

A condition on circular chains: a restatement of i-within-i¹

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1. THE ISSUE

Chomsky's (1981) i-within-i condition (also written as i/i) blocks co-indexation of a phrase with one of its proper subconstituents:

(1) * [... a_i ...]_i

We argue here that the i-within-i condition as stated in (1) and used in current work is both empirically inadequate and theoretically incoherent.² Many of the data that the i-within-i condition has been taken to account for should, instead, be accounted for by a range of unrelated constraints. However, a condition on the interpretation of the reference of free pronominals and anaphors – which we state as a definition of circular chains – is, in fact, motivated and will adequately account for the data involving referential circularity that have previously been accounted for with the i-within-i condition.

2. THE HISTORY OF THE I-WITHIN-I CONDITION AND A PRAGMATIC ACCOUNT OF IT

Disjoint reference conditions have appeared in the philosophical and linguistic literature for many years. Perhaps the earliest condition within the (eventual) Government and Binding (GB) framework (that is, within the framework that later incorporated the i-within-i condition) is found in Vergnaud (1974). He considered data such as:

- (2) (a) * [The son of the woman who killed him]_i was a Nazi.
(b) * [The book by the man who designed it]_i cover_j will be coming out next week.
(c) * [The conclusion of the text that precedes it]_i is a nonsequitur.

[1] A shorter, earlier version of this paper appears in Hoeksema & Napoli (1989). We thank Isabelle Haik and the anonymous referees for comments on a draft of this paper.

[2] There are a number of variations in the literature on the schema in (1). For instance, Williams (1982) restricts both coindexed phrases to NPs, calling it the NP_i/NP_j constraint. Zwarts (1976) argues, on the basis of data from Dutch, that the i-within-i condition applies to all projections of N and not just to NP. Our main points in this paper apply to these variants of the i-within-i condition, as well.

To account for this sort of example, Vergnaud (1974: 34) proposed the Disjunction Condition (See also Zwarts, 1976, and Jullens, 1983.):

- (3) If, in a string, two noun phrases NP₁ and NP₂ are anaphorically related, then the string must be analyzable as ... NP₁... NP₂... or as ... NP₂... NP₁....

While the Disjunction Condition was later generalized to the syntactic i-within-i condition in the way discussed in Section 3 below, it was originally clearly rooted in the problem of referential circularity. In Section 4 below we pursue the path opened up by Vergnaud's insights, looking at more recent semantic accounts of referential circularity and proposing our own.

A common position of linguists regarding the Disjunction Condition and its generalized descendant, the i-within-i condition, is that this condition makes sense for pragmatic reasons. For example, an explicit pragmatic explanation is given in Higginbotham & May (1981). This explanation, which at first appears plausible enough, goes as follows. The reference of a pronoun must be resolved by finding an antecedent in the discourse or else by deictic anchoring to some prominent entity in the discourse situation. In the former case we enter an infinite loop if the reference of the antecedent in turn is dependent on the reference of the pronoun, as is the case when the pronoun is one of its parts. Hence the unacceptability of the examples in (2). In Higginbotham and May's sense, then, an antecedent is the entity, linguistic or nonlinguistic, that provides the referent to the pronoun it antecedes. There is, therefore, a semantic notion which cannot be defined in structural terms, unlike the definition of ANTECEDENT based on binding common to much work in GB. We here adopt their notion, while still taking exception to their argument.

Before criticizing Higginbotham and May, we note that there is an important sense in which they are clearly on the right track. Their explanation of i-within-i effects would be applicable only to instances of i-within-i in which all the relevant indices are referential. The i-within-i condition, therefore, could not be interpreted as a purely syntactic condition. We believe this is correct (as we argue below in Sections 3 and 4). Higginbotham (1983: 418) and Hornstein (1984: 112) both note this point, as well.

However, the particular pragmatic solution of Higginbotham & May (1981), while, we repeat, initially attractive, does not work in all the relevant cases and, hence, cannot be correct. Brody (1982) makes this point sharply. Take for instance:

- (4) * [her_i childhood friend's wife]_i

Some reflection (perhaps quite a bit of reflection) will tell us that this NP means the same thing as 'the one who is the wife of her childhood friend'. The reference of the pronoun is determined by finding the unique person in

the domain of discourse who is married to her childhood friend, which normally does not require an infinite loop. Yet the phrase is ungrammatical. Brody also points out that in mathematics specifications of numbers in terms of themselves are not necessarily uninformative. Within the set of natural numbers, for instance, the equation:

$$(5) n = 1/n$$

has the unique solution 1. This is immediately obvious, even though it might seem that to know what $1/n$ is, one must first know what n is, and vice versa. The equation:

$$(6) n = n$$

on the other hand, is both circular and uninformative. The point is that there is no logical necessity why reference could not be determined circularly.

