Chapter 21

Anaphoric Binding

Stefan Müller
Humboldt-Universität zu Berlin

António Branco
University of Lisbon

This chapter is an introduction into the Binding Theory assumed within HPSG. While it was inspired by work on Government & Binding in the beginning, it turned out that reference to tree structures alone is not sufficient and that reference to the syntactic level of argument structure is required. Since the argument structure is tightly related to the thematic structure, HPSG's Binding Theory is a mix of aspects of thematic binding theories and entirely configurational theories. This discusses both the advantages of this new view and open issues.

1 Introduction

Binding Theories deal with questions of coreference and correspondence of forms▌ For example, the reflexives in (1) have to refer to the referent of an NP in the same clause and they have to have the same gender as the NP they are coreferent with:

(1) a. Peter$_i$ thinks that Mary$_j$ likes herself$_{*i/j/*k}$.

  b. * Peter$_i$ thinks that Mary$_j$ likes himself$_{*i/*j/*k}$.

  c. * Mary$_i$ thinks that Peter$_j$ likes herself$_{*i/*j/*k}$.

  d. Mary$_i$ thinks that Peter$_j$ likes himself$_{*i/j/*k}$.

The indices show what bindings are possible and which ones are ruled out. For example, in (1a), *herself* cannot refer to *Peter*, it can refer to *Mary* and it cannot refer to some discourse referent that is not mentioned in the sentence (indicated

by the index k). Coreference of *himself* and *Mary* is ruled out in (1b), since *himself* has an incompatible gender.

At first look it may seem possible to account for the binding relations of reflexives on the semantic level: it seems to be the case that reflexives and their antecedents have to be semantic arguments of the same predicate.[1] For examples like (1), this makes the right predictions, since the reflexive is the undergoer of *likes* and the only possible antecedent is the actor of *likes*. However, there are raising predicates like *believe* not assigning semantic roles to their objects but nevertheless allowing coreference of the raised element and the subject of *believe*:[2]

(2)   John$_i$ believes himself$_i$ to be a descendant of Beethoven.

The fact that *believes* does not assign a semantic role to its object is confirmed by the possibility to embed predicates with an expletive subject under *believe*:[3]

(3)   Kim believed there to be some misunderstanding about these issues.

So, it really is the clause or – to be more precise – some syntactically defined local domain in which reflexive pronouns have to be bound.[4]

Personal pronouns can not refer to an antecedent within the same clause:

(4)   a.   Peter$_i$ thinks that Mary$_j$ likes her$_{*i/*j/k}$.
      b.   Peter$_i$ thinks that Mary$_j$ likes him$_{i/*j/k}$.
      c.   Mary$_i$ thinks that Peter$_j$ likes her$_{i/*j/k}$.
      d.   Mary$_i$ thinks that Peter$_j$ likes him$_{*i/*j/k}$.

As the examples show, the pronouns *her* and *him* cannot be coreferent with the subject of *likes*. If a speaker wants to express coreference, he or she has to use a reflexive pronoun as in (1).

Interestingly, the binding of pronouns is less restricted than the one of reflexives, but this does not mean that anything goes. For example, a pronoun cannot

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[1]See Riezler (1995) for a way to formalize this in HPSG.

[2]See Pollard & Sag 1994: Chapter 3.5 and Abeillé 2020, Chapter 13 of this volume on raising. The example (2) is taken from Manning & Sag (1998: 128).

[3]The example is due to Pollard & Sag (1994: 137). See the sources cited above for further discussion.

[4]Another argument against a binding theory relying exclusively on semantics is different binding behavior in active and passive sentences: since the semantic contribution is the same for active and passive sentences, the difference in binding options cannot be explained in semantics-based approaches. For more on passive see Section 13. For a general discussion of thematic approaches to binding see Pollard & Sag (1992: Section 8) and Pollard & Sag (1994: Section 6.8.2).

Draft of 13th March 2020, 08:17

bind a full referential NP if the NP is embedded in a clause and the pronoun is in the matrix clause:

(5)   a.   He$_{*i/*j/k}$ thinks that Mary$_i$ likes Peter$_j$.

       b.   He$_{*i/*j/k}$ thinks that Peter$_i$ likes Mary$_j$.

The sentences discussed so far can be assigned a structure like the one in Figure 1. Chomsky (1981; 1986) suggested that tree-configurational properties
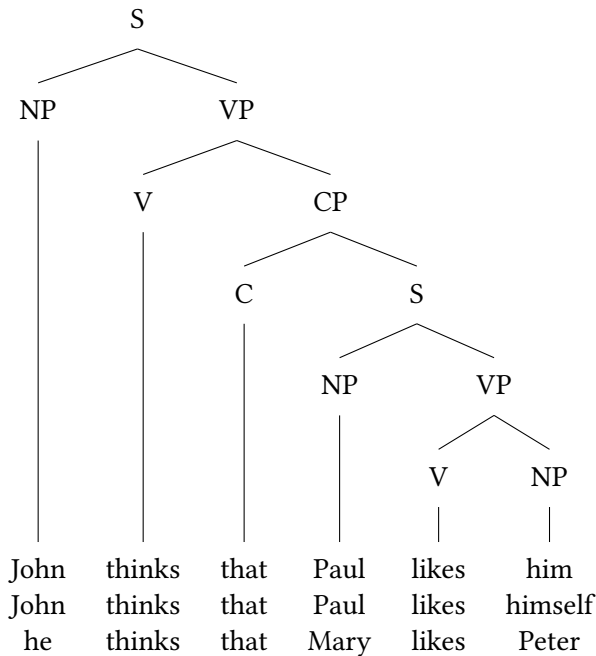

Figure 1: Tree configuration of examples for binding

play a role in accounting for binding facts. He uses the notion of c(onstituent)-command going back to work by Reinhart (1976). c-command is a relation that holds between nodes in a tree. Accoring to one definition, a node Y is said to c-command another node Z, iff Y and Z are sisters or if a sister of Y dominates Z.[5]

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[5]"Node A c(onstituent)-commands node B if neither A nor B dominates the other and the first branching node which dominates A dominates B." Reinhart (1976: 32)

    Chomsky (1986) uses another definition that allows one to go up to the next maximal projection dominating A. As of 2020-02-25 the English and German Wikipedia pages for c-command

To take an example, the NP node of *John* c-commands all other nodes dominated by S. The V of *thinks* c-commands everything within the CP including the CP node, the C of *that* c-commands all nodes in S including also S and so on. The CP c-commands the *think*-V, and the *likes him*-VP c-commands the *Paul*-NP. Per definition, a Y binds Z just in case Y and Z are coindexed and Y c-commands Z. One precondition for being coindexed (in English) is that the person, number, and gender features of the involved items are compatible.

Now, the goal is to find restrictions that ensure that reflexives are bound locally, personal pronouns are not bound locally and that referential expressions like proper names and full NPs are not bound by other expressions (anaphors, pronouns or fully referential expressions). The conditions that were developed for GB's Binding Theory are complex. They also account for the binding of traces that are the result of moving elements by transformations. While it is elegant to subsume the filler-gap relations under a general Binding Theory, proponents of HPSG think that coreferential semantic indices and filler-gap dependencies are crucially different.[6] The places of occurrence of gaps (if they are assumed at all)

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have two conflicting definitions of c-command. The English version follows Sportiche et al. (2013: 168), whose definition excludes c-command between sisters: "Node X c-commands node Y if a sister of X dominates Y."

[6]The treatment of relative and interrogative pronouns is special, but they have a special distribution that has to be accounted for. Relative clauses are the topic of Section 8. Bredenkamp (1996: Section 7.2.3) was an early suggestion to model binding relations of personal pronouns and anaphors by the same means as filler-gap dependencies (see Borsley & Crysmann (2020), Chapter 14 of this volume for an overview of the mechanisms for dealing with unbounded dependencies). Bredenkamp did not work out his proposal in detail (see p. 104–105). He used the SLASH feature for percolation of binding information, which probably would result in conflicts with true non-local dependencies. A possible way to fix this seems to be the introduction of special nonlocal features for binding as was suggested by Hellan (2005). Bredenkamp relies on the use of the SUBJ feature for binding subject-related pronouns, but the SUBJ feature is not used for finite verbs in German. Usually all arguments of finite verbs are selected via one list: COMPS (see Müller 2020a: Section 4, Chapter 10 of this volume for details). Furthermore the subject of non-finite verbs in control constructions is usually not realized and hence there is no subj-head schema that could take care of binding off the respective nonlocal dependency. Bredenkamp did not formulate disjointness constraints, but Hellan (2005) developed a way to do this. Like Bredenkamp's approach Hellan's approach has problems with binding by implicit subjects in control constructions since his schemata for combining the subject with a VP containing a reflexive are not applicable because of the lack of an overt subject (see also Abeillé 2020, Chapter 13 of this volume on the treatment of control in HPSG). The only way out of this dilemma seems to be to assume a unary branching projection discharging the pronoun information and binding it to the unexpressed subject. This entails that pronoun binding has a reflex in syntactic structure (an additional unary projection), in my opinion an unwanted consequence of this proposal.

Note that percolating binding information seems to be the only way to account for bind-

is restricted by other components of the theory. For an overview of the treatment of nonlocal dependencies in HPSG see Borsley & Crysmann (2020), Chapter 14 of this volume.

We will not go into the details of the Binding Theory in Mainstream Generative Grammar (MGG)[7], but we give a verbatim description of the ABC of Binding Theory (ignoring movement). Chomsky distinguishes between so-called R-expressions (referential expressions like proper nouns or full NPs/DPs), personal pronouns and reflexives and reciprocals. The latter two are subsumed under the term *anaphor*. Principle A says that an anaphor must be bound within the least maximal projection containing a subject. Principle B says that a pronoun that is governed by some element G has to be A-free in the least maximal projection M containing G and a subject. Principle C says that a referential expression Z heading its own chain has to be A-free in the domain of the head of the chain of Z.

Some researchers questioned whether syntactic principles like Chomsky's Principle C and the respective HPSG variant should be formulated at all and it was suggested to leave an account of the unavailability of bindings like the binding of *he* to full NPs in (5) to pragmatics (Bolinger 1979: 302; Bresnan 2001: 227–228; Bouma, Malouf & Sag 2001: 44). Walker (2011: Section 6) discussed the claims in detail and showed why Principle C is needed and how data that was considered problematic for syntactic binding theories can be explained in a configurational binding theory in HPSG. Hence the following discussion includes a discussion of Principle C in its various variants.

2 A non-configural Binding Theory

As was noted above, English pronouns and reflexives have to agree with their antecedents in gender. In addition there is agreement in person and number. This is modeled by assuming that referential units come with a referential index in their semantic representation. The following makeup for the semantic contribution of nominal objects is assumed:

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ing data for HPSG variants assuming that linguistic objects do not have internal structure, e.g., Sign-Based Construction Grammar. See Müller (2020c: Section 1.4.2), Chapter 34 of this volume for discussion.

[7]We follow Culicover & Jackendoff (2005: 3) in using the term *Mainstream Generative Grammar* when referring to work in Government & Binding (Chomsky 1981) or Minimalism (Chomsky 1995).

(6) Representation of semantic information contributed by nominal objects adapted from Pollard & Sag (1994: 248):

$$
\begin{bmatrix}
\textit{nom-obj} \\[2pt]
\text{INDEX} \quad
\begin{bmatrix}
\textit{index} \\
\text{PER} \quad \textit{per} \\
\text{NUM} \quad \textit{num} \\
\text{GEN} \quad \textit{gen}
\end{bmatrix} \\[2pt]
\text{RESTRICTIONS} \quad \textit{set of restrictions}
\end{bmatrix}
$$

Every nominal object comes with a referential index with person, number and gender information and a set of restrictions. In the case of pronouns, the set of restrictions is the empty set, but for nouns like *house*, the set of restrictions would contain something like $house'(x)$ where x is the referential index of the noun *house*. Nominal objects can be of various types. The types are ordered hierarchically in the inheritance hierarchy given in Figure 2. Nominal objects
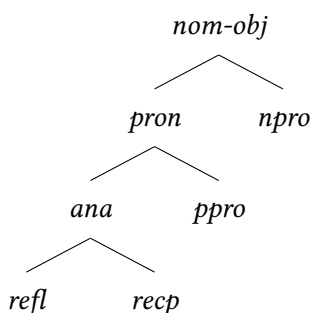

Figure 2: Type hierarchy of nominal objects

(*nom-obj*) can either be pronouns (*pron*) or non-pronouns (*npro*). Pronouns can be anaphors (*ana*) or personal pronouns (*ppro*) and anaphors are devided into reflexives (*refl*) and reciprocals (*recp*).

