Reconstruction Effects in Relative Clauses

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Herausgegeben von Manfred Bierwisch,
Hans-Martin Gärtner und Manfred Krifka

unter Mitwirkung von
Regine Eckardt (Konstanz) und Paul Kiparsky (Stanford)

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Edited by
Manfred Krifka and Mathias Schenner

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Mathias Schenner

An introduction to reconstruction effects in relative clauses

Reconstruction effects in relative clauses are a class of phenomena where the external head of the relative clause seems to behave as if it occupied a position within the relative clause, as far as some commonly accepted principle of grammar is concerned. An often cited example is (1), where the pronoun *his* in the relative head appears to be bound by the quantified noun phrase *every man* in the relative clause – although the latter does not c-command the former, which is commonly required for binding.

(1) The [$_{NP}$ relative of *his*] [$_{CP}$ which *every man* admires most] is his mother.

Several solutions have been developed in various theoretical frameworks. One interesting aspect about reconstruction effects in relative clauses is that they can be used as a benchmark for competing theories of grammar: Which architecture of the syntax-semantics interface can provide the most satisfying explanation for these phenomena? This volume brings together researchers working in different frameworks but looking at the same set of empirical facts, enabling the reader to develop their own perspective on the perfect tradeoff between syntax and semantics in a theory of grammar.

The following sections provide some background for the discussions in this volume and include pointers to relevant contributions. Section 1 introduces reconstruction effects in general, section 2 adds relative clauses to the picture and surveys the empirical focus of this volume. Sections 3 and 4 sketch and compare the two main lines of analysis, known as syntactic vs. semantic reconstruction, and section 5 concludes.

Mathias Schenner, Leibniz-Centre General Linguistics (ZAS) Berlin

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1 Reconstruction effects

1.1 Introducing reconstruction effects

One way to view reconstruction effects is as a class of systematic counterexamples to otherwise well motivated grammatical principles. Let's take Principle A of Binding Theory (Büring 2005). A simplistic version is given in (2).

(2) Reflexive pronouns must be locally bound.

For our purposes it is useful to disentangle this principle in two ways. First, we want to avoid the use of a deontic modal and replace (2) by the more explicit conditional statement in (3), following the standard view that binding principles are filters on grammatical structures.

(3) If a sentence contains a reflexive pronoun that is not locally bound, then the sentence is ungrammatical.

Second, we supply a simple version of the notion of binding in terms of coindexing and c-command in (4) and (5). The notion of locality will be left unanalyzed; for our illustrative purposes this qualification could be dropped entirely.

(4) A DP α *binds* a DP β iff
(a) α and β are coindexed, and
(b) α c-commands β.

(5) A constituent α *c-commands* a constituent β iff
(a) α does not dominate β, and
(b) every (branching) node dominating α also dominates β.

Finally, there is one additional principle that we would like to use:

(6) Observational adequacy: A sentence is grammatical iff it is acceptable.

Now we are ready to look at an example sentence that is said to exhibit a reconstruction effect:

(7) Which pictures of *herself*$_1$ did *Alice*$_1$ see?

Here are two observations about this sentence a linguist might make:

(8) The sentence (7) is acceptable.

(9) The sentence (7) contains a reflexive pronoun that is not locally bound.

The first observation is an empirical generalization that utterances of the sentence are acceptable to speakers of English. The second observation in (9) is less empirical in that it depends on several theoretical assumptions of our theory of grammar. Still, based on standard assumptions about constituent structure in the generative tradition and the definition of binding in (4), it should be uncontroversial that the reflexive pronoun *herself* in (7) is not bound. In particular, it is not bound by the coindexed *Alice* because the latter does not c-command the pronoun.

At this point we can easily derive a contradiction from the set of principles and observations introduced above. From (6) and (8) it follows that (7) is grammatical. From (3) and (9) it follows that (7) is ungrammatical.

Of course, this argument is usually not spelled out at this level of detail, because it is intuitively clear that in the light of examples like (7), a grammar that contains a principle like (2) faces an undergeneration problem: There are sentences that are acceptable but ruled out by Principle A. However, this setup allows us to think more systematically about how we can avoid this contradiction. It has been derived from four main premises, so we have at least the following four options:

- Reject (8). We could question the relevant empirical data.
- Reject (6). We could willingly give up observational adequacy and restrict our grammar to a proper subset of the English language that does not contain violations of Principle A.
- Reject (9). We could modify our syntactic assumptions in such a way that reflexive pronouns can somehow be bound by seemingly non-c-commanding antecedents in cases like (7).
- Reject (3). Finally, we could modify the binding principle itself in some way to allow for cases like (7).

While the first two reactions are adequate moves under certain circumstances, we will only consider the last two possible remedies for the contradiction here. First, we could reject (9) by revising our notion of binding in such a way that the reflexive pronoun in examples like (7) comes out as being bound. There are several ways to do this, for example by switching to a weaker command relation or by relaxing the c-command requirement to include traces, like in (10).

(10) A DP α *binds* a DP β iff
(a) α and β are coindexed, and
(b) α c-commands β or a trace of a phrase containing β.

Second, we could replace the formulation of Principle A in (3) by a qualified version that is hardened against the mentioned contradiction. So far, we have tacitly assumed that sentences like (7) are associated with exactly one syntactic structure and that this is the one relevant to Principle A. But in a derivational syntactic theory that assumes multiple stages or levels of syntactic representation, it needs to be clarified what exactly constitutes the input to filters like Principle A. Assuming that the wh-phrase in (7) occupies a derived position and originated in the direct object position of the verb, where it received its thematic role, as in (11), a straightforward revision would be to require that Principle A holds at a stage in the derivation before any wh-movements happen (at NP-structure, see Riemsdijk & Williams 1981) or even before any movements happen at all (at D-structure).

(11) did *Alice*$_1$ see [$_{DP}$ which pictures of *herself*$_1$]

However, this approach has largely been abandoned in the light of examples that suggest that overt wh-movement can create new binding options for reflexive pronouns contained in the wh-phrase (see e.g. Barss 2001: 676 for a summary). From a semantic point of view, there is another problem with this approach, at least if it is assumed that the interpretation function does not take D-structures like (11) as input, but post-movement structures like (7) where the original bindee is no longer in the c-command domain of the original binder. The problem is more prominent in cases like (12), where the reflexive pronoun depends on a quantified noun phrase. This shows that a purely syntactic solution to the problem why Principle A should not rule out sentences like (7) or (12) is not enough, unless it also provides an explanation for why a reflexive pronoun like *herself* can semantically depend on a non-c-commanding quantificational noun phrase like *no girl* in a sentence like (12).

(12) [$_{DP}$ which pictures of *herself*$_1$]$_2$ did [*no girl*]$_1$ see $\_\__2$

This observation and the fact that neither D-structure nor S-structure are appropriate as inputs for binding principles suggests that yet another level might play a role: Logical Form (LF). But how can we, starting from S-structures like (13), arrive at a syntactic structure that satisfies Principle A?

(13) [$_{DP}$ which pictures of *herself*$_1$]$_2$ did *Alice*$_1$ see $\_\__2$

Two options come to mind: Move again or move back. First, we could (covertly) move the binder (here: *Alice*) further up the syntactic tree to a position from which it c-commands the phrase containing the bindee (here: *herself*) again. This option turns out to be insufficient: excessive wh-movement cannot solve the problem in general (see e.g. Fox 1999: 160–161 for an argument and also the discussion of example (24) below). Second, we could undo the wh-movement of the phrase containing the bindee. This idea of undoing movements at later stages motivated the term *reconstruction* and goes back to Chomsky (1977). The effect of pushing moved phrases back into their original positions can also be achieved by conceptually perhaps more appealing mechanisms, for example by defining binding in terms of trace-aware command relations, like in (10).

The advent of the Minimalist Program (Chomsky 1995) and its elimination of intermediate representational levels like D-structure and S-structure further backed the idea that principles of Binding Theory are applied at LF. An important innovation was the copy theory of movement that replaced the move-and-undo operations required for reconstruction by copy-and-delete operations. More concretely, while wh-movement in pre-Minimalist generative grammar used to index the moved constituent and create a coindexed trace at the origin, as in (13), it now just introduces an identical copy at the target position, as in (14).

(14) [which pictures of *herself*$_1$] did *Alice*$_1$ see [which pictures of *herself*$_1$]

Logical Forms are subject to economy principles that regulate the deletion of superfluous copies, which results in stripped-down structures like (15) for (14).

(15) [which] did *Alice*$_1$ see [pictures of *herself*$_1$]

While it is intuitively clear that an LF like (15) satisfies Principle A, it is less clear how the semantic component should deal with economized representations of this kind and it turns out that some non-trivial woodworking is required to prepare these tree structures for compositional interpretation (as discussed in Fox 2000 and Heim this volume; also see section 3.1 for some hints).

1.2 Defining reconstruction effects

The previous section introduced reconstruction effects by way of the example in (7), repeated here as (16) with movement decorations, where the reflexive pronoun *herself* behaves as if it were in its pre-movement position as far as Principle A is concerned.

(16) [$_{DP}$ which pictures of *herself*$_1$]$_2$ did *Alice*$_1$ see $\_\_{}_2$

But can we have a more general characterization of reconstruction effects? Extrapolating from the example just given, it seems that reconstruction effects involve (i) some subexpression that is somehow connected to two different positions in the syntactic structure of the containing expression and (ii) a principle that senses the subexpression in the position in which it is not spelled out, i.e. phonologically visible. Chomsky & Lasnik (1993: 536) describe the notion of reconstruction as follows, where *P* is a property of linguistic expressions:

> *P* holds at LF under *reconstruction*, that is, with the moved phrase treated "as if" it were in the position of its trace

If we abstract from the movement dependency between the two connected positions, we arrive at the more general phenomenon of connectivity effects. Sportiche (2006: 38) gives the following characterization:

> Connectivity effects are cases in which a phrase seems to behave as if it occupied a position different from its ‘surface’ position, i.e., the position that it seems to be occupying in the spoken string.

It is clear from the discussion in Sportiche (2006) that the “behavior” of a phrase is judged relative to certain principles (or properties). Let’s try to turn this into a more explicit definition:

(17) An expression *E* within a phrase *P* shows a *connectivity effect* with respect to a principle *R* iff there are positions p_1 and p_2 within *P*, such that
(a) *E* is phonologically realized at p_2,
(b) *E* is visible to *R* at p_1, and
(c) $p_1 \neq p_2$.