In sum, we reject this pragmatic explanation for the i-within-i condition and in Section 4 below we develop an alternative account.

3. A SYNTACTIC INTERPRETATION OF I-WITHIN-I

The decade following Vergnaud (1974) witnessed a proliferation of the notation of indices to indicate many relationships beyond coreference. Williams (1980) used coindexing to indicate the subject-predicate relationship (which he argues observes well-defined syntactic restrictions) and many have adopted the use of predication indices (see the discussions of Hornstein, 1984, and Zubizarreta, 1982, below). Chomsky (1981) used coindexing to indicate agreement between the subject and INFL, and the binding of variables by operators (where, again, coindexation takes place within given syntactic configurations). Williams (1982) used coindexing to indicate the head-phrase relationship. While this is just a brief sampling, and while we handle below each instance only skeletally, these examples are representative of the ways in which the mechanism of indices has been used.

These works and many others of that period invoke a more comprehensive form of Vergnaud's Disjunction Condition, what we have been calling the i-within-i condition (as commonly stated in (1)) to account for the failure of certain structures in which a phrase with a given index is properly contained in another phrase of the same index. The Disjunction Condition is thus generalized in two ways: (i) instead of being a condition on NPs, it is a condition on a phrase of any category properly contained within a phrase of any other category; and (ii) the indices are no longer only referential indices, but any kind of indices. Since coindexation is just a device, and often not a terribly appropriate one (as Higginbotham, 1983, argues) to express syntactic relationships, the result is that the new i-within-i condition is no longer related to semantic anomaly in any clear way.

Many linguists have recognized that the inclusion of indices other than

referential indices in the *i*-within-*i* condition forces us to find a grammatical rather than pragmatic explanation for this condition. However, no coherent explanation has emerged in the literature. Instead, it is often claimed that *i*-within-*i* is simply a condition on any kind of index – an *ad hoc* part of formal syntax that is unrelated to any other constraints in the grammar (as in Hornstein, 1984: 112). Below we review a number of proposals that invoke this interpretation of the *i*-within-*i* condition, gathering together evidence already existent in the literature and adding new evidence, all of which shows how each attempt at exploiting this interpretation of the *i*-within-*i* condition is empirically inadequate or insufficiently motivated.

3.1. Hornstein (1984)

Hornstein (1984) argues that the *i*-within-*i* condition applies to all indexing dependencies, including the predication relation. He thus invokes the *i*-within-*i* condition to rule out:

- (7) *John_i is [his_i cook]_i.

The index assigned to the predicate nominal comes about by way of the predication relation between *John* and *his cook*. That is, (7) with predication coindexation states that John is assigned the property of being a cook for himself. This contrasts with an identity or equivalence interpretation of the copula in (7) (see Williams, 1983; Doron, 1988, among much literature in a philosophical vein), in which we would get the reading that John and his cook are the same person. The index assigned to *his* is a referential index. On this account, predication and referential indices are treated as indistinguishable as far as the *i*-within-*i* condition is concerned. And no appeal is made to semantic incoherence.

Indeed, there certainly is no semantic incoherence in (7). Yet it would appear that there is no violation of a syntactic condition on indices, either. Witness perfectly acceptable examples with similar coindexing configurations, such as:

- (8) John_i is definitely [his_i father's son]_i; just look at the way he acts!
 (9) John_i was [the last of his_i family]_i.

Furthermore, if we add the word *own* to (7) above, the sentence becomes grammatical and with the predicational (rather than identity) reading:

- (10) John_i is [his_i own cook]_i.

In order to account for (7) vs (10), Hornstein (1984: 113) is led to propose the *ad hoc* modification to the *i*-within-*i* condition to the effect that 'it applies only to a phrase that is both coindexed with a containing phrase and of relatively low embedding in that phrase', where the *his* of *his own* in (10) 'must be construed as "too deep" to be affected by the *i*/*i* Condition because of the presence of "own"' (see Hornstein, 1984: 166, fn. 8). The *his* in (8)–(9)

would also be too deep to be affected by the *i*-within-*i* condition, according to Hornstein.

