Anaphoric dependencies: A window into the architecture of the language system

By Eric Reuland

"The split between linguistics and psycholinguistics in the 1970's has been interpreted as being a retreat by linguists from the notion that every operation of the grammar is a mental operation that a speaker must perform in speaking and understanding language. But, putting history aside for the moment, we as linguists cannot take the position that there is another way to construct mental representations of sentences other than the machinery of grammar. ....There is no retreat from the strictest possible interpretation of grammatical operations as the only way to construct linguistic representations." (Alec Marantz, lecture notes 2000)

1. Introduction

The above motto offers intriguing prospects, but no prospects are without challenges. Marantz is right that our ability to compute interpretive dependencies as they are reflected in for instance trace theory is not something it makes sense to put to the "psycholinguistic test" as in earlier discussions about the "derivational theory of complexity". We compute these dependencies, and do so (mostly) very fast and easily. This is a result that stands, hence should be taken into account by any version of cognitive psychology. Yet, as any theory, our theory of grammar is vastly underdetermined by the data. Although as linguists we cannot take the position that there is another way to construct mental representations of sentences other than "the machinery of grammar", it is perfectly possible that there is another way than specified by "the machinery of grammar we just proposed". If there is no retreat from the strictest possible interpretation of *our theory of* (this, of course, I added) grammatical operations as the only way to construct linguistic representations, the outside world (and a considerable part of the inside world as well) will take this as a serious commitment. If as linguists, or as proponents of a particular linguistic theory, we would systematically fail to exhibit interesting connections between individual operations or classes of such operations and observations about the workings of the cognitive system which other colleagues obtain using different experimental techniques, we are still

in trouble, if only because of the dynamics of science. Just like many linguists judge a theory not only by whether it allows you to express linguistic truths, but also by whether it mysteriously incites you to unearth new truths (Reuland, 2000), so our other colleagues in cognitive science will also judge our pet theories by the fruits they bear.

2. Individual operations and architectural properties

Just as interpretive dependencies between dislocated arguments and their predicates must be taken into account irrespective of your pet theory of human cognition, so must dependencies between anaphoric expressions and their antecedents, be they anaphors in a strict sense, pronominals, or definite descriptions. From dependencies there's no escape, just like there's no escape from Merge.

How realistic is it to expect demonstrable convergence from different data types; i.e. how realistic is it to expect that our theoretical choices – initially motivated by regularities in sound-meaning pairings – will be reflected in data from brain imaging, but also language acquisition or language impairment? It is such convergence that would justifiably give us some confidence that we are on the right track. In this overview I will discuss some converging evidence that has been obtained, indicating that there are intriguing vista's ahead of us on this path.

Clearly, it would not be realistic to expect at this point converging evidence at the micro level of linguistic structure. Although quite imaginable in principle, we don't yet seem to have experimental conditions (in a broad sense) with the resolution that is required to make visible, for instance, individual merging steps in the computation, in so far as these are distinct from lexical retrieval (effects of the latter are occasionally observable).

However, it is different at higher levels. It may very well be possible to observe the effects of the

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compounding of operations or differences between types of operations, or the interaction (or absence thereof) between different types of operations. If brain research is to help us at all, we do expect to find correspondences at the architectural level. As will be shown, this is indeed a level for which results have already been obtained. These results warrant a further exploration of this type of correspondence, taking as a working hypothesis the following thesis:

> **Correspondence thesis:**
> *Differences between (major) modules of the grammatical system correspond with differences in processes at the neural level and vice versa.*

Although, ideally, such issues of organization should be approached taking into account the full range of available knowledge and expertise, in a more practical world we should also be content formulating initial hypotheses from the perspective of our own field of knowledge, and let those guide research into the real-time processes involved.

In this article we will focus on the ongoing discussion as to how the domain of anaphoric dependencies should be cut up. An important dimension in this discussion is provided by the issue of modularity. Is the mechanism underlying anaphoric dependencies essentially unitary or not? In the non-modular category one finds approaches that in other respects are rather different. The canonical binding theory and its elaborations (Chomsky, 1981; Chomsky, 1986; Fiengo & May, 1994; Manzini & Wexler, 1987), which are essentially syntactic approaches using the somewhat unrestricted character of GB-theory belong in this category, but also minimalist approaches, varying from Chomsky (1995) who argues that binding takes place at the conceptual-Intentional interface to approaches such as Hornstein (2001) and Kayne (2001) who place binding in narrow syntax, but also approaches in Discourse Representation Theory and computational linguistics (Kamp & Reyle, 1993; Jäger, 2001). Also cognitive, typologically inspired and optimality theoretic approaches that view anaphoric dependencies as governed by expressibility conditions on a continuous scale (Van Hoek 1997, König & Siemund 2000, Hendriks & De Hoop 2001, to mention a few sources) belong in this group.

The second type of approach holds that anaphoric dependencies reflect a modular system which involves qualitatively different components of the language system as a whole (see, initially, Helke 1971 and a brief remark in Chomsky 1976, and for more extensive discussions Reinhart, 1983; Pica, 1985; Wexler & Chien, 1995; Reinhart & Reuland, 1991, 1993; Pollard & Sag, 1992; Grodzinsky & Reinhart, 1993; Reuland, 2001).

In this article I will focus on the modular/non-modular distinction, ending up with the evidence from psycholinguistic investigations that has been brought to bear on this question.

3. Canonical binding theory

Canonical binding theory is based on the assumption that anaphors such as English *himself*, Icelandic *sig* and *sjalfan sig*, Dutch *zich* and *zichzelf*, etc. are referentially defective elements that must depend on some other expression for their interpretation. Pronominals such as E. *him*, Icel. *hann*, Du. *hem*, etc., are not defective in that sense. They may, but need not depend on another expression for their interpretation. An interpretive dependency is linguistically expressed by the annotation of the anaphor or pronominal and its antecedent by an index. (Two expressions may bear the same index only if they are non-distinct in features for person, number and gender; non-distinctness, rather than identity of features is required since in many languages one anaphoric element is compatible with masculine or feminine, singular or plural antecedents.)

Generally, a distinction is made between co-indexing in general and a subcase, namely binding. Binding occurs if in addition to co-indexing, antecedent and antecedee satisfy c-command. A widely accepted definition is given in (1) (see Reinhart, 1976, 1983 for discussion).

(1) *a* c-commands *b* if and only if *a* does not contain *b* and the first branching (or maximal) projection dominating *a* also dominates *b*;

(2) is, then, the standard condition on binding:

(2) *a* binds *b* iff *a* and *b* are co-indexed and *a* c-commands *b*

Anaphors must have an antecedent that is sufficiently nearby; pronominals must have one that is sufficiently far away. The restrictions on admissible indexings are expressed by the binding conditions, here given in their canonical form (Chomsky, 1981), with governing category representing the measure of structural distance involved (see the appendix):

(3) Binding conditions:
   A: an anaphor is bound in its governing category
   B: a pronominal is free in its governing category

In the canonical binding theory any DP is inserted with an index; co-indexing represents intended *coreference* (or *covaluation* to use a more general term which we will henceforth employ). This intended covaluation is assumed to be part of the meaning of a sentence (Fiengo & May, 1994). Also, conversely, intended covaluation, under this assumption, should be linguistically expressed by co-indexing. The only escape from this is if one lacks information about the relevant facts, such as the speaker's intentions, or if it is the part of the meaning of a sentence that the values of two expressions be identified. This position can be illustrated on the basis of the following text:

(4) The robber had entered the vault. John's accuser swore that he had taken the diamonds.

Suppose *he* is intended to refer to *the robber*. This is expressed by co-indexing *the robber* and *he*. Suppose the speaker doesn't wish to take a stand on whether

John's accuser is right and *John* and *he/the robber* are actually the same person. If so, the indexing should be as in (4'):

(4') The robber_i had entered the vault. John_j's accuser swore that he_i had taken the diamonds.

Yet, criminal investigation can subsequently establish that *he* and *John* (and the robber) are one and the same person. This does not affect the propriety of the indexing in (4'). On the other hand, if the speaker wants to take a stand on the issue, *John* and *he* can and should be co-indexed. Similarly, given that some subsequent statement *John is the robber* is not a tautology, *John* and *the robber* should not be co-indexed, even though, if the sentence is true they refer to the same individual.

4. From governing category to BT-compatibility

As observed by Huang (1982) the definition of *governing category* in (3) is problematic in view of the fact that in the subject position of NPs, anaphors and pronominals are not in complementary distribution. Given that *their* in *The men love their dogs* is apparently free in its GC, why is it that *each other* in *The men love each other's dogs* can be appropriately bound? Pursuing an earlier idea by Huang (1982), Chomsky (1986) proposed an alternative for computing the local domain. The core domain is that of a *Complete Functional Complex* (CFC), a domain in which all grammatical functions of a given predicate are realized. The Binding domain of some element α is the smallest CFC containing α for which there is an indexing I which is BT compatible. The notion of BT-compatibility reflects the following assumptions: i) anaphors must be bound; ii) pronominals need not be bound; iii) any indexing to be taken into consideration must obey the i-within-i condition; iv) nominal heads may carry indices, but are not possible antecedents. So, for an anaphor the binding domain is the smallest CFC in which it can be bound under some indexing I, for a pronominal the binding domain is the smallest CFC in which it can be free under I. In order for an anaphor in the subject position of a finite clause to be correctly ruled out, Chomsky adopts a proposal by Lebeaux (1983) who assumes that anaphors undergo abstract movement towards their antecedents at LF; anaphor-movement from the subject position of a finite clause leaves a trace that violates a general condition on the licensing of traces, the ECP (empty category principle), see Chomsky (1981, 1986) for discussion. This led to an intensive investigation of the relation between binding and movement, as discussed in the next section. (Note, that a principle like ECP is, in fact, no longer stateable in current conceptions of grammar.)

5. Binding and movement

In the canonical binding theory, what makes items into anaphors or pronominals is taken to be independent of other properties. For instance, Chomsky (1981) posits two binary features [±anaphoric] and [±pronominal]. These features are not related to any other properties of the items containing them, and yield four categories, each with an overt and a zero counterpart: [+anaphoric, −pronominal] (overt = anaphors such as *himself*, covert = trace of A-movement); [−anaphoric, +pronominal] (overt = pronominals such as *him*, covert = pro, the empty subject in null-subject languages); [−anaphoric, −pronominal] (overt = NPs with lexical heads, covert = trace of A'-movement); [+anaphoric, +pronominal] (overt = an element that cannot exist for reasons discussed below, covert = PRO, the understood empty subject of non-finite clauses). The idea that both traces and anaphors depend for their interpretation on an antecedent led to ongoing attempts to explain both binding and movement from the same basic principles, where occasionally binding provided the basis for movement, but also, conversely, movement has been taken to underlie binding, as in works such as Pica (1987, 1991) and Hestvik (1991, 1992).

