. The Head Raising Analysis of Reduced Relative Clauses

We propose the following head raising analysis of reduced relative clauses. For example, the reduced relative clause in (10a) has the structure in (10b).



As shown in (12), DP (the head of the reduced relative clause) moves from within *v*P to *ing*P. Then we predict that DP can be a part of the idiom in the reduced relative clause. This prediction is correct:

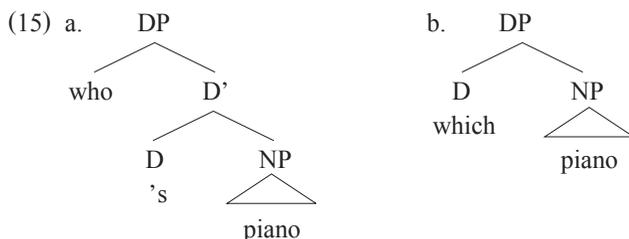
(13) I was surprised at the headway being made by Mary.

In (13), the idiomatic interpretation of *make headway* is available. The reduced relative clause in (13) has the structure in (14).

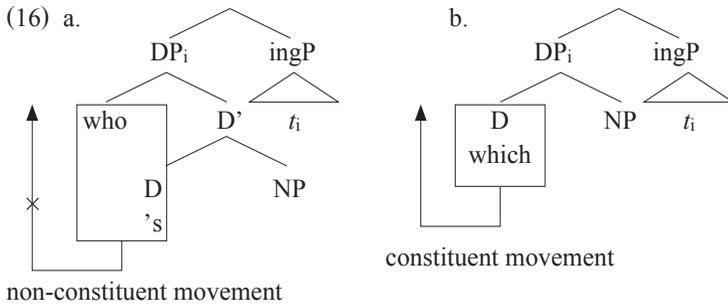
(14) [DP the<sub>j</sub> [<sub>ingP</sub> [DP the<sub>j</sub> headway]<sub>i</sub> [<sub>ingP</sub> -ing [<sub>vP</sub> be made [DP the headway]<sub>i</sub> by Mary]]]]

The reduced relative clause is derived by movement and projection of D after movement of DP to *ing*P.<sup>5</sup> *Headway* forms an idiom with *made* at the base position. The idiomatic interpretation is thereby obtained.

The second syntactic test is relevant to the interrogative *wh*-phrases *whose NP* and *which NP*. Their syntactic structures are illustrated in (15a-b).



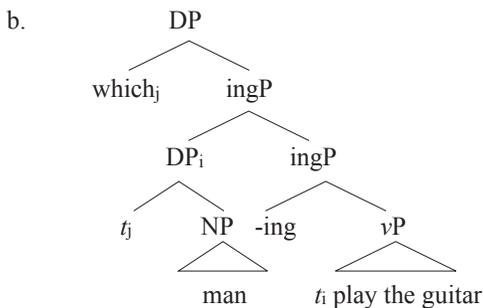
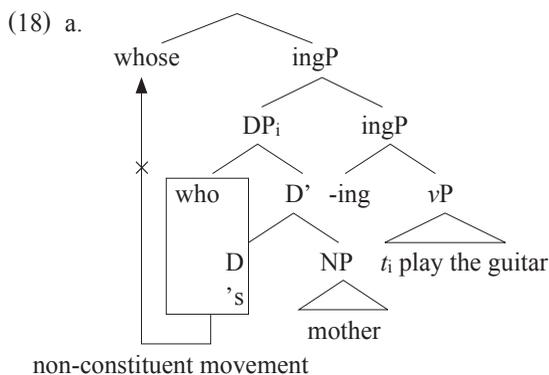
We assume that *whose* of *whose piano* in (15a) consists of two words, *who* and *'s*, which occupy [Spec, DP] and the D head, respectively, while *which* of *which piano* in (15b) is the D head. Note that D moves and projects under the head raising analysis of reduced relative clauses. The D head *'s* then moves together with *who*, given that *'s* is a suffix and forms a complex word with its host *who*. In the case of *which NP*, the D head *which* undergoes movement. This is shown in (16a-b).