HPSG's Binding Theory differs from GB's Binding Theory in referring less to tree structures but rather to the notion of obliqueness of arguments of a head. The arguments of a head are represented in a list called the argument structure list. The list is the value of the feature ARG-ST. The ARG-ST elements are descriptions of arguments of a head containing syntactic and semantic properties of the selected arguments but not their daughters. So they are not complete signs but *synsem* objects. See Abeillé & Borsley (2020), Chapter 1 of this volume for more on the general setup of HPSG theories. The list elements are ordered with respect to

their obliqueness, the least oblique element being the first element:[8]

(7) SUBJECT > PRIMARY > SECONDARY > OTHER COMPLEMENTS
            OBJECT   OBJECT

This order was suggested by Keenan & Comrie (1977). It corresponds to the level of syntactic activity of grammatical functions. Elements higher in this hierarchy are less oblique and can participate more easily in syntactic constructions, like for instance, reductions in coordinated structures (Klein 1985: 15), topic drop (Fries 1988), non-matching free relative clauses (Bausewein 1990: Section 3; Pittner 1995: 195; Müller 1999a: 60–62), passive and relativization (Keenan & Comrie 1977), and depictive predicates (Müller 2008: Section 2). In addition, Pullum (1977) argued that this hierarchy plays a role in constituent order (but see Section 12.) And, of course, it was claimed to play an important role in Binding Theory (Grewendorf, 1983: 176; 1985: 160; 1988: 60; Pollard & Sag 1994: Chapter 6).

The ARG-ST list plays an important role for linking syntax to semantics. For example, the index of the subject and the object of the verb *like* are linked to the respective semantic roles in the representation of the verb:[9]

(8) *like*:

$$
\begin{bmatrix}
\text{ARG-ST} & \left\langle \text{NP}_{\boxed{1}}, \text{NP}_{\boxed{2}} \right\rangle \\
\text{CONT} &
\begin{bmatrix}
\text{IND} & \textit{event} \\
\text{RELS} & \left\langle
\begin{bmatrix}
\textit{like} \\
\text{ACTOR} & \boxed{1} \\
\text{UNDERGOER} & \boxed{2}
\end{bmatrix}
\right\rangle
\end{bmatrix}
\end{bmatrix}
$$

A lot more can be said about linking in HPSG and the interested reader is referred to Wechsler, Koenig & Davis (2020), Chapter 9 of this volume for this.

After these introductory remarks, we can now turn to the details of HPSG's Binding Theory: Figure 3 shows a version of Figure 1 including ARG-ST informa-

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[8]While Pollard & Sag (1987: 120) use Keenan & Comrie's (1977) version of the Obliqueness Hierarchy in (i), they avoid the terms *direct object* and *indirect object* in Pollard & Sag (1992: 266, 280) and Pollard & Sag (1994).

   (i) SUBJECT > DIRECT > INDIRECT > OBLIQUES > GENITIVES > OBJECTS OF
             OBJECT   OBJECT   COMPARISON

[9]NP$_{\boxed{1}}$ is an abbreviation for a feature description of a nominal phrase with the index $\boxed{1}$ (see Abeillé & Borsley (2020), Chapter 1 of this volume). The feature description in (8) is also an abbreviation. Path information leading to CONT is omitted since it is irrelevant for the present discussion.

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tion. The main points of HPSG's Binding Theory can be discussed with respect
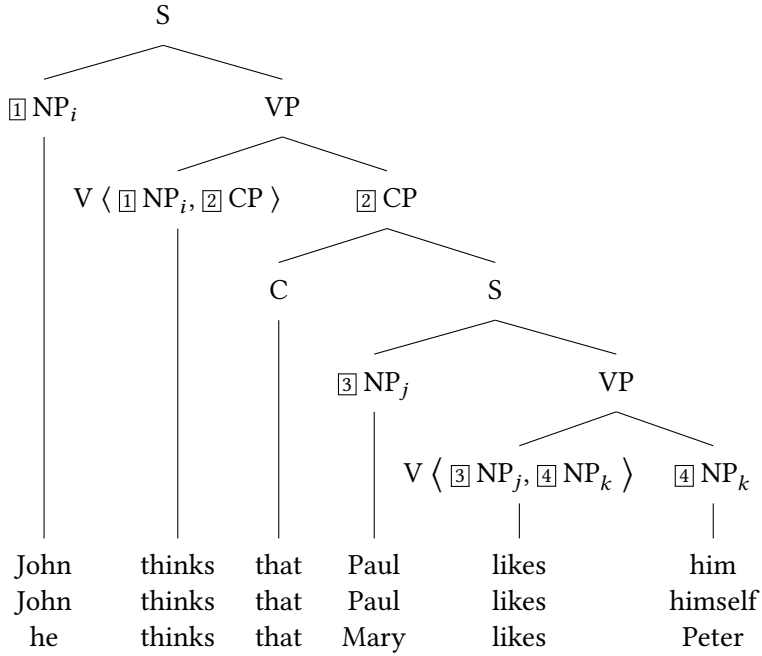

Figure 3: Tree configuration of examples for binding with ARG-ST lists

to this simple figure: anaphors have to be bound locally. The definition of the domain of locality is rather simple. One does not have to refer to tree configurations, since all arguments of a head are represented locally in a list. Simplifying a bit, reflexives and reciprocals must be bound to elements preceding them in the ARG-ST list and a pronoun like *him* must not be bound by a preceding element in the same ARG-ST list.

To be able to specify the conditions on binding of anaphors, pronouns and non-pronouns some further definitions are necessary. The following definitions are definitions of local *o-command*, *o-command* and *o-bind*. The terms are reminiscent of *c-command* and so on but we have an "o" rather than a "c" here, which is supposed to indicate the important role of the obliqueness hierarchy. The definitions are as follows:

(9) Let Y and Z be *synsem* objects with distinct LOCAL values, Y referential. Then Y *locally o-commands* Z just in case Y is less oblique than Z.

(10)   Let Y and Z be *synsem* objects with distinct LOCAL values, Y referential. Then Y *o-commands* Z just in case Y locally o-commands X dominating Z.

(11)   Y (*locally*) *o-binds* Z just in case Y and Z are coindexed and Y (locally) o-commands Z. If Z is not (locally) o-bound, then it is said to be (*locally*) *o-free*.

(24) says that an ARG-ST element locally o-commands any other ARG-ST element further to the right of it. The condition of non-identity of the two elements under consideration in (24) and (10) is necessary to deal with cases of raising, in which one element may appear in various different ARG-ST lists. See Section 10 below and Abeillé (2020), Chapter 13 of this volume for discussion of raising in HPSG. The condition that Y has to be referential excludes expletive pronouns like *it* in *it rains* from entering o-command relations. Such expletives are part of ARG-ST and valence lists, but they are entirely irrelevant for Binding Theory, which is the reason for their exclusion in the definition.

The definition of o-command uses the relations of locally o-command and dominate. With respect to Figure 3, we can say that NP_i o-commands all nodes below the CP node since NP_i locally o-commands the CP and the CP node dominates everything below it. So NP_i o-commands C, NP_j, VP, V, and NP_k.

The definition of *o-bind* in (11) says that two elements have to be coindexed and there has to be a (local) o-command relation between them. The indices include person, number and gender information (in English), so that *Mary* can bind *herself* but not *themselves* or *himself*. With these definitions, the binding principles can now be stated as follows:

Principle 2 (HPSG Binding Theory)
Principle A *A locally o-commanded anaphor must be locally o-bound.*

Principle B *A personal pronoun must be locally o-free.*

Principle C *A nonpronoun must be o-free.*

Principle A accounts for the ungrammaticality of sentences like (12):

(12)   * Mary likes himself.

Since both *Mary* and *himself* are members of the ARG-ST list of *likes*, there is an NP that locally o-commands *himself*. Therefore there should be a local o-binder. But since the indices are incompatible because of incompatible gender values, *Mary* cannot o-bind *himself*, *himslef* is locally o-free and hence in conflict to Principle A.

Similarly, the binding in (13) is excluded, since *Mary* locally o-binds the pronoun *her* and hence Principle B is violated.

(13)   Mary$_i$ likes her$_{*i}$.

Finally, Principle C accounts for the ungrammaticality of (14):

(14)   He$_i$ thinks that Mary likes Peter$_{*i}$.

Since *he* and *Peter* are coindexed and since *he* o-commands *Peter*, *he* also o-binds *Peter*. According to Principle C, this is forbidden and hence bindings like the one in (14) are ruled out.

For ditransitives, there are three elements on the ARG-ST list: the subject, the primary object and the secondary object. If the secondary object is a reflexive, Principle A requires this reflexive to be coindexed with either the primary object or the subject. Hence, the bindings in (15) are predicted to be possible and the ones in (16) are out:

(15)   a.   John showed Mary$_i$ herself$_i$.
        b.   John$_i$ showed Mary himself$_i$.

(16)   a.   * John showed herself Mary.
        b.   * I showed you herself.

This list-based Binding Theory seems very simple. So far we explained binding relations between coarguments of a head where the coarguments are NPs or pronouns. But there are also prepositional objects, which have an internal structure with the referential NPs embedded within a PP.

Pollard & Sag (1994: 246, 255) discuss examples like (17):

(17)   a.   John$_i$ depends [on him$_{*i}$].
        b.   Mary talked [to John$_i$] [about himself$_i$].

As noted by Pollard & Sag (1994: 246), the second example is a problem for the GB Binding Theory since *John* is inside the PP and does not c-command *himself*. Examples involving case-marking prepositions are no problem for HPSG however, since it is assumed that the semantic content of propositions is identified with the semantic content of the NP they are selecting. Hence, the PP *to John* has the same referential index as the NP *John* and the PP *about himself* has the same index as *himself*. The ARG-ST list of *talked* is shown in (18):

(18)   ⟨ NP, PP, PP ⟩

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                          S
              ┌───────────┴───────────┐
          ☐1 NP                       VP
              │              ┌─────────┼──────────────┐
              │         V ⟨ ☐1, ☐2, ☐3 ⟩   ☐2 PP_i          ☐3 PP_i
              │              │        ┌───┴───┐        ┌───┴───┐
              │              │        P     NP_i       P      NP_i
              │              │        │      │         │       │
            Mary          talked     to    John      about   himself
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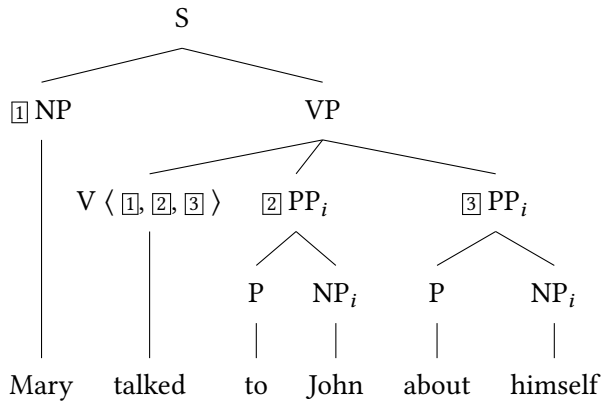
Figure 4: Binding within prepositional objects poses a challenge for
GB's Binding Theory

The Binding Theory applies as it would apply to ditransitive verbs. Since the
first PP is less oblique than the second one, it can bind an anaphor in the second
one. The same is true for the example in (17a): since the subject is less oblique
than the PP object it locally o-commands it and even though the pronoun *him* is
embedded in a PP and not a direct argument of the verb the pronoun cannot be
bound by *him*. An anaphor would be possible within the PP object though. Of
course the subject NP can bind NPs within both PPs: both *to herself* and *about
herself* would be possible as well.