A domain where a movement approach to binding has been extensively pursued is that of long-distance anaphora.

6. Long-distance anaphora

In general a relation between an anaphor and its antecedent is defined as **long-distance** when the antecedent is outside the **governing category** of the anaphor as defined in (3), or, more succinctly, when the binding relation crosses a subject. Much of the discussion in the literature centers on the question of whether long-distance anaphora is restricted to certain anaphor types, and on the question of what motivates it. Another issue is whether all anaphor-antecedent relations are of the same type.

This issue is connected to the more fundamental question of why anaphors have to be bound. Bouchard (1984) argued that in order to be interpreted, an argument must have a full specification of phi-features. Many languages have anaphors that lack a full specification for phi-features. If so, they must acquire a full specification in order to be interpreted. This type of element is often taken to include Dutch *zich*, Icelandic *sig*, Norwegian *seg*, (Mandarin) Chinese *ziji* and Japanese *zibun*. In line with Lebeaux (1983), for such anaphors, binding is then taken to result from abstract movement to an element supplying them with phi-features. If the moved element is just a head, standard conditions on movement yield that arguments, in particular subjects, do not count as interveners. Hence, one would expect no locality restriction on their binding domain except in so far as such restrictions follow from general properties of movement.

It has thus been proposed that abstract movement of the anaphor *ziji* in Chinese to a source for phi-features underlies long-distance anaphora in Chinese (for instance, Batistella, 1987, and Cole, Hermon &

Sung, 1990). These authors assume that *ziji* is an X^0 constituent which undergoes head-movement to a suitable target. A c-commanding NP will not do, since it is a maximal projection. The only element that meets the requirements that it c-commands the anaphor, is in head position, and carries phi-features is AGR. The result is summarized in (5).

(5) SE-heads move to AGR at LF.

It is assumed that AGR is inside I, so the movement is to I. Since AGR is always co-indexed with the subject and SE-anaphors always associate with AGR, it follows that SE-anaphors, in their grammatical (non-logophoric) use are subject-oriented. (Readers unfamiliar with the 'SE' terminology, please see (19) below.) It is assumed that movement of *ziji* is not restricted, since any higher subject is a possible antecedent, provided no blocking effect obtains.

The blocking effect in Chinese can be briefly characterized as follows: the path between *ziji* and its envisaged antecedent may not contain a possible antecedent with a different specification for person from the latter.

Huang and Tang (1991) retain the idea of LF-movement, but argue that *ziji* is syntactically *pro-ziji*. Movement of *ziji* is, then, in fact successive-cyclic A'-movement of an XP, adjoining it to IP, instead of X^0- movement. This movement, they argue, is not subject to antecedent-government requirements. They assume that *ziji* picks up its phi-features immediately in the local domain. Once it has phi-features it may be interpreted as bound by any potential higher-up antecedent provided it has moved into the latter's domain. Thus, in each of the positions it occupies *ziji* may undergo local binding. The blocking effect reduces to a mismatch between phi-features initially acquired and the phi-features of an intervening potential binder. Once movement leads to a configuration in which there is a mismatch, as between 3rd person and 1st person, the derivation is blocked. Such blocking effects have not been reported for languages with a ''strong'' verbal Agreement.

This relation between verbal inflection and blocking can, then, be understood on the basis of the following informal representation, with the relevant dependencies indicated regardless of details of order and hierarchical structure:

(6)

Subject   Anaphor   INFL   t
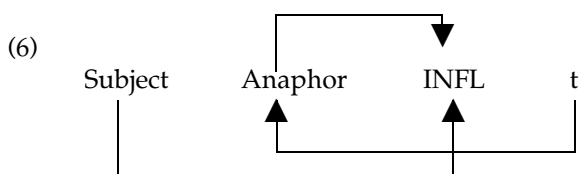
As a widely adopted implementation runs, an INFL entirely without phi-features is susceptible to adopting features from the anaphor, which leads to a clash with the subject features if they are different. An INFL with phi-features stays firm and limits feature exchange to the subject as its canonical ''mate''. An LF movement approach has also been argued for Japanese *zibun* (Katada, 1991).

Across the Germanic languages the binding domain of simplex anaphors such as Icelandic *sig* and its cognates (henceforth SE-anaphors) shows considerable variation, which from the LF-movement perspective requires an independent explanation, but which we will leave aside here.

The literature on long-distance anaphora exemplifies our main concern in this article: are all relations between anaphors and their antecedents essentially of the same nature, or do we have to allow for different strategies in the grammatical system broadly conceived?

In order to capture the variation in the domains in which anaphors must be bound, both across languages and, for anaphors of different types, within the same language Manzini and Wexler (1987) proposed a parameterized binding theory, in which the governing category selected could differ per language or anaphor type. The nature of the relation between a long-distance anaphor and its antecedent was assumed to be constant however. The variation space was formulated as in (7):

(7) a. a is a governing category for b iff a is the minimal category which contains b and PARAMETER
     b. PARAMETER-values: has (i) a subject, (ii) an INFL, (iii) a Tense, (iv) an indicative Tense, (v) a root Tense

This approach motivated a search for a more principled theory of parameter values. But, importantly from our present perspective, already Thráinsson (1976a,b) found evidence that, in fact, not all anaphoric dependencies are of the same type. Briefly, anaphoric forms may be used as bound variables or as logophors, as will be discussed in the next section.

7. Anaphors and logophors

7.1. English: the case of SELF-anaphors
While conditions A and B in their canonical format present an elegant theory, right from their conception complications were found that generated a continuous flow of subsequent discussion. As we saw in section 4, in DPs the canonical binding theory works less than straightforwardly, as discussed in Huang (1982) and Chomsky (1986).

Already Chomsky (1981) noted that complementarity between pronominals and anaphors is not observed in locative PPs.

(8) a. *Mary* put the book next to *her/herself*
     b. *John* looked around *him/??himself*

Barss (1986) discusses yet another potential challenge to the canonical approach in the effect of Wh-movement on binding domains, namely the role of reconstruction versus interpretation in derived position in the interpretation of anaphors that have been moved along under wh-movement. In (9a) the

anaphor *himself* can only have *Bill* as its antecedent. In (9b) both *John* and *Bill* are possible antecedents.

(9) a. John said [that Bill liked [that picture of himself] best]
   b. **[Which picture of** *himself***]** did *John* say [**t′** that *Bill* liked **t** best]

The facts of (9b) indicate that binding possibilities may be computed from the positions a constituent moved through. The lower trace position yields Bill as a possible antecedent, the intermediate trace position yields John as a possible antecedent. However, as noted in Chomsky (1995), reconstruction cannot always be an option. Otherwise, one would lose the contrast between (10a) and (10b). In (10a) *he* and *John* cannot co-refer, which follows from condition C, but only if reconstruction is obligatory. In (10b) coreference is allowed, which follows if reconstruction is at least optional.

(10) a. **the claim that** *John* **was asleep** *he* won't discuss **t**
    b. **the claim that** *John* **made** *he* won't discuss **t**

Chomsky concludes that clearly some form of reconstruction is needed, but that the precise conditions under which it obtains require further research.

Facts as in (11) had earlier led to incorporating the condition on accessibility into the definition of Governing Category (see Appendix, example 3).

(11) *We* thought [that [pictures of *each other*] would be on sale]

The Agr of the subordinate clause cannot qualify as a SUBJECT for *each other*, since co-indexing the two would violate the *i-within-i condition*, hence the governing category of *each other* is the matrix clause.

However, even so challenges for condition A remained. Already in the seventies Ross (1970), Cantrall (1974) and Kuno (1987 and references cited there) observed that first and second person anaphors in English can occur without a linguistic antecedent, as illustrated in (12):

(12) Physicists like yourself are a godsend (Ross, 1970)

Violations of condition A are not limited to first and second person anaphors. As noted by Pollard and Sag (1992), Postal (1971) had observed that picture noun reflexives as in (13) are not subject to the same constraints as ordinary reflexives.

(13) a. Max_1 likes [jokes about him_1/$himself_1$]
    b. Max_1 likes [Mary's jokes about him_1/ $himself_{(*)1}$]

In (13a) the complementarity between anaphors and pronominals breaks down; in (13b) the bracketed * indicates the standard judgement reported in the literature. However, Keller & Asudeh (2001), using a Magnitude Estimation (ME) Methodology, report that the majority of speakers accept the anaphor here (indicated by the brackets). Zribi-Hertz (1989)

discusses many examples of English anaphors taken from actual texts that do not obey the binding conditions, including cases with a first person anaphor like (14a) as well as cases with a third person anaphor like (14b):

(14) a. She gave both Brenda and myself a dirty look
    b. It angered him that she … tried to attract a man like himself

In none of those cases does the accessibility condition make the required distinction. Bouchard (1984) concluded that a general distinction exists between true anaphors and exempt anaphors, where only true anaphors are subject to the binding theory. Exempt anaphors must be interpreted by some other process.

A line adopted in much current research is that exempt anaphors are interpreted as *logophors*, a type of pronoun that is particularly sensitive to discourse conditions and not subject to the structural binding conditions. Note that such a step is not logically enforced. It is virtually always possible to add clauses to the canonical definition of governing category etc. in order to obtain the required descriptive effect. The question is how illuminating such steps would turn out to be.

Given the necessity for precision (lest our theories stop being falsifiable), one must sharply distinguish between two questions: how are true anaphors to be distinguished from exempt anaphors, and how are the latter interpreted? The first question requires careful investigation of the syntactic conditions under which an anaphoric form is exempt from condition A. It is an independent question whether all the exempt forms indeed meet the conditions on logophoricity as they were originally formulated by Clements (1975). (Reinhart, 1996 notes that in retrospect Reinhart & Reuland, 1993's using the term *logophoric* for *exempt from condition A* may have been confusing.) One may conceive of at least three possible states of affairs, namely i) that they do indeed all independently qualify as logophoric in the original sense, ii) that they don't or iii) that only a subset does. In the last decade the distribution of bound versus exempt anaphors in English has been carefully investigated. Three illustrative contrasts are given in (15)–(17).