Schematically, this can be represented as follows:

(18) Phonological: $[_P \ldots [_{p_2}\ E\ ] \ldots [_{p_1} \ldots] \ldots]$
Input to *R*: $[_P \ldots [_{p_2} \ldots] \ldots [_{p_1}\ E\ ] \ldots]$

This captures the idea that connectivity effects arise when an expression is somehow connected to two different syntactic positions: one where it is spelled out and one where it is visible to some grammatical principle. There are still some aspects to be filled in. For instance, we might want to require that *E* is invisible to *R* at p_2, or add a general rule that expressions are never visible at multiple positions at the same time, i.e. to the same principle.

Reconstruction effects are special cases of connectivity effects where the connected positions are related by movement. However, merely adding the clause ‘p_1 and p_2 are related by movement’ does not suffice, because this would include cases where the non-surface position of *E* is not one of its past positions, but a future position in its movement chain, as with covert Quantifier Raising. By contrast, the term *reconstruction* is reserved for moving things back into positions that they have previously occupied.

(19) An expression *E* within a phrase *P* shows a *reconstruction effect* with respect to a principle *R* iff there are positions p_1 and p_2 within *P*, such that
(a) *E* is phonologically realized at p_2,
(b) *E* is visible to *R* at p_1,
(c) $p_1 \neq p_2$, and
(d) there is a movement chain $(p_2, \ldots, p_1)$.

Schematically, this can be represented as follows:

(20) Phonological: $[_P \ldots [_{P_2}\ E_i\ ] \ldots [_{P_1}\ \__i\ ] \ldots]$
Input to *R*: $[_P \ldots [_{P_2} \ldots] \ldots [_{P_1}\ E\ ] \ldots]$

One problematic aspect of this definition is the use of the term *movement chain* in the definiens. Ideally, we would like to characterize reconstruction effects in a theory-neutral way in order to identify the empirical facts to be explained and then compare the predictive success of different theoretical approaches to them. There are two ways to think about this: First, one could speculate that any sufficiently rich theory of grammar will have some mechanism that corresponds to movement dependencies in derivational frameworks. This intertranslatability would ensure a certain degree of theoretical innocence of the notion. Second, reconstruction effects might be an artifact of movement-based syntactic frameworks and might not correspond to a natural class of empirical facts. However, in that case, we can at least resort to the more general concept of connectivity effects that can be defined in a more theory-neutral way (albeit it still relies on some theoretical concepts like tree positions and visibility to principles).

1.3 Classifying reconstruction effects

The definitions given in the previous section suggest some natural parameters for classifying connectivity and reconstruction effects. We will discuss five parameters in the following: principles, optionality, partiality, movement type, target position. More detailed overviews are provided by Barss (2001) and Sportiche (2006).

Principles. One obvious parameter is the principle that triggers the reconstruction effect. In our introductory example (7) it was Principle A from Binding Theory. Reconstruction effects are discussed with respect to all *Binding Theory* principles. If there are world or situation pronouns in syntax, we might also need a Binding Theory for them to prevent overgenerating coindexing patterns, and reconstruction effects have been discussed for these principles as well (Percus 2000, Lechner 2013).

A second principle, related to but distinct from the syntactic Binding Theory filters, is *pronominal binding* between a quantificational noun phrase and a pronoun. We have already encountered this principle in our discussion of example (12). The general configuration is indicated in (21).

(21) [... *bindee*$_1$ ...]$_2$ [... *binder*$_1$ ... [... $\_{}_2$ ...]]

Some instances are (22) from Riemsdijk & Williams (1981: 188) and (23) with examples from German involving topicalization and scrambling that are discussed by Frey (1993), Sternefeld (1997) and Lechner (1998) among others.

(22) [which of *his*$_1$ poems]$_2$ would [*every poet*]$_1$ like to read $\_{2}$?

(23) a. [*Seine*$_1$ Mutter]$_2$ liebt *jeder*$_1$ $\_{2}$
his mother loves everybody
'Everybody loves his mother'

b. dass [*seine*$_1$ Mutter]$_2$ *jeder*$_1$ $\_{2}$ liebt
that his mother everybody loves
'that everybody loves his mother'

A third principle is *relative scope*. Like Binding Theory, this is an extensive topic by itself (see Ruys & Winter 2011 for a survey). The general idea is that syntactic c-command corresponds to semantic scope. If the c-command relations at surface structure do not match the observed scope relations, syntactic approaches employ movement operations to provide appropriate c-command relations at the level of syntactic structure that is visible to the semantic component. For most cases, a rule of Quantifier Raising (QR) is used that covertly moves a quantified DP to a specifier position of a local clause, typically higher up the tree (May 1977). However, there are instances of scope ambiguity that are not naturally accounted for by QR but seem to require reconstruction. A case in point is the example in (24), which allows for an inverse scope reading where the raising verb *expected* has scope over *someone* (which receives a non-specific interpretation this way). No raising of nominal elements will yield this reading, whereas reconstructing the overt subject of the raising verb into its original theta position will.

(24) [*Someone from New York*]$_1$ is *expected* [$\_{1}$ to win the lottery]

Of course, there are other strategies to derive the intended meaning. In fact, May (1977: 18) formulates QR in a way that allows downward movement and makes use of this fact in his analysis of quantified subjects in raising verb constructions (May 1977: 188–196).

A fourth principle concerns *idioms*, syntactically complex expressions whose meaning is not a function of their parts. This characterization implies that idioms need to be interpreted as a whole, i.e. their syntactic parts need to reach the interpretation function as a unit. If an idiom appears to be teared apart at surface structure, some mechanism has to put it together again before handing it to the semantic component. So goes the argument for reconstruction for idiom interpretation. (25) is an example from Sportiche (2006: 47) that illustrates this point.

(25) [How much *care*]$_1$ do you think Mary *took* $\_{1}$ of Bill?

Summing up, we have mentioned four areas that provide principles relevant to reconstruction effects: (1) Binding Theory, (2) pronominal binding, (3) relative scope, and (4) idioms. Except for Binding Theory, all of the mentioned principles are interpretive principles: They require a certain syntactic configuration (e.g. c-command, syntactic binding) to yield a certain semantic effect (e.g. scope, semantic binding). With respect to these principles, reconstruction effects are instances of apparent *syntax-semantics mismatches*, where an expression is spelled out at one position but interpreted at another. Not all of these mismatches are reconstruction or connectivity effects, some show a different footprint and can be handled by other mechanisms like QR. Nor are all reconstruction or connectivity effects syntax-semantics mismatches: Reconstruction for mere filtering principles, like Binding Theory, does not directly relate to interpretation.

Optionality. Another parameter for classifying reconstruction effects is optionality. As we have seen, a reconstruction effect involves a principle R, an expression E and two positions p_1 and p_2 that are related by movement. Reconstruction is *obligatory* if E is only ever visible to R at its origin p_1, never at the movement target p_2. Reconstruction is *optional* if the grammar allows for cases in which E is visible to R at p_1 and also for cases in which E is visible to R at p_2. Finally, reconstruction is *impossible* if E can only be visible to R at p_2, never at p_1. If we use '✓' to indicate that the grammar allows for E to be visible to R in that position and '∗' to indicate that the grammar does not allow this, we can summarize these three cases as in (26).

(26) a. $[_{\mathrm{P}} \ldots [_{p_2} \ast] \ldots [_{p_1} \checkmark] \ldots]$ obligatory reconstruction
b. $[_{\mathrm{P}} \ldots [_{p_2} \checkmark] \ldots [_{p_1} \checkmark] \ldots]$ optional reconstruction
c. $[_{\mathrm{P}} \ldots [_{p_2} \checkmark] \ldots [_{p_1} \ast] \ldots]$ obligatory non-reconstruction

Optional reconstruction for interpretive principles, like relative scope, enables multiple readings of a sentence. For example, (24) is ambiguous between a surface scope reading that corresponds to the syntactic structure without reconstruction (*someone from NY* c-commands *expected*) and an inverse scope reading that corresponds to the syntactic structure with reconstruction (*someone from NY* is c-commanded by *expected*).

The principles of Binding Theory are considered to differ in optionality. Roughly speaking, reconstruction for Principle A is optional, while reconstruction for Principle C is obligatory (Sportiche 2006: 56). The latter case is illustrated by (27a) which would not be ungrammatical if reconstruction were not obligatory. However, there are similar examples like (27b) that are grammatical. Analyses of this *anti-reconstruction* effect bring in additional factors like differences between arguments and adjuncts (Barss 2001: 689–692).

(27) a. *? [Which argument that *John*$_1$ is a genius]$_2$ did *he*$_1$ believe $\_{}_2$?
b. [Which argument that *John*$_1$ made]$_2$ did *he*$_1$ believe $\_{}_2$?

Reconstruction is not always optional for interpretive principles either. For instance, (28) lacks a reading in which *every building* is in the scope of *10 percent likely*, suggesting that reconstruction is impossible in this case (Sportiche 2006: 57).

(28) [*Every building*]$_1$ is *10 percent likely* [_$_1$ to collapse].

Partiality. So far, we have assumed that an expression *E* that shows a reconstruction effect is visible as a whole to a principle *R* in a previously occupied position. But this might not always be the case. A common way to split up *E* is to distinguish the *movement trigger* (e.g. a wh-word) from the *pied-piped material* that is pulled along. It is often assumed that in wh-movement, the wh-operator itself does not reconstruct, only the pied piped material (see (15) above for an example). The partiality parameter concerns the portion of the expression *E* that undergoes reconstruction: In *radical* (or *total*) reconstruction, the whole expression *E* is affected, whereas in *partial* reconstruction only its pied piped parts are.

Movement type. Reconstruction effects can also be classified by the type of movement relation that holds between the two involved positions p_1 and p_2. It is commonly assumed that reconstruction effects can be found with both A-movement and A$'$-movement (see Sportiche 2006: 50–56 for an overview), although reconstruction of A-movement is more controversial because of examples like (28) that don't allow for it.

Target. If an expression undergoes movement multiple times, additional reconstruction possibilities might arise. For instance, if *E* moves from its original position p_1 to p_2 and then on to p_3, as sketched in (29), reconstruction might in principle target either p_2 or p_1.

(29) $[_{\mathrm{P}} \ldots [_{p_3}\ E_j\ ] \ldots [_{p_2}\ [\ \_{}_j\ ]_i\ ] \ldots [_{p_1}\ \_{}_i\ ] \ldots]$

In general, reconstruction effects are not limited to positions that are immediately related by movement but can involve positions that are separated by multiple hops (see e.g. Sportiche 2006: 49). This is consistent with our definition in (19), which only requires that the two relevant positions are part of a single movement chain.

2 Relative clauses

Relative clauses come in many varieties. We will limit ourselves to restrictive headed relative clauses, characterized by Bianchi (2002: 197) as follows:

> A headed relative clause is a syntactically complex modifier involving abstraction over an internal position of the clause (the *relativization site*) and connected to some constituent it modifies (the *relative "head"*).