An immediate problem for this modification of the condition is posed by the examples in (2) and (4), which constitute Vergnaud's original motivation for (his precursor of) the *i*-within-*i* condition. In each of these cases the pronoun illicitly coindexed with the container NP is deeply embedded. Furthermore, examination of other languages tells us that whatever condition blocks (7), it cannot be a condition that belongs to universal grammar (which the *i*-within-*i* condition is supposed to be). In fact, initially it appears to be a somewhat capricious condition that varies from language to language and calls for detailed study. Hoeksema and Napoli (1989) found that while Dutch and German present facts parallel to those in English example (7), Swedish, Norwegian,³ and Danish present slightly different data, with additional complications for each language, where the Danish counterpart to English (7) is perfectly acceptable with the reading of coreference.⁴ Given the variation in data in these closely related languages, it seems that some condition is about – but it will require close study of the individual languages to figure out what that condition might be. Beyond Danish, Hoeksema and Napoli found that the Armenian counterpart and the Finnish counterpart (for at least some speakers) to English (7) are acceptable on the relevant reading. It is clear, then, that the *i*-within-*i* condition is empirically inadequate: it should not be taken as relevant to the unacceptability of (7). In fact, while (7) in isolation resists an interpretation involving coreference, coreference is certainly possible in English in this same structure given an appropriate context. Richardson and Chametzky (1985) point out examples such as:

- (11) This is a non-cooperative household; just as I am my maid, John is his cook.

[3] It is interesting to note that Hellan (1986) has argued that the Norwegian reflexive anaphor *sig* is acceptable only if it is contained in a constituent understood as predicted of the antecedent. If this condition is correct, then some reflexives are not just exceptions to the *i*-within-*i* condition as interpreted by Hornstein: they are only acceptable when they violate it.

[4] The range of data found in these Scandinavian languages is not transparently related to the fact that they have a reflexive possessive. All these languages have a reflexive possessive, yet Swedish allows the counterpart of (7) only with the reflexive possessive and even then the cognate of English *own* must be present (in (7) it would be *sin egen*); Norwegian allows the counterpart of (7) with the reflexive possessive alone (*sin*) or with the nonreflexive possessive plus the word for 'own' (in (7) it would be *hennes egen*); and Danish allows the counterpart of (7) with the nonreflexive possessive alone (in (7) it would be *hans*). Furthermore, as mentioned below, both Armenian and Finnish (at least for some speakers) allow the counterpart to (7) and neither language has a reflexive possessive.

Still, we suspect that languages which have a reflexive possessive will be more likely to allow the counterpart to (7) with that reflexive possessive, because reflexive possessives, if they function as arguments of the head noun which they stand in specifier position to, can be considered anaphors with a local antecedent (the subject NP). See the discussion of (12) through (17) below in the text.

The parallel structure of the contrasting material leads us easily to a reading of coreference between *John* and *his*. A structural account of (7), then, is inadequate, even for English.

Finally, we want to point out an interesting observation about Hornstein's examples: we note that beside (12), we also have (13) in English (at least for some speakers), albeit with a different interpretation:

(12) John is not his own boss.

(13) [Don't talk to John! Talk to his boss!] John is not his boss!

(12) means that John doesn't work for himself, while (13), with coreference between *John* and *his*, asserts that John and his boss are two different individuals. We assume that (13) is an equivalence or identity sentence, whereas (12) illustrates predication. In 12 *his* functions, in our opinion, as an argument (John 'bosses' himself), but in (13) it functions as a specifier.⁵ Further support of this claim (which runs against Montague's (1974) identification of the two uses) comes from other predication structures in which we find only the counterpart to (12), not to (13):

(14) Let's make Eddie his own boss.

(15) *Let's make Eddie_i his_i boss.

Of course, in eliciting informant judgments, one should (and we did not in all cases) control for the subtle distinction between identity and predicational uses of the copula. It seems to us that genitives function as arguments in cases such as (15), while the identity statements as well as nonpredicative statements in general allow the genitives to act as specifiers. In the latter case the semantic role of the genitive is much freer. Consider for example the possible interpretations of (16) and (17):

(16) Grace wants to be her own doctor.

(17) Grace wants to be her doctor.