In (16a), the suffix *'s* undergoes movement with its host *who*. This is a non-constituent movement, which is not allowed. Meanwhile, the movement of *which* is a constituent movement. There is no problem with this movement. Therefore, we predict that *whose NP* cannot be the head of the reduced relative clause, while *which NP* can be the head of the reduced relative clause. This prediction is borne out:

- (17) a. \*Whose mother playing the guitar did you meet?  
 b. Which man playing the guitar did you meet?

The contrast between (17a) and (17b) shows that *whose NP* cannot be the head of the reduced relative clause. The structures of the reduced relative clauses are (18a-b).

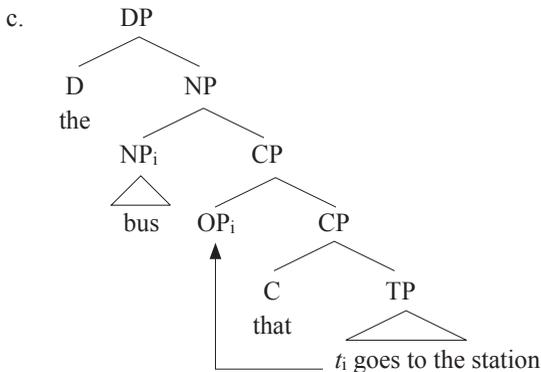
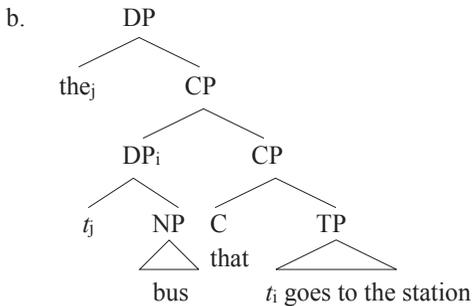


In (18a), *whose mother* moves to *ingP*, forming the SO {*DP*, *ingP*}. The label of the SO cannot be determined. The movement of *'s* with *who* leaves only the *-ing* head visible to labeling so that the label of {*DP*, *ingP*} is *-ing*. However, the non-constituent movement of *who-'s* is impossible. Therefore, (17a) is ungrammatical.<sup>6</sup> In (18b), *which man* moves to *ingP*, which forms the unlabeled SO {*DP*, *ingP*}. If the D head *which* moves, leaving its copy behind, the SO is labeled as *-ing* because *which* is a copy, and it is invisible to labeling. *Which* projects at the landing site, deriving the reduced relative clause. There is no problem with this derivation. Thus, (17b) is grammatical.

## 4.2. The Matching Analysis and Head Raising Analysis of *That*-Relative Clauses

Following Aoun and Li (2003) and Hulsey and Sauerland (2006), we propose that both the matching analysis and the head raising analysis are available for *that*-relative clauses. The relative clause exemplified in (19a) is analyzed in two different ways as shown in (19b, c).

(19) a. This is the bus that goes to the station.



The analysis shown in (19b) is the head raising analysis. DP moves to CP, forming the SO {DP, CP}. Its label cannot be determined. The movement of *the* leaves the D head invisible to labeling. This leaves only the C head visible to labeling, and therefore, the label of {DP, CP} is C. The moved D head *the*

projects at the landing site, deriving the *that*-relative clause.

Meanwhile, the analysis indicated in (19c) is the matching analysis. The null operator moves to CP, forming the SO {OP, CP}. We suggest that the null operator has no head so that only the C head is visible to labeling. Therefore, the label of {OP, CP} is C. The relative clause CP adjoins to NP, and the null operator in the CP edge establishes the predication relation with NP, sharing the same index with NP.<sup>7</sup> Consequently, NP is interpreted as the antecedent of the null operator. Finally, *the* merges with NP, deriving the *that*-relative clause.