3 Reconstruction

Pollard & Sag (1994: 265) point out an interesting consequence of the treatment
of nonlocal dependencies in HPSG: since nonlocal dependencies are introduced
by traces that are lexical elements rather then by deriving one structure from
another one as is common in Transformational Grammar, there is no way to re-
construct some phrase with all its internal structure into the position of the trace.
Since traces do not have daughters, $\_j$ in (19a) has the same local properties (part
of speech, case, referential index) as *which of Claire's$_i$ friends* without having its
internal structure.[10]

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[10]Some of the more recent theories of nonlocal dependencies even do without traces. See Borsley
& Crysmann (2020), Chapter 14 of this volume for details.

(19)   a. I wonder [which of Claire's$_i$ friends]$_j$ [we should let her$_i$ invite _$_j$ to
            the party]?
        b. [Which picture of herself$_i$]$_j$ does Mary$_i$ think John likes _$_j$?

Since extracted elements are not reconstructed into the position where they
would be usually located, (19a) is not related to (20):

(20)   We should let her$_i$ invite which of Claire's$_i$ friends to the party.

Claire would be o-bound by *her* in (20) and this would be a violation of Princi-
ple C, but since traces do not have daughters, no problem arises.

   This is an interesting feature of the Binding Theory introduced so far, but as
Müller (1999b: Section 20.2) pointed out, it makes wrong predictions as far as
German and English are concerned. (21) is the English example:

(21)   [Karl$_i$'s friend]$_j$, he$_{*i}$ knows _$_j$.

According to the definition of o-command, *he* locally o-commands the object of
knows. This object is realized as a trace. Therefore the local properties of *Karl's
friend* are in relation to *he* but since traces do not have daughters, there is no
o-command relation between *he* and *Karl*, hence *Karl* is o-free and Principle C is
not violated. Hence there is no explanation for the impossibility to bind *Karl* to *he*.
In order to fix this, some notion of reconstruction would have to be introduced
in HPSG's BT but then the account of (19) would be lost.

4 A totally non-configurational binding theory

The initial definition of o-command contains the notion of domination and hence
makes reference to tree structures. Pollard & Sag (1994: 279) pointed out that the
binding of *John* by *he* in (22a) is correctly ruled out since *he* o-commands the
trace of *John* and hence Principle C is violated. But since they follow GPSG in
assuming that English has no subject traces (Pollard & Sag 1994: Chapter 4.4),
this account would not work for (22b).

(22)   a. John$_{*i}$, he$_i$ said you like _$_i$.
        b. John$_{*i}$, he$_i$ claimed left.

Later work in HPSG abolished traces alltogether (Bouma, Malouf & Sag 2001;
Borsley & Crysmann 2020, Chapter 14 of this volume but see Müller 2014; 2016:
Chapter 19 on empty elements in general) and hence BT cannot rely on domi-
nance any longer. This section deals with the revised version of Binding Theory

not making reference to dominance. I will first discuss the revision of local o-command involving one additional aspect having to do with Control Theory and then the revision of o-command without the notion of dominance.

4.1 Local o-command including subjects of embedded verbs

Pollard & Sag (1994: Section 6.8.3) revise the definition of local o-command in a way that includes the subject of embedded verb phrases in order to combine control and binding theory.[11]

(23) Let Y and Z be *synsem* objects with distinct LOCAL values, Y referential.
      Then Y locally o-commands Z just in case either:
      i.   Y is less oblique than Z; or
      ii. Y locally o-commands some X that subcategorizes for Z.

The second clause was intended to apply to verbs selecting VPs or predicative phrases. At the time HPSG's BT was developed, all valents of a head were represented in a list called SUBCAT list. Pollard & Sag (1994: Chapter 9) changed this and introduced the SPR feature for specifiers in NPs, the SUBJ feature for the representation of subjects and the COMPS feature for complements. The intention behind the second clause of the definition is to include the subject of an embedded verb into the local domain of control verbs. So the natural reformulation of (23) is (24):

(24) Let Y and Z be *synsem* objects with distinct LOCAL values, Y referential.
      Then Y locally o-commands Z just in case either:
      i.   Y is less oblique than Z; or
      ii. Y locally o-commands some X having Z as its SUBJ value.

Pollard & Sag (1994: 303) assume the following valence for a subject control verb like *promise*:

(25) ⟨ NP$_i$(, NP), VP[SUBJ ⟨ NP:*refl*$_i$ ⟩] ⟩

According to the definition of local o-command, the subject NP of the embedded verb is local to the subject NP and the object NP of the matrix verb and because of Principle A it has to be bound to the subject. Enforcing this binding is strictly speaking unnecessary since Pollard & Sag (1994: Chapter 7) developed a Control Theory taking care of this. But this type of organization has a nice side effect: it

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[11]See also **Branco2007a** for arguments that subjects of controlled verbs should be treated as reflexives to be bound in the domain of the control verb.

explains Visser's Generalization according to which subject control verbs do not passivize. Since passive suppresses the first argument (bearing structural case) and turning it into an optional *by* phrase one would get the following representation:

(26)   ⟨ NP$_i$, VP[SUBJ ⟨ NP:*refl$_i$* ⟩], PP[*by*]$_i$ ⟩

The coindexing between the downstairs subject and the *by*-PP is due to Control Theory and the coindexing between the NP$_i$ and the downstairs subject is enforced by Principle A of the BT. The result is that three items are coindexed in (26), which leads to all sorts of binding conflicts and hence examples like (27) are ruled out (Pollard & Sag 1994: 305):

(27)   a.   * Kim$_i$ was promised to leave by Sandy$_i$/Kim$_i$.

　　　 b.   * John$_i$ was promised to leave by him$_i$.

　　　 c.   ?* John$_i$ was promised to leave by himslef$_i$.

   Interestingly the situation seems to be parallel in German. Sentences like the following are rather strange:

(28)   Klaus   wurde versprochen, früher abzufahren.
       Klaus.DAT was   promised   earlier to.leave
       Intended: 'Somebody promised Klaus to leave early.'

The sentence is bad if the meaning is that somebody promises that he or she will leave early. It improves if Klaus will leave early together with the one who made the promise. And, as Müller (2002: 129) showed passivization of subject control verbs is possible in German:

(29)   a.   Wie oft   schon wurde von der Stadtverwaltung versprochen,
            like often yet   was   by the council   promised
            Abhilfe zu schaffen.[12]
            remedy to manage
            'As often, the council promised to resolve the matter.'

       b.   Erneut wird versprochen, das auf eine Dekade angesetzte
            Investitionsprogramm mit einem Volumen von 630 Billionen Yen
            (10,5 Billionen DM) vorfristig zu erfüllen, […][13]
            'Again, one promised to complete the investment program planned
            for one decade with the total amount of 630 trillion Yen before the
            agreed date.'

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[12]Mannheimer Morgen, 13.07.1999, Leserbriefe; Keine Abhilfe.

[13]Süddeutsche Zeitung, 28.06.1995, p. 28.

All of these examples are fine with *uns* 'us' as the object of *versprechen* 'to promise▮' as well. So, if one assumes that a central phenomenon like control is handled parallely in English and German, the controlled subject should not be treated as a reflexive local to the arguments of control verbs.

A further problem for including the downstairs subject into the local o-command relation is posed by raising-to-subject verbs with an object. *believe* is an example:

(30) a. Donald$_i$ believes himself$_i$ to be a liar.

 b. $\langle\, \boxed{1}\,NP_i,\, NP_i,\, VP[\text{ SUBJ } \langle\, \boxed{1}\, \rangle\, \rangle$

The ARG-ST list of *believe* contains the subject NP (*Donald*), the NP of the reflexive (*himself*) and the VP (*to be a liar*). Since the subject of the VP is regarded as local to *Donald* and *himself*, we have a situation in which *Donald* locally o-commands *himself* and *himself* o-commands *Donald* (in the SUBJ list of the embedded VP). Hence the second *Donald* is bound by *himself*, which is a violation of Principle C. Note that Pollard & Sag (1994: 253) took measures to deal with raising by excluding two elements with identical LOCAL values in the definition of o-command. So the two Donald's would not cause problems, but the example in (30a) involves one intermediate NP, namely *himself*. The definition of local o-command could be fixed by requiring that Z is not raised. This requirement is more general than the requirement to have a LOCAL value different from the one of Y since it includes the case in which Z is raised and different from Y.[14] But since the inclusion of the downstairs subject would make wrong predictions for German anyway and its merits for English short passives are unclear (Pollard & Sag 1994: 306), I suggest leaving the definition of local o-command the way it originally was, that is, without the reference to subjects of embedded verbs.

4.2 o-command

The revised non-configurational variant of o-command suggested by Pollard & Sag (1994: 279) has the form in (31):[15]

---

[14]Note that the general statement that something is not raised is much more involved than requiring that the LOCAL values of two elements are distinct, since the requirement that something is not raised requires a check of all other elements on the higher ARG-ST list for non-identity. Some approaches to valence mark the status of arguments with respect to raising explicitly by assuming a boolean feature RAISED (**Prez99**; **Meuerers99**). This would simplify things considerably.

[15]I replaced subcategorized by reference to the ARG-ST list.

(31) Let Y and Z be *synsem* objects with distinct LOCAL values, Y referential.
      Then Y o-commands Z just in case either:

    i.   Y is less oblique than Z; or

   ii. Y o-commands some X that has Z on its ARG-ST list; or

  iii. Y o-commands some X that is a projection of Z (i.e. the HEAD values
       of X and Z are token-identical).

This definition of course has the problem pointed out in the previous subsection.

> Check whether there are examples in which one needs both an upstairs and a down-
> stairs ARG-ST.
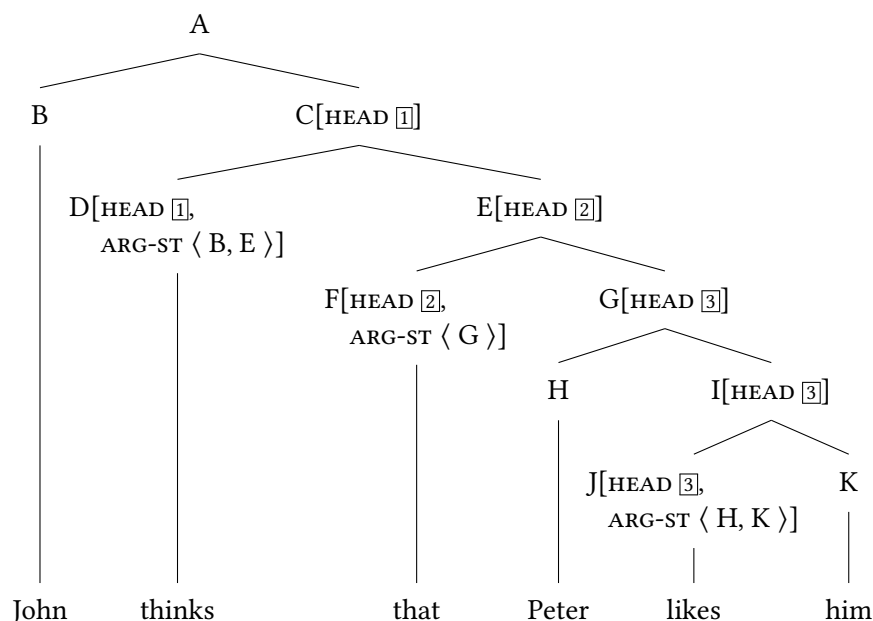
Figure 5: Tree for explanation of the o-command relation

According to the definition, B o-commands E by clause i. B o-commands F,
since it o-commands E and E is a projection of F (clause iii). B also o-commands
G, since B o-commands F and F has G on its ARG-ST list (clause ii). Since B o-
commands G, it also o-commands J, since G is a projection of J (clause iii). And
because of all this B also o-commands H and K, since B o-commands J and both
H and K are members of the ARG-ST list of J (clause ii).