In (16) Grace is said to want to 'doctor' herself, while (17) says that Grace wants to swap identities with her doctor. In the second case, her doctor does not have to be the person who is responsible for her medical care at all. It could be any doctor who is in some salient way connected to Grace – maybe the doctor she is dating or the doctor she is working for or the doctor she is painting. The specifier reading is also available for *her own*, but then we must have a contrastive reading of (16). Argument readings depend on the possibility of interpreting the head noun as a relational concept. However, the argument reading appears not to be available to regular possessive

pronouns in English, presumably due to the same factors which bar personal pronouns from argument positions when their antecedent is a c-commanding clausemate, if we accept Higginbotham's (1983) suggestion that possessive pronouns modified by *own* can sometimes function as local anaphors. It is this, and not the i-within-i condition, which accounts for the perceived unacceptability in ordinary contexts of sentences such as (7) in languages such as English on the reading with internal co-reference.

3.2. Zubizarreta (1982)

A second type of application of the i-within-i condition to predication indices is found in Zubizarreta (1982). She argues that the *raison d'être* of S' deletion with raising verbs is to avoid a violation of the i-within-i condition. The trace of NP movement is coindexed with *Milton* in (18). And the S' of the infinitival clause is coindexed with *Milton* by the predication relation:

(18) Milton_i seems [_{S'} _i to be drowning]_i.

In the absence of S' deletion, the resulting coindexing between trace and S' would be a violation of the i-within-i condition. However, Aoun (1985) calls into question the empirical adequacy of Zubizarreta's explanation. He points out that in a sentence like:

(19) Bertha believes [Rudolph to be a lousy reindeer].

we have no potential for an i-within-i condition violation, yet S' deletion is still called for. Therefore, Zubizarreta has given no compelling evidence that the i-within-i condition is a motivating factor for S' deletion.

3.3. Chomsky (1981)

Chomsky (1981) proposes that the relationship of agreement between INFL and subject be marked by indices. He then appeals to the i-within-i condition to explain the grammaticality of sentences like:

(20) John_i saw [_{S'} [_i that a picture of himself]_i] INFL_i was on the wall.

The problem here is that the reflexive does not appear to be bound locally. Chomsky proposes to solve this problem by introducing the notion of accessible SUBJECT. According to Chomsky's definitions, the binding domain of an anaphor must contain an accessible SUBJECT. A SUBJECT is either INFL if INFL contains AGR, or else it is the structural subject. A SUBJECT is accessible to some phrase if the latter is c-commanded by it and coindexation with the SUBJECT would not violate the i-within-i condition. Since INFL of the embedded clause in (20) is coindexed by the agreement relation with the subject *a picture of himself*, it is not accessible to *himself* because coindexation with *himself* would violate the i-within-i condition.

[5] This corresponds to the interpretation our Finnish informant who accepted the Finnish counterpart to English (7) offered us (and note that not all Finnish speakers accept (9)):

(f) Pekka_i on [hanen_i tohtori]_i.
'Pekka is his doctor.'

In the reading with coreference, Pekka is understood to 'doctor' himself.

This analysis (as well as the revised version in Chomsky, 1986) fails in at least two ways. Kuno (1987) points out that the i-within-i condition is too strong, incorrectly ruling out grammatical examples like:

- (21) They made sure that nothing would prevent each other's pictures from being put on sale.

Keenan (1988) points out further that the explanation for (20) which relies on the i-within-i condition fails to allow for the acceptability of other cases of long-distance anaphora in English, such as:

- (22) Mary_i complained [that the teacher INFL gave extra help to everyone but herself]_i.

In (22) the SUBJECT (INFL of the embedded clause) is accessible to the anaphor *herself* because coindexation between the two would not violate the i-within-i condition. Chomsky's account of (20), then, would lead us to expect (22) to be ungrammatical. Thus, if (20) and (22) should be handled by a single explanation, that explanation cannot rely on the i-within-i condition. (See also criticisms of the 1981 version of the notion SUBJECT in Johnson, 1987.)

3.4. Williams (1982)

Williams (1982) invokes the i-within-i condition in at least three distinct ways. First, he uses it to account for the failure of a secondary predicate in a nominal like:

- (23) * [John's_i arrival dead]_i

Williams argues that *dead* must be coindexed with the N' that dominates *arrival dead* because of his Strict Opacity Condition (SOC). The SOC states that a node X cannot be free in Y, for any Y. 'X is free in Y if X is neither coindexed with a c-commanding NP in Y nor coindexed with Y itself' (Williams, 1982: 281). This reasoning leads Williams to some suspect stipulations on the grammar. For example, consider:

- (24) [John's_i [_Npride]_N in himself]_N]_{N'}

Since *himself* is not coindexed with a c-commanding NP in N', the SOC requires *himself* to be coindexed with N'. But N, N', and N'' are all coindexed (according to Williams, 1982: 279). N'' and *himself* are therefore coindexed. But *himself* and *John's* are also coindexed. Consequently, *John's* is coindexed with N'', resulting in a violation of the i-within-i condition. Yet (24) is acceptable.