(15) a. It angered him that she … tried to attract a man like himself
    b. *It angered him that she tried to attract himself

(16) a. Max boasted that the queen invited Lucie and himself for a drink
    b. *Max boasted that the queen invited himself for a drink

(17) a. This letter was addressed only to myself
    b. *This letter was addressed to myself

What the exempt cases have in common is that the anaphor is not itself a (syntactic) argument of the main predicate, rather it is properly contained in such an argument. For instance, in (15a), the object

argument of *attract* is *a man like himself*, in (16a) the object argument of *invite* is *Lucie and himself*, not just *himself*, in (17a) *myself* bears focus. Systematic accounts of the distribution of true versus exempt anaphors are presented in Reinhart & Reuland (1991, 1993) and Pollard & Sag (1992).

Pollard and Sag base their approach on an obliqueness hierarchy (see Appendix):

(18) An anaphor must be co-indexed with a less oblique coargument, if there is one.

If an anaphor fails to have a less oblique coargument it is exempt.

Reinhart & Reuland (1991, 1993) distinguish between simplex anaphors or SE-anaphors (Dutch *zich*, Icelandic *sig*, etc.) and SELF anaphors (English *himself*, Dutch *zichzelf*, Icelandic *sjalfan sig*) and their respective functions as shown by the following typology of anaphoric expressions:

(19)	SELF	SE	PRONOUN
Reflexivizing function:	+	−	−
R(eferential independence:)	−	−	+

Unlike SE-anaphors, SELF-anaphors mark a predicate of which they are arguments as reflexive. A syntactic predicate, i.e. a predicate with a subject, must be interpreted as reflexive if it is reflexive marked. If a SELF-anaphor is not an argument of a syntactic predicate, it is exempt. (Note that, as shown by Anagnostopoulou and Everaert (1999) [+R] and [+Reflexivizing] are not incompatible given the occurrence of this combination in Modern Greek. It will be important to investigate to what extent this revised typology covers the full set of anaphoric expressions.)

Regardless of further differences in scope, in this particular domain both theories entail that the interpretation of exempt anaphors, and only of these, is not governed by the standard binding conditions. Pollard and Sag argue that instead they are subject to processing and discourse constraints. The role of processing constraints is illustrated by sensitivity to the nature of intervenors, as illustrated in (20) (examples from Pollard & Sag, 1992, with some indexings added):

(20) a. Bill$_j$ remembered that *Tom$_i$* saw [a picture of himself$_{i/*j}$] in the post office
      b. Bill$_j$ remembered that the *Times$_i$* had printed [a picture of himself$_{*i/?j}$] in the Sunday Edition
      c. Bill$_j$ thought that *nothing$_i$* could make [a picture of himself$_{*i/j}$ in the Times] acceptable to Sandy

As these examples show, an intervening argument does or does not block a crossing dependency depending on whether it qualifies as a potential antecedent. The relevance of discourse conditions to the interpretation of exempt anaphors is illustrated by contrasts as in (21):

(21) a. 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.
      b. *Mary was quite taken aback by the publicity John$_i$ was receiving. That picture of himself$_i$ in the paper had really annoyed her, and there was not much she could do about it.

There is a clear difference in acceptability between these two discourses. Yet, structurally the position of the anaphor *himself* is identical in both cases. The only relevant contrast is in the discourse status of the antecedent. In (21a) John's consciousness is being reported, in (21b) it is not (rather Mary's). Hence, in (21b) *John* does not yield a proper discourse antecedent for *himself*. In (16a), for instance, the antecedent is an agent of communication. These are typically associated with logophoric interpretation.

However, not in all cases has such an independent characterization been provided. Whether it can be found, or whether the interpretation of a subclass of exempt anaphors is only restricted by general discourse conditions, is still a matter of investigation. (Note, that it is in principle possible that a certain class of exempt anaphors is only restricted by being a low accessibility marker in the sense of Ariel, 1990.)

Since exempt anaphors can have antecedents that are quite far away, they have often been analyzed as involving long-distance binding. One of the important methodological considerations for the study of long-distance anaphora is that in each case it should be accurately determined whether interpretation involves binding, free discourse based interpretation, or a logophoric strategy (see Cole, Hermon & Lee, 2000 for much material and discussion). The same applies to the Barss facts given in (9). A systematic investigation should take into account that these examples involve exempt anaphors. As yet it is an open question whether this will lead to resolving the remaining puzzles.

Much is still unclear about the status of discourse conditions. To what extent are they linguistic, or do they belong to man's general cognitive endowment. Cole & Hermon (2000) provide interesting evidence from crosslinguistic variation among various Chinese dialects spoken in Hong Kong. Whereas the syntactic conditions facilitating free anaphors are virtually identical among these dialects, the discourse conditions that must be met by the antecedent vary. This indicates that discourse structure is more 'linguistic' than one might have thought, a fact that merits more extensive investigation and may have far-reaching consequences for our conception of the position of discourse structure in the language system.

7.2. Icelandic: the case of *sig*
The earliest discussion pointing towards a systematic distinction between structural binding and logophoricity is by Clements (1975), who took Hagège (1974) as a starting point. Clements presented a discussion of Icelandic, which subsequently gave rise to an extensive line of research in the Scandinavian languages.

The investigation of Icelandic yielded systematic differences between long-distance "anaphor-binding" into (subjunctive) finite clauses and long-distance binding into infinitival clauses indicating that only the latter falls under the structural binding theory (for instance, Thráinsson, 1976a,b; Maling, 1982, 1986; Anderson, 1986; Hellan, 1991; Thráinsson, 1991 and Reuland & Sigurjónsdóttir, 1997). The former occurrences of long-distance anaphors have a much freer distribution in that they do not require a c-commanding antecedent, but they are sensitive to discourse factors. (22) is an illustrative example of the absence of c-command:

(22) a. [$_{DP}$ Skoðun Jóns$_i$] er [að sig$_{i,acc}$ vanti$_{subj}$ hæfileika]
"Opinion John's is that SIG lacks talents"
"John's opinion is that SIG lacks talents" (cf. Maling, 1984:222)

Sells (1987:451) reports the following minimal pair:

(23) a. Barnið$_i$ lét ekki í ljós [að það hefði$_{subj}$ verið hugsað vel um sig$_i$]
"The child put not in light that there had been thought well about SIG"
"The child didn't reveal that SIG had been taken good care of"

   b. *Barnið$_i$ bar þess ekki merki [að það hefði$_{subj}$ verið hugsað vel um sig$_i$]
"The child bore it not signs that there had been thought well about SIG"
"The child didn't look as if SIG had been taken good care of"

In (23a) the child is the person whose consciousness is being reported. In (23b) it has no such role. An important point is that the antecedent may also be absent, given the right discourse conditions:

(24) María var alltaf svo andstyggileg. þegar Olafur$_j$ kaemi segði hún sér$_{i/*j}$ áreiðanlega að fara ... (Thráinsson, 1991)
Mary was always so nasty. When Olaf would come, she would certainly tell himself [the person whose thoughts are being presented – not Olaf] to leave

This issue should be addressed by any theory that links an incomplete specification for phi-features to uninterpretability.

As in the case of English just discussed, logically one would have to distinguish between the syntactic conditions licensing exemption of the requirement that *sig* be bound (since *sig* allows long-distance binding anyway, it is not subject to the canonical condition A), and the way in which it is interpreted if it is syntactically free. Reuland (2001) proposes that *sig* is exempt from a structural binding requirement if it is prevented from entering a syntactic chain with a subject. Chain formation is mediated by Infl, but blocked by a subjunctive for reasons discussed there. Unlike what one finds for English *himself*, all instances of exempt *sig* appear to be logophoric in its

core sense (that is, their interpretation is always dependent on perspective; see Hellan, 1991; Reuland & Sigurjónsdóttir, 1997).

Some of the earlier work on anaphors in Italian also addresses issues that in retrospect typically involve binding versus logophoricity (Napoli, 1979; Giorgi, 1984; see Reuland, 1990 for some discussion).

The precise role and nature of possible blockers merits further investigation in view of the fact that Faorese lacks a morphological subjunctive, but nevertheless has a logophoric use of its cognate anaphor *seg* in the same type of environments (see Barnes, 1986).

Despite the fact that many issues still remain to be investigated, it is fair to conclude that what we do know presents a serious challenge to any theory that aims at covering all types of anaphoric dependencies by a single module of the language system.

8. Predicates, licensing and pronominals

Languages often have a richer anaphora system than modern English. Many have a 3-way or even 4-way distinction between pronominals, simplex anaphors (**SE-anaphors**) and complex anaphors (with a possible subdivision), instead of the 2-way distinction found in English. Furthermore, certain languages admit bound pronominals in environments where the canonical binding theory only allows anaphors.

8.1. Predicates

Much of the complexity of binding systems results from the interaction between binding and properties of predicates. (Williams, 1994 in fact argues that binding itself is defined on thematic grids.) Consider a situation where binder and bindee are both arguments of the same predicate. This is represented in (25), where *Pronoun* is used as a cover term for *anaphors* and *pronominals*:

(25) DP$_i$ P(redicate) Pro(noun)$_i$

Such a predicate is defined to be *reflexive* (Reinhart & Reuland, 1993). On the basis of the surface form the following two cases can be distinguished: i) P allows subject and object to have different values; ii) P does not allow this. In the latter case P is *intrinsically reflexive*. In English, *behave* is such a predicate, and in Dutch its counterpart *gedragen*. One may have either *John behaved* or *John$_i$ behaved himself$_i$*. The latter is technically reflexive and may be associated with a logical syntax representation of the form (26a). Semantically, *behave* denotes a property, not a relation. Consequently, (26a) reduces to (26b):

(26) a. John (λx (x behaved x))
   b. John (λx (x behaved))

This is in line with the fact that in the other option, *John$_i$ behaved*, a direct object is syntactically absent. Other verbs, such as *wash* allow a transitive use, but also allow object omission. Thus, one can have the

transitive *John washed the kids*, a reflexive *John washed himself*, and also *John washed* without an object (but note, that the latter is infelicitous if inserted in the position of the dots in *John washed the kids and ...*). This raises the question of how the two types of *wash* are related. (That it has a dual entry shows up independently in the fact that in nominalizations with no marking whatsoever, it allows a reflexive interpretation as in *wassen is gezond* 'washing (oneself) is healthy'. Non-reflexive predicates do not allow such a reflexive interpretation under nominalization.)

Reinhart (2001) shows that this pattern reflects an operation on the lexical grid. In English, and in principle universally, a lexical operation may reduce the internal role. The predicate resulting from applying this reduction operation to the transitive predicate *wash* is an intransitive variant of *wash*, denoting a property.