Now we are in a position to evaluate the adequacy of the head raising analysis and matching analysis of *that*-relative clauses. As usual, we first apply the idiom test. The head raising analysis predicts that a part of an idiom can be the head of *that*-relative clauses. This prediction is correct:

(20) a. The headway that we made was satisfactory.

(Schachter 1973: 31)

b. [DP the<sub>j</sub> [CP [DP the<sub>j</sub> headway]<sub>i</sub> [CP that [TP we had made [DP the headway]<sub>i</sub>]]]]]

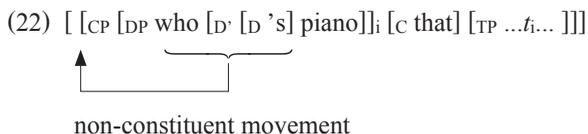
In (20a), *headway* of *make headway*, which is an idiom, can be the head of the *that*-relative clause. This shows that the head raising analysis is available for *that*-relative clauses. The structure of the *that*-relative clause in (20a) is (20b). DP *the headway* moves to CP, and then D moves and projects, deriving the *that*-relative clause. *Headway* forms a constituent with *make* at the base position. Thus, the idiomatic interpretation is permitted in the *that*-relative clause.<sup>8</sup>

Next, we apply the *whose NP* test. Remember that *whose* of *whose NP* is a non-constituent, as shown in (21).

(21) [DP who [D' [D 's] piano]]  
non-constituent

If the suffix *'s* undergoes movement, it moves together with its host *who*. This movement is banned because *who-'s* is a non-constituent. Here, note that

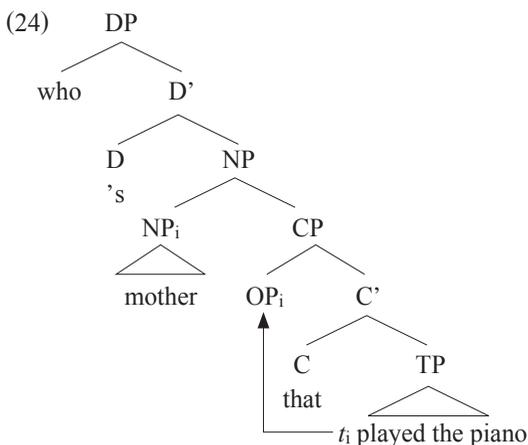
movement of *who-'s* takes place under the head raising analysis of *that*-relative clauses. Consider (22).



DP *whose piano* moves to CP, and then the D head *'s* moves together with its host *who*. The movement of *who-'s* is a non-constituent movement, which is not permitted. Therefore, under the head raising analysis, we predict that *whose NP* cannot be the head of the *that*-relative clauses. However, this prediction is not borne out:

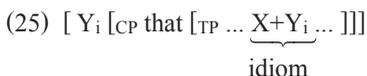
- (23) a. Whose mother that played the piano met Mary?  
 b. Which mother that played the piano met Mary?

(23a) shows that *whose NP* can be the head of the *that*-relative clause. If only the head raising analysis were available, the grammaticality of (23a) would be problematic. In fact, it is not a problem if the matching analysis is also available. Under the matching analysis, the structure of the *that*-relative clause in (23a) is (24).



The null operator moves to [Spec, CP] and CP adjoins to NP. The null operator enters into a predication relation with NP, as a result of which NP is interpreted as the antecedent of the null operator. Next, the D head 's merges with NP and *who* merges into [Spec, DP], deriving the *that*-relative clause. There is no problem with this derivation. Therefore, (23a) is grammatical.