In order to account for the contrast in grammaticality between (23) and (24), Williams resorts to the claim that anaphoric relationships are not seen by the Predicate Structure (PS) level and that the SOC is relevant only to PS

and not to LF. These stipulations on the grammar are not independently motivated. We note also the peculiarity of Williams' claim that the head-of relationship be expressed by coindexation, redundantly, given that it is already expressed by X' notation, and that – as Richardson and Chametzky (1985) argue – this very coindexation runs counter to the i-within-i condition.

There are at least two other problems with Williams' account of (23). First, predicates that are not APs are acceptable inside nominals, when precisely the same indexing relations should hold in Williams' analysis. In (25) and (26) we have an NP and a PP predicate inside the containing NP:

- (25) Even [John's exposure [as a Nazi]] didn't affect his position in the country club.
 (26) [John's death [at only 64]] surprised us.

Second, in structures with a distinct intonation peak (as with contrastive stress) on the relevant AP and in structures which exhibit a certain 'heaviness', we find that even APs are acceptable to the ears of our informants.

- (27) [John's explanation sober] was no better than his explanation drunk.
 (28) [John's arrival at precisely 8:15 buck naked] threw the party into chaos.

((28) is a variation on an example in Napoli, 1989.) In order to discount (27) and (28) as counterexamples, one would have to argue that the bracketed NPs were different in structure from that in (23) in ways crucial to Williams' argument. However, it is not obvious to us that NPs like those in (27) and (28) differ syntactically from that in (23). (For a semantic account of the unacceptability of (23) versus the acceptability of (25)–(28), see Napoli, 1989.) We conclude that the i-within-i condition is neither a well-motivated nor empirically adequate account of the unacceptability of (23).

A second way in which Williams uses the i-within-i condition is in his explanation for the fact that there is no NP raising in nominals:

- (29) * [John's_i likelihood _{t_i} to leave]_i

Here, as in (23) above, the fact that the index of the entire NP must be identical to the index of the trace inside it follows from Williams' Strict Opacity Condition. But Higginbotham (1983: 415–418) argues that this is an inappropriate invocation of the i-within-i condition, and he, instead, rules out (29) as a violation of the Theta Criterion.

In a third instance, Williams uses the i-within-i condition to argue that the predication relation cannot hold between a head N and an NP in its specifier position. That is, if a genitive NP were a subject argument of a head N predicate, they would be coindexed (by predication coindexing). But the head N will be coindexed with the entire NP (by head-phrase coindexing). So the genitive NP will be coindexed with the entire NP, which properly contains it.

That this is an inappropriate invocation of the i-within-i condition is shown in Napoli (1989), where we find multiple arguments for analyzing the following NPs in Italian and English (and in many other languages, some of which are exemplified below) as exhibiting the subject-predicate relationship within them.

- (30) [quel matto, di Giorgio]_i (Italian)
'that madman (of) Giorgio'
- (31) [that scoundrel Jones]
- (32) [die oen van een Jaap] (Dutch)
'that dumbo (of) Jaap'
- (33) [dieser Schwachkopf Schulze] (German)
'that weakhead Schulze'
- (34) [mon cretin de mari] (French, from Milner, 1978)
'my cretin of a husband'

Here the head N assigns a property to another NP within the same overall NP. So, for example, in (30) *matto* assigns the property of being a madman to *Giorgio*. Only nouns that can be used as evaluative predicates in copular sentences can appear in head N position in this type of noun phrase. Accordingly, only NPs that are appropriate subjects of such a predicate in sentences with predication across a copula can appear inside an NP like those in (30)–(34) as the subject of this predicative head N. Similar NPs open to an analysis as containing the subject-predicate relationship are found throughout the Romance and Germanic languages. It seems clear that applying the i-within-i condition to predication indices is unmotivated.

In conclusion, we are unconvinced by Williams' various uses of the i-within-i condition.

3.5. *The argument so far*

Above we have offered a brief account of six applications of the i-within-i condition to nonreferential indices and refutations of these accounts. But these are just a representational sampling – the tip of the iceberg. The i-within-i condition as a purely syntactic condition (with no attention to referential circularity – or with only brief and inconsistent remarks about circularity) has been invoked repeatedly in the past ten years, and with little justification.