In Dutch verbs like *gedragen* 'behave', *schamen*, 'be ashamed', etc. do not allow an object to be absent. Rather, they require the simplex anaphor *zich*. Verbs such as *wassen* 'wash' do not require the simplex anaphor, but allow it. Reinhart (2001) shows that Dutch, like English, allows internal role reduction, but unlike what happens in English a reflex of transitivity is left in the form of a structural Case residue. This Case residue is also there in the other verbs discussed, and what the simplex anaphor *zich* does is check this Case (as would be independently required by current theories of Case as in Chomsky, 1995).

In English only a limited number of verbs (primarily verbs of 'grooming') allows object omission. In Dutch such verbs all have *zich*, but the class of Dutch verbs allowing *zich* is considerably larger. It includes transitive verbs like *verdedigen* 'defend', *snijden* 'cut', verwonden 'hurt', *ontwapenen* 'disarm', etc. Unlike the verbs of the *behave* class these verbs also allow a complex anaphor. Vikner (1984) describes a relatively small closed class of verbs with mixed reflexivization properties in Danish. In Dutch, however, this class of verbs appears to be open; Barnes (1986) describes a similar situation for Faroese. Yet, there is an important class of verbs that do not allow *zich*, but instead require the complex anaphor *zichzelf = himself*, as in *George$_i$ bewondert zichzelf$_{i}$/*zich$_i$* 'George admires himself'. This class of verbs includes: i) transitive verbs such as *haten* 'hate', *bewonderen* 'admire', *kennen* 'know', *bezitten* 'possess'; ii) predicates expressing similarity (Safir, 1992, see also Safir, 1998); iii) all verbs with a subcategorized PP object, such as *vertrouwen op* 'rely on', *afhankelijk zijn van* 'depend on'. Safir (1992) proposed that informativeness plays a role in explaining why similarity predicates require a complex anaphor. König and Siemond (2000) propose that the factor distinguishing *zich* and *zichzelf* verbs is pragmatic. On the basis of French, Zribi-Hertz (1989) makes a similar claim. That is, complex anaphors are required to express a reflexive instantiation of an action that is most naturally other-directed and simplex anaphors where the action is most naturally self-directed, or, alternatively, where the reflexive instantiation is unexpected versus expected.

Although much is still unclear about the lexical properties determining the membership of these classes, the facts discussed so far indicate such a pragmatic approach cannot be all there is. It is hard to determine a sense in which *bewonderen* 'admire' is more other-directed than *snijden* 'cut' or in which reflexive instantiations of *kennen* 'know' are less expected than reflexive instantiations of *ontwapenen* 'disarm'. Moreover, the fact that in Dutch, verbs with prepositional objects always require a complex anaphor if the object is locally bound, is an independent indication that a structural factor is involved. It is important to note that the following pattern in French (Zribi-Hertz, 1989), which is taken to suggest that a pragmatic factor such as ''unexpected'' versus ''expected'' is at work, does not show up in Dutch.

(27) a. Jean est fier de lui/lui-même ''Jean is proud of himself''
b. Jean est jaloux de *lui/lui-même ''Jean is jealous of himself''
c. Jean bavarde avec *lui/lui-même ''Jean mocks with himself''
d. Jean parle de lui/lui-même ''Jean talks to himself''

In the Dutch equivalents the complex anaphor *zichzelf* is always required. This indicates that a syntactic process can overwrite a pragmatic pattern.

Also note, that *zich* and its cognates in other languages cannot be simply expletives, as a counterpart of object omission in English. In many environments *zich* is a real argument anaphor. For instance, it alternates with the pronominal *hem* in *Jan$_i$ legde het boek naast zich$_i$/hem$_i$* 'John put the book next to him' and it occurs as a small clause subject in *Jan$_i$ voelde [zich$_i$ wegglijden]* 'John felt [himself slide away]'. Given that *zich* is a possible argument it is surprising that it cannot occur in the object position of predicates of the non-mixed type, such as *bewonderen = admire*. One can at least draw the following conclusions: i) The lexical operation of internal role reduction is restricted in scope (Reinhart, 2001); ii) Where role reduction does not apply some independent principle must rule out the simplex anaphor. That is, apparently, role reduction cannot apply to *bewonderen* 'admire', but, if it does not, why cannot *Jan bewonderde zich* nevertheless be interpreted as *John (λx (x admired x))*? The general pattern comes down to this: *A complex anaphor is required in cases where binding creates a reflexive predicate by 'brute force'.* This leads to two important issues: Why are (lexical) role reduction and 'brute-force' reflexivization restricted? The former is an open question. The latter has been discussed in Reuland (1998, 2001) and related to the workings of the computational system: variable tokens that are *too close* cannot be distinguished as different occurrences, hence cannot occupy different positions in the theta-grid of a predicate.

8.2. Reflexivity and licensers

The requirement that reflexivity must be licensed holds generally across languages. Faltz (1977) and Schladt (2000) present extensive overviews. Schladt, for instance, includes in his overview 147 languages from many different linguistic families which all require a special marking of reflexive constructions. (Prima facie exceptions can be found among creole languages. Whether these are true or apparent exceptions is an interesting matter of research. It is well possible, that certain structural conditions for the formation of (semantically) reflexive predicates are not met.)

The means languages employ to license reflexive constructions are varied, though. Faltz's typology distinguishes between 'head-reflexives' and 'adjunct reflexives'. Head reflexives are based on an element that occurs independently as a nominal head (not seldom a body part), generally with a pronominal specifier. In Basque, for instance, the phrase *bere burua* can mean ''his head'' in *he put the cap on his head*, but also *himself* as in *he killed himself*. The relation may be understood as one of inalienable possession (Pica, 1987, 1991). Adjunct reflexives are construed of a pronoun or SE-anaphor and an adjunct, marking emphasis or focus, which may also attach to lexical NPs. According to Jayaseelan (1997), Malayalam represents this option.

Schladt presents a wider variety of possibilities. Languages may use SELF-type elements as in various branches of Germanic, but also forms of duplication of the bound element, clitics, a range of verbal affixes, and prepositional constructions are used in addition to clear instances of body-parts or focus markers. Not all licensers are part of the anaphoric element, or even nominal. In Kannada, for instance, the licenser is a verbal affix, as extensively discussed by Lidz (1995). In Sakha (a Turkic language from the eastern part of Siberia) one finds affixal reflexive marking on the verb, alongside an argument reflexive (Vinokurova, in prep.). In some languages a different construction is used, such as embedding the bound element in a PP.

A related issue is that in German the canonical 3rd person anaphor is a monomorphemic *sich*. Unlike Dutch *zich*, its distribution is not clearly restricted by lexical properties of the predicate. So, one has *er schämt sich* 'he is ashamed' alongside *er hasst sich* 'he hates himself'; the same holds true for all persons. One indication of a potential structural difference is that the *sich* in *er hasst sich* can be topicalized and stressed as in *sich hasst er*, whereas the sich in *er schämt sich* cannot. In Dutch *zich* can never be topicalized, even when it is a true argument, as in **zich voelde hij t wegglijden* 'himself he felt slip away'. If the possibility to bear stress reflects differences in internal structure, the two types of *sich* could be argued to be structurally distinct. Reinhart (2000) develops an alternative. Based on crosslinguistic patterns in middle formation she proposes that German *sich* is like a Romance clitic in that it freely reduces the internal argument. If so, no further licensing of reflexivity is needed. Although

German allows the morpheme *selbst* to be attached to *sich* and *pronominals*, there is little evidence that it is more than an emphatic element (but see the discussion of datives in Reinhart & Reuland, 1993, and Reuland & Reinhart, 1995).

Whether the element used to license reflexivity also must do so, varies. As we saw, in English, in certain environments SELF-anaphors are exempted. In other languages, for instance Malayalam, the licensing anaphor does not need to be locally bound (Jayaseelan, 1997). This is illustrated by cases such as *raaman$_i$ wicaariccu [penkuttikal tan-ne$_i$ tanne sneehikkunnu enn@]* 'Raman thought [girls SE-acc self love Comp] = Raman thought that the girls loved him(self)'. Here the anaphor *tan-ne tanne* in the downstairs clause is bound by the upstairs *raaman*, as compared to *raaman$_i$ tan-ne$_i$ *(tanne) sneehikunnu* 'Raman SE-acc self loves = Raman loves himself' where the presence of *tan-ne* is obligatory in order to license local binding. Such facts constitute a challenge for the canonical binding theory and indicate that a far more systematic investigation of extant cross-linguistic variation, especially concerning various types of body-part reflexives is highly important for a proper understanding of the principles underlying binding.

8.3. Locally bound pronominals

Creole languages are often reported to lack condition B, although this does not hold true in general. (See for interesting discussions and facts, Déchaine and Manfredi, 1994; Dubois, 2001; Lefebvre, 1999; Muysken, 1993; Muysken & Smith, 1994.) The case of Frisian (and also Old English) shows that such reports merit careful scrutiny. Frisian has been cited as a language without an anaphor-pronominal distinction. This is not correct, though. Frisian has a 2-way system, but different from English. In fact, its system is rather like Dutch. Only, it lacks the SE-anaphor *zich*. Instead it has the pronominal *him* 'him', *har* 'her', *har(ren)* 'them' (given in their strong forms) where Dutch has *zich*. Consequently, Frisian has local binding of pronominals in all persons (see Everaert, 1987, 1991). These elements are true pronouns. Consequently, a sentence like *Jan fielde him fourtglieden* 'John felt PRON slip away' is ambiguous between a reading in which John slips away and a reading in which someone else slips away, unlike its Dutch counterpart with *zich*. Although, just like Dutch, Frisian pronominals have weak forms alongside strong forms, the weak/strong distinction is irrelevant to local binding. Where Dutch has the complex anaphor *zichzelf*, Frisian has an anaphor as well, namely the complex anaphor *himsels*, etc. So, in terms of the requirement to license a reflexive predicate, Frisian is no different from Dutch. It is striking that in current discussions of Old English which has also been claimed to lack anaphors (but see Van Gelderen, 2000) no convincing cases have been given of sentences with a locally bound pronominal where the Frisian counterpart is not grammatical as well. This does not imply that they cannot be found,

only that the case is less evident than it might seem, and still requires further investigation (see Keenan, 2000).