This recursive definition of o-command is really impressive and it can account

for binding phenomena in approaches that do not have empty nodes for traces in the tree structures, but there are still open issues.[16]

As was pointed out by Hukari & Levine (1996: 490), Müller (1999b: Section 20.4.1) and Walker (2011), adjuncts pose a challenge for the non-configurational Binding Theory. For example, a referential NP can be part of an adjunct and since adjuncts are usually not part of ARG-ST lists they would not be covered by the definition of o-command given above. *John* is part of the reduced relative clause modifying *woman* in (32).

(32)   He$_{*i}$ knows the woman loved by John$_i$.

Since the relative clause does not appear on any ARG-ST list, *he* does not o-command *John* and hence there is no Principle C violation and the binding should be fine.

Several authors suggested including adjuncts into ARG-ST lists of verbs (Chung 1998: 168; Przepiórkowski 1999: 240; Manning, Sag & Iida 1999: 60), but this would result in conflicts with BT if applied to the nominal domain (Müller 1999b: Section 20.4.1.). The reason is that nominal modifiers have a semantic contribution that contains an index that is identical to the index of the modified noun.[17] If there are several such modifiers, we get a conflict since we have several coindexed non-pronominal indices on the same ARG-ST list, which would violate Principle C.

---

[16]Note that the label *totally non-configurational Binding Theory* seems to suggest that dominance relations do not play a role at all and hence this version of BT could be appropriate for HPSG flavors like Sign-Based Construction Grammar that do not have daughters in linguistic signs (see Sag (2012) and Müller (2020c: Section 1.4.2), Chapter 34 of this volume for discussion). But this is not the case. The definition of o-command in (31) contains the notion of projection. While this notion can be formalized with respect to a complex linguistic sign having daughters in Constructional HPSG as assumed in this volume, this is impossible in SBCG and one would have to refer to the derivation tree, which is something external to the linguistic signs licensed by a SBCG theory. See also footnote 6.

[17]See Arnold & Godard (2020: Section 2.2), Chapter 15 of this volume and Müller (1999a) on relative clauses. Sag (1997) suggests an approach to relative clauses in which a special schema is assumed that combines the modified noun with a verbal projection. This approach does not have the problem mentioned here. However, prenominal adjuncts would remain problematic as Müller's (1999b) example in (i) shows:

(i)   Er$_{*i}$ kennt die Karl$_i$ betrügende Frau.
       he   knows the Karl betraying   woman
       'He knows the woman betraying Karl.'

The adjectival participle behaves like a normal adjectival modifier. For Principle C to make the right predictions, there should be a command relation between *er* and the parts of the prenominal modifier. PP adjuncts within nominal structures are a further instance of problematic examples.

There are two possible solutions that come to mind. The first one is pretty ad hoc: one can assume two different features for different purposes. There could be the normal index for establishing coindexation between heads and adjuncts and heads and arguments and there could be a further index for binding. Adjectives would then have a referential index for establishing coindexation with nouns and an additional index that is a state, which would be irrelevant for the binding principles.

The second solution to the adjunct problem might be seen in defining o-command with respect to the DEPS list. The DEPS list is a list of dependents that is the concatenation of the ARG-ST list and a list of adjuncts that are introduced on this list (Bouma, Malouf & Sag 2001). Binding would be specified with respect to ARG-ST and dominance with respect to DEPS (which includes everything on ARG-ST). The lexical introduction of adjuncts has been criticized because of scope issues by Levine & Hukari (2006) and there are also problems related to binding: Hukari & Levine (1996: 490) pointed out that there are differences when it comes to the interpretation of pronouns in examples like (33a,b) and (33c,d):

(33)   a. They$_i$ went into the city without anyone noticing the twins$_{*i/j}$.

　　　b. They$_i$ went into the city without the twins$_{*i/j}$ being noticed.

　　　c. You can't say anything to them$_i$ without the twins$_{i/j}$ being offended.

　　　d. You can't say anything about them, without Terry criticizing the twins$_{i/j}$ mercilessly.

While the subject pronoun cannot be coreferential with *the twins* inside the adjunct, the object pronoun in (33c,d) can. If we just register adjuncts on the DEPS list, we are unable to refer to their position in the tree and hence we cannot express any statement needed to cover the differences in (33). Note that this is crucially different for elements on the ARG-ST list in English, since the ARG-ST of a lexical item basically determines the trees it can appear in in English: the first element appears to the left of the verb as the subject and all other elements to the right of the verb as complements. However, this is just an artifact of the rather strict syntactic system of English, this is not the case for languages with freer constituent order like German, which causes problems to be discussed below (see Section 7.1).

There is another issue related to the totally non-configurational version of the BT: in 1994, HPSG was strictly head-driven. There were rather few schemata and most of them were headed. Since then more and more constructional schemata were suggested that do not necessarily have a head. For example, relative clauses were analyzed involving an empty relativizer (Pollard & Sag 1994: Chapter 5;

Arnold & Godard 2020: Section 2.2, Chapter 15 of this volume). One way to eliminate this empty element from grammars is to assume a headless schema that combines the relative phrase and the clause from which it is extracted directly (Müller 1999a: Section 2.7). In addition there were proposals to analyze free relative clauses in a way in which the relative phrase is the head (Wright & Kathol 2003: 383). So, if *whoever* is the head of *whoever is loved by John*, the whole relative clause is not a projection of *loved* and hence the arguments of *loved* will not be found by the definition of o-command in (31). This means that *John* is not o-commanded by *he*, which predicts that the binding in (34) is possible, but it is not.

(34)   He$_{*i}$ knows whoever is loved by John$_i$.

Further examples of phenomena that are treated using unheaded constructions are serial verbs in Mandarin Chinese: Müller & Lipenkova (2009) argue that VPs are combined to form a new complex VP with a meaning determined by the combination. None of the combined VPs contributes a head. No VP selects for another VP.

I think there is no way of accounting for such cases without the notion of dominance. For those insisting on grammars without empty elements, the solution would be a fusion of the definition given in (31) with the initial definition involving dominance in (10). Hukari & Levine (1995) suggested such a fusion. This is their definition of vc-command:

(35)   v(alence-based) c-command:
       Let α be an element on a valence list that is the value of the valence
       feature γ and α' the DTRS element whose SYNSEM value is
       structure-shared with α. Then if the constituent that would be formed by
       α' and one or more elements β has a null list as its value for γ, α
       vc-commands β and all its descendants.

Rewritten in more understandable prose this definition means that if we have some constituent α' then its counterpart in the valence list vc-commands all siblings of α' and their decedents provided the valence list on which α' is selected is empty at the next higher node. We have two valence lists that are relevant in the verbal domain: SUBJ (some authors use SPR instead) and COMPS. The COMPS list is empty at the VP node and the SUBJ list ist empty at the S node. So, the definition in (35) makes statements about two nodes in Figure 6: the lower VP node and the S node. For Figure 6, this entails that the object NP *the car* vc-commands *bought* since *the car* is an immediate daughter of the first projection with empty COMPS list. The NP *they* vc-commands the VP *bought the car without anybody*
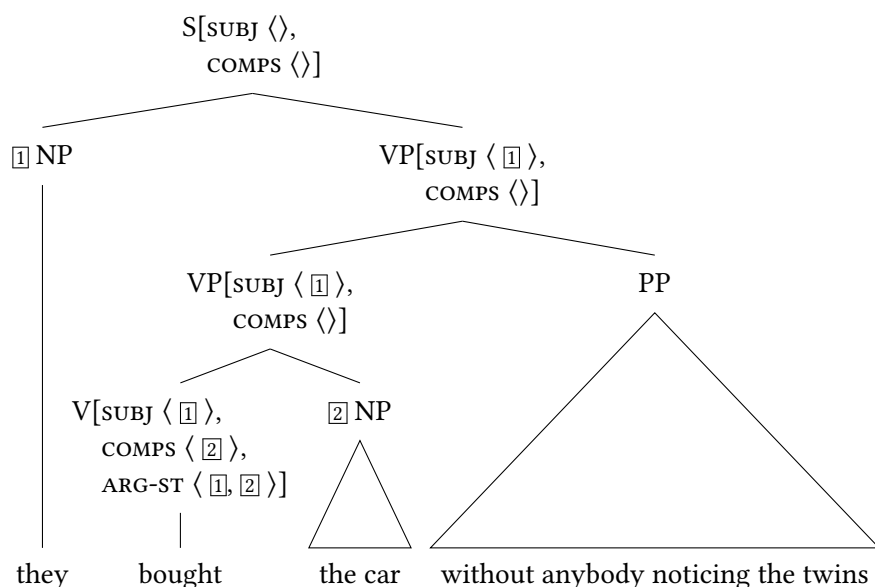
Figure 6: Example train for explaining vc-command: The subject vc-commands the adjunct because it is in the valence list of the upper-most VP and this VP dominates the adjunct PP

noticing the twins, since both are immediately dominated by the node with the empty SUBJ list.

The proposal by Hukari & Levine was criticized by Walker (2011: 235), who argued that the modal component in the definition is not formalizable and suggested the following revision:

(36)   Let α, β, γ be *synsem* objects, and β' and γ' signs such that β': [SYNSEM β] and γ': [SYNSEM γ]. Then α vc-commands β iff
   i.   γ': [SS|LOC|CAT|SUBJ ⟨ α ⟩] and γ' dominates β', or
   ii. α locally o-commands γ and γ' dominates β'.

Principle C is then revised as follows:

(37)   Principle C: A non-pronominal must neither be bound under o-command nor under a vc-command relation.

Walker uses the tree in Figure 7 to explain her definition of vc-command. The second clause in the definition of vc-command is the same as before: it is based on local o-command and domination. What is new is the first clause. Because

The annotations should be extra not part of the node. Especially for the PP.

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⬚ NP   VP[SUBJ ⟨ ⬚ ⟩] = γ'

VP[SUBJ ⟨ ⬚ = α ⟩]   PP = β'

V[SUBJ ⟨ ⬚ ⟩,
COMPS ⟨ ⬚ ⟩,
ARG-ST ⟨ ⬚, ⬚ ⟩]   ⬚ NP

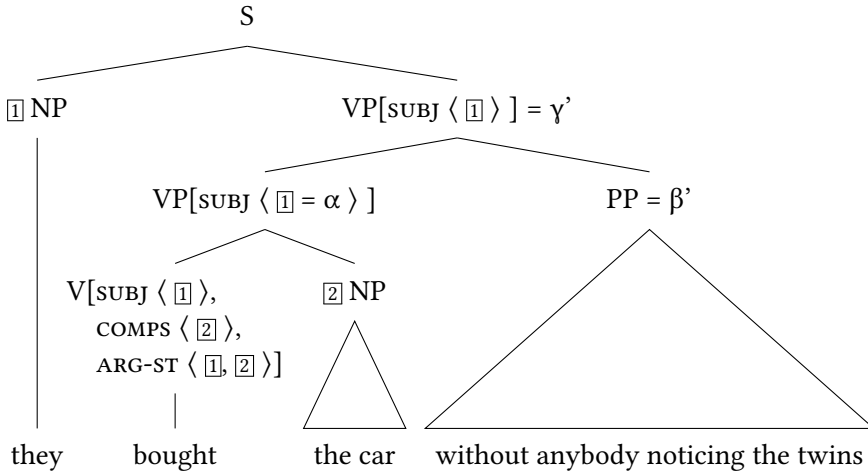they   bought   the car   without anybody noticing the twins

Figure 7: Example train for explaining vc-command: The subject vc-commands the adjunct because it is in the valence list of the upper-most VP and this VP dominates the adjunct PP

of this clause the subject vc-commands the adjunct since the subject ⬚ is in the SUBJ list of the top-most VP (α) and this top-most VP (γ') dominates the adjunct PP (β').

There is an interesting puzzle here as far as the formal foundations of HPSG are concerned (Richter 2020, Chapter 3 of this volume): usually binding theories are defined with respect to some tree structures. So the structures are assumed to exist and then there are constraints put onto them to rule out certain bindings. The definition of Hukari & Levine contains a modal component talking about structures that would be licensed. Walker criticizes this and formulates a definition that does without this part. However, by doing so the problem does not go away. If HPSG grammars are seen as a set of constraints describing models of linguistic objects, there would not be a linguistic object for * *Mary likes himself.* and hence one could not say that *Mary* o-commands *himself*. Hence, there is a problem, whether one names it in the definition or not. It seems to be necessary to conceptualize binding conditions as something external to the core theory of HPSG: a filter that is applied on top of everything else as is common in more implementation-oriented approaches to HPSG in in the generate and test model of GB.