4. A CONDITION ON CIRCULAR CHAINS

We have presented evidence of a variety of types that a purely syntactic formulation of the i-within-i condition is unmotivated. There is no evidence that we know of that anything resembling the i-within-i condition, as applying to agreement, predication, and head-phrase indices, is part of grammar. Furthermore, Aoun (1985: 168) has shown that the i-within-i

condition does not hold of the indices assigned to traces left by quantifier raising. We conclude that there is no condition resembling the i-within-i condition that applies to non-referential indices.

Yet, the fact remains that the sentences in (2), repeated here for convenience, in which only referential indices are involved in the structure that concerns us, and examples like them noted in Vergnaud (1974), are ungrammatical with the interpretations given here:

- (2) * [The son of the woman who killed him]_i was a Nazi.
* [The book by the man who designed it]_i cover_j will be coming out next week.
* [The conclusion of the text that precedes it]_i is a nonsequitur.

Other such examples abound:

- (35) * [The proof of its_i existence]_j baffled the logicians.
- (36) * [Her_i best friend's wife]_j lives in Cherry Hill.
- (37) * [Books about them]_i bore me.

There is clearly some sort of semantic condition against referential circularity at issue here, the question is precisely how this condition is to be properly formulated.

Notice first that full NPs – also called R-expressions – contained inside another NP do not obey the condition, nor do anaphors contained inside another NP:⁶

- (38) [John's_i father's only son]_j isn't here.
- (39) [A man in love with himself]_i isn't interesting to talk with.
- (40) [John's_i father's only friend]_j
as in: Guess who John's father's only friend is — John!
- (41) [a poetess in love with herself]_i
- (42) [a house divided against itself]_i

[6] We are here assuming that NPs such as:

- (i) * [a picture of itself]_i
- (ii) * [socks with holes in themselves]_i
- (iii) * [friends of [each other]_i]_j
- (iv) * [whatever mechanism rules out the condition we are seeking to formulate in the text, but by whatever mechanism rules out the corresponding sentences:
(v) * This picture is of itself.
(v) * These socks have holes in themselves.
(vi) * The friends are {of/to} each other.

(See Napoli, 1989, Chapter 6, Section 5.3 for discussion and an account of (v)). If, instead, it should turn out that anaphors are, in fact, sensitive to the condition under discussion in the text, this condition is then not a condition on free pronouns, but on free pronouns and free anaphors. The exact statement of the condition in (71) below, however, need not be changed in any way.

Of course, in (38) coindexation would be the result of certain entailments. The point is, however, that we interpret (38) with the indicated coreference and there is no semantic anomaly here, in clear violation of the i-within-i condition.

This is true of R-expressions and anaphors, regardless of how deeply embedded the R-expression or anaphor may be:

- (43) [the mayor who peijured himself]_i

Furthermore, not all pronominals exhibit the condition. So, in contrast to (2) and (4) and (35)-(37), we find:

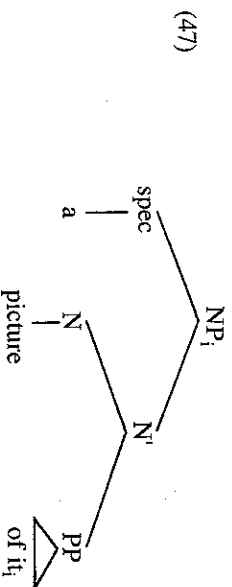
- (44) [a poetess in love with her, topic]_i
[the mayor who destroyed his_i city]_i
[socks with holes in them]_i

Chomsky (1981: 229, fn. 63) suggests that we exclude from the condition all cases where the inner constituent with index i is coindexed with the head of the i-marked constituent containing it – as in (44). He gives no deeper nor more detailed explanation.

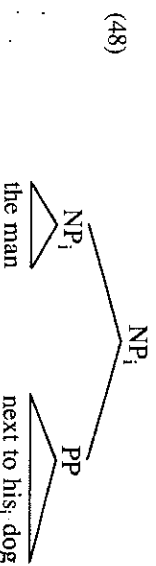
Haik (1983), in contrast, offers a highly detailed account. She compares NPs such as (45) (similar to (35)-(37)) with NPs such as (46) (similar to (41)-(44)):

- (45) * [a picture of it]_i
(46) [the man next to his_i dog]_i

She argues that in (45) the pronoun *it* is an argument of the head N *picture* and receives a theta role from it. She follows Chomsky (1981) in assuming that an argument must be governed by its theta-assigner. The structure for (45) is then:



But in (46), neither *his* nor *his dog* is an argument of the head N *man*. Instead, the PP *next to his dog* predicates of (in her terminology) the NP *the man*. The structure for (46) is then:



So in (45)/(47) *it* has no NP internal to the overall NP to act as an antecedent; accordingly, *it* is coindexed with the overall NP and the construction is referentially circular. But in (46)/(48) *his* has the NP *the man* as its antecedent. Thus *his* is properly bound within the overall NP and no referential circularity arises. (A similar proposed difference in structures for examples like (45) vs (46) is found in Zwarts, 1976.)