Reuland and Reinhart (1995) relate local binding of this class of pronominals in Frisian to an independent property of the Case system; these pronominals are underspecified for structural Case. Such relevance of Case distinctions also shows up in German dialects. As noted by Keller (1961, 1978) certain dialects, unlike standard High German, allow locally bound pronominals in PPs, but not if they are accusative. Other dialects allow any non-accusative pronominal argument to be locally bound, but no accusative argument. Interestingly even High German shows Case sensitivity in that a c-commanding Dative argument cannot bind a direct object *sich* anaphor. Such a sensitivity to Case is quite unexpected from the perspective of the canonical binding theory. It is much more natural from the perspective of a minimalist approach to binding which allows formal morpho-syntactic relations to encode binding relations or, instead, block syntactic encoding. (Menuzzi, 1999 provides intriguing evidence from Brazilian Portuguese to the effect that certain restrictions on local binding reduce to purely syntactic conditions on chain formation.) It is worthwhile to further explore this possibility and provide a full implementation.

Extending this discussion to cover a substantial part of the languages of the world would lead beyond the confines of this overview. The literature contains considerable discussion of contrasts in Mandarin Chinese between a simplex anaphor *ziji* and a complex anaphor *ta ziji*, where the former is often classed as long-distance and the latter as local. A contrast between a simplex anaphor *zibun* and a complex anaphor *zibun zisin* has been reported in Japanese. Whereas *zibun zisin*, like other complex anaphors based on *zibun*, is local, the precise properties of *zibun* are much debated. It has been typed as an element much like a typical SE-anaphor (Aikawa, 1993), but also as en element more like a Frisian type pronominal, which in some of its uses also reflects the more complex structure that has been claimed for German *sich*. Matters tend to be obscured by the fact that its interpretation is much more sensitive to discourse factors that generally enter into logophoric interpretation than its counterparts in Germanic (see Hara, 2002 for illuminating discussion). Space limitations prevent a more extensive discussion here.

9. The role of indices in the grammar

As discussed in Section 3 the canonical binding theory is stated in terms of coindexing and c-command. The status of indices has generated a debate that in one form or other continues up to the present day. According to, for instance, Chomsky (1980), indices bear a close association to the discourse entities an expression refers to. As we saw, also in a Fiengo and May type of approach (Fiengo & May, 1994), the indexing reflects an essential part of the meaning of a sentence. An alternative conception of indices is that they are nothing more than annotations of the structure; they reflect certain syntactic dependencies to the extent in which these enter into determining the relevant semantic relations. From this perspective it is conceivable that they can be eliminated from the structure.

Reinhart (1983) and subsequent work argues that the linguistic status of co-indexing is strictly determined by the binding theory. C-command and co-indexing determine where the relation between an antecedent and an anaphor or pronominal is one of *variable binding*. It is variable binding that is governed by the binding theory; co-indexing is an annotation of the structure that is only interpreted in the context of the binding theory.

Thus, within the canonical binding theory the indexing in (28) is a part of the syntactic structure that is semantically interpreted, although, since there is no c-command, *John* does not bind *him*:

(28) Pictures of John$_1$'s father belong to him$_1$

In Reinhart's approach indices as in (28) are not part of the syntactic structure. It is entirely proper to represent the sentence as in (28'a) without indices. The syntactic structure does not prescribe whether (28'a) is assigned the interpretation (28'b), (28'c), etc.

(28)' a. Pictures of John's father belong to him
       b. Pictures of John's father belong to him & him = John
       c. Pictures of John's father belong to him & him = Peter, etc.

That is, assigning *him* and *John* the same individual as their values has the same status in the theory as assigning *him* any other male individual as a value. What value is actually assigned is fully determined by the interpretive component. In Reinhart's approach the interpretation represented by (28)/(28'b) typically instantiates what has been called "accidental coreference". In a Fiengo & May type approach "accidental coreference" is limited to cases like (4) where to the relevant parties involved it is not known whether *John* is actually identical to *he/the robber*.

Clearly, the two approaches embody a different view of cutting the pie of anaphoric dependencies. In a Fiengo & May type approach the bulk of the work is done in the syntax, and only a marginal part of it is left to an interpretive component. In a Reinhart type of approach the work is rather equally divided over the interpretive component and the computational system (syntax and logical form, governing binding relations), leading up to a modular approach to binding.

I will not review the various pros and cons at this point, except for noting that in the context of the minimalist program (Chomsky, 1995) the issue got sharpened in a very specific way.

10. Binding and the minimalist program

The MP proposes that the computational system of human language (henceforth C$_{HL}$) reflects the combi-

natorial properties of a purely morpho-lexical voca-bulary. Its guiding hypothesis is that C_{HL} is an optimal solution for a system pairing form and interpretation and which is to meet the specific conditions imposed by the human systems of thought and perception/articulation. A perfect language should meet the condition of *inclusiveness*: any struc-ture formed by the computation is constituted of elements already present in the lexical items selected. No new objects such as indices are added in the course of the derivation. Hence, indices, the core ingredient of the canonical binding theory, are not available within C_{HL} (unlike in Chomsky, 1980, 1981). This means that the binding theory cannot be part of C_{HL} proper, but instead is relegated to the C-I interface; unless, of course, the effect of indices can be mimicked using elements that are part of the morphological inventory of the language.

This issue, and the associated problems, can be illustrated on the basis of a proposal by Elbourne (2001). He argues for a unified semantics for E-type pronouns and pronouns as individual variables, since, as he notes, their semantics is quite distinct, but no language makes a formal distinction between the two. Elbourne introduces a concept of indices as phono-logically null NPs and pronouns as definite articles that take an index/null NP as their argument. The analysis, interesting as it is, brings back the initial puzzle in another guise: no language makes a formal distinction between these different null NPs. In fact what is implied is either an infinite inventory of null NPs or an infinite ambiguity of this NP. Clearly, the problem is not so much whether or not the notion of an index can be mimicked, but how well any particular way of mimicking it can be motivated. Or ultimately, whether we need it at all within, or outside C_{HL}.

Within the context of the minimalist program Reuland (2001) elaborates a conception of the division of labour between the computational and interpretive systems in the spirit of Reinhart's view on indexings. Whether a certain dependency is encoded in the syntax does not depend on meaning per se. Encoding reduces to the possibility of composing independently existing grammatical dependencies, each of them just using the mechanisms involved in feature checking and movement. The basic pattern is illustrated below, where R1 is the agreement/Case dependency, R2 a V-I dependency and R3 again a Case dependency.

(29)   DP   I   V   pro
              └──┬──┘ └─┬─┘ └─┬──┘
                R1   R2   R3
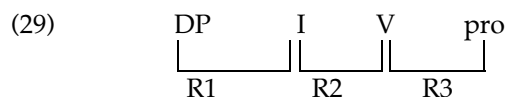
Each of these dependencies is effectively a depend-ency between formal features established by checking. These dependencies can be composed. The composi-tion process allows *pro* (where we take *pro* to vary over pronominals and SE-anaphors) and its antece-dent to form a chain just in case *pro* is a SE-anaphor. Only dependencies involving SE-anaphors can be thus encoded (dependency formation with SELF-anaphors is more indirect, see Reuland, 2001 for

discussion). Dependencies involving pronominals cannot. For reasons discussed in Reuland (2001), the process of chain formation is blocked by the presence of number on the tail. SE-anaphors can thus enter a syntactic chain since they lack a number specifica-tion. Binding of pronominals is not encoded in narrow syntax. It is represented by variable binding (see Reinhart, 2000) which is encoded at the C-I interface. Accidental coreference is just an unavoida-ble result of the fact that the interpretive system may freely assign a pronominal any value that is available in the discourse storage. Since the preencoding of a dependency in the syntax makes use of feature checking, no indices are introduced in the computa-tional system.

This implementation makes extensive use of covert feature movement. It is to be expected that the analysis can also be implemented in a system with Agree (Chomsky, 1998) although this implementa-tion has not been carried out yet. In the light of the following alternative it would be interesting to pursue it.

Hornstein (2001) and Kayne (2001) explore the possibilities in the minimalist program for Move to directly implement binding. (30) provides a sample of the type of derivation proposed by Kayne.

(30) a. John thinks he's smart
     b. – thinks [John he] is smart
     c. John thinks [~~John~~ he] is smart

(30b) is the source of (30a). A DP and a pronominal are generated as a double, with the DP in the specifier of the projection headed by the pronoun. The DP is moved (a movement that is sanctioned if movement into theta-positions is allowed), leaving behind a copy, as in (30c) that is not spelled out. Hence, the dependency between pronoun and antecedent is elegantly captured by using only copy and merge. Kayne crucially assumes that this is the only way for a (weak) pronominal to be interpreted. As Kayne puts it: "Antecedent-pronoun relations (...) REQUIRE movement out of a constituent of the form [*John-he*]. That is the ONLY way to express an antecedent-pronoun relation." It follows from this approach to pronoun interpretation that accidental coreference cannot exist (except in cases of mistaken identity, etc.). (But note, that for certain languages, for instance Dutch or German, it may not be clear that weak pronouns require an antecedent, or that strong ones cannot be bound.) Cross-sentential anaphora can be accommodated if sequences of sentences in a para-graph as in (31a) are in fact equivalent to conjoined sentences as in (31b) (see also Chierchia & McConnel-Ginet, 2000). Sideward movement as proposed by Nuñes (2001), will then allow deriving (31b) from (31c):

(31) a. John is famous. He's smart too.
     b. John is famous, and he's smart too = John is famous, and [~~John~~ he]'s smart too
     c. – is famous; [John he] is smart

Kayne proposes that condition B follows from a property of the structure of the verbal projection. A crucial intermediate step he suggests is that there is movement of the doubling constituent, but that there is no appropriate licensing position for a pronoun within VP or between VP and the subject theta position.

Although not discussed in detail, Kayne proposes that it is essentially the same mechanism that is involved in anaphor binding. This is illustrated in (32), where (32b) (= Kayne's (80)) is the source of (32a):

(32) a. John thinks highly of himself
    b. thinks highly of D0 [John-he] ('s) self

Unlike in the case of a pronominal, there is an intermediate position available for *self*, hence local binding is possible.

That accidental coreference does not exist, is a consequence of Kayne's specific assumption about the interpretation of weak pronouns. It does not appear to be essential for the movement approach per se.

The approach sketched generates a considerable amount of further questions, both conceptual and formal. How far-reaching these are largely depends on how strongly the claim that dependencies are encoded along these lines is pressed. For instance, if one considers sentences, or texts with one antecedent and *n* occurrences of covalued pronominals, the source must have the form of a layered structure [DP, $pron_1$,......,$pron_n$] with multiple specifiers or equivalent. Basically, this means that the notion of a numeration, if one wants to keep it, is a textual, not a sentential notion. For one set of pronominal dependencies in a text, it is one DP in one sentence that must provide the source. It somewhat depends on how one envisages the relation between a numeration and the planning of how to express a thought, but it looks as if from the perspective sketched all dependencies must be planned ahead.