There is a further difference between Hukari & Levine's and Walker's definition: the former applies to Specifier-Head structures, in which the singleton

element of the SPR list is saturated. We will return to this in Section 6. Note also that the definition of Hukari & Levine includes the sibling VP among the items commanded by the subject, while Walker's definition includes elements dominated by this VP only.[18] This difference will also matter in Section 6.

Hukari & Levine's examples involve a subject-object asymmetry. Interestingly, a similar subject-object asymmetry seems to exist in German, as Grewendorf (1985: 148) pointed out:

(38) a. In Marias$_i$ Wohnung erwartete sie$_i$ ein   Lustmolch.
        in Maria's flat   waits   her.ACC a.NOM lecher
        'A lecher waits for Maria in her flat.'

     b. * In Marias$_i$ Wohnung erwartete sie$_i$ einen Lustmolch.
          in Maria's flat   waits   she.NOM a.ACC lecher
          Intended: 'Maria waits for a lecher in her flat.'

While the fronted adjunct can bind the object in (38a), binding the subject in (38b) is ruled out. Walker's proposals for English would not help in such examples, since all arguments of finite verbs are represented in one valence list in grammars of German. Hence the highest domain in which vc-command is defined (taking Hukari & Levine's definition) is the full clause since COMPS would be empty at this level. There is the additional problem that the adjunct is fronted in a non-local dependency (German is a V2 language) and that the arguments are scrambled in (38a). There is no VP node in the analysis of (38a) that is commonly assumed in HPSG grammars of German and it is unclear how a reconstruction of the fronted adjunct into a certain position could help explaining the differences in (38).

4.3 Conclusion

Concluding this section, it seems that a totally non-configurational Binding Theory seems to be impossible because of adjuncts and the combination of configurational and non-configurational parts seems appropriate. The subject of the embedded verb should not be included among the local domain of VP embedding verbs.

> check raising issues.
> provide final definitions.

---

[18]The situation is similar to the different versions of c-command in MGG. See footnote 5.

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5 Exempt anaphors

The statement of Principle A has interesting consequences: if an anaphor is not locally o-commanded, Principle A does not say anything about requirements for binding. This means that anaphors that are initial in an ARG-ST list may be bound outside of their local environment. The following example by Pollard & Sag (1994: 270) shows that a reflexive can even be bound to an antecedence outside of the sentence:

(39) John$_i$ was going to get even with Mary. That picture of himself$_i$ in the paper would really annoy her, as would the other stunts he had planned.[19]

A further example are NPs within adjunct PPs. Since there is nothing in the PP *around himself* that is less oblique than the reflexive, the principles governing the distribution of reflexives do not apply and hence both a pronoun and an anaphor is possible:

(40) a. John$_i$ wrapped a blanket around him$_i$.

  b. John$_i$ wrapped a blanket around himself$_i$.

Which of the pronouns is used is said to depend on the *point of view* of the speaker (**Kuroda65a** for further discussin and a list of references see Pollard & Sag 1994: 270).

The exemptness of anaphors seems to cause a problem since the Binding Theory does not rule out sentencens like (41):

(41) * Himself sleeps.

This is not a real problem for languages like English, since such sentences are ruled out because *sleeps* requires an NP in the nominative and *himself* is accusative (Brame 1977: 388; Pollard & Sag 1994: 262). However, as Müller (1999b: Section 20.4.6) pointed out, German does have subjectless verbs like *dürsten* 'be thirsty' and *grauen* 'to dread' and here the problem is real:

(42) a. Den   Mann friert.
        the.ACC man   cold.is
        'The man is cold.'

  b. * Einander   friert.[20]
        eachother.ACC cold.is

---

[19](Pollard & Sag 1994: 270)
[20](Fanselow 1986: 349)

    c.   Den   Mann dürstet.
         the.ACC man   thirsts
         'The man is thirsty.'

    d. * Sich   dürstet.
         SELF.ACC thirst

Note that subjectless verbs usually can be used with an expletive subject:

(43) a. weil   es   den   Mann friert
         because EXPL the.ACC man   cold.is

     b. weil   es   den   Mann dürstet
         because EXPL the.ACC man   thirsts
         'because the man is thirsty'

This does not help to explain these examples away since expletives are non-referential and hence they do not o-command any other item.

    This line of thought leads to English examples that are problematic: the analysis of extraposition with expletive *it* results in a similar ARG-ST list:

(44) a. It bothers me that Sandy snores.
     b. * It bothers myself that Sandy snores.

According to Pollard & Sag (1994: 149) the *it* in (44) is non-referential. Hence there is nothing that o-commands the accusative object and hence anaphors would be exempt in the object position and sentences like (44b) are predicted to be grammatical.

6 Nominal heads as binders

The definition of o-command has an interesting consequence: it does not say anything about possible binding relations between heads and their dependents. What is regulated is the binding relations between co-arguments and referential objects dominated by a more oblique coargument. As Müller (1999b: 419) pointed out, bindings like the one in (45) are not ruled out by the Binding Theory of Pollard & Sag (1994: Chapter 6):

(45) his$_{*i}$ father$_i$

The possessive pronoun is selected via SPR and hence a dependent of *father* (Müller 2020b; Machicao y Priemer & Müller 2020), but the noun does not appear

in any ARG-ST list (assuming an NP analysis). The consequence is that Principle B and C do not apply and the o-command-based Binding Theory just does not have anything to say about (45). This problem can be fixed by assuming Hukari & Levine's (1995) version of Principle C together with their definition of vc-command in (35). This would also cover cases like (46):

(46) his$_{*i}$ father of John$_i$

What is not accounted for so far is Fanselow's (1986: 344) examples in (48):

(47) a. * die Freunde$_i$ voneinander$_i$
          the friends   of.each.other
      b. der Besitzer$_i$ seines$_{*i}$ Botes
          the owner of.his boat

These examples would be covered by an *i*-within-*i*-Condition as suggested by Chomsky (1981: 212). Chomsky's condition basically rules out configurations like the one in (48):

(48) (… x$_i$ …)$_i$

Pollard & Sag (1994: 244) discuss the *i*-within-*i*-Condition in their discussion of GB's Binding Theory but do not assume anything like this in their papers. Nor was anything of this kind adopted anywhere else in th discussion of binding. Having such a constraint could be a good solution, but as Fanselow (1986) working in GB pointed out, such a condition would also rule out cases like his examples in (49):

(49) a. die sich$_i$ treue   Frau$_i$
          the SELF faithful woman
          'the woman who is faithful to herself'
      b. die einander$_i$ verachtenden Männer$_i$
          the each.other despising   men
          'the men who despise each other'

German allows for complex prenominal adjectival phrases. The subject of the respective adjectives or adjectival participles are coindexed with the noun that is modified. Since the reflexive and reciprocal in (49) are coindexed with the non-expressed subject and since this subject is coindexed with the modified noun (Müller 2002: Section 3.2.7), a general *i*-within-*i*-Condition cannot be formulated for HPSG grammars of German. The problem also applies to English, although English does not have complex prenominal adjectival modifiers. Relative clauses basically produce a similar configuration:

(50)   the woman$_i$ seeing herself$_i$ in the mirror

The non-expressed subject in (50) is the antecedent for *herself* and since this element is coindexed with the antecedent noun of the relative clause, we have a parallel situation.

Chomsky (1981: 229, Fn. 63) notes that his formulation of the *i*-within-*i*-Condition rules out relative clauses and suggests a revision. However, the revised version would not rule out the examples above either, so it does not seem to be of much help.

So some special constraint seems to be needed that rules out binding by and to the head of nominal constructions unless this binding is established by adnominal modifiers directly.

7 A general Binding Theory with reference to obliqueness or language-specific binding conditions

7.1 Obliqueness and constituent order

As was explained above the order of the elements in the ARG-ST list is seen as crucial for the determination of possible bindings and reflexivization. Anaphors may refer to elements further to the left on the ARG-ST list. If one assumes a nom, acc, dat order on the ARG-ST list, Grewendorf's (1988: 58) binding examples in (51) are correctly predicted.

(51)   a.   Der Arzt   zeigte   den   Patienten$_j$ sich$_j$ / ihm$_{*j}$ im
            the doctor showed the.ACC patient   SELF.DAT   him.DAT in.the
            Spiegel.
            mirror

            'The doctor showed the patient himself in the mirror.'

       b.   Der Arzt   zeigte   dem   Patienten$_j$ ihn$_j$ / sich$_{*j}$ im
            the doctor showed the.DAT patient   him.ACC   SELF.ACC in.the
            Spiegel.
            mirror

But, as Eisenberg (1986: 184) points out, bindings like those in (52) exist as well:

(52)   a.   Ich empfehle   ihm$_j$ sich$_j$.
            I   recommend him.DAT SELF.ACC

       b.   Du ersparst ihm$_j$ sich$_j$.
            you spare   him.DAT SELF.ACC

   c. Du verleidest ihm$_j$ sich$_j$.
      you put.off   him.DAT SELF.ACC
      'You put him off himself.'

The examples in (52) show that datives may bind accusatives. As (53) shows, *empfehlen* 'recommend' allows for passivization, so the accusative object is a direct object in the sense of the obliqueness hierarchy and should be seen as less oblique than the dative.

(53) Dieser   Stoff wurde ihm   empfohlen.
      this.NOM cloth was   him.DAT recommended

      'This cloth was recommended to him.'

It is an open issue how this situation can be resolved. One way is to make binding principles verb (class) dependent and independent of the obliqueness hierarchy or to assume that it is verb (class) dependent and that verbs like those in (52) have a different order of elements in the ARG-ST list. Of course this could have consequences for other parts of the grammar relying on the order of elements in the ARG-ST list (see Section 12 for further discussion).

Note also that (51b) causes a Principle C violation. Since accusative (direct object) is less oblique than dative (indirect object), *ihn* 'him' (locally) o-binds *dem Patienten* 'the patient', which is prohibited by Principle C. This seems to indicate that linear order plays a role in binding. Since the order on the ARG-ST list determines the constituent order in English, similar problems do not arise in English. In a configurational Binding Theory involving movement and c-command, the dative would be higher in the tree and hence c-command the accusative but due to the analysis of scrambling in HPSG (Müller 2020a, Chapter 10 of this volume) this is not the case. Müller (2004) discusses various alternative analyses of constituent order. Chapter 10 of this book presents the one that is commonly assumed: there is a fixed order of elements of the ARG-ST list and heads may be combined with their arguments in any order. The alternative would be to assume multiple lexical items with different ARG-ST lists, each corresponding to one possible ordering of the arguments (Uszkoreit 1986). This would fix the problem with (51b) but it would cause new problems since subjects may be ordered after objects without changing binding behavior (see also Riezler 1995: 13):[21]

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[21]This shows that statements of Principle A incorporating precedence cannot be universally true: "A bound anaphor must be bound by a co-argument that precedes it." (**AW96a-Workshop** for and Ackerman et al. 2017: 44 for Moro). Rather than incorporating linear precedence into Principle A, this constraint should be stated separately on a language by language basis.

(54) a. dass der   Mann sich   vorstellt
          that the.NOM man   SELF.ACC introduces
          'that the man introduces himself'

      b. dass sich   der   Mann vorstellt
          that SELF.ACC the.NOM man   introduces
          'that the man introduces himself'

The reflexive has to be bound to the subject independent of the relative order of subject and accusative object. If constituent order were connected to the order of elements in the ARG-ST list, one would have to reverse the order of elements to be able to analyze sentences like (54b), but then *sich* would be exempt and *der Mann* would be bound (Principle C violation).