We take issue with Haik's account, although we adopt her insight that the crux of the matter is whether or not the pronominal is internally bound. First, note that the Dutch and German counterparts to (45) are equally ungrammatical, while the counterparts to (46) are equally grammatical. Thus Haik would, presumably, extend her account to Dutch and German. However, both Dutch and German allow modifiers to appear between the specifier and the head noun:

- (49) een op zichzelf zeer trotse man (Dutch)
a on himself very proud man
'a very proud of himself man'
(50) die nach ihn kommende Koenige (German)
the after him coming kings
'the kings coming after him/succeeding him'

And English speakers we have asked accept (although certainly they recognize the markedness of the word order) the gloss of (49) marginally and equally to the ordinary word order:

- (51) ?a man very proud of himself
(cf. ?a very proud of himself man)

In (49)-(51) there is no intact internal NP that can serve as the antecedent for the anaphor (*zichzelf*, *himself*) or pronoun (*ihn*). These anaphors/pronouns are free within the overall NP, so, according to Haik, the structures should be referentially circular. But they are not – witness their grammaticality.

A second argument against Haik's account of (45) versus (46) is based on a theoretical flaw rather than on issues of empirical inadequacy. Haik's account cannot be extended to explain the grammaticality of:

- (52) [the artist that *Op_i* Ruth prefers *t_i*]

(In 52 *Op* stands for the phonetically null *wh*-operator). Here *t_i* is coindexed with the overall NP. In order to account for this structure's grammaticality, we must analyze it as not referentially circular. So *t_i* must be bound internally. But the string *the artist_i*, even if it were an intact NP, could not bind *t_i* since the *wh*-operator must bind *t_i*, and a single trace cannot be doubly bound. Therefore Haik (1987) must account for (52) in a distinct way from (46) (via her A'-binding, and see Haik (1983)). If (46) and (52) should be

accounted for with a single explanation, Haik's analysis misses a generalization.⁷

We turn now to our own account of (35)–(37) vs (41)–(44) and (45) vs (46). It is clear that the relevant condition applies to pronominals that are free within the specified domain (that is, within the overall NP we are examining), as Haik has shown, but does not apply to R-expressions, anaphors, or pronominals that are bound within the overall NP. We adopt here the distinction between bound and free that is argued for at length in Reinhart (1983). Reinhart's main argument for this distinction comes from sloppy and strict readings of ellipses. For example, consider:

- (53) John killed his dog and so did Bill.

This sentence has three readings: John and Bill each killed his own dog (the sloppy reading); John and Bill killed John's dog; John and Bill killed some other person's dog. For relative clauses we can also find multiple readings:

- (54) Nobody likes a professor who ridicules his papers.

There are three readings for 54: (a) *his* bound to *nobody*, (b) *his* bound to *who*, and (c) *his* free, referring to some other party. Bound readings are usually not characterizable in terms of coreference (although the device of coindexation is typically employed here). This is obvious with quantifiers: *nobody* or *every third student* does not refer to some entity or other, hence cannot possibly corefer with anything. Like *nobody* are relative pronouns, interrogative pronouns and their ilk. There is no clear sense in which *who* refers (and in Montague Grammar interrogative pronouns are sometimes translated as lambda operators). (For more discussion of these points, see Partee, 1976; and Dowty, Wall & Peters, 1981.)