There is in fact a rather interesting way to interpret this issue (going beyond the discussion by Kayne). One could argue that this position leads to the empirical claim that the Move mechanism is limited to one planning unit. If so, in terms of the perspective in this overview, the nature of the encoding of anaphoric dependencies should vary as to whether the dependency is within or crosses a planning unit (leaving open how small or large these planning units are). Given our leading thesis concerning the nature of the relation between "structure" and "process", one would expect this contrast to be reflected at the process level, which in turn would justify the necessary experimental effort.

An implementation of this approach in minimalist syntax raises a number of theoretical questions, some of which are informally addressed by Kayne (without attempting to resolve them). It requires a theory of movement that is considerably less constrained than assumed in the earlier versions of the minimalist program. For instance, anaphoric dependencies can easily cross the bulk of constituents that are islands to movement: coordinate structures, adjuncts, etc. are all easily bound into. Also the incorporation of non-c-command anaphora, backward anaphora, etc., requires attention and specific assumptions. For the moment these observations should suffice, since further discussion of these issues would lead us beyond the scope of this article.

A variant that would share some of the spirit of the Kaynean approach is to abolish the approach based on "en-bloc-bulk-insertion-followed-by-movement" of all pronominal copies and their antecedent, and replace it by a one-for-one copy-and-merge-approach (including merger into other subtrees in the stack of things in the working space of the assembly line, to introduce that metaphor). Alternatively one could allow unlimited copying of elements in the working space. The copying ensures covaluation, assuming that copies cannot have a different interpretive fate. For binding by pronominal antecedents this would work rather straightforwardly; for binding by non-pronominal antecedents it would effectively require that what is copied are just their φ-features. So, the process in (30) instead of being representative of all encoding of pronominal binding, would illustrate only the first step. *John thinks [~~John~~ he] is smart* would in fact stand for (33):

(33)   John thinks [~~John~~ φ] is smart

Along the variant sketched, the first step would be to have [~~John~~ φ] somewhere in the working space. Make as many copies of φ as you wish, and merge them where needed, and subsequently spell them out as pronominals, since pronominals are bundles of φ-features anyway. This would only require the assumption that the φ-feature bundles of DP are visible for the syntax and can be manipulated by the computational system (as also discussed in Reuland, 2001).

In the end, it seems that this line brings us back full circle to the view of Fiengo and May, with the notion of sharing an index replaced by "being a copy of". If so, the question comes up to what extent the relaxation of the conditions on Move result in more than a notational variant of a co-indexing approach.

Kayne's approach reflects a stance that is interesting from the general perspective of this overview: it really says that there is one mechanism responsible for all anaphoric dependencies.

In this respect, it is conceptually in line with more computationally inspired approaches to anaphora resolution. For instance, Jäger (2001) remarks:

"From the perspective of semantic resource management there is no fundamental difference between binding and coreference. While binding involves binding of multiple variable occurrences by one λ-operator, coreference comes down to the multiple use of one lexical resource. (...) Given that these conceptually similar phenomena – binding and coreference – are not overtly distinguished in natural language, it seems somewhat artificial to separate them in linguistic theory."

Similarly, in standard DRT (as presented in Kamp & Reyle, 1993), there is essentially only one mechanism for establishing anaphoric relations. In so far as anaphors and pronominals behave differently, as expressed by conditions A and B, this is accommodated by incorporating these conditions as restrictions in the construal rules of anaphors and pronominals. Nevertheless, from the perspective of the structure of the theory both the existence and the format of these restrictions is essentially arbitrary, hence do not affect the assessment that it is an essentially unified system.

11. The burden of interpretation

Unified systems have their attractions and it is important to push certain analytical tools to their limits. Yet, where-ever a phenomenon by its very nature involves different components of a complex system, there is never an a priori advantage to accommodating a class of facts in one component over another. (Of course, there is always a preference of using tools and conceptions we understand over tools and conceptions we don't.) It seems uncontroversial that language involves both a computational and an interpretive system. The minimal requirement on an interpretive system I_{HL} is that it reads off expressions made available by C_{HL} and turns them into instructions to update an information state, accessing a cognitive faculty along the lines of what Chomsky (1998) calls the *language of thought*. Just like, by necessity, C_{HL} has the operation Merge, I_{HL} has the operation Int, which has as its domain expressions E_L from C_{HL} and as its range expressions e_C from the conceptual system. (NB. We may consider all brain states as finitely representable, hence also the *language of thought* can be conceived as a set of expressions of some sort, although it's clearly not *Language*). (The only escape from the necessity that there be an interpretive system would be to claim that there is no non-linguistic knowledge. That is, all knowledge is propositional, and moreover the format of expressions of this propositional knowledge is that and only that which is specified by C_{HL}. I am not sure whether this is a position that has actually been defended. It is certainly not the position taken in Chomksy (1998) or anywhere else, nor would it seem supported by the facts.)

For both the computational system and the interpretive system, the necessary tools are available, and theories pursued and sometimes hotly debated. e_C will definitely contain expressions for individuals. What this entails will be discussed in the next section.

12. Variable binding and covaluation

Even if e_C would be very restricted in its expressive power, we may be sure that it will contain expressions representing individuals of the domain of discourse. As we know independently, different (sub)expressions in C_{HL} may be interpreted as the same individual. This clearly must be allowed in the case of two definite descriptions such as *morning star* and *evening star*. But also the possibility that *John* and *he* in (34) are interpreted as the same individual comes for free.

(34) John thinks he's smart

That is, if a dependency as in (34) must be encoded within C_{HL}, this is a contingent fact of language, not a state of affairs that would be favoured on the basis of a priori considerations (either methodological or derived from the perfection of language).

The above is an attempt (somewhat post-hoc) to clarify an issue in a debate that in this form never took place, but is more like an undercurrent in much of the discussion of the relation between C_{HL} and interpretive systems over the last quarter century. (See Fiengo & May, 1994, and Reuland, 2001, 449 fn 12 for some explicit discussion, though).

The upshot is that, given that the possibility for *John* and *he* to be covalued exists anyway, any additional means to represent their dependency must be specifically motivated.

Reinhart (1983) and in subsequent work takes the position that the only means in addition to covaluation that is motivated is variable binding. Variable binding obtains under the following conditions:

(35) i) α and β are co-indexed
     ii) α c-commands β
     iii) in logical syntax β is translatable as a variable

Note that iii) is mostly left implicit but it is made explicit in Reinhart (2000).

A well-known illustration of variable binding versus covaluation is given in (36):

(36) a. Only Lucie respects her husband
     b. Covaluation: Only Lucie (λx (x respects her husband)) & her = Lucie
     c. Binding: Only Lucie (λx (x respects x's husband))

Under the covaluation interpretation Lucie is the only woman who respects Mr A., who she is married to; so the sentence would be false if there is some other woman who respects Mr A., moreover, the sentence says nothing about other woman-husband pairs. Under the binding interpretation, the sentence is about woman-husband pairs; of these pairs only Lucie and her husband form a respecting couple, but it is perfectly compatible with lots of women respecting Mr A.

In this view, the binding conditions only govern variable binding. Covaluation is not restricted by the binding conditions. Consequently, the system accepts sentences such as (37) with *he* and *Oscar*, or *him* and *Bill* covalued:

(37) a. Everyone has finally realized that Oscar is incompetent. Even *he* has finally realized that *Oscar* is incompetent. (Evans, 1980)
     b. I know what Mary and *Bill* have in common. Mary adores *him* and *Bill* adores *him* too. (Reinhart, 1983)

Since from this perspective binding condition B can always be bypassed by covaluation (in the case of referential antecedents) the next question is why this is not always possible. If it were, binding condition B could always be voided. This issue has led to an ongoing debate over the years between what we can broadly call two views, that are nevertheless similar in one important respect: the choice between binding and covaluation involves the choice between accessing distinct modules of the language system, or perhaps even broader, the choice between accessing two distinguishable cognitive faculties (though both are naturally involved in language). One is the computational system (possibly somewhat broader than C_{HL}) the other the interpretive system.

The debate is about how the choice is made. One theory (Reinhart, 1983; Grodzinsky & Reinhart, 1993) argues that the choice between them in this view is governed by an economy principle (but see Reinhart, 2000 for an interpretation based on cooperation).

The other approach (Heim, 1998; Thornton & Wexler, 1999) takes it that there is no covaluation in a strict sense. Rather, where it looks as if we have admissible covaluation, the discourse elements involved are always distinguishable as different guises.

12.1. Rule I

Grodzinsky & Reinhart (1993) formulate the principle governing the choice as in (38):

(38) *Rule I: Intrasentential Coreference*
  NP A cannot corefer (be covalued) with NP B if replacing A with C, C a variable A-bound by B, yields an indistinguishable interpretation

The rationale for Rule I given in Reinhart (1983) and Grodzinsky & Reinhart (1993) is that the computational system wants to close unsaturated expressions as soon as it can: it is more economical to close unsaturated expressions than to keep them open. When the system closes an expression, it does so blindly; it does not take into account any effect of this decision once it has been made. The choice is only affected by information available at the relevant point of the decision tree.

As already noted by Fiengo & May (1994), applying Rule I requires reference to two derivations and comparing them; so one sentence may not contain enough information to evaluate it anaphorically. Grodzinsky & Reinhart (1993) find independent motivation in the delayed condition B effect (Wexler & Chien, 1985), illustrated in (39).

(39) a. (*)Oscar touches him (Children 50%)
  b. *Every boy touches him

At an age where children already know that anaphors are subject to condition A and are virtually error free, they make 50% mistakes in cases like (18a), but not in cases like (18b) with a quantificational antecedent. As they note, children and also agrammatic aphasics have a guessing pattern in such cases. They seem at a loss about what to do. This guessing pattern is interpreted as indicating an overflow of their processing capacity: evaluating (39a) requires a comparison between possible derivations, (39b) involves no such comparison, since the subject allows no referential interpretation. It is therefore predicted that subjects with limited processing capacity, either since they are insuffiently mature (as one may assume children to be), or since their processing capacity is damaged (as in the case of agrammatic aphasics) will precisely show the pattern in (39).

The view that limitations on processing capacity underlie the condition B errors of children and agrammatic aphasics is taken up by Avrutin (1994) (see also Avrutin, 1999). Avrutin proposes that the limited processing capacity leads to a more general problem with making inferences about speaker's intentions. In his view, children may mistakenly understand the use of the pronoun in cases like *Mama Bear washed her* as deictic and assume that such deictic use of a pronoun to refer to Mama Bear may well be in accordance with the speaker's intentions.