According to this, headed relative clauses crucially involve two syntactic positions, the relativization site and the relative head. It is the connection between these two positions that forms the basis for all reconstruction effects that have been argued to arise with relative clauses. More concretely, in example (30) the relative head *book* is related to the object position of *wrote* in the relative clause. The position of the relativization site is marked by '_' in the following examples, which should be understood as a purely descriptive device that does not imply the presence of a trace or copy.

(30) the book [which Alice wrote _]

The next two subsections summarize basic assumptions about the syntax and semantics of restrictive headed relative clauses. The third subsection surveys reconstruction effects found with relative clauses.

2.1 Syntax

There are two major issues in the syntax of relative clauses (Bianchi 2002):

- The *Modification Problem*:
  How is the relative clause syntactically related to the modified phrase?
- The *Connectivity Problem*:
  How is the surface head connected to the relativization site?

Modification problem. Starting from (30) as a simple example of a relative clause in a minimal context, we can identify three main components, as shown in (31): a determiner (D), a relative head (NP), and a relative clause, which we assume to be an instance of a complementizer phrase (CP).

(31) $[_{\text{D}}$ the] $[_{\text{NP}}$ book] $[_{\text{CP}}$ which Alice wrote _]

If we assume binary branching, no movement and surface order, then there are only two structural possibilities:

(32) a. [[D NP] CP]
     b. [D [NP CP]]

If we add headedness specifications, assuming endocentricity, we get four possibilities for each structural variant in (32), as shown in (33). Headedness is indicated using the projection relation < from Stabler (1997).

(33) aa. $[_< [_< \text{D NP}]\ \text{CP}]$ ba. $[_< \text{D}\ [_< \text{NP CP}]]$
ab. $[_< [_> \text{D NP}]\ \text{CP}]$ bb. $[_< \text{D}\ [_> \text{NP CP}]]$
ac. $[_> [_< \text{D NP}]\ \text{CP}]$ bc. $[_> \text{D}\ [_< \text{NP CP}]]$
ad. $[_> [_> \text{D NP}]\ \text{CP}]$ bd. $[_> \text{D}\ [_> \text{NP CP}]]$

Some of these structures are unlikely candidates, in particular (33ac), (33ad) and (33bd) are sentential phrases which fail to capture the nominal properties of constructions like (31). However, most of the remaining structures found their proponents. (33bc) is the NOM-S analysis (e.g. Partee 1975) that later morphed into (33ba) when the idea became popular that the determiner is the head of nominal phrases. The structure in (33ab) corresponds to the NP-S analysis (e.g. Ross 1967), its DP variant in (33aa) is a more modern contender adopted by Sternefeld (this volume). By contrast, (33bb) is the analysis proposed by Kayne (1994), which assumes that the determiner takes a sentential complement, with the head noun sitting in the specifier position of the relative clause.

Connectivity problem. The relative head provides a link between the relative clause (in particular, the relativization site) and its external environment. But how is this link represented in syntax? There are three main lines of competing analyses (see de Vries 2002 or Salzmann 2006 for detailed surveys).

First, the *Head External Analysis* argues that the relative head originates outside the relative clause, there is A′-movement of a relative operator (a pronoun like *which* or a silent *Op*) within the relative clause, and the relative clause is adjoined to the head NP. Assuming a TP layer below the CP layer of the clause, this results in the structure (34) for our example (30).

(34) $[_{\text{DP}}$ the *book* $[_{\text{CP}}$ [*which*]$_1$ $[_{\text{TP}}$ Alice wrote $\__1$]]]

Second, the *Head Raising Analysis* (also known as *Promotion Analysis*) states that the relative head originates inside the relative clause, mediated by a movement of a wh-phrase to the edge of the embedded CP, as indicated in (35). This opens the possibility to reconstruct it in a position inside the relative clause.

(35) $[_{\text{DP}}$ the *book*$_2$ $[_{\text{CP}}$ [*which* $\__2$]$_1$ $[_{\text{TP}}$ Alice wrote $\__1$]]]

Third, the *Matching Analysis* assumes that corresponding to the external head there is a separate internal head which is phonologically deleted under identity (or recoverability) with the external head. In contrast to the head raising analysis, the internal head and the external head are not part of a common movement chain. This analysis is sketched in (36).

(36) $[_{\text{DP}}$ the *book* $[_{\text{CP}}$ [*which ~~book~~*]$_1$ $[_{\text{TP}}$ Alice wrote $\__1$]]]

These analyses differ in their empirical predictions. In fact, reconstruction effects in relative clauses are the main line of argument for a head raising analysis. The contributions by Salzmann and by Webelhuth, Bargmann and Götze in this volume explore and analyze the available syntactic evidence in detail. In any case, many apparent reconstruction effects do not necessitate a syntactic head raising analysis and several contributions in this volume show how these effects can be derived based on a head external analysis, e.g. for Binding Theory (Krifka) or for pronominal binding (Barker, Jacobson, Sternefeld).

2.2 Semantics

From a semantic point of view, relative clauses are a means to construct complex adjectives from clauses. This idea goes back at least to Quine (1960: 110):

> A relative clause [...] has the form of a sentence except that a relative pronoun stands in it where a singular term would be needed to make a sentence[.] [...] At any rate the peculiar genius of the relative clause is that it creates from a sentence '… *x* …' a complex adjective summing up what that sentence says about *x*.

Accordingly, we assume that simple relative clauses like (37a) denote properties of individuals, represented in (37b) as a pair of a lambda term and its type, separated by a colon. Here we use expressions of a simply typed lambda calculus to represent meanings, leaving their model-theoretic interpretation implicit. Metalanguage constants are written in bold.

(37) a. $[_{\text{CP}}$ which$_1$ Alice wrote $\__1$ $]$
b. $\lambda x\, [\textbf{wrote}(x)(\textbf{Alice})] : (e, t)$

The basic idea is that the relative clause expresses a proposition that is abstracted over at the argument corresponding to the relativization site. This is combined by intersection, expressed as conjunction in the metalanguage, with the meaning of the head noun, as in (38b) for (38a).

(38) a. $[_{\text{NP}}$ book$]$ $[_{\text{CP}}$ which$_1$ Alice wrote $\__1$ $]$
b. $\lambda x\, [\textbf{book}(x)\ \textbf{and}\ \textbf{wrote}(x)(\textbf{Alice})] : (e, t)$

The meaning of the head noun combined with the relative clause can then form the argument to a determiner, for example as in (39) or (40). Here we are assuming a head external syntactic analysis of relative clauses with a structure based on (33ba).

(39) a. $[_{\text{DP}}$ $[_{\text{D}}$ the$]$ $[_{\text{NP}}$ $[_{\text{NP}}$ book$]$ $[_{\text{CP}}$ which$_1$ Alice wrote $\__1$ $]]]$
b. $\textbf{the}(\lambda x\, [\textbf{book}(x)\ \textbf{and}\ \textbf{wrote}(x)(\textbf{Alice})]) : e$

(40) a. $[_{\text{DP}}$ $[_{\text{D}}$ every$]$ $[_{\text{NP}}$ $[_{\text{NP}}$ book$]$ $[_{\text{CP}}$ which$_1$ Alice wrote $\__1$ $]]]$
b. $\lambda Q\, [\textbf{every}(\lambda x\, [\textbf{book}(x)\ \textbf{and}\ \textbf{wrote}(x)(\textbf{Alice})])(Q)] : ((e, t), t)$

There is an intimate connection between relative clauses and questions, both syntactically and semantically. Simple constituent questions like (41a) have been argued to denote properties like (41c), just what we have assumed for relative clauses like (41b).

(41) a. who did Alice meet?
b. who Alice met
c. $\lambda x\,[\mathbf{met}(x)(\mathbf{Alice})] : (e, t)$

This parallel extends to functional readings of questions and relative clauses (Engdahl 1986, Jacobson 1994, Sharvit 1999, Krifka 2001). In its functional reading, the question in (42a) does not ask for an individual such that everybody met that individual, but for a function from individuals to individuals such that everybody met the individual the function returns for them. Formally, this can be represented as a property of individual-valued functions, as shown in (42c). A possible answer is the expression *his mother* that can be interpreted as a function that returns the unique mother for its argument, as indicated in (42d), where **the** maps a two-place predicate of type $(e, (e, t))$ to an individual-valued function of type (e, e). Roughly speaking, $\mathbf{the}(R)$ is the function λx [the unique y such that $R(x)(y)$].

(42) a. Who did everybody$_1$ meet? His$_1$ mother.
b. The relative [$_{CP}$ who everybody$_1$ met _] was his$_1$ mother.
c. $\lambda f\,[\mathbf{everybody}(\lambda x\,[\mathbf{met}(f(x))(x)])] : ((e, e), t)$
d. $\mathbf{the}(\lambda x\,[\lambda y\,[\mathbf{mother\text{-}of}(x)(y)]]) : (e, e)$

One crucial aspect of the formal representation of functional readings is that the relativization site is analyzed as a *layered trace* (von Stechow 1990) that combines two bound variables, f and x. The functional relative clause in (42b) exemplifies a type of relative clauses that is often discussed in the context of reconstruction effects, as we will see shortly.

2.3 Reconstruction effects

We are finally ready to bring the two topics of sections 1 and 2 together and survey empirical phenomena that have been characterized as reconstruction effects in relative clauses. The common structure of these phenomena is that (part of) the relative head E is visible to a principle at the position of the relativization site. This configuration is sketched in (43).

(43) Phonological: [$_{NP}$ … E …] [$_{CP}$ … _ …]
Input to R: [$_{NP}$ … …] [$_{CP}$ … E …]

Strictly speaking, the term *reconstruction effect* is only appropriate against the background of a theory of relative clauses that assumes, like the head raising analysis does, that the relative head and the relativization site are linked by a movement chain. Here we use it in a weaker sense as a descriptive term for a class of empirical phenomena that have at least been argued to involve reconstruction, whatever their most satisfying analysis will turn out to be.

There are four main types of principles that play a role in discussions of reconstruction effects in relative clauses: principles of Binding Theory, pronominal binding, relative scope, and idioms. We will discuss them in turn.

First, there are reconstruction effects for principles of *Binding Theory* that involve relative clauses, parallel to the cases we have seen for wh-questions in section 1. Schachter (1973: 32) gives the following examples. In (44a), Principle A can only be satisfied if the reflexive pronoun *himself* is visible at the relativization site rather than in the position of the relative head. Similarly, the ungrammaticality of (44b) is taken to show that the full DP *John* can only be visible to Principle C at the relativization site, where it is c-commanded by a coindexed pronoun, rather than in the position of the relative head, where no violation of Principle C would occur.

(44) a. The $[_{NP}$ portrait of himself$_1]_2$ $[_{CP}$ that John$_1$ painted $\__2]$ is extremely flattering.

b. * The $[_{NP}$ portrait of John$_1]_2$ $[_{CP}$ that he$_1$ painted $\__2]$ is extremely flattering.