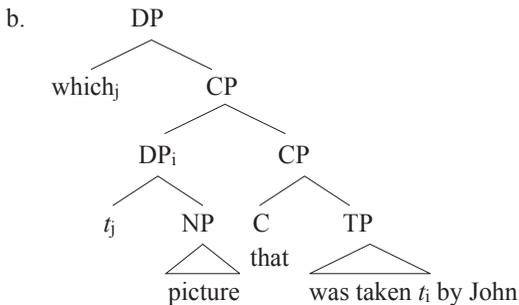
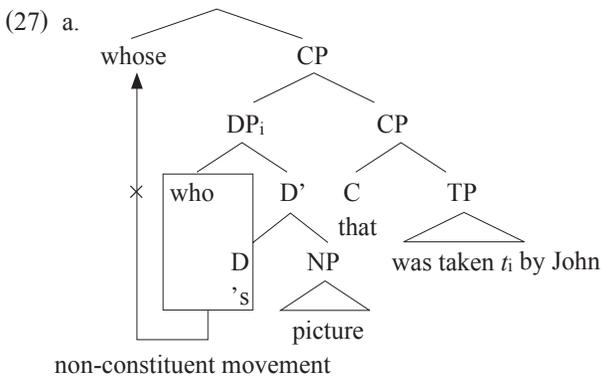
Note that *whose NP* can be the head of the *that*-relative clause in (23a) because the matching analysis is available. Importantly, *whose NP* should not be able to be the head of *that*-relative clauses in a context of an idiom, because the head raising analysis of *that*-relative clauses is required in the context of the idiom. Consider (25).



Given that X and Y form an idiom, the moved element Y should be a lexical word or phrase rather than a null operator. Thus, the head raising analysis is obligatory in the context of the idiom. We predict, then, that *whose NP* cannot be the head of *that*-relative clauses in the context of the idiom. This prediction is correct.

- (26) a. \*Whose picture that was taken by John is expensive?  
 b. Which picture that was taken by John is expensive?

(26a) shows that *whose NP* cannot be the head of the *that*-relative clause in the context of the idiom, *take a picture*, while *which NP* can be the head of the *that*-relative clause, as in (26b). The *that*-relative clauses in (26a-b) have the structures in (27a-b), respectively.



In (27a), *whose picture* is base-generated as the embedded object and moves to CP. The label of the SO {DP, CP} cannot be determined. The movement of *who-'s* leaves only the C head visible to labeling, so the label of {DP, CP} is C. However, the movement of the non-constituent *who-'s* is impossible. Therefore,

(26a) is ungrammatical. By contrast, in (27b), the movement of the D head *which* is possible. Therefore, (26b) is grammatical.<sup>9</sup>

## 5. The Head Raising Analysis of Comparative Clauses

We have discussed the derivation of *that*-relative clauses and reduced relative clauses using the idiom test and the *whose NP* test. In this section, we deal with comparative clauses, showing that the head raising analysis is plausible.

So far, three analyses have been proposed for comparative clauses. They are the deletion analysis (Bresnan (1973, 1975, 1976)), the *wh*-movement analysis (Chomsky (1977), Kennedy (1999a, 1999b)), and the head raising analysis (Lechner (2004)). Each analysis is shown in (28b-d).

- (28) a. We need a better forum [than we have *e* right now].  
 b. We need a better forum [than we have ~~an *x-much good forum*...~~]  
  
 c. We need a better forum than [CP OP<sub>i</sub> [TP we have *t<sub>i</sub>* right now]]  
 d. We need [DP a [DegP [better forum]<sub>i</sub> Deg than we have [DP D *t<sub>i</sub>* ]...]]

First, the deletion analysis of the comparative clause in (28a) is indicated in (28b). The degree element *x-much good* modifies *forum* and *an x-much good forum* undergoes deletion under identity with *a better forum*. Second, the *wh*-movement analysis is shown in (28c), where the *wh*-operator moves to the embedded [Spec, CP]. Third, according to Lechner's (2004) head raising analysis, the compared constituent *better forum* moves from within the comparative clause to the matrix clause as shown in (28d). The deletion analysis is different from the *wh*-movement analysis and the head raising analysis in that the gap in the comparative clause is created by deletion rather than movement. The deletion analysis then predicts that the gap can be inside an island. However, this prediction is not correct. Consider (29).