12.2. Guises

Heim (1993/1998) and Thornton & Wexler (1999) elaborate an alternative to the bound variable/coreference contrast based on the notion of a guise. Under this approach *Bill* and *him* in the second clause of (37b) are not strictly speaking interpreted as the same semantic object, but as different guises. Informally speaking, one may say that in this view, the semantic representation of a pronoun may still reflect a linguistic description by which the object to which it refers has been introduced. So, in (37b), *him* may stand for *the person Mary adores*. The availability and assignment of guises is governed by pragmatic considerations. Assuming that condition B is sensitive to difference in guise, *Bill adores him too* will only violate condition B if *him* has the Bill-guise. If it has the guise of *the person Mary adores* condition B is respected. In a guise based approach condition B extends beyond variable binding in a strict sense. See Baauw and Delfitto (1999) for a discussion of various implications of a guise based approach. In this approach, children's errors with condition B stem from their lack of knowledge concerning real-world conditions. Thornton & Wexler (1999: 102) formulate this as the hypothesis of extended guise creation:

(40) *Extended guise creation*

  Children create guises in a superset of the contexts in which adults do. Children create guises in which adults do not, but they do not fail to create guises where they are allowed by adults.

12.3. Morpho-syntactic factors

There is a variety of results (as discussed in Koster, 1993; Philip & Coopmans, 1996; Hestvik & Philip,

1997 and Baauw, 2000 which indicate that morpho-syntactic properties of pronominals constitute a further and independent factor. For instance, Dutch children may even allow local variable binding as in *ieder meisje waste haar*. This indicates that also from the perspective of acquisition a further differentiation within broad syntax is warranted, since morpho-syntactic factors are in the province of C_{HL} in a strict sense (narrow syntax). This is in line with the role of narrowly syntactic factors in crosslinguistic variation in the local binding of pronominals discussed above.

12.4. Conclusion

We can draw the following general conclusion from this discussion:

(41)   The findings about the delayed condition B effect obtained converge in showing that anaphoric dependencies do not just involve one mechanism, but at least two: one involving the computational system broadly conceived (broad syntax), the other the interpretive system.

This conclusion is highly important from the perspective of our overall concern in this article. It seems fair to conclude that facts of this kind pose a challenge for any non-modular approach to anaphoric dependencies.

13. Interlude: preliminary summing up

So far we have found that the computation of anaphoric dependencies involves a variety of mechanisms within the language system: lexical properties such as argument structure and operations on it, strictly syntactic properties such as Case, and conditions on chains, variable binding as a property of logical syntax, value assignment as a property of the interpretive system, discourse factors such as source of the speech act or center of consciousness, and perhaps factors such as informativeness or user's expectations. Broadly speaking these mechanisms belong to the lexicon, narrow syntax, broad syntax/ the C-I interface and the interpretive system. Given the discussion in Sections 1 and 2 and specifically the correspondence thesis we would expect such differences to show up at the neural/processing level. It should be noted that this type of neuro-linguistic research is only beginning. However, the results that have been obtained so far are quite intriguing.

14. Anaphoric versus logophoric interpretation of picture noun reflexives

Harris, Wexler and Holcomb (2000) carried out an ERP investigation of picture noun reflexives. ERPs are changes in voltage recorded at the scalp which are time-locked to specific stimulus events. ERPs show a sensitivity to certain grammatical and semantic processes in spoken and written language.

A negative-going wave with a peak latency of 400 ms (N400) is larger in amplitude to words that are not supported by a given semantic context. One interpretation of this pattern is that the N400 reflects the process of semantic integration. A different ERP component, the P600 (a positive-going wave peaking around 600 ms), has been shown to be sensitive to certain syntactic processes, its relative amplitude being larger whenever a reader or listener detects a structural violation (see Harris, Wexler & Holcomb (2000) and the literature cited there for more discussion).

The pattern they found is illustrated in:

(42)   a. *John's brothers like himself
       b.   John's brothers like themselves
(43)   a. #John's brothers like [Bill and himself]
       c.   John's brothers like [Bill and themselves]

(42a) is ungrammatical since the c-commanding DP *John's brothers* does not match in number with the anaphor *himself*, whereas *John* which does match with the anaphor does not c-command it. In (42a) *himself* is in argument position, hence it reflexive-marks the predicate *like*, which consequently should be reflexive, which it cannot be due to the number mismatch. In (43a), by contrast, *himself* is not a syntactic argument of *like*, but properly contained in such an argument. Hence, it is exempt from condition A (see Reinhart & Reuland, 1993; for Pollard & Sag, 1992 the same conclusion holds, be it for a different reason). Nevertheless the sentence is unacceptable.

For a theory in which all anaphoric dependencies are essentially of the same kind and involve the same mechanism this should be no reason to expect any difference in status between (42a) and (43a). Since both are ill-formed, the theory should account for that by one and the same mechanism, and no differences at the processing/neural level should be expected. According to Reinhart & Reuland and Pollard & Sag, the unacceptability of (43a) is not due to a structural factor; rather it is a consequence of the fact that *John* does not meet discourse conditions on antecedents of logophors; it is not a center of consciousness, nor a source. So, there is a difference between the two cases: the ill-formedness of (42a) is manifest in the syntax; the ill-formedness of (43a) is not.

It is a finding in the ERP literature that, when arguments of verbs appear at the point where a syntactic violation is detected, a centroparietal positivity occurs, peaking at 600 ms after the presentation of the stimulus (P600). In this particular case Harris, Wexler & Holcomb (2000) did indeed detect such a P600 in sentences with the structure of (42a), consistent with other types of syntactic anomalies. *himself* in sentences with a similar structure as (43a) (not a syntactic argument of the predicate) failed to elicit the same response, though. Harris, Wexler & Holcombe concludes by saying that "this provides evidence that there are 2 processes involved in parsing this binding construction, one syntactic and another as yet

unidentified, perhaps involving meaning or pragmatics.'' Such evidence constitutes a challenge to unified approaches to anaphoric dependencies.

A contrast between logophors and co-argument reflexives is also found in child language. Avrutin and Cunningham (1997) report that children make more errors with logophoric reflexives than with co-argument reflexives.

15. Anaphoric dependencies in Broca's aphasia

Piñango (2001) studies the nature of the interpretation of referential pronouns as revealed by the comprehension patterns of pronouns and reflexives observed in Broca's aphasia. In off-line studies (truth value judgement tasks) Broca's patients perform well in their comprehension of reflexives, but somewhat poorly in their comprehension of pronouns, that is, they make condition B errors. Such results can, for instance, be understood in terms of an impaired processing capacity. Surprisingly, in on-line studies reviewed by Piñago, results have been found that are seemingly inconsistent. For instance, Love *et al.* (1998) study priming effects. So, in the sentence (44), right after the anaphor or pronominal a letter string (signalled here with ''[1]'') flashes on a computer monitor.

(44) The **boxer**$_i$ said that the **skier**$_j$ in the hospital had blamed him$_{i/*j}$/himself$_{j/*i}$ [1] for the recent injury

The task is to assess whether the string flashed is a word of English. When assessing binding for the reflexive, the letter string flashed represents a word semantically related to *skier*. This represents the ''correct antecedent'' condition. In the ''aberrant antecedent'' condition, the target is semantically related to *boxer*. These two related targets are compared to two comparable unrelated ones (control targets). A facilitation effect obtains when the reaction time (RT) for the related target is significantly lower than the RT for the unrelated target. That is, if at the point of the pronoun the related target elicits a lower RT than the unrelated target, one may conclude that facilitation for the related target has taken place. This is interpreted as an instance of binding.

Normal controls and Wernicke's show activation when *boxer* acts as the antecedent for the pronoun, and no activation when *boxer* acts as antecedent for the reflexive. Thus, these subjects show a pattern that reflects the formation of correct binding relations. Moreover, these two groups show appropriate activation of *skier* for the reflexive, and no activation for *skier* when the pro-form is the pronoun.

Broca's patients, by contrast, exhibit no priming for reflexives. This is surprising in view of the fact that in off-line tasks they perform well on reflexives. They show aberrant priming for pronouns – that is, the pronoun primes but for the wrong antecedent (*skier* in this case).

Piñango argues that this pattern of performance is captured if i) syntactic tree formation for sentence interpretation is ''slowed-down'' in Broca's patients (by limited processing capacity), and ii) non-syntactic information emerges as a potential competing source of sentence interpretation (e.g., coreference). *Above-chance* performance is predicted for reflexives in off-line techniques as follows. The only way a reflexive, being a syntactic argument of the predicate, can be interpreted is as a bound-variable, which requires syntactic tree formation to be executed (i.e., the antecedent must c-command the reflexive). So, even though the syntactic tree is slowed down, the interpretive system is forced to wait for the syntactic structure to be formed since without it, no interpretation is possible.

In on-line studies absence of priming for reflexives is predicted. Activation of an antecedent for a reflexive requires a fully formed syntactic representation since just like in the off-line case, c-command is a necessary prerequisite for bound-variable interpretation. At the time the experimental task taps the system – immediately after the reflexive has been heard – the syntactic tree is still not fully formed (since in the Broca's system this process is slowed down). This means that at that moment the reflexive cannot be properly interpreted. In the cross modal task, this translates into no facilitation of the antecedent.

In the case of the online evidence, aberrant priming for pronouns is similarly predicted. Simple coreference (a non-syntactic process) is always available as a possible source of interpretation for pronouns, as soon as the pronoun is heard. In the absence of a fully formed syntactic tree, this mechanism of coreference becomes the only means of interpretation available to the system in an online task, which, in this case, only serves to mislead the system. In the cross-modal task this is observed in the form of facilitation for the wrong antecedent (the semantically related target for the wrong antecedent elicited a lower reaction time than the control target).

Piñango concludes that the evidence strongly suggest that even though the interpretation of pronominals per se is not dependent on the integrity of Broca's area, other interacting and constraining mechanisms, such as availability of a bound-variable interpretation are. It is these mechanisms which depend on Broca's area but which are observed only under specific experimental conditions (i.e., on-line comprehension). This indicates that a proper understanding of anaphoric dependencies requires theories that distinguish between processes within different linguistic subsystems (semantics/discourse versus syntax proper). It also indicates that the study of language breakdown presents a source of evidence in the investigation of the language system at all levels of description.