Reconstruction for the principles of Binding Theory, which are non-interpretive, as mentioned in section 1.3, might seem to necessitate a syntactic approach to reconstruction. However, Krifka (this volume) develops an alternative analysis of apparent Condition C effects under reconstruction that does not require any syntactic movement.

Second, reconstruction for *pronominal binding* concerns cases where the external relative head contains a pronoun that appears to be bound by an element inside the relative clause. This configuration is known as *binding into the head* (Jacobson 2002a). An example is given in (45), where the quantified DP *every man* inside the relative clause appears to bind the pronoun *his* in the relative head.

(45) The $[_{NP}$ relative of his$_1]$ $[_{CP}$ $[_{DP}$ every man$]_1$ admires _ most] is his$_1$ mother.

One origin of this type of examples is the discussion of functional relative clauses in Geach (1968: 124), who explores the contrast between the sentences in (46).

(46) a. The one woman $[_{CP}$ whom $[_{DP}$ every true Englishman$]_1$ honours _ above all other women] is his$_1$ Queen.

b. The one woman $[_{CP}$ whom $[_{DP}$ every true Englishman$]_1$ honours _ above all other women] is his$_1$ mother.

While these sentences do not involve binding into the head, they do exhibit pronouns that appear to be bound by a quantified DP inside a relative clause that is not c-commanding them. These kinds of *connectivity effects*, discussed in detail by Romero (this volume), are mostly restricted to copular sentences (see Cecchetto 2005), but there are some examples of similar effects in non-identity sentences, like (47) from Sharvit (1999: 449) or (48) from Safir (1999: 613).

(47) The $[_{NP}$ picture of himself$_1]$ $[_{CP}$ which $[_{DP}$ every student$]_1$ hated _] annoyed his$_1$ friends.

(48) The $[_{NP}$ picture of his$_1$ mother$]$ $[_{CP}$ that $[_{DP}$ every soldier$]_1$ kept _ wrapped in a sock$]$ was not much use to him$_1$.

The phenomenon of binding into the head plays a central role in several contributions in this volume, including those by Barker, Heim, Jacobson, and Sternefeld. We will also peek at possible analyses in section 3.

Third, there are several types of examples where an element *E* in the relative head appears to take scope below an element *F* inside the relative clause. This is schematically shown in (49), where *R* is a *relative scope* principle that maps syntactic c-command to semantic scope.

(49) Phonological: $[_{NP}$ … *E* … $]$ $[_{CP}$ … *F* … _ … $]$
Input to *R*: $[_{NP}$ … … $]$ $[_{CP}$ … *F* … *E* … $]$

Some examples are given in (50). The first example in (50a) from Salzmann (2006: 22) involves two nominal elements, where the denotation of *two patients* can depend on the interpretation of the lower DP *every doctor*.

(50) a. the $[_{NP}$ two patients$]$ $[_{CP}$ that $[_{DP}$ every doctor$]$ will examine _ tomorrow$]$
b. The $[_{NP}$ longest book$]$ $[_{CP}$ that John said $[_{CP}$ that Tolstoy wrote _$]]$ is *War and Peace*.
c. The $[_{NP}$ gifted mathematician$]$ $[_{CP}$ that Bill claims to be _$]$ should be able to solve this equation.
d. The $[_{NP}$ book$]$ $[_{CP}$ John needs to write _$]$ must have more impact than the one he has already written.

In (50b), Bhatt (2002) argued, the adjectival modifier in the relative head can scope above or below *John said*. This has been taken as evidence for a syntactic account of reconstruction that allows to interpret a copy of the relative head in any of the positions generated by successive cyclic movement. A critical discussion of this argument can be found in the contribution by Heycock to this volume.

Grosu & Krifka (2007) discuss another scope-related effect, illustrated in (50c), where the relative head is interpreted below an intensional operator within the relative clause. Moltmann (this volume) develops a semantic analysis of the related class of intensional relative clauses that includes examples like (50d).

A fourth class of reconstruction effects involves *idioms*. As mentioned in section 1.3, the idea here is that, if the chunks of an idiom need to form a syntactic unit when they are handed to the semantic component, examples like (51) from Schachter (1973: 31–32) require syntactic reconstruction.

(51) a. The [$_{NP}$ headway]$_1$ [$_{CP}$ that we made $\_{}_1$] was satisfactory.
b. The [$_{NP}$ careful track]$_1$ [$_{CP}$ that she's keeping $\_{}_1$ of her expenses] pleases me.

Idioms and their implications for the analysis of relative clauses are discussed in detail by Webelhuth, Bargmann & Götze (this volume).

This completes our short inventory of reconstruction effects in relative clauses. For a more extensive collection, see Salzmann (this volume).

3 Analyzing reconstruction effects

Reconstruction effects involve phrases that are said to behave "as if" they were in a different position. But what does that really mean? How can we analyze reconstruction effects formally in a theory of grammar?

According to Gazdar et al. (1985: 1), a grammar is an "interpreted formal system defining the membership of the collection of linguistic expressions, and assigning a structure and an interpretation to each member". In other words, we want a system that is able to derive correct pairings of form (syntactic structures) and meaning (semantic representations). In particular, we want the system to capture that the relative head may depend (in some sense) on elements within its associated relative clause, i.e. account for apparent reconstruction effects in relative clauses. In this section we will explore different strategies for achieving this.

We can broadly distinguish two basic approaches to the design of the syntax-semantics interface. One approach is to organize syntax and semantics in a *serial architecture* where "syntax feeds semantics". This perspective is taken by mainstream generative grammar implementing the Minimalist Program (Chomsky 1995). The syntactic component operates autonomously – syntactic operations like internal and external merge have no direct semantic effects – and hands in completed structures (LFs) to the semantic component for subsequent interpretation.

The second main approach is to setup a *parallel architecture* where syntax and semantics work hand in hand, in the sense that every syntactic operation is coupled with a semantic operation. At every step in the structure-building process, we are dealing with expressions that have phonological, syntactic and semantic structure. This perspective on grammar architecture, also known as *direct compositionality* (Barker & Jacobson 2007), is embodied in frameworks like categorial grammar or type-logical grammar.

In the following subsections we will sketch how sentences involving reconstruction effects in relative clauses, in particular binding into the head, can be analyzed under these two approaches. The constructions in (52) will serve as the probes.

(52) a. the [$_{NP}$ book] [$_{CP}$ which Alice wrote _]
b. the [$_{NP}$ relative of his] [$_{CP}$ which every man admires _]

Syntactic reconstruction, characteristic for serial grammar architectures, is discussed in section 3.1. Semantic reconstruction, typically found in parallel grammar architectures, but also compatible with serial architectures, is introduced in section 3.2. The approaches will then be compared in section 4, addressing the question whether there are reasons to favor one approach over the other.

3.1 Syntactic reconstruction

Syntactic reconstruction is based on the idea that phrases that behave "as if" they were in a different position really are in that different position at the relevant level of representation. But how does this work in detail? We will look at two versions of a serial grammar architecture, both grounded in mainstream generative syntax. The first one uses a trace-based approach to movement, the second one adopts the copy theory of movement.

3.1.1 LF with traces: Analysis of a simple relative clause

First, we sketch the derivation of the meaning of a simple relative clause against the background of a generative syntax framework in the style of Government and Binding that assumes a level of Logical Form as input to the interpretation function and that assumes that movements leave coindexed traces. The setup of the framework follows Heim & Kratzer (1998).

In order to arrive at appropriate LFs, a syntactic rule of Quantifier Raising (QR) is assumed that moves the relative pronoun from the relativization site within the relative clause to its edge. This rule leaves a trace at the origin and inserts a coindexed binder just below the target position. It can be stated as follows (based on Heim & Kratzer 1998: 185–188 and Büring 2005: 164):

(QR) Replace $[_{CP} \ldots [_{DP}\ \alpha] \ldots]$ by $[_{CP} [_{DP}\ \alpha] [\lambda_i [_{CP} \ldots \_\_{}_i \ldots]]]$, where i is a positive integer.

Note that binder indices of the form 'λ_i' are part of the syntactic structure, at least at LF, and as such they are elements of our object language.

Under a head external analysis of relative clauses, we arrive at the following LF for a simple example:

(53) $[_{DP}$ the $[_{NP} [_{NP}$ book$] [_{CP}$ which $\lambda_1 [_{TP}$ Alice wrote $\_\_{}_1]]]]$

It is straightforward to interpret this structure using standard semantic tools. For the sake of explicitness, we use the following set of (slightly adapted) interpretation rules from Heim & Kratzer (1998).

(FA) If α is a branching node and $\{\beta, \gamma\}$ the set of its children, then, for any assignment g, if $[\![\beta]\!]^g$ is a function whose domain contains $[\![\gamma]\!]^g$, then $[\![\alpha]\!]^g = [\![\beta]\!]^g([\![\gamma]\!]^g)$.

(PM) If α is a branching node and $\{\beta, \gamma\}$ the set of its children, then, for any assignment g, if $[\![\beta]\!]^g$ and $[\![\gamma]\!]^g$ are both functions of type (e, t), then $[\![\alpha]\!]^g = \lambda x\, [[\![\beta]\!]^g(x)$ **and** $[\![\gamma]\!]^g(x)]$.

(PA) Let α be a branching node with children β and γ, where β dominates only a binder index λ_i. Then, for any variable assignment g, $[\![\alpha]\!]^g = \lambda x\, [[\![\gamma]\!]^{g[i \mapsto x]}]$.

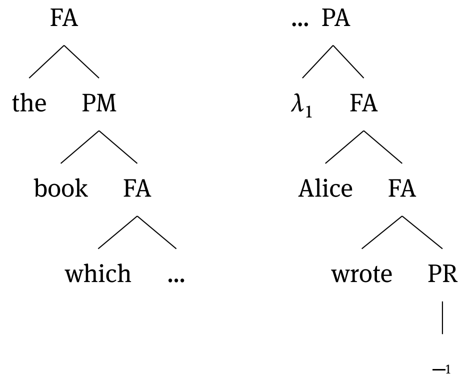
(PR) If α is a pronoun or a trace, g is a variable assignment, and $i \in \mathrm{dom}(g)$, then $[\![\alpha_i]\!]^g = g(i)$.

The type-driven rule of Functional Application (FA) is the default mode of combination. For semantically combining the relative head with the relative clause, the rule of Predicate Modification (PM) can be used. The binder indices introduced by the syntactic rule of QR are interpreted using Predicate Abstraction (PA). Finally, pronouns and traces do not have lexical entries under this setup but are handled by the rule (PR).

If we assume that our lexicon contains the entries in (54), we can apply these rules to the LF in (53) as shown in (55) in order to arrive at its interpretation in (56).