- (29) \*The shapes were longer than I wondered whether they would be *e*.  
(Kennedy 2002: 558)

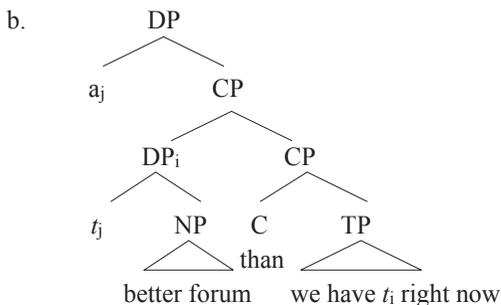
The gap in a comparative clause cannot occur in a *wh*-island. The deletion analysis cannot account for the ungrammaticality of (29). Meanwhile, the *wh*-movement analysis and the head raising analysis both correctly predict the ungrammaticality of (29) because movement is involved in the derivation of comparative clauses under both analyses. The question then arises of which of the two analyses is more plausible. Below, we show that the head raising analysis of comparative clauses is more plausible using the idiom test and the *whose NP* test. Before proceeding, we digress to note that although we agree with the head raising analysis of comparative clauses, Lechner's (2004) head raising analysis is not satisfactory. Consider (28d) in detail. Under Lechner's analysis, *better forum* moves out of DP. However, generally speaking, the constituent consisting of an adjective and a noun cannot be extracted out of DP. Consider (30).

- (30) a. \*How tall man did you see *a*?  
b. [how tall man]<sub>i</sub> did you see [<sub>DP</sub> *a* *t*<sub>i</sub>]

*How tall* cannot move out of DP, leaving the D head *a* behind. This problem motivates a search for the novel head raising analysis of comparative clauses.

We propose our head raising analysis of comparative clauses so that the comparative clause in (28a) (repeated here as (31a)) has the structure in (31b).

(31) a. We need a better forum [than we have *e* right now].



We follow Bresnan (1973) in assuming that the comparative clause is CP headed by *than*. DP *a better forum* moves to CP, forming the SO {DP, CP}. The label of the SO cannot be determined. After the movement of the D head *a*, only the C head becomes visible to labeling. Therefore, the label of {DP, CP} becomes C. The D head projects at the landing site, deriving the comparative clause. Note that our head raising analysis does not have the problem that Lechner's head raising analysis faces. This is because DP moves to the matrix clause and there is no extraction out of DP.

Now, let us examine the plausibility of the head raising analysis on the basis of the idiom test and the *whose NP* test. First, we apply the idiom test. Under the head raising analysis, DP rather than the null operator moves to CP. We then predict that a part of an idiom can be the head of the comparative clause. This prediction is borne out:

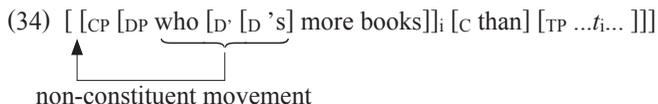
(32) Mel made more headway than Freddie made. (Carlson 1977: 536)

In (32), the idiomatic interpretation of *make headway* is available. The comparative clause has the structure in (33).

(33) [<sub>DP</sub> D<sub>j</sub> [<sub>CP</sub> [<sub>DP</sub> D<sub>j</sub> more headway]<sub>i</sub> [<sub>CP</sub> than Freddie made [<sub>DP</sub> D more headway]<sub>i</sub> ]]]

DP *more headway* moves to CP, and then D further moves and projects, becoming the head of the comparative clause. *Headway* forms a constituent with *made* at the base position. The idiomatic interpretation is thereby obtained.<sup>10</sup>