16. Differences in interpretation cost

Piñango, Burkhardt, Brun, and Avrutin (2001) examines syntax-discourse relations by investigating the

interpretation processes of different types of anaphoric elements during real-time sentence comprehension. They carried out two experiments assessing the following contrasts: bound variable pronoun (45a) vs. referring pronoun (45b) and coargument reflexive (46a) vs. exempt/"logophoric" reflexive (46b):

(45) a. Everyone$_i$ thinks that students like him$_i$….
        (bound variable pronoun (BVP))
    b. The teacher$_i$ thinks that students like him$_i$….
        (referring pronoun (RP))

(46) a. The lawyer$_i$ who was young defended himself$_i$…. (coargument reflexive (CR))
    b. The daughter$_i$ hid a present behind herself$_i$….
        (exempt reflexive (LR))

These contrasts differ exclusively with respect to the mechanisms underlying the interpretation of the pronominals. In the (a) cases, interpretation is obtained via a mechanism in syntax alone (i.e., broad syntax/logical syntax in (45a) leading to a bound variable interpretation; obligatory reflexive marking in (46a)); whereas in the (b) cases, the language processor has to access information beyond that provided in the syntax. In order to determine whether this contrast is actually reflected in language processing, a Cross-Modal Lexical Decision Interference Paradigm was used: a technique where two tasks, understanding a sentence (primary task) and performing a lexical decision (secondary task), compete for processing resources. The RT to the lexical decision represents an indicator of the amount of resources required to construct the interpretation of the pronominal. Given the correspondence thesis of Section 2 it may be expected that whenever the processing mechanism needs to access discourse information, additional computational work is required. It is, therefore, predicted that interpretation of (b) cases will be costlier to the processor as compared to the (a) counterparts. Hence, processing of the (b) cases should reduce the amount of resources available for the secondary task, which would be reflected in a higher RT for this task. This prediction is supported by the results: For both experiments, difference in RTs for the control position was non-significant. The RTs in experimental position for RP's were significantly higher than for BVP's ($t(19) = 3.65$, $p = 0.001$). Similarly, RTs for LR's were significantly higher than those for CR's: ($t(26) = 1.70$, $p = 0.005$).

Piñango, Burkhardt, Brun, and Avrutin (2001) conclude that these results support models that distinguish between types of processes involved in interpretation. Moreover, the results suggest that representational distinctions regarding levels of information – in this case, syntax vs. discourse – are reflected in the course of real-time processing.

17. By way of conclusion

In this article I have reviewed a number of issues that to my mind play an important role in current discussions of anaphoric dependencies, and that I expect to do so in the future. It turned out to be utterly impossible to even try to strive for completeness in coverage of the field. The field is so rich that I simply could not manage to touch on many issues that by themselves would merit a whole article. Instead of aiming at full coverage I set out to follow two lines reflecting two questions: i) are anaphoric dependencies an essentially unitary phenomenon, or are different components of the language faculty involved? and ii) is it already possible to observe correspondences between distinctions at the architectural level and distinctions between processes at the neural level? It will be apparent that, personally, I have a clear opinion on these matters. I am convinced that anaphoric dependencies do involve different components of the language faculty for reasons set out in Reuland (2001) which I will not repeat here. I am also convinced that the answer to the second question is positive, and that the results obtained support my conviction as to the first question.

However, certainty is a rare commodity in science. The goal of this article is not to reiterate those convictions, but rather to bring out what the challenges are. A one-mechanism approach to anaphoric dependencies, either minimalist or computationally inspired, is an interesting endeavor, even though it is not a priori more desirable. As I started out saying, in the end the success of theories will be determined by the fruits they bear. There is much more that could have been said. In addition to evidence from processing, or from agrammatism, also the study of genetically determined factors in language may be expected to yield important results. There is for instance some very interesting work on anaphora in Downs' Syndrome (Perovic, 2001). Space limitations prevent me from pursuing this here.

Let me end by briefly touching on two issues for further research that follow from the discussion here. i) If morphosyntax does indeed play a role in some, but not all instances of binding, it should be possible to find reflections of this in the way in which processing takes place using techniques that differentiate between early morphosyntactic stages and later stages in processing. ii) Given that there must be an interpretive component distinct from C_{HL} it is reasonable to ask what type of work it does.

Such a question leads to the question of how thick the C-I interface is: Is there on the "meaning side" of the grammar (just like on the PF side, see Chomsky, 1995) a domain of symbolic manipulation that does not obey inclusiveness, with properties that are arbitrary from the perspective of the domain of interpretation? This leads up to the following grand issue that may keep us busy for quite some time and hence seems fit to conclude this contribution with:

Grand Issue: What is the nature of the interface between (narrow) syntax (C_{HL}) and the "Language of thought"?

Appendix: Some technical issues and definitions

Canonical Binding theory
(1) *a* c-commands *b* if and only if *a* does not contain *b* and the first branching (or maximal) projection dominating *a* also dominates *b*
(2) *a* binds *b* iff *a* and b are co-indexed and *a* c-commands *b*
(3) Binding conditions:
A: an anaphor is bound in its governing category
B: a pronominal is free in its governing category
Governing category is defined as follows:
γ is a governing category for α if and only if γ is the minimal category containing α, a governor of α, and a SUBJECT *accessible to* α

The SUBJECT of a category is its most prominent nominal element (including the agreement features in finite clauses).

α is accessible to ß if and only if ß is in the c-command domain of α, and assignment to ß of the index of α would not violate the *i-within-i condition*

i-within-i condition
*[$_\tau$ ... δ ...], where τ and δ bear the same index

Binding conditions in Pollard & Sag (1992)
(4) *Definitions of O-command and O-binding*
A o-commands B just in case A locally o-commands some C dominating B
A *o-binds* B just in case A and B are co-indexed and A o-commands B. If B is not o-bound it is said to be *o-free*.
(5) *Binding Theory*
A. A locally o-commanded anaphor must be locally o-bound
B. A personal pronoun must be locally o-free
C. A non-pronoun must be o-free

Binding conditions in Reinhart & Reuland (1993)
(6) *Definitions*:
a. The *syntactic predicate* formed of (a head) P is P, all its syntactic arguments and an external argument of P (subject)
The *syntactic arguments* of P are the projections assigned Θ-role or Case by P
b. The *semantic predicate* formed of P is P and all its arguments at the relevant semantic level
c. A predicate is *reflexive* iff two of its arguments are co-indexed
d. A predicate (of P) is *reflexive-marked* iff either i) P is lexically reflexive or ii) one of P's arguments is a SELF-anaphor
(7) *Binding conditions*:
A: A reflexive-marked syntactic predicate is reflexive
B: A reflexive semantic predicate is reflexive-marked

(8) *Generalized Chain definition*
C = (α_1,..., α_n) is a chain iff C is the maximal sequence such that
i) there is an index i such that for all j, 1 < j < n, α_j carries that index, and
ii) for all j, 1 < j < n, α_j governs α_{j+1}
(9) *Condition on A-chains* (condition on well-formedness)
A maximal A-chain (α_1,..., α_n) contains exactly one link – α_1 – which is completely specified for grammatical features

Rule I (Grodzinsky & Reinhart, 1993)
(10) Rule I: Intrasentential Coreference
NP A cannot corefer (be covalued) with NP B if replacing A with C, C a variable A-bound by B, yields an indistinguishable interpretation

How to understand Rule I: Consider the task to interpret a simple sentence such as *Bill adores him*. There are two routines to take: the binding routine and the covaluation routine. *Bill* binding *him* gives *Bill λ x (x adores x)*; covaluing gives *Bill λ x (Bill adores him) & him = Bill*; these are indistinguishable; hence Rule I states that the binding routine must be chosen. The fact that condition B subsequently rules the binding result out does not affect the choice for binding. At the choice point the system operates blindly. In a case like *I know what Mary and **Bill** have in common. Mary adores **him** and Bill adores **him** too*, things are different. The first sentence implies that we will be looking for a property that Mary and Bill have in common. The first conjunct of the second sentence says that Mary has the property of *him-adoration* where *him* is Bill; under the binding routine the second conjunct would assign to Bill the property λ x (x adores x), which is the property of self-adoration; this is not the property ascribed to Mary; given the first conjunct, what Mary and Bill have in common should be Bill-adoration. This interpretation can be obtained by using the covaluation strategy; given this difference in interpretation Rule I states that covaluation is allowed. Condition B is not invoked since there is no binding. Therefore the sentence is ruled in.

Rule I revised (Reinhart, 2000)
Problems:
i) Why is the strict reading in cases such as (11) allowed? Construing the first conjunct as variable binding would be more economical than interpreting *her* referentially.

(11) a. Mary likes her cat and Cindy does too
b. Mary (λx (x likes x's cat)) and Cindy (λx (x likes x's cat))
c. Mary (λx (x likes y's cat)) and Cindy (λx (x likes y's cat)) & y = Mary

If Rule I licenses the coreferential interpretation, since there is a meaning difference in the second conjunct, this leads to a problem if we are to rule out (12). Here

the second conjunct (λx (x likes Max's mother)) cannot license coreference in the first:

(12) *He likes Max's mother, and Felix does too (he = / = Max)

ii) Antecedents may be non-referential, as in (13):

(13) a. Every wife thinks that only she respects her husband
    b. Covaluation: Every wife (λx (x thinks that [only x (λy (y respects x's husband))])))
    c. Binding: Every wife (λx (x thinks that [only x (λy (y respects y's husband))])))

Revisions:

i) (Logical) concept of binding: binding is a relation between operators and variables (not between arguments), as in (14):

(14) *Logical Syntax definition of A-binding*
    a A-binds b iff a is a sister of a λ-predicate whose operator binds b

Covaluation, which also applies to bound variables, replaces *coreference* in the formulation of Rule I, as in (15):

(15) *Covaluation*
    a and b are co-valued iff neither A-binds the other and they are assigned the same value

Rule I is now given as (16):

(16) *Rule I*
    a and b cannot be covalued in a derivation D, if
    a. a is in a configuration to A-bind b, and
    b. a cannot bind b in D, and
    c. The covaluation interpretation is indistinguishable from what would be obtained if a A-binds b
    [To check c, construct a comparison-representation by replacing b with a variable bound by a]

The original version of Rule I was based on the intuition "close an open expression as soon as you can". For the revised Rule I, Reinhart gives the following rationale: "if a certain interpretation is blocked by the computational system, you would not sneak in precisely the same interpretation for the given derivation, by using machinery available for the systems of use". What both have in common is a preferential status of using the computational system over using other resources. Under the former the strategy is: use the computational system first, under the latter it is: check it first. Under both strategies it is the first system that is considered.

Acknowledgements

An Anaphoric Dependencies Bibliography

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