(54)
a. $[\![\text{the}]\!] = \lambda P\, [\mathbf{the}(P)] : ((e, t), e)$
b. $[\![\text{book}]\!] = \lambda x\, [\mathbf{book}(x)] : (e, t)$
c. $[\![\text{which}]\!] = \lambda P\, [P] : ((e, t), (e, t))$
d. $[\![\text{Alice}]\!] = \mathbf{Alice} : e$
e. $[\![\text{wrote}]\!] = \lambda x\, [\lambda y\, [\mathbf{wrote}(x)(y)]] : (e, (e, t))$

(55)



(56) **the**$(\lambda x$ [**book**(x) **and wrote**(x)(**Alice**)])

Under this analysis the relative pronoun *which* does not make any substantial contribution because the conjunctive linking of relative clause and relative head is handled by a separate rule of composition (PM). We have chosen to render the relative pronoun effectively invisible in the semantics by assigning an aptly typed identity function to it in (54c); for the general case one could use the polymorphic version in (57) instead. Alternatively, one could assume that the relative pronoun is invisible or deleted at LF by some rule that eliminates superfluous elements.

(57) $[\![\text{which}]\!] = \lambda\xi\ [\xi] : \forall\alpha\ [(\alpha, \alpha)]$

We will use evaluation trees like (55) with lexical items as leaves and interpretation rules as inner nodes for summarizing the analyses in all approaches below. They are intended to show at a glance which semantic mechanisms are involved in the interpretation of a construction.

3.1.2 LF with copies: Analysis of a simple relative clause

Now we move on to a head-raising analysis of relative clauses based on the copy theory of movement, mainly following the footsteps of Bhatt (2002) and Heim (this volume). If we were assuming, as before, that movement leaves traces, a head-raising analysis of (52a) would result in an LF like (58). However, with the copy theory of movement, we end up with what we might call a Proto-LF like (59).

(58) $[_{\text{DP}}$ the $[_{\text{CP}}$ $[_{\text{NP}}$ book] λ_2 $[_{\text{CP}}$ $[_{\text{DP}}$ which $\_\_{}_2$] λ_1 $[_{\text{TP}}$ Alice wrote $\_\_{}_1$]]]]

(59) $[_{\text{DP}}$ the $[_{\text{CP}}$ $[_{\text{NP}}$ book] $[_{\text{CP}}$ $[_{\text{DP}}$ which book] $[_{\text{TP}}$ Alice wrote which book]]]]

It is unclear how to interpret this structure using standard semantic tools. There are two ways to go: First, we could enrich the semantics in such a way that it recognizes copies and knows how to treat them directly as variables, as discussed in Ruys (2011, 2015). Second, we could add an intermediate step at the interface in which we refurbish Proto-LFs in such a way that the result can be consumed by a standard interpretation function. In particular, Fox (2000) develops a mechanism called *Trace Conversion* for this purpose. The specifics of the presentation below more closely follow Heim (this volume), who implements the idea using two type-shifters.

In order to refurbish a Proto-LF, the following three mechanisms are required, which we will label (TCB), (DEL) and (TCT). First, given a structure with two copies of a constituent, (TCB) simultaneously inserts a binder index in the immediate scope of the higher copy and a matching variable as a sister to the lower copy. In effect, this mimics the creation of operator-variable dependencies that is achieved as a result of applying (QR) in trace-based approaches to movement and LF.

(TCB) Given a Proto-LF of the form [... α ... [... [α] ...]] in which the two occurrences of α are copies of each other, transform it as follows, where i is a positive integer: [... α [λ_i [... [... [[α] $\_{i}$] ...]]]],

Second, (DEL) deletes appropriate parts of each copy in accordance with certain economy principles that structures must satisfy at LF, like Copy Economy (CE) and Operator Economy (OE) (see e.g. Barss 2001: 682 for a summary).

(DEL) Delete superfluous material.

(CE) Copy Economy: Eliminate redundancy of copies, down to recoverability.

(OE) Operator Economy: Minimize the content of operator positions.

Third, (TCT) injects two type-shifters at appropriate places in the remains of the lower copy in order to render it locally interpretable.

(TCT) Given a syntactic structure that contains a constituent [[α] $\_{i}$], replace it by [†the [[α] [†ident $\_{i}$]]].

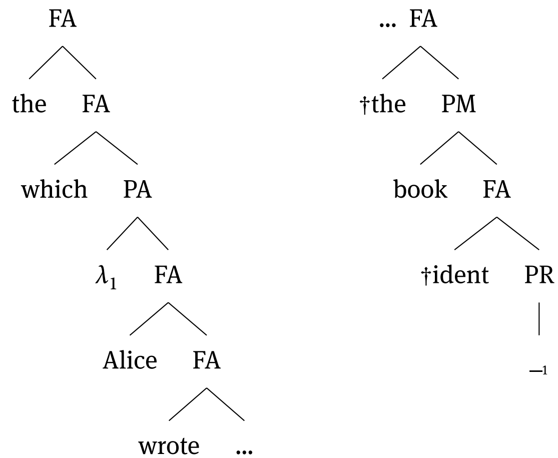
These two type-shifters are defined as follows (adapted from Heim this volume), where the '†' prefix only serves the purpose of distinguishing these elements from other potentially homophonous elements in the object language. We will simply treat these two entries as additional items in our lexicon as shown in (60).

(60) a. $[\![\dagger\text{the}]\!] = \lambda P\,[\mathbf{the}(P)] : ((e,t),e)$

b. $[\![\dagger\text{ident}]\!] = \lambda x\,[\lambda y\,[x = y]] : (e,(e,t))$

Now let's apply this setup to the example (59), repeated as (61a). For the sake of concreteness, we assume that the relative head is in the specifier position of the clause and that the determiner takes the relative clause directly as an argument, as in (33bb). The Proto-LF in (61a) is transformed into a proper LF, using the steps outlined above. First, we setup the binding configuration by applying (TCB), resulting in (61b). Second, we remove redundant copies as licensed by (DEL), resulting in (61c). Third, we apply (TCT) to arrive at the interpretable structure in (61d). Using the semantic rules introduced earlier, as indicated in the evaluation tree in (62), results in the interpretation in (63).

(61) a. [$_{DP}$ the [$_{CP}$ book [$_{CP}$ which book [$_{TP}$ Alice wrote [$_{DP}$ which book]]]]]
b. [$_{DP}$ the [$_{CP}$ book [$_{CP}$ which book [λ_1 [$_{TP}$ Alice wrote [[$_{DP}$ which book] _$_1$]]]]]]
c. [$_{DP}$ the [$_{CP}$ which [λ_1 [Alice wrote [[book] _$_1$]]]]]
d. [$_{DP}$ the [$_{CP}$ which [λ_1 [Alice wrote [†the [[book] [†ident _$_1$]]]]]]]

(62)


(63) **the**(λy [**wrote**(**the**(λx [**book**(x) **and** $y = x$]))(**Alice**)])

The semantic effect of interpreting the lower copy of the relative head *book* is evident if we compare (63) to (56): *book* is now interpreted in the scope of *wrote*, an important step toward capturing reconstruction effects.

3.1.3 LF with copies: Syntactic reconstruction

In the next step we use these tools to sketch how syntactic reconstruction can account for binding into the head examples like (64).

(64) The relative of his which every man admires is his mother.

The interpretation of functional relative clauses requires a few additional assumptions that go beyond what we have introduced so far. First, as already mentioned in section 2.2, the relativization site is analyzed as a *layered trace* (von Stechow

1990) that depends on both the relative head and the quantificational noun phrase that binds the pronoun inside the relative head. The indexing in (65) indicates these dependencies.

(65) the $[_{NP}$ relative of $\text{his}_1]_2$ $[_{CP}$ which $[_{DP}$ every $\text{man}]_1$ admires —$_{2(1)}$]

Second, in a functional reading the relative head and the relative clause, whose meanings are combined by intersection, are not predicates of type $\langle e, t\rangle$. It is usually assumed that there exists some type shifter that turns the relative head into a predicate of functions (Engdahl 1986, Jacobson 1994). This is independent of the presence of a bound pronoun in the relative head and is also required for functional relatives with simple heads like (66).

(66) the $[_{NP}$ woman] $[_{CP}$ which every man admires] is his mother

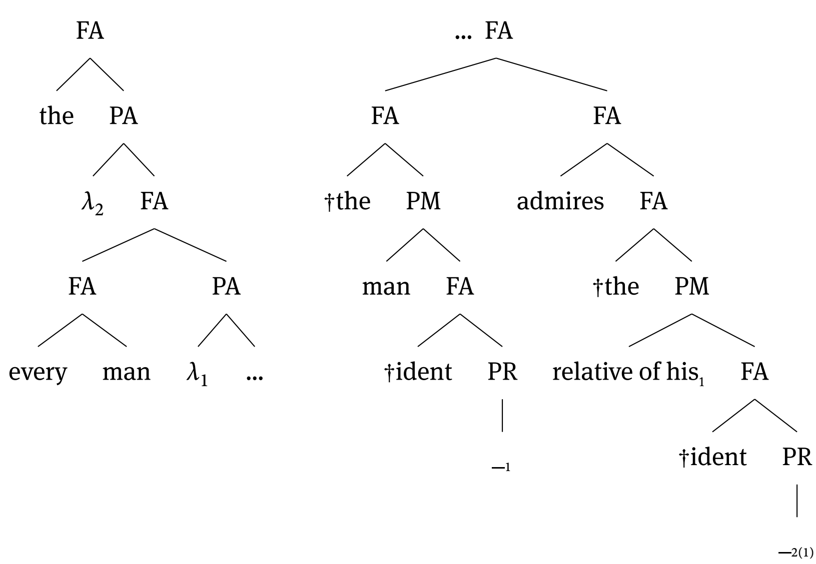
However, Heim (this volume) leverages the copy theory of movement and independently motivated mechanisms of presupposition projection to render a separate operator or rule for shifting the meaning of the relative head superfluous.

Let's return to (64). A possible Proto-LF under the copy theory of movement is given in (67a). Its transformation into a proper LF using (TCB), (DEL) and (TCT) as before results in something like (67b). The corresponding evaluation tree is shown in (68) and the target interpretation is given in (69).