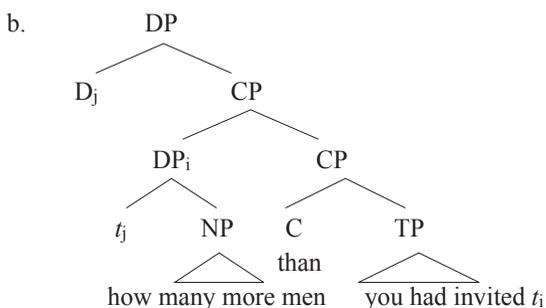
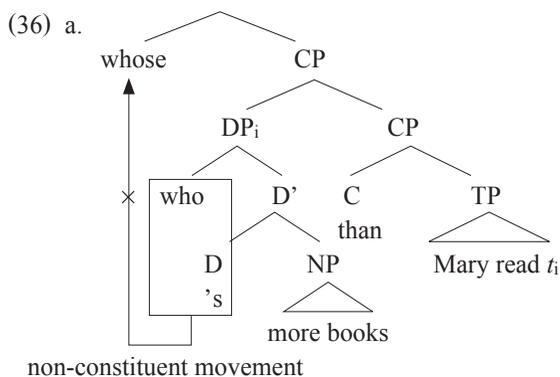
Next, let us turn to the *whose NP* test. Note that the D head *'s* moves together with *who*, given that *'s* forms a complex word with *who*. Consider (34).



After DP *whose more books* moves to CP, *who-'s* undergoes movement. However, this non-constituent movement is prohibited. Thus, we predict that *whose NP* cannot be the head of comparative clauses. This prediction is correct:

- (35) a. \*Whose more books than Mary read did you read?  
 b. How many more men than you had invited decided to come?  
 (Pinkham 1985: 51)

*Whose NP* cannot be the head of the comparative clause as in (35a), while *how many NP* can be the head of the comparative clause as indicated in (35b). The structures of comparative clauses in (35a-b) are shown in (36a-b), respectively.



In (36a), DP *whose more books* moves to CP, forming the unlabeled SO {DP, CP}. Here, *who-'s* undergoes further movement, leaving only the C head visible to labeling. Therefore, the label of {DP, CP} is C. Although the label of the SO is determined, the non-constituent movement of *who-'s* is impossible. Therefore, (35a) is ungrammatical. In (36b), we assume that *how many more* is inside NP. Then, after DP *how many more men* moves to CP, null D moves and projects, deriving the comparative clause. There is no problem with the movement of null D. Therefore, (35b) is grammatical.

## 6. Conclusion

In this paper, it has been shown that the idiom test and the *whose NP* test confirm that the matching analysis and the head raising analysis are available

for *that*-relative clauses, while only the head raising analysis is available for reduced relative clauses. This is summarized in (37).

(37)

	head raising analysis	matching analysis
<i>that</i> -relative clause	✓	✓
reduced relative clause	✓	*

As (37) shows, the matching analysis is not available for reduced relative clauses. Why is the matching analysis unavailable for reduced relative clauses? We suggest that this is because reduced relative clauses lack the CP projection. Generally, the target of operator movement is CP. Thus, reduced relative clauses have no landing site for null operator movement, and therefore, the matching analysis is unavailable for reduced relative clauses.

Our analysis of relative clauses has three implications. First, it supports Chomsky's (2008, 2013, 2015) minimal-search-based labeling algorithm. Second, it supports Donati's (2006) argument that the moved element can project at the landing site. Third, it supports the view of Aoun and Li (2003), Hulse and Sauerland (2006), and Miyamoto (2010) that both the matching analysis and the head raising analysis are available for relative clauses.

## Notes

1. For convenience, we use the trace *t* rather than the copy in the tree diagram unless relevant to the discussion.
2. Tozawa (2016) proposes another version of the head raising analysis. We will not pursue this alternative here.
3. One might wonder whether the N head is visible to labeling. We suggest that the N head is so deeply embedded that it cannot be visible to minimal search for the lexical item.
4. We suggest that the movement of the D head does not violate the subject condition. As the D head becomes the label at the landing site, the movement can be regarded as DP-internal movement rather than extraction out of DP.
5. Chomsky (2013, 2015) eliminates projection from the theory of grammar. In

this paper, the terms *project* and *projection* are used as shorthand to indicate that an element becomes the label of a constituent.