Riezler (1995: 12) discusses the data in (55):

(55) a. Auf der Faschingsparty haben wir ihm$_i$ sich$_i$ selbst vorgestellt.
          at   the carnival.party have we him.DAT SELF.ACC   presented
          'At the carnival party, we presented to him himself.'

      b. Auf der Faschingsparty haben wir ihn$_i$ sich$_i$ selbst vorgestellt.
          at   the carnival.party have we himACC SELF.DAT   presented
          'At the carnival party, we presented him to himself.'

Examples like these seem to suggest that the two objects have the same oblique-ness since the accusative can bind the dative and vice versa. So, one could assume that these elements are not ordered on the ARG-ST list. While this would solve the problem of (55), it would introduce another problem: reordering of arguments was accounted for by discharging arguments in an arbitrary order from an ordered list. Now, if the data structure from which elements are canceled-off is not ordered there is too much freedom and the result is spurious ambiguities.

As Grewendorf (1985: 140) notes the reflexive must not precede its antecedent if the antecedent is an object:

(56) a. Peter überließ sich$_{*i}$ die   Schwester$_i$.
          Peter left   SELF.DAT the.ACC sister
          Intended: 'Peter left the sister to himself.'

      b. Peter überließ die   Schwester$_i$ sich$_i$.
          Peter left   the.ACC sister   SELF.DAT
          'Peter left the sister to himself.'

7.2 Binding and prepositional objects

We already discussed the English examples in (17b) with two prepositional objects and showed that the second PP can contain a reflexive referring to a preceding PP and that HPSG's Binding Theory explains this nicely. However, the situation in German is different, as the following data from Grewendorf (1988: 58) show:

(57) a. Ich sprach mit Maria$_i$ über sie$_i$ / *sich.
          I   talked with Maria about her   SELF

          'I talked with Maria about herself.'

      b. Ich beklagte   mich   bei Maria$_i$ über sie$_i$ / *sich.
          I   complained myself at Maria about her   SELF

          'I complained to Maria about herself.'

The conclusion of the discussion in the previous two subsections is that a Binding Theory that is entirely based on obliqueness seems to be not possible and that language-specific binding rules referring to specific situation involving case and part of speech are necessary (see Grewendorf (1988: Chapter 6) for such rules for German in GB).

7.3 Disentangeling ARG-ST and grammatical functions

Manning & Sag (1998) discuss data from Toba Batak, Western Austronesian language. They assume that the ARG-ST elements are in the order actor and undergoer, but since Toba Batak has two ways to realize arguments, the so-called *active voice* and the *objective voice* either of the arguments can be the subject.

(58) a. Mang-ida si Ria si Torus
          AV-see   PM Ria PM Torus

          'Torus sees/saw Ria.'

      b. Di-ida si Torus si Ria
          OV-see PM Torus PM Ria

          'Torus sees/saw Ria.'

Manning & Sag argue that verb and the adjacent NP form a VP which is combined with the final NP to yield a full clause. They furthermore argue that neither sentence in (58) is a passive or anti-passive variant of the other. Instead they suggest that the two variants are simply due to different mappings from argument structure (ARG-ST) to surface valence (SUBJ and COMPS). They provide the following lexical items:

(59) a. *mang-ida* 'AV-see':

$$
\begin{bmatrix}
\text{PHON} & \langle\ \textit{mang-ida}\ \rangle \\
\text{SUBJ} & \langle\ \boxed{1}\ \rangle \\
\text{COMPS} & \langle\ \boxed{2}\ \rangle \\
\text{ARG-ST} & \langle\ \boxed{1}\,\text{NP}_i,\ \boxed{2}\,\text{NP}_j\ \rangle \\
\text{CONT} & \begin{bmatrix} \textit{seeing} \\ \text{ACTOR} \quad i \\ \text{UNDERGOER} \quad j \end{bmatrix}
\end{bmatrix}
$$

b. *di-ida* 'OV-see':

$$
\begin{bmatrix}
\text{PHON} & \langle\ \textit{di-ida}\ \rangle \\
\text{SUBJ} & \langle\ \boxed{2}\ \rangle \\
\text{COMPS} & \langle\ \boxed{1}\ \rangle \\
\text{ARG-ST} & \langle\ \boxed{1}\,\text{NP}_i,\ \boxed{2}\,\text{NP}_j\ \rangle \\
\text{CONT} & \begin{bmatrix} \textit{seeing} \\ \text{ACTOR} \quad i \\ \text{UNDERGOER} \quad j \end{bmatrix}
\end{bmatrix}
$$

The analysis of (58b) is given in Figure 8. Since the second argument, the logical object and undergoer is mapped to SUBJ in (59b), it is combined with the verb last.

But since binding is taken care of at the ARG-ST list and this list is not affected by voice differences, this account correctly predicts that the binding patterns do not change independent of the realization of arguments: as the following examples show, it is always the logical subject, the actor (the initial element on the ARG-ST list) that binds the non-initial one.

(60) a. [Mang-ida diri-na$_i$] si John$_i$.
          AV-saw   self-his   PM John

          'John saw himself.'

      b. * [Mang-ida si John$_i$] diri-na$_{*i}$.
            AV-saw   PM John   self-his

          Intended: 'John saw himself.' with *himself* as the (logical) subject

(61) a. * [Di-ida   diri-na$_i$] si John$_i$
            OV-saw self-his   PM John

          Intended: 'John saw himself.' with *himself* as the logical subject

      b. [Di-ida   si John$_i$] diri-na$_i$
          OV-saw PM John   self-his

          'John saw himself.'

Manning & Sag (1998: 121) point out that theories relying on tree configurations will have to assume rather complex tree structures for one of the patterns to establish the required c-command relations. This is unnecessary for ARG-ST-based binding theories.
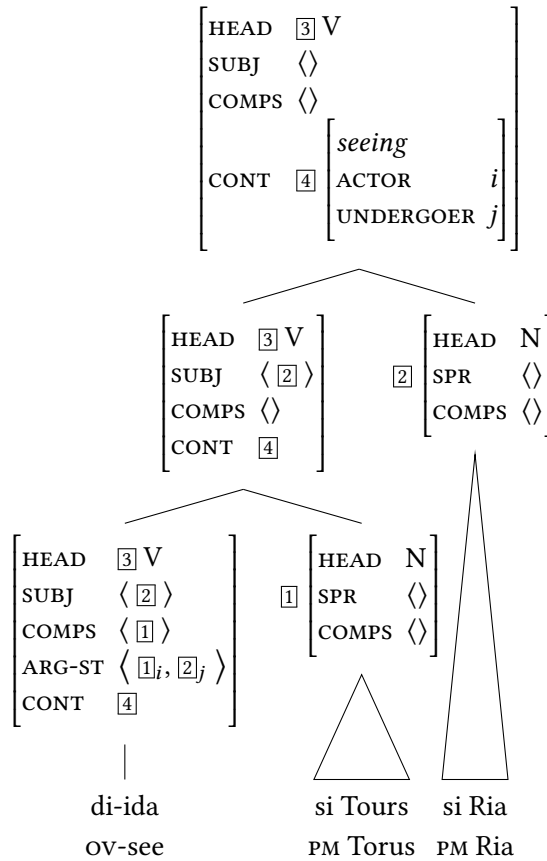
$$\begin{bmatrix} \text{HEAD} & \boxed{3}\ \text{V} \\ \text{SUBJ} & \langle\rangle \\ \text{COMPS} & \langle\rangle \\ \\ \text{CONT} & \boxed{4}\ \begin{bmatrix} seeing \\ \text{ACTOR} & i \\ \text{UNDERGOER} & j \end{bmatrix} \end{bmatrix}$$

$$\begin{bmatrix} \text{HEAD} & \boxed{3}\ \text{V} \\ \text{SUBJ} & \langle\,\boxed{2}\,\rangle \\ \text{COMPS} & \langle\rangle \\ \text{CONT} & \boxed{4} \end{bmatrix} \qquad \boxed{2}\ \begin{bmatrix} \text{HEAD} & \text{N} \\ \text{SPR} & \langle\rangle \\ \text{COMPS} & \langle\rangle \end{bmatrix}$$

$$\begin{bmatrix} \text{HEAD} & \boxed{3}\ \text{V} \\ \text{SUBJ} & \langle\,\boxed{2}\,\rangle \\ \text{COMPS} & \langle\,\boxed{1}\,\rangle \\ \text{ARG-ST} & \langle\,\boxed{1}_i, \boxed{2}_j\,\rangle \\ \text{CONT} & \boxed{4} \end{bmatrix} \qquad \boxed{1}\ \begin{bmatrix} \text{HEAD} & \text{N} \\ \text{SPR} & \langle\rangle \\ \text{COMPS} & \langle\rangle \end{bmatrix}$$

di-ida   si Tours si Ria

ov-see   PM Torus PM Ria

Figure 8: Analysis of Toba Batak example in objective voice according to Manning & Sag (1998: 120)

Wechsler & Arka (1998) discuss similar data from Balinese and provide a parallel analysis. See also Wechsler (1999) for a comparison of GB analyses with ARG-ST-based HPSG analyses.

The conclusion to be drawn from this section is that obliqueness should not be defined in terms of grammatical functions as was done in (i) above but rather with reference to a thematic hierarchy as suggested by Jackendoff (1972). This would not make a difference for languages like English, but for languages like Toba Batak and Balinese the arguments may be mapped to different grammatical functions depending on the voice the verb is realized in.

> Say that binding cannot happen on a thematic level because of raising. Peter believes himself to win. believe(Peter,win(himself)) I show Peter to himself. Peter was shown to myself by me. Peter was shown to me by me. Passive active differences cannot be covered. weil Hans sich nicht lachen sah sehen(Hans,nicht(lachen(sich)))

8 Relative pronouns

While relative pronouns share many properties with personal pronouns, the syntax of relative and interrogative clauses places additional demands on the distribution of the respective pronouns. For languages like English and German a (non-reduced) relative clause consists of a relative phrase and a sentence in which this relative phrase is missing. The relative phrase has to contain a relative word. The simplest case is of course a relative clause with just a relative pronoun in initial position but as Ross (1967: 109) pointed out the relative pronoun may be deeply embedded.

(62) a. Here's the minister [[in [the middle [of [whose sermon]]]] the dog barked].[22]

  b. Reports [the height of the lettering on the covers of which] the government prescribes should be abolished.[23]

Pollard & Sag (1994: Chapter 5) accounted for the distribution of relative pronouns by using a GPSG-style percolation mechanism that is used to percolate the information about the referential index of the relative pronoun to the maximal level of the relative phrase. The percolation of index information makes it possible to keep the normal syntax of relative phrases, which is a big advantage for HPSG in comparison to functor-based approaches like Categorial Grammar (see Pollard (1988) for discussion) and Dependency Grammar (see Hudson (2020: Section 5.2), Chapter 33 of this volume on Pied Piping in Dependency Grammar). This index information of the relative pronoun is then identified with the referential index of the noun that is modified. By identifying the indices it is ensured that relative pronouns and their antecedent match in gender and number in languages like German. This is parallel to the treatment of personal pronouns but the explicit sharing of the relative pronoun index with the index of the modified noun excludes bindings to antecedents outside of the clause, which is possible with personal pronouns. For further discussion of relative clauses see Sag (1997), Arnold & Godard (2020), Chapter 15 of this volume and Müller (1999a).

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[22]Pollard & Sag (1994: 212).
[23]Ross (1967: 109).

Draft of 13th March 2020, 08:17

9 Coindexing vs. coreference and pragmatic binding

Pollard & Sag (1994: 75) distinguish between coindexing and coreference. They explicitly mention this possibility in the discussion of examples like the ones in (63):[24]

(63) a. It isn't true that nobody voted for John$_i$. JOHN$_j$ voted for him$_i$. (in a context where both uses of *John* refer to the same person)

  b. He$_i$ [pointing to Richard Nixon] voted for Nixon$_j$.

The definition of o-binding requires coindexing. Indices include person, number and gender information. Since the anaphors in (64) are objects and the subjects o-command them locally, Principle A requires the subject to bind the anaphor and since this is impossible in (64b) due to gender mismatches, the sentence is ungrammatical.

(64) a. John knows himself.

  b. * John knows herself.