(67) a. $[_{DP}$ the $[_{CP}$ relative of his $[_{CP}$ which relative of his $[_{CP}$ every man $[_{CP}$ every man admires which relative of his]]]]]

b. $[_{DP}$ the λ_2 $[_{CP}$ every man λ_1 $[_{CP}$ [†the man †ident —$_1$] admires [†the relative of his_1 †ident —$_{2(1)}$]]]]

(68)



(69) $\mathbf{the}(\lambda f\,[\mathbf{every}(\lambda x\,[x \in \mathrm{dom}(f)])(\lambda x\,[\mathbf{relative\text{-}of}(x)(f(x))])$ **and** $\mathbf{every}(\lambda x\,[x \in \mathbf{man}(x)])(\lambda x\,[\mathbf{admire}(f(x))(x)])])$

Several variations of this approach are conceivable. For example, we have somewhat arbitrarily chosen to keep two copies of *man* (as in Fox 1999) but only the lower copy of *relative of his* (as in Heim this volume). The interpretation also depends on more general (polymorphic) lexical entries for the inserted type shifters and the definite determiner, which needs to allow for a predicate of functions as argument. Instead of going into the details of the derivation, we refer the reader to Heim (this volume) for a full account in this tradition.

Syntactic reconstruction based on the copy theory of movement is a powerful mechanism for deriving reconstruction effects. It requires, however, the adoption of a few controversial assumptions like the raising analysis of relative clauses and certain invasive refurbishing actions on LF structures to render them interpretable. Somewhat paradoxically, an elegant method of implementing the latter is by injecting semantic type shifters, which are more characteristic of semantic approaches to reconstruction.

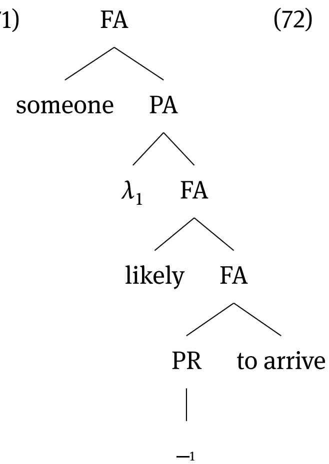
3.2 Semantic reconstruction

Semantic reconstruction is an umbrella term for semantic approaches to reconstruction effects that do not require tampering with syntactic structures. By design, they only target interpretive reconstruction effects (pronominal binding, relative scope, idioms), unlike syntactic approaches to reconstruction, which also cover non-interpretive effects (Binding Theory). Thus, a purely semantic approach needs to include a separate explanation for apparent reconstruction effects that arise with principles of Binding Theory.

Several techniques have been developed for capturing reconstruction effects with semantic means. Allowing flexible types for traces is probably the best-known semantic approach to scope reconstruction (von Stechow 1991, Cresti 1995, Rullmann 1995, Ruys 2015). The basic idea is illustrated in (72) for the scope reconstruction example in (70) and its evaluation tree in (71), which is identical for the two readings. If the trace $\__1$ is interpreted as a variable of type e then the surface scope reading results, see (72a). If the trace is instead interpreted as a variable of the type of a generalized quantifier $\langle\langle e,t\rangle,t\rangle$ then the function-argument relations in the top and bottom instances of (FA) in (71) are reversed, resulting in the inverse scope reading shown in (72b).

(70) Someone$_1$ is likely $\__1$ to arrive.

(71)



(72) Evaluation of the top node in (71)

a. with $\underline{\hspace{0.5em}}_1$ of type e:
FA(**someone**, λx [**likely**(**arrive**(x))])
= **someone**(λx [**likely**(**arrive**(x))])

b. with $\underline{\hspace{0.5em}}_1$ of type $((e, t), t)$:
FA(**someone**, λz [**likely**(z(λx [**arrive**(x)]))])
= **likely**(**someone**(λx [**arrive**(x)]))

Another technique that can be used to account for reconstruction effects with pronominal binding has been developed by Sternefeld (1997). Here the idea is that bound pronouns are not translated as regular variables, but as “pseudo-variables” like $\lambda g\ [g(i)]$ for *him*$_i$, where g ranges over assignment functions. Bound variables are thus treated as functions from assignments to individuals and the semantic apparatus is extended accordingly to allow abstraction over assignment functions. In this way, coindexing information can be smuggled past the standard evaluation rules for variables in the lambda calculus. In fact, Sternefeld (this volume) builds on a calculus that explicitly allows for “binding by beta reduction”, a form of variable capture carefully avoided by standard lambda calculi. Büring (2005: 252) also sketches a possible implementation of this idea, using the two silent operators in (73).

(73) a. $[\![\uparrow \alpha]\!]^g = \lambda g\ [[\![\alpha]\!]^g]$

b. $[\![\downarrow \alpha]\!]^g = [\![\alpha]\!]^g\ (g)$

The idea is then to freeze the indexing information using ↑ and release it using ↓ when the local assignment function provides the desired mapping from indices to individuals, as indicated in (74). In this way, the interpretation of pronouns can be “delayed” until they reach a fitting environment.

(74) the [↑ relative of his$_1$]$_2$ that [every man]$_1$ admires ↓ $\underline{\hspace{0.5em}}_2$

A similar effect is achieved in the variable-free framework by Jacobson (1999), in which pronouns are analyzed as denoting (partial) identity functions.

These semantic techniques are compatible with a polystratal derivational grammar architecture (see e.g. Ruys 2015 for a semantic approach to scope reconstruction in a Minimalist framework based on the copy theory of movement).

However, many proponents of semantic reconstruction do not see a need for a separate transformational engine in syntax and are instead committed to a grammar architecture in which form and meaning of an expression are computed in parallel. The frameworks of type-logical grammar (Moortgat 2011) and categorial grammar (Steedman & Baldridge 2011) provide elegant implementations.

In order to convey a taste of how these systems work, let's look at a very basic version of a categorial grammar. A linguistic expression can be represented as a triple of form, syntactic category and meaning, for example $\langle$Alice, DP, **Alice**$\rangle$. In many categorial frameworks it is common to represent these triples using a three-place typing relation, for example Alice $\vdash$ **Alice** : DP. When two expressions are merged to form a complex expression, their components are combined according to certain rules. These rules can be expressed in a compact way using a natural deduction notation familiar from inference rules in logic, as illustrated in (75).

(75) $$\dfrac{\text{Alice} \vdash \textbf{Alice} : \text{DP} \qquad \text{sleeps} \vdash \lambda x\,[\textbf{sleeps}(x)] : \text{DP}\backslash\text{CP}}{\text{Alice sleeps} \vdash \textbf{sleeps}(\textbf{Alice}) : \text{CP}}\ \backslash\text{e}$$

This sample derivation uses the backslash elimination (or backward application) rule that combines an expression or type A and an expression of type A\B to an expression of type B. Semantically, this corresponds to function application. For expressions of type A/B that are followed by expressions of type B, there is a corresponding rule of forward slash elimination (or forward application) with the same semantics. Both rules are shown in (76). They are the equivalent of the type-driven rule (FA) that was used in the section on syntactic reconstruction.

(76) $$\dfrac{\text{X} \vdash M : \text{A} \qquad \text{Y} \vdash N : \text{A}\backslash\text{B}}{\text{X Y} \vdash N(M) : \text{B}}\ \backslash\text{e} \qquad \dfrac{\text{X} \vdash N : \text{B/A} \qquad \text{Y} \vdash M : \text{A}}{\text{X Y} \vdash N(M) : \text{B}}\ /\text{e}$$

For the analysis of a simple relative clause we need two more rules: type lifting and function composition, shown in (77). Type lifting is a unary rule that shifts the meaning of a proper name to a generalized quantifier.

(77) $$\dfrac{\text{X} \vdash M : \text{A}}{\text{X} \vdash \lambda x\,[x(M)] : \text{B}/(\text{A}\backslash\text{B})}\ \text{l} \qquad \dfrac{\text{X} \vdash M : \text{A/B} \qquad \text{Y} \vdash N : \text{B/C}}{\text{X Y} \vdash \lambda x\,[M(N(x))] : \text{A/C}}\ \text{b}$$

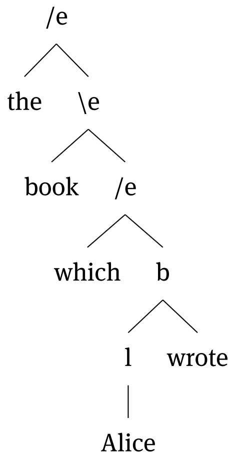
We assume that the entries in (78) are part of our lexicon. Here we analyze *which* as providing the conjunctive link between the relative clause and the relative head. The evaluation tree for our running example (52a) is shown in (79), resulting in the target interpretation in (80).

(78) a. the $\vdash \lambda P\,[\textbf{the}(P)]$: DP/NP
b. book $\vdash \lambda x\,[\textbf{book}(x)]$: NP
c. which $\vdash \lambda P\,[\lambda Q\,[\lambda x\,[P(x)\ \textbf{and}\ Q(x)]]]$: (NP\NP)/(CP/DP)

d. Alice ⊢ **Alice** : DP

e. wrote ⊢ $\lambda x\ [\lambda y\ [\mathbf{wrote}(x)(y)]]$: (DP\CP)/DP

(79)



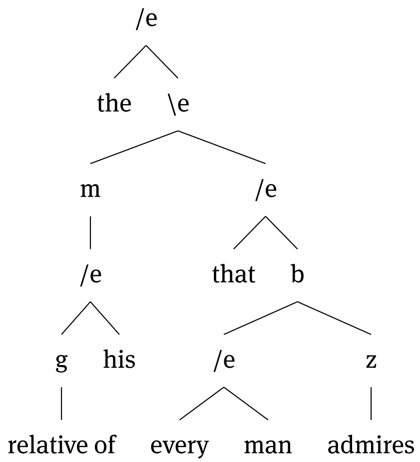
(80) **the**(λx [**book**(x) **and wrote**(x)(**Alice**)])

Jacobson (1999, 2002a, this volume) uses a variable-free semantics based on combinatory categorial grammar and demonstrates how reconstruction effects can be handled in this framework. Using a carefully motivated set of combinatory rules, it is possible to derive correct interpretations for sentences that involve apparent reconstruction effects, without assuming syntactic movement and by directly combining adjacent expressions in their surface arrangement. This is illustrated in (83) for our running reconstruction example (52b) with its target interpretation in (84). The additional combinators required for this analysis are g and z for handling pronouns and binding, shown in (81) and (82), and a decurrying rule m for functional interpretations of relative clauses. The vertical slash notation A|B for expressions of category A that need an antecedent of category B and the rule format used here are adopted from Jäger (2005: 100). For a detailed account, see Jacobson (this volume).

(81) $$\frac{\mathrm{X} \vdash M : \mathrm{A/B}}{\mathrm{X} \vdash \lambda x\ [\lambda y\ [M(x(y))]] : \mathrm{A|C/B|C}}\ \mathrm{g}$$

(82) $$\frac{\mathrm{X} \vdash M : \mathrm{(B\backslash A)/C}}{\mathrm{X} \vdash \lambda x\ [\lambda y\ [M(x(y))(y)]] : \mathrm{(B\backslash A)/C|B}}\ \mathrm{z}$$

(83)



(84) $\mathbf{the}(\lambda f\,[\mathbf{every}(\lambda x\,[x \in \mathrm{dom}(f)])(\lambda x\,[\mathbf{relative\text{-}of}(x)(f(x))])$ **and** $\mathbf{every}(\lambda x\,[x \in \mathbf{man}(x)])(\lambda x\,[\mathbf{admire}(f(x))(x)])])$

Barker (this volume) presents an alternative semantic approach to reconstruction phenomena on top of a continuation-based grammatical framework (Barker & Shan 2014).