6. An anonymous reviewer points out that if *whose* is a relative pronoun, *whose* NP can be the head of the reduced relative clause as shown in (i).
  - (i) The report cites eight witnesses whose statements suggesting Wilson acted in self-defense had matched the forensic evidence.

We suggest that the relative pronoun *whose* is the D head. The reduced relative clause in (i), then, has the structure in (ii).

(ii) [DP [D whose]<sub>j</sub> [ingP [DP t<sub>j</sub> [NP statements]]]<sub>i</sub> [ingP -ing [vP t<sub>i</sub> suggesting ...]]]  
*Whose statements* moves to ingP and then the D head *whose* moves and projects, deriving the reduced relative clauses. We will not pursue this issue any further.

7. In (19c), CP adjoins to NP. One might wonder what the label of the adjunction structure is. We suggest that the adjunct elements are invisible to labeling. In this case, only the N head is visible to labeling because CP is an adjunct. Thus, the label of the SO consisting of NP and CP is N.
8. Carlson (1977) finds that some determiners can occur with *headway* in a context like (20a) and others cannot. Observe (ia-b).
  - (i) a. {The, All, That, What} headway (that) Mel made was astounding.
  - b. \*{Some, Much, Most, Little, This,  $\phi$ , etc.} headway that Mel made was satisfactory. (Carlson 1977: 535-536)

Carlson argues that the relative clauses in (ia) are the amount relatives, which are derived by the head raising analysis. *Headway*, then, moves from the object position in the relative clause to the matrix clause. *Headway* forms an idiom with *made* in the relative clause. Therefore, the relative clauses in (ia) are grammatical. By contrast, the relative clauses in (ib) are restrictive relative clauses and they are derived by the matching analysis. Under this analysis, *headway* cannot form an idiom with *made* in the relative clause. Therefore, the relative clauses in (ib) are ungrammatical.

We argue for the head raising analysis of reduced relative clauses. Then, we predict that the head of the reduced relative clauses cannot have the determiners in (ib). This prediction is not borne out.

- (ii) He said [companies using older versions of Windows] should take precautionary measures.

The reduced relative clause head (*companies*) can occur without a determiner. We leave this problem to further research.

9. An anonymous reviewer notes that *whose* relative clauses do not exhibit recon-

struction effects. Consider (i).

(i) I saw the two students whose friends (John thought) every teacher visited.

(no narrow scope for *two students*) (Aoun and Li 2003: 244)

*Two students* cannot take narrow scope over *every teacher* in the relative clause. This might be attributed to the property of *wh*-relative clauses. Specifically, (i) is a *wh*-relative clause. In this case, *two students* (the antecedent of *whose*) does not reconstruct. Actually, Aoun and Li (2003) argue that *wh*-relative clauses show no reconstruction effect. Consider (ii).

(ii) ??The portrait of himself<sub>i</sub> which John<sub>i</sub> painted is extremely flattering.

(Aoun and Li 2003: 111)

(ii) shows that it is impossible that *himself* reconstructs and is bound by *John* in the *which* relative clause. In this way, *wh*-relative clauses do not exhibit reconstruction effects.

10. An anonymous reviewer wonders how *headway* forms an idiom with the matrix verb *made*. The derivation of the matrix clause is shown in (i).

(i) [Mel [VP made [DP D<sub>j</sub>] [CP [DP t<sub>j</sub> more headway]<sub>i</sub>] [CP than Freddie made t<sub>i</sub> ]]]]

After the comparative clause is formed, the matrix verb *made* merges with DP. Given that DP is an extended projection of N (Grimshaw (1991)), *made* can form the idiom *headway*. This way, the idiom is derived.

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