However, the inclusion of coindexing into the definition of o-binding causes a problem since nothing rules out a coreference like the one in (65):

(65) John$_{i'}$ likes her$_{*i'}$.

The apostrophes show coreference rather than coindexation. According to the definition, *John* does not o-bind *her* since the two NPs cannot be coindexed. Hence, *her* is o-free and Principle B is not violated even though the coreference in (65) is impossible. One could now stipulate that coreference is excluded in case of gender mismatches, but the problem is more general and not restricted to gender. Eisenberg (1994: 197) discusses a German example with number mismatches:

(66) Auf der Brücke stand ein Paar. Sie stritten sich heftig.
  on the bridge stood a.sg couple they.pl argued self fiercely

  'There was a couple on the bridge. They argued fiercely.'

---

[24]The following sentence is an attested example of a sentence in which one would expect a reflexive rather than a pronoun:

  (i) I saw me but I thought I was my dad! (J. K. Rowling *Harry Potter and the Prisoner of Azbakan*, London: Bloomsbury, 1999, p. 301)

The sentence is uttered as part of a description of a time travel. Harry Potter traveled back three hours in time and could see the visitor from the future (himself).

The pronoun *sie* 'they' refers to *ein Paar* although *sie* is plural and *ein Paar* is singular. HPSG's Binding Theory does not have anything to say about coreferences in texts, but it is easy to create similar examples with pronoun binding within a single sentence:

(67) a. Das Paar$_{i'}$ behauptet, dass sie$_{i'}$ sich lieben.
the couple.SG claims that they.PL self love.PL

b. Das Paar$_i$ behauptet, dass es$_i$ sich liebt.
the couple.SG claims that it.SG self love.SG

The two NPs cannot be coindexed in (67a) since the number of the two NPs is different.[25] Wechsler & Zlatić (2003: Section 9.2.1) discuss similar mismatches in Serbo-Croatian. They call the phenomenon *pragmatic agreement*. They formulate rules for female/male pronouns referring to neuter antecedents, but the examples discussed here involve number differences. As we will see below a simple rule concerning all pronouns will not work for German since there are some forms of "pragmatic agreement" that work for relative and personal pronouns while others work for personal pronouns only and strict agreement is required for relative pronouns.

As in (65), *das Paar* does not o-bind *sie* in (68), since it cannot be coindexed:

(68) Das Paar$_{i'}$ kennt sie$_{*i'}$.
the couple.SG knows they.PL

'The couple knows them.'

Hence, the coreference in (68) does not violate any binding principles but it should be excluded by something like Principle B requiring that a pronoun must not be bound by/coreferential with something local.

Similarly Principle C does not apply in (69):

(69) Sie$_{*i'}$ behaupten, dass das Paar$_{i'}$ sich liebt.
they.PL claim that the couple.SG self loves

'They claim that the couple loves each other.'

One could assume that *Paar* is underspecified with respect to number, but this would require an approach to agreement that does not refer to the index.

---

[25]The number is also shown by the agreeing verbs. One way to model agreement is to assume that the verb selects a subject with an index with person and number features corresponding to the agreement features of the verb (Pollard & Sag 1994: Section 2.4.2). See Wechsler & Zlatić (2003) and Wechsler (2020), Chapter 6 of this volume on agreement. The alternative would be to have separate purely syntactic agreement features for NPs. *das Paar* would be singular as far as agreement is concerned but could have a referential index that can be singular or plural.

(70) a. Das Paar   schläft.
          the couple.SG sleeps.SG
          'The couple sleeps.'

      b. * Das Paar   schlafen.
          the couple.SG sleep.PL
          Intended: 'The couple sleeps.'

Similarly, the match of the relative pronoun and the noun it refers to is usually established by sharing the index (Pollard & Sag 1994: Chapter 5; Sag 1997; Müller 2007: Chapter 11; Arnold & Godard 2020, Chapter 15 of this volume). While Müller (1999b: 417–418) has data for neuter nouns in German like *Mädchen* 'girl' and *Weib* archaic for 'woman', showing that the relative pronoun may be both the neuter relative pronoun *das* and the female pronoun *die*, the plural relative pronoun with coreference to *Paar* is strictly ungrammatical:

(71) a. das Paar,   das   sich liebt,
          the couple.SG that.SG self loves

      b. * das Paar,   die   sich lieben,
          the couple.SG that.PL self love

Furthermore, as pointed out by Müller (1999b: 418), underspecifying the number feature would run into problems with sentences like (72) containing two different pronouns bound by the same NP:

(72) Das Paar$_i$ behauptet, dass es$_i$ sich liebt und dass sie$_i$ sich
      the couple.SG claims   that it.SG SELF loves and that they.PL SELF
      nie   streiten.
      never argue

      'The couple claims that they love each other and that they never argue with each other.'

Since the number value of *Paar* is underspecified, both *es* and *sie* would be compatible with the index of *Paar*, but identifying the index of *Paar* with one pronoun makes it incompatible with the other one.

> subsumption test

Now, HPSG developed some new and interesting techniques to cope with conflicting demands in coordinate structures (see Levine et al. 2001: 207 and Abeillé & Chaves 2020: Figure 9, Chapter 17 of this volume) and these seem to be applicable here as well: Figure 9 shows a type hierarchy that has a common subtype
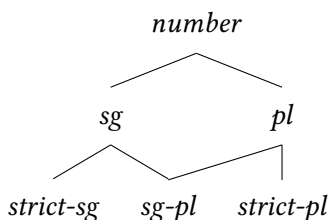
Figure 9: Type hierarchy making the types *sg* and *pl* compatible

of *sg* and *pl*. (72) can be analyzed now since *Paar* can be specified to be of type *sg* and this would be compatible with *es* (*sg*) and *sie* (*pl*): the result of identifying all indices would result in an index with number value *sg-pl*.

While this general compatibility of singular and plural looks frightening at first sight, one can avoid collapsing all occurrences of singular and plural into *sg-pl* by specifying the number value of linguistic objects that are strictly singular by assigning the type *strict-sg* to them. So *Haus* 'house' would have the number value *strict-sg* and would be incompatible with *pl*.

This technique can also be used for relative pronouns: for example, *die* could be specified as *strict-pl* and hence would be incompatible with words like *Paar* 'couple', which are *sg*. This would correctly rule out (71b), but the problem with such a solution would be that nouns can be combined with relative clauses and referred to with pronouns within one sentence:

(73)   Das Paar*ᵢ*,   das   sich küsst, behauptet, dass es*ᵢ*   sich liebt und
       the couple.SG that.SG SELF kisses claims   that it.SG SELF loves and
       dass sie*ᵢ*   sich nie   streiten.
       that they.PL SELF never argue
       'The couple claims that they love each other and that they never argue with each other.'

To make things even more complicated, there are other cases in which relative pronouns can differ in gender. Müller (1999b: 417–418) provides examples for neuter nouns in German like *Mädchen* 'girl' and *Weib* archaic for 'woman', showing that the relative pronoun may be both the neuter relative pronoun *das* and the female pronoun *die*. The examples in (74) show that the relative pronoun can be *die* (feminine = sexus) and the examples in (75) show that it may be *das* corresponding to the neuter gender of *Mädchen* and *Weib*.

(74)   a.   Jenes *Mädchen* ist es, das   vertriebene, *die*   du gewählt hast.[26]
            this.N girl.N   is it that.N banished   who.F you choosen have

            'This is the girl, the banished one, who you chose.'

       b.   und auch Zeset, sein vollwüchsiges *Weib*, *die*   Dienst tat bei
            and also Zeset his.N full.grown.N   wife.N who.F service did at
            Mut-em-enet, stellte er an,   daß sie auf sie einwirke im   Sinne
            Mut-em-enet hired he PART that she on him influence in.the sense
            seiner Gehässigkeit,[27]
            his   malevolence

            'and he also hired his full-grown wife Zeset, who worked as a maiden
            at Mut-em-enet, so that she influenced her in the sense of his
            malevolence'

(75)   a.   Das *Mädchen*, *das*   Rosen und andere Blumen herumtrug,
            the. girl.N   who.N roses and other   flowers around.carried
            bot   ihm *ihren* Korb   dar, […][28]
            offered him her.F basket PART

            'The girl carrying roses and other flowers around offered her basket
            to him.'

       b.   Nun sitz ich hier, wie ein altes *Weib*,   *das*   *ihr*   Holz von
            now sit I   here like an.N old.N woman.N who.N her.F wood of
            Zäunen stoppelt und *ihr*   Brot an den Türen, […][29]
            fences gleans   and her.F bread at the doors

            'I sit here now like an old woman gleaning her wood at fences and
            her bread at the doors […]'

The examples in (75) additionally have possessive pronouns with female gen-
der. The conclusion is that "simple" underspecification approaches do not work
and that additional indices are needed for pragmatic binding of nouns like *Paar*
'couple' and *Mädchen* 'girl' but that relative pronoun binding does not work uni-
formly for these cases and some special treatment seems to be required in addi-
tion.

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[26]Goethe, *Hermann und Dorothea*, Berliner Ausgabe, volume 3, p. 609, Berlin: Aufbau, 1960. See
   also Jung (1967: 139).

[27]Thomas Mann, *Joseph und seine Brüder*, 1948, SFV 1960, volume 4/5, p. 980.

[28]Goethe, *Wilhelm Meisters Lehrjahre*, Hamburger Ausgabe, volume 7, p. 90.

[29]Goethe, *Die Leiden des jungen Werther*, Hamburger Ausgabe, volume 6, p. 99.

A further, more technical problem with type-based solutions as the one suggested in Figure 9 is that underspecified types basically stand for a disjunction of maximally specific types: *sg* stands for *strict-sg* ∨ *sg-pl*. Since models of linguistic objects have to be maximally specific (Richter 2020, Chapter 3 of this volume), this means that nouns like *Paar* 'couple' would have two models. In situation in which there is no pronoun to decide between *strict-sg* and *sg-pl*, our theory would license two models for every phrase the noun occurs in, a clearly unwanted result.

Concluding this section on pragmatic binding, a solution for cases like those in German and Serbo-Croatian seems to require multiple indices (a pragmatic one in addition to what is usually assumed) and binding principles that allow reference to the pragmatic index as an alternative to reference to the normal one.

10 Raising and o-command

> Maybe drop that section

A further problem has to do with predicate complex constructions in languages like German. Researcher working on SOV languages like German, Dutch or Korean assume that the verbs form a verbal complex. The arguments of the embedded verb are attracted by the governing verb. This technique was developed in the framework of Categorial Grammar and taken over to HPSG by Hinrichs & Nakazawa (1989; 1994). See also Godard & Samvelian (2020), Chapter 12 of this volume. Figure 10 shows the analysis of the following example:

(76) dass der Sheriff den Dieb sich überlassen wird
      that the sheriff the thief self leave   will
      'The sheriff will leave the thief to himself.'

The verb *überlassen* 'to leave' is ditransitive and takes a nominative ($\boxed{1}$), a dative ($\boxed{2}$), and an accusative argument ($\boxed{3}$). A verb selecting another verb for verbal complex formation takes over the argument of the embedded verb. The auxiliary *wird* 'will' selects *überlassen* 'to leave' ($\boxed{4}$) and the arguments of *überlassen* ($\boxed{1}$, $\boxed{2}$, $\boxed{3}$). The ARG-ST list of *wird* contains *den Dieb* and *sich* and hence *den Dieb* locally o-binds *sich*, but *sich* also binds *den Dieb* since *sich* ($\boxed{3}$) is less-oblique than the verbal complement $\boxed{4}$ and $\boxed{4}$ selects for *den Dieb* ($\boxed{2}$). For the latter reason, Principle C is violated.