4 Comparing the approaches

Having sketched both syntactic and semantic approaches to reconstruction effects, one crucial question remains: Which approach is the superior one? Are there reasons other than personal preferences and acquired habits that can objectively guide our decisions about grammar design and the architecture of the syntax-semantics interface?

In general, there are two types of arguments for deciding between competing approaches:

- Empirical arguments: Do the approaches differ in their empirical predictions? Which approach is better at correctly deriving acceptable constructions and correctly ruling out unacceptable constructions?
- Conceptual arguments: Are there conceptual or technical reasons for preferring one approach over the other, for example: simplicity, explicitness, formal precision, computability or cognitive plausibility?

First, several empirical arguments have been brought forward. On the one hand, Heycock (1995) and Fox (1999) have argued that scope reconstruction feeds Condition C, that is, that scope reconstruction is impossible in the following structural configuration (Fox 1999: 163):

(85) $[_{QP}$ ... r-expression$_1$ ...$]_2$ ... pronoun$_1$ ... $\_{}_2$

Examples like (86) are provided as evidence: The semantics of *invent* requires scope reconstruction, but this leads to a violation of Condition C, rendering the example ungrammatical. Since scope reconstruction appears to be impossible without inducing a Condition C violation, it must involve a syntactic rather than a semantic mechanism.

(86) * $[_{DP}$ How many stories about Diana$_1$'s brother$]_2$ is she$_1$ likely to invent $\_{}_2$?

For a detailed re-evaluation of this argument, see Krifka (this volume). In general, the analysis of interactions between different types of reconstruction effects provides a rich set of empirical facts for theories to explain. Heycock (this volume) takes a look at possible correlations between reconstruction for binding conditions, idioms and adjectival modifiers in relative clauses. Truckenbrodt (this volume) explores the interactions between stress reconstruction, idiom interpretation and Condition C effects.

On the other hand, Jacobson (2002a) presents stacked relative clauses like (87), where a quantifier in one relative clause binds a pronoun in the other, as a challenge for syntactic theories of reconstruction: There is no obvious way to (re-)construct a syntactic representation in which all bindees are in the c-command domain of their binders.

(87) The $[_{NP}$ assignment$]_3$ $[_{CP}$ that *every student*$_1$ gave $\_{}_3$ *her*$_2]$ $[_{CP}$ that *every phonology professor*$_2$ most praised *him*$_1$ for $\_{}_3]$ was the last one *he*$_1$ handed in to *her*$_2$.

Additional evidence in favor of a semantic approach to reconstruction comes from an empirical study on binding into the head cases in German reported by Radó, Konietzko & Sternefeld (this volume).

Second, also conceptual arguments have been voiced as a relevant factor in the controversy between syntactic and semantic reconstruction. Jacobson (2002b) compares alternative approaches to the overall organization of the grammar and the syntax-semantics interface and argues that we should prefer Direct Compositionality on conceptual grounds since it provides the simplest overall architecture. Simplicity is definitely a goal shared with practitioners of the *Minimalist* program, but to some degree even simplicity seems to be in the eye of the beholder. What is simpler: a handful of combinatory rules for constructing expressions or a fully generic merge operation coupled with a few general principles? Even when all relevant details are known, the decision could be difficult without agreed upon

Tab. 1: This simplistic view of the tradeoff between syntax and semantics is falsified by the existence of constructions like functional relative clauses: Multiple syntactic levels in a serial grammar architecture cannot compensate for the absence of polymorphic types in semantics.

grammar architecture	syntax	semantics
serial: syntax feeds semantics	poly-stratal	mono-morphic
parallel: grammar composes signs	mono-stratal	poly-morphic

objective standards for simplicity that go beyond subjective assessments, which are likely to be shaped by factors like personal familiarity.

Explicitness, formal precision and computability are additional desiderata that may be used to decide between competing theories. Jacobson (2002b: 601) noticed a “trend away from writing explicit ‘fragments’” that accompanied the shift away from Direct Compositionality. Maybe upcoming large-scale computational approaches to syntax and semantics will manage to reverse this trend. In combination with large corpora they could even allow for a quantitative comparison of the predictive success of competing theories.

5 Conclusion

Reconstruction effects in relative clauses not only constitute an interesting set of empirical facts, but also provide a useful benchmark for competing theories of grammar and the syntax-semantics interface. Accounts have been developed both in serial grammar architectures, typically involving some form of syntactic reconstruction, and in parallel grammar architectures, where richer semantic mechanisms are used to explain the same set of empirical data. There is no perfect dichotomy between syntactic and semantic approaches to reconstruction. The simplistic view in Table 1 that syntactic and semantic mechanisms are perfectly equivalent is untenable if we consider constructions like functional relative clauses. Even syntactic approaches to reconstruction will require layered traces and higher semantic types in order to arrive at correct interpretations.

The contributions in this volume search for the best balance between syntactic and semantic components in the analysis of reconstruction effects. Lechner (this volume) even argues for a hybrid theory of reconstruction in which syntactic and semantic reconstruction complement each other.

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Manfred Krifka

A Direct Compositionality approach to Condition C effects under reconstruction and their exceptions

Condition C effects under reconstruction, as the lack of a co-referring reading of *Mary wondered* [[*which stories about Tom*$_i$] *he*$_{*i}$ *knew* _], have been discussed as evidence for an LF account in which the moved expression is reconstructed in the position of its trace (cf. Fox 1999). This paper develops an alternative explanation under a Direct Compositionality account, which assumes competition with structures that involve syntactically bound readings, e.g. [[*which stories about himself*] *Tom knew* _], in line with Reinhart (1983). It shows that a number of exceptions to Condition C effects under reconstruction are due to factors that mitigate against syntactically bound readings, and hence weakens the competitive structure. The conclusion of this paper is that Condition C effects should not be conceived as an argument for the LF account, but are fully compatible with a Direct Compositionality account.

1 Condition C effects and the Syntax/Semantics interface

1.1 Surface Interpretation, LF Interpretation, and Reconstruction

This article is concerned with a set of phenomena related to the way how syntactic structures are interpreted. There are two general strategies. The first approach, called “Direct Compositionality”, or “Surface Interpretation”, assumes that syntactic rules, independently motivated by syntactic constituency tests, create strings of words; these syntactically structured strings are then interpreted by semantic rules that are guided by the syntactic structure. The second approach assumes that the input to semantic interpretation is a derived or enriched syntactic structure. The enrichment may be formulated in different ways, e.g. the surface structure may

Manfred Krifka, Humboldt University of Berlin & Leibniz-Centre General Linguistics (ZAS) Berlin

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be mapped to distinct syntactic structures following certain rules, called "Logical Forms", or "LFs", or syntax may generate additional structure, like phonologically empty nodes with semantic interpretation, that are not strictly required for the description of well-formed syntactic structures. Semantic interpretation then uses such enriched syntactic structures as input, and hence I will call this strategy "Enriched Surface Interpretation."

There is ongoing controversy about which approach should be preferred (cf. e.g. Barker & Jacobson 2007). There is a certain tradeoff between the two strategies: Surface Interpretation assumes a simpler syntactic component, but needs more complex semantic interpretation rules; Enriched Surface Interpretation allows for a straightforward semantic interpretation, but requires a more complex syntax with rules that relate visible syntactic structures to a form to LF or assumes an enriched syntactic structure. Therefore, complexity measures that would lead to a preference of one theory over the other are not easy to apply.

In this situation it is important to consider phenomena that one strategy cannot handle in a natural way, whereas the other does. The current article discusses one such phenomenon that involves so-called Reconstruction, which was brought forward as an argument against the Surface Interpretation approach most prominently in Fox (1999).

Reconstruction concerns cases in which a constituent α occurs in one position in the syntactic string but is related to another position, resulting in a structure $[\ \alpha\ [...\ t_\alpha\ ...]]$, where α is the syntactic constituent in its surface position, and t_α is the other, or "base" position. Reconstruction phenomena are cases in which the constituent α appears to be interpreted in its base position, t_α; they suggest that the input to semantic interpretation is not the surface structure $[\ \alpha\ [...\ t_\alpha\ ...]]$, but rather a derived structure $[\ \_\ [...\ \alpha\ ...]]$ in which α is interpreted in its "reconstructed" position. While the term "reconstruction" is motivated by the LF variant of the Enriched Surface approach, it is used here as a theory-neutral term that should cover the relevant phenomena of the syntax/semantics interface in general.

This article will discuss a particular reconstruction phenomenon, namely Condition C effects, as they have been acknowledged to pose a serious problem for Surface Interpretation even by the proponents of that approach (cf. Jacobson 2004). I will discuss these effects, which are notoriously difficult to judge, and can be present or absent depending on a number of factors that are quite unclear in their nature. I will argue for an explanation of these effects following a suggestion in Jacobson's paper, and earlier proposals by Sharvit (1999), Sternefeld (2001) and Cecchetto (2001) rooted in work by Reinhart (1983), that analyzes Condition C effects as caused by a competition with syntactic structures involving bound pronouns. The novel contribution of the current paper is an explanation of the various exceptions to these apparent Condition C effects. It takes inspiration from the last line of Jacobson's article: "a faith in direct compositionality should inspire us to look for a more explanatory account of things like Condition C effects," and I hope that it contributes to an understanding of these effects beyond the architectonical issues concerning the syntax/semantics interface.

But first we will have a more detailed look at the two approaches towards reconstruction, which we will call the "semantic" vs. the "syntactic" account, respectively.

1.2 Reconstruction: Syntactic Accounts

Consider again the structure [α [... t_α ...]], where α is a syntactic constituent in surface position, and t_α is the related base position of α in the underlying structure. After reconstruction, under the syntactic account, α will be interpreted in its base position. That is, the syntactic expression α would figure in the computation of the meaning of [... α ...]. This means that purely structural features of α could be of relevance for the interpretation, and even for the grammaticality, of the expression [α [... t_α ...]]. In the Minimalist Framework, this approach is presented in the copy theory of movement (cf. Chomsky 1993, Corver & Nunes 2007). In this theory, a structure [α [... α ...]] is generated, with two copies of the string α. It is then assumed that in the phonological realization, the second copy is deleted, resulting in [α [... $\cancel{\alpha}$ ...]], whereas a structure in which the first copy is deleted, [$\cancel{\alpha}$ [... α ...]], serves as the input to semantic interpretation.

For the purpose of this paper, I will present the syntactic account of reconstruction within the first framework, as it comes with a worked-out treatment for model-theoretic, semantic interpretation (Heim & Kratzer 1998). However, this choice should not affect the general argument. As an example, consider the following sentence and its two possible interpretations:

(1) *Someone from New York is likely to win the lottery*.
   a. 'There is a person from New York, and this person is likely to win the lottery.'
   b. 'It is likely that there is a person from New York that will win the lottery.'

The phrase *someone from New York* can be understood as specific, referring to a particular person that can be identified beforehand – either by the speaker or by the assumption that there exists some other identification procedure (cf. e.g. Yeom 1998). For example, if there is a person from New York that bought 90% of the lottery tickets, and the speaker knows that and knows who this person is, (1) is true under reading (a). The phrase can also be understood as non-specific, not referring to a particular person. For example, if 90% of the lottery tickets have been bought by New Yorkers, (1) is true under reading (b). Of course, (1)(b) would also be true in the first scenario, but the second scenario does not verify reading (1)(a).

The two readings can be generated by assuming that the syntactic structure of (1) is mapped to two distinct Logical Forms, which are given schematically below.

(2) a. [$_{QP}$ *someone from NY*] [1 [*is likely* [t_1 *to win the lottery*]]]

b. __ *is likely* [[$_{QP}$ *someone from NY*]$_1$ *to win the lottery*]

We first consider (2)(a). This corresponds to the surface form, which records the fact that the quantifier phrase *someone from New York* is both the subject of the raising predicate, *likely*, and the subject of the infinitive construction. The mechanism of relating the quantifier phrase to the subject position of the infinitive construction follows the textbook account in Heim & Kratzer (1998). That is, if a constituent α is moved, this is indicated by an indexed trace at the base position and at the sister constituent of α; the sister constituent of α at the site where α is moved to is marked by the index of the trace. The semantic interpretation rules would lead to a wide-scope interpretation of *someone from New York*, relative to the modal adverb *likely*. This is illustrated in the sketch of a derivation in (3), which follows the convention that $[\![\cdot]\!]$ is a recursive interpretation function, where $[\![...]\!]^{i\to x}$ means that expressions with the index i in [...] are to be interpreted as the variable x. In our case, this affects the interpretation of the trace, t_i.

(3) $[\![$[*someone from NY*] [1 [*be likely* [t_1 *to win the lottery*]]]$]\!]$

a. = $[\![$*someone from NY*$]\!]$($[\![$[1 [*be likely* [t_1 *to win the lottery*]]]$]\!]$)

b. = $[\![$*someone from NY*$]\!]$($\lambda x_1$$[\![$*be likely* [$t_1$ *to win the lottery*]$]\!]^{1\to x_1}$)

c. = $[\![$*someone from NY*$]\!]$(λx_1[$[\![$*be likely*$]\!]^{1\to x_1}$($[\![t_1$ *to win the lottery*$]\!]^{1\to x_1}$)])

d. = $\lambda P\exists x[\text{Person}(x) \wedge \text{from NY}(x) \wedge P(x)](\lambda x_1[\textsc{likely}(x_1 \text{ wins lottery})])$

e. = $\exists x[\text{Person}(x) \wedge \text{from NY}(x) \wedge \textsc{likely}(x \text{ wins the lottery})]$

In the transition from (a) to (b), a rule is applied that interprets an indexed expression [1 [... t_i ...]] as $\lambda x_i[\![[...\ t_i\ ...]]\!]^{i\to x_i}$, a function from x_i to the meaning of [... t_i ...], where all expressions with index i are interpreted as x_i. The raising predicate *be likely* is interpreted here for simplicity as an operator that scopes over a clausal structure, an infinitive construction with a trace in its subject position.

In (2)(b), the subject phrase is reconstructed into its base position. Applying standard semantic rules would lead to a narrow-scope interpretation with respect to the modal.

(4) $[\![$[*be likely* [[*someone from NY*] [*to win the lottery*]]]$]\!]$

a. = $[\![$*be likely*$]\!]$($[\![$*someone from NY*$]\!]$($[\![$*win the lottery*$]\!]$))

b. $= \textsc{likely}(\lambda P \exists x[\text{Person}(x) \wedge \text{from NY}(x) \wedge P(x)](\lambda x[x \text{ wins lottery}]))$

c. $= \textsc{likely}(\exists x[\text{Person}(x) \wedge \text{from NY}(x) \wedge x \text{ wins lottery}])$

In the copy-theory of movement (cf. Chomsky 1995, Sauerland 1998), the subject appears in two copies, and can be interpreted either in the higher or in the lower position, cf. (5)(a,b). For the wide-scope reading, we would have to assume that the lower copy is interpreted as a bound variable, which would involve a type change from a quantifier to an entity. We then can assume similar semantic interpretation rules as above.

(5) a. [*someone from NY*]$_1$ *is likely* [[~~*someone from NY*~~]$_1$ *to win the lottery*]

b. [~~*someone from NY*~~]$_1$ *is likely* [[*someone from NY*]$_1$ *to win the lottery*]

What both versions of the syntactic approach have in common is that the input to semantic interpretation is enriched, in some way or other: The reconstructed version of the LF in (2)(b) is not a possible surface form, and neither are the syntactic structures generated by the copy theory of movement in (5). Their only raison d'être is to allow for the generation of the observed readings.

1.3 Reconstruction: Semantic Accounts

We now turn to Surface Interpretation, of which there are also various implementations. Here, I will assume a version that assumes syntactic traces, in order to make possible a direct comparison with Enriched Surface Interpretation. This means that we assume a structure [α [... t_α ...]], but now this structure is interpreted directly: Its meaning $[\![$[α [... t_α ...]]$]\!]$ is computed compositionally from the meanings of the intermediate parts $[\![\alpha]\!]$ and $[\![$[... t_α ...]$]\!]$. Under this architecture of semantic interpretation, it is not the syntactic expression α that is related to the base position t_α in the computation of $[\![$[... t_α ...]$]\!]$. Rather, it is the meaning of α, rendered as $[\![\alpha]\!]$, that is related to the way how the base position t_α is interpreted, rendered as $[\![t_\alpha]\!]$. The interpretation cannot refer to purely structural syntactic features of α within the interpretation of [... t_α ...], only to the meaning, $[\![$[... t_α ...]$]\!]$.

It is important to realize that the semantic approach is more restrictive, in the following sense. In general, a syntactic expression α contains more information than its meaning, $[\![\alpha]\!]$, as distinct expressions α, α' with $\alpha \neq \alpha'$ can have the same meaning: $[\![\alpha]\!] = [\![\alpha']\!]$. So, formal differences between α and α' might result in differences of acceptability between [α [... t_α ...]] and [α' [... t_α ...]] in the syntactic account – after syntactic reconstruction, [... α ...] might be grammatical, but [... α' ...] may fail to be grammatical. But such purely formal differences cannot result in differences of acceptability in the semantic account, simply because they are not reflected in the meanings $[\![\alpha]\!]$, $[\![\alpha']\!]$, and these meanings are all that the semantic approach to reconstruction has access to. As a consequence, with the semantic account we have to assume that all differences between expressions α, α' that lead to differences in grammaticality judgements in reconstruction contexts [... t_α ...] must have a reflex in the semantic interpretation, that is, it must hold that $[\![\alpha]\!] \neq [\![\alpha']\!]$.

After these methodological clarifications, let us consider how the readings of (1) are derived. For our discussion we should assume a slightly more liberal way of combining meanings, which makes reference to the semantic types of the meanings to be combined:

(6) $[\![[\alpha\ \beta]]\!] = \{[\![\alpha]\!], [\![\beta]\!]\}, = [\![\alpha]\!]([\![\beta]\!])$ or $[\![\beta]\!]([\![\alpha]\!])$, whichever is well-formed.

One implementation of the readings of (1) is that the base position of the subject, represented as a trace in (2)(a), is semantically interpreted in an ambiguous way: It is either of the type of entities, *e*, or of the type of quantifiers, *(et)t* (cf. Strigin 1994, Sternefeld 2001). This can be expressed by assuming type-ambiguous traces in syntax, e.g. t_i for traces of type *e*, and T_i for traces of type *(et)t*. Alternatively, we could assume that the base positions are not ambiguous, but underspecified; they are compatible with either a type *e* interpretation, or a type *(et)t* interpretation. However, then the interpretation $[\![\cdot]\!]$ would not be a function anymore, but a relation, leading to a more complex architecture of the syntax/semantics interface. Also, we would then predict that in cases of VP ellipsis cases like (7) have a reading in which the subject quantifiers might differ in scope, which is not the case.

(7) *Someone from NY is likely to win a big price in the lottery, and someone from Philadelphia is, too.*

For these reasons, I assume the first option here, that we may have type *e* traces and type *(et)t* traces. The wide-scope interpretation can be derived as in (8), whereas the narrow-scope interpretation can be derived as in (9).

(8) $[\![[\textit{someone from NY}]\ [1\ [\textit{be likely}\ [t_1\ \textit{to win the lottery}]]]]\!]$

a. $= \{[\![\textit{someone from NY}]\!], [\![[1\ [\textit{be likely}\ [t_1\ \textit{to win the lottery}]]]]\!]\}$

b. $= \{[\![\textit{someone from NY}]\!], \lambda\xi_1[\![[\textit{be likely}\ [t_1\ \textit{to win the lottery}]]]\!]^{1\to\xi_1}\}$

c. $= \{[\![\textit{someone from NY}]\!], \lambda\xi_1[\{[\![\textit{be likely}]\!]^{1\to\xi_1}, [\![[t_1\ \textit{to win the lottery}]]\!]^{1\to\xi_1}\}]\}$

d. $= \{[\![\textit{someone from NY}]\!], \lambda\xi_1[\{\textsc{likely}, \{[\![\textit{to win the lottery}]\!]^{1\to\xi_1}, [\![t_1]\!]^{1\to\xi_1}\}\}]\}$

e. $= \{[\![\textit{someone from NY}]\!], \lambda x_1[\{\textsc{likely}, \{[\![\textit{to win the lottery}]\!]^{1\to x_1}, x_1\}\}]\}$

f. $= \{[\![\textit{someone from NY}]\!], \lambda x_1[\{\textsc{likely}, \{\lambda x[\text{win-lottery}(x)], x_1\}\}]\}$

g. $= \{[\![\textit{someone from NY}]\!], \lambda x_1[\{\textsc{likely}, \lambda x[\text{win-lottery}(x)](x_1)\}]\}$

h. $= \{[\![\textit{someone from NY}]\!], \lambda x_1[\{\textsc{likely}, \text{win-lottery}(x_1)\}]\}$