Kiss (1995: 33):

```
                              CP
                        ╱           ╲
                    C                   S
                                ╱              ╲
                           ① NP                 V′
                                          ╱           ╲
                                      ② NP              V′
                                               ╱            ╲
                                           ③ NP               V
                                                        ╱            ╲
                                                ④ V ⟨ ①, ②, ③ ⟩   V ⟨ ①, ②, ③, ④ ⟩
```
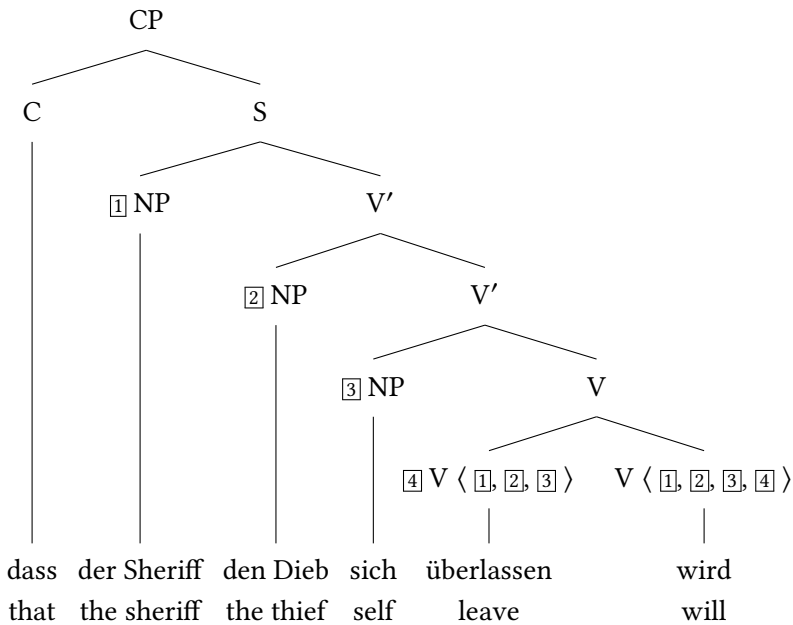
dass	der Sheriff	den Dieb	sich	überlassen	wird
that	the sheriff	the thief	self	leave	will

Figure 10: Analysis of a German sentence with a verbal complex

(77) Der Junge$_i$ ließ das Mädchen$_j$ das Boot für sich$_{i/j}$ reparieren.

(78) a. Peter ließ sich den Mann helfen.
      b. Peter ließ sich von dem Mann helfen.

van Noord & Bouma (1996)

Bouma et al. (2001: 9): As observed by van Noord and Bouma (1996), comple-
ment inheritance is incompatible with the notion of 'local domain' that is crucial
for binding theory. If binding applies to argument structure, however, and com-
plement inheritance is defined for the valence feature COMPS only, the problem
is avoided.

11 Locality

Müller (1999b: Section 20.4.7) pointed out that examples like (79) involving anaphors▮
within coordinations are problematic for the HPSG Binding Theory:

(79) Wir beschreiben ihm$_i$ [sich$_i$ und seine Familie].
     we describe   him   SELF and his   family
     'We describe him and his family to him.'

Fanselow (1987: 112) discussed such examples in the context of a GB-style Binding Theory. Such coordination examples are used since weight plays a role in ordering constituents and putting the reflexives into a coordination makes the examples more natural. The example may still seem a bit artificial but there are attasted examples from newspapers (Müller 1999b: 420):

(80)   a.   Die Erneuerung war ausschließlich auf Druck von außen zustande
         gekommen. Sie verdankte   sich keineswegs dem Bedürfnis, vor
                     she to.be.due.to SELF not.at.all   the desire   before
         sich und der Öffentlichkeit Rechenschaft abzulegen.[30]
         SELF and the public   account   to.give
         'This was not due to the the desire to give account to oneself and the public.'

     b.   Martin Walser versucht, sich und die Nation zu verstehen.[31]
         Martin Walser tries   SELF and the nation to understand
         'Martin Walser tries to understand himself and the nation.'

These sentences pose a challenge for the way locality is defined as part of the definition of local o-command. Local o-command requires that the commander and the commanded phrase are members of the same ARG-ST list (24), but the result of coordinating two NPs is usually a complex NP with a plural index:

(81)   Der Mann und die Frau   kennen / * kennt   das Kind.
       the man   and the woman know   knows the child
       'The man and the woman know the child.'

The NP *der Mann und die Frau* 'the man and the woman' is an argument of *kennen* 'to know'. The index of *der Mann und die Frau* 'the man and the woman' is local with respect to *das Kind* 'the child'. The indices of *der Mann* 'the man' and *die Frau* 'the woman' are embedded in the complex NP.

    For the same reason *sich* is not local to the subject of *abzulegen* in (80) and not local to *ihm* in (79). This means that the anaphor is not locally o-commanded in any of the sentences and hence Binding Theory does not say anything about the binding of the reflexive in these sentences: the anaphors are exempt.

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[30]Taz UNIspezial WS 94/95, 10.15.94, p. 16

[31]taz, 12.10.98, p. 1

For the same reason, *ihn* 'him' is not local to *er* 'he' in (82b) and hence the binding of *ihn* 'him' to *er* 'he', which should be excluded by Principle B, i not ruled out.

(82) a. Er$_i$ sorgt nur für [sich$_i$ und seine Familie].
          he cares only for SELF and his   family
          'He cares for himself and his family only.'

      b. Er$_i$ sorgt nur für [ihn$_{*i}$ und seine Familie].
          he cares only for him and his   family

If one assumed transformational theories of coordination deriving (82) from (83), ref the problem would be solved, but as has been pointed out frequently in the literature such transformation-based theories of coordinations have many problems (Bartsch & Vennemann 1972: 102; Jackendoff 1977: 192–193; Dowty 1979: 143; den Besten 1983: 104–105; Klein 1985; Eisenberg 1994**Borsley**) and nobody ever assumed something parallel in HPSG (see Abeillé & Chaves (2020), Chapter 17 of this volume on coordination in HPSG).

(83) Er$_i$ sorgt nur für sich und er$_i$ sorgt nur für seine Familie.
      he cares only for SELF and he cares only for his   family

12 Linking, order, scope and binding

While Keenan & Comrie (1977) showed that the obliqueness hierarchy is relevant for activeness of grammatical functions crosslinguistically, it is an open question whether this hierarchy should be assumed to hold for all lexemes in all languages and if so, whether it plays a role in the same phenomena universally. As was discussed by Wechsler, Koenig & Davis (2020), Chapter 9 of this volume, the ARG-ST list plays an important role in linking theories. In an analysis of (84a), *the dog* is the direct object, while *dem Hund* bearing dative case is the indirect object in (84b):

(84) a. The elephant gave the dog a ball.

      b. Der   Elephant gab dem   Hund einen Ball.   (German)
          the.NOM elephant gave the.DAT dog   a.ACC ball

While Müller (1999b) ordered arguments in valence lists according to the obliqueness hierarchy in (i), Müller (2015) decided to keep the ARG-ST lists and hence also the linking patterns constant across languages. Müller (2019) analyzes the Germanic languages with ARG-ST lists having the same order of elements and

linking patterns, the differences are captured by a different distribution of lexical and structural case and a different mapping from ARG-ST to SPR and COMPS. See Przepiórkowski (2020), Chapter 7 of this volume for more on case assignment and ARG-ST in HPSG.

Kiss (2005) develops an account of quantifier scope determination for German arguing that scope is determined with respect to an unmarked order.[32] The unmarked order is nominative, dative, accusative for most German verbs (Höhle 1982). This does not correspond to universal tendencies, according to which the direct object precedes the secondary object (Pullum 1977). Kiss uses the ARG-ST list to represent the unmarked constituent order. The consequence is that German seems to require a nom, dat, acc order for (uniform) linking, constituent order, and scope and nom, acc, dat for binding. If this really is the case, one seems to need two separate lists to be able to represent both orders.

13 ARG-ST lists with internal structure

Manning & Sag (1998) discuss binding in passive clauses. They suggest that the passive is analyzed as a lexical rule demoting the subject argument and adding an optional PP. If this lexical rule involves the ARG-ST list, this means that the former object is the initial argument on the ARG-ST list and that reflexives must be bound by this element rather than by the logical subject of the passivized verb which is optionally expressed in the *by*-PP.

(85)　$\begin{bmatrix} \text{ARG-ST} & \langle \boxed{1}_i, \boxed{2}, ... \rangle \\ \text{CONT} & \boxed{3} \end{bmatrix} \mapsto \begin{bmatrix} \text{ARG-ST} & \langle \boxed{2}, ... \rangle \, (\oplus \langle \text{PP}[by]_i \rangle) \\ \text{CONT} & \boxed{3} \end{bmatrix}$

However, Perlmutter (1984) argued that more complex representations are necessary to capture the fact that some languages allow binding to the logical subject of the passivized verb. He discusses examples from Russian. While usually the reflexive has to be bound by the subject as in (86a), the antecedent can be either the subject or the logical subject in passives like (86a):

(86)　a. Boris$_i$　　mne　　rasskazal anekdot o　　sebe$_i$.
　　　　Boris.NOM me.DAT told　　joke　　about SELF
　　　　'Boris told me a joke about himself.'

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[32]See Höhle (1982) for a definition of *normal order*.

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b. Eta kniga   byla kuplena Borisom$_i$ dlja sebja$_i$.

   this book.NOM was bought Boris.INSTR for SELF

   'This book was bought by Boris for himself.'

In order to capture the binding facts, Manning & Sag (1998) suggest that passives of verbs like *kupitch* 'buy' have the following representation at least in Russian.

(87) *kuplena* 'bought':
$$
\begin{bmatrix}
\text{ARG-ST} \ \langle \ \text{NP}[nom]_j, \ \langle \ \text{NP}[instr]_i, \text{PRO}_j, \text{PP}_k \ \rangle \ \rangle \\[2ex]
\text{CONT} \
\begin{bmatrix}
buying \\
\text{ACTOR} \quad\quad i \\
\text{UNDERGOER} \quad j \\
\text{BENEFICIARY} \quad k
\end{bmatrix}
\end{bmatrix}
$$

The ARG-ST list is not a simple list like the list for English but it is nested. The complete ARG-ST list of the lexeme *kupitch* 'buy' is contained in the ARG-ST list of the passive. The logical subject is realized in the instrumental and the logical object is stated as PRO$_j$ on the embedded ARG-ST but as full NP in the nominative on the top-most ARG-ST list. This setup makes it possible to account for the fact that a long distance anaphor[33] like the reflexive in the PP may refer to one of ┌ reference the two subjects: the nominative NP in the upper ARG-ST list and the NP in the instrumental in the embedded result. The PRO element is kept as a reflex of the argument structure of the lexeme. Such PRO elements play a role in binding phenomena in languages like Chi-Mwi:ni also discussed by Manning & Sag.

In order to facilitate distributing the elements of such nested ARG-ST lists to valence features like SUBJ and COMPS, Manning & Sag (1998: 124, 140) use a complex relational constraint that basically flattens the nested ARG-STs again and removes all occurrences of PRO.

14 Conclusion

This chapter discussed several approaches to Binding Theory in HPSG. It is shown that approaches based on an obliqueness order are not sufficient for some languages, that language-specific binding rules are needed and that order (e.g., scram-

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[33]Long distance anaphors must obey the following binding principle:

   (i)   Principle Z: A locally o-commanded long distance anaphor most be o-bound.

   This means that it either can be bound locally or by a suitable binder higher up in the structure.

bling in German) plays a role for binding which is not accounted for if obliqueness is made the sole criterion for legitimate bindings.

> elaborate, give explicit rules for German

Examples from so-called pragmatic binding show that HPSG's Binding Theory has to be extended to include rules that account for bindings with pronouns with different number features and different gender features.

It was shown that the right combination of non-configurational aspects (order of elements on a list with respect to a thematic hierarchy, allowing for expletives and raised arguments in the list and accounting for arguments not realized overtly) with configurational aspects (dominance relations including dominance of adjuncts) results in a novel and unique approach to many problems that do not have straightforward alternative analyses.

Abbreviations

AV Agentive Voice
OV Objective Voice
PM pivot marker

15 Todo

Abeillé et al. (1998); Branco (2002); Branco & Marrafa (1999); Branco (1998); Pollard (2005); Pollard & Xue (2001); Riezler (1995); Xue & McFetridge (1998); Xue et al. (1994); Büring (2005)

Acknowledgements

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Part III

Other levels of description