The claim that the distinction between free and bound pronominals is the relevant distinction in accounting for the grammaticality difference between examples like (35)–(37) versus (41)–(44) makes sense for the following reason: the indexed elements contained in the overall NPs in (41)–(44) are all

[7] Haik (1987), building on Haik (1983, 1984), tackles the question of circularity in the interpretation of so-called VP-Deletion structures. While a discussion of VP-Deletion structures is beyond the scope of this article, we would like to point out two things here. First, Haik's account of:

(i) John talked to everyone that Peter did.
is based on assuming that the quantified NP is moved at LF, thereby making the structure not an antecedent-contained deletion at all. But this account holds even without assuming Haik's conditions on binding (see the discussion in Baltin, 1987; and see May, 1985). On the other hand, sentences like:

(ii) *John wanted to appear to.
cannot, obviously, be accounted for by quantifier raising (since there is no quantified NP here). We have yet to come to grips with this and similar issues raised by the analysis of VP-Deletion sentences.

bound to an operator, if we assume the following lambda representations or some GB-equivalent thereof:

- (41) $\lambda P \exists x: P(x) \ \& \ \lambda y [\text{fin-love-with}(y, y)](x)$
 (42) $\lambda P \exists x: P(x) \ \& \ \text{house}(x) \ \& \ \lambda y [\text{divided-against}(y, y)](x)$
 (43) $\lambda P \exists ! x: P(x) \ \& \ \text{mayor}(x) \ \& \ \lambda y [\text{perjure}(y, y)](x)$
 (44) $\lambda P \exists x: P(x) \ \& \ \text{poetess}(x) \ \& \ \lambda y [\text{fin-love-with-}y\text{'s topic}(y)](x)$
 $\lambda P \exists ! x: P(x) \ \& \ \text{mayor}(x) \ \& \ \lambda y [\text{destroy } y\text{'s city}(y)](x)$
 $\lambda P \exists x: P(x) \ \& \ \text{socks}(x) \ \& \ \lambda y [\text{with-hole-in}(y, y)](x)$

The point is that bound referential elements are never sensitive to material outside the scope of the operator binding them. Hence the acceptability of the examples in (41)–(44) is to be expected. The bound reading of an example such as *a poetess in love with her topic* is seen most clearly in environments where this expression does not refer to any particular person, such as generic contexts like *A poetess in love with her topic would never write this uninspired stuff*. Since there is no reference here, coreference of the pronoun *her* with some antecedent is likewise impossible.

Furthermore, R-expressions are not dependent upon other linguistic material for determining their own reference. Hence the acceptability of examples like (38) and (40) is to be expected.

It might be objected that most of the examples in (41)–(44) have no overt operator, nor do they have a complementizer position where a non-overt operator is usually located. However, in logico-semantic representations such as those given in (41)–(44) modifiers should be treated equally, whether they have overt operators (as relative clauses do) or not.

We disagree with Aoun's (1985) claim that non-overt binders behave differently from overt ones here. For instance, in the NPs:

- (55) men who destroy themselves

and

- (56) men destroying themselves

the presence of an overt binder (*who* in 55) makes no difference for the acceptability of the reflexive. Furthermore, the fact that PRO has no phonetic matrix does not make (57a) open to any wider range of interpretations than (57b).

- (57) (a) John wants PRO to be his doctor.
 (b) John is his doctor.

A GB equivalent of (41)–(44) would presumably posit a PRO element for the subject argument variable. This PRO (and not the lambda-operator) would serve as the proper A-binder of the anaphors. Thus the generalization could be maintained that anaphors are argument-bound. While we are not sure that there is any direct syntactic evidence for PRO in, for example,

adnominal PPs, we are willing to grant this point because it does not affect our argument in the least. It means simply that instead of the binding possibilities for overt anaphors, we have to explain the binding possibilities (or control possibilities) of their antecedent, PRO. Now the observation to be explained is that PRO in complements to nouns behaves differently from PRO in modifying phrases. The following minimal pair illustrates this point rather clearly:

- (58) (a) The spies received orders [PRO to contradict each other].
 (b) The spies received orders [PRO contradicting each other].

In (58a) PRO must be bound by the main clause subject, but in (58b) it must be bound by the non-overt lambda-operator. In (58a) it is not possible to interpret PRO (and hence, *each other*) as referring to the orders received by the spies.

Our account also applies to bound variables created by movement and hence subsumes Sportiche's (1983) contention that the i-within-i condition does not apply to empty categories, such as traces (see also Aoun, 1985). The status of the trace of NP movement in this connection is not entirely clear to us. Huang (1982, 1983) proposes that the i-within-i condition is really part of the definition of 'accessible SUBJECT' and claims that the latter is concerned only with anaphors, not pronouns. So in his account the i-within-i condition must apply to the trace of NP movement.

Our argument, then, takes as a starting point that the binding conditions must be stated at some level of logical form or semantic representation, and not at S-structure. Another important assumption we are making is that the binding conditions are sensitive to Reinhart's (1983) distinction between bound and free pronominals, in addition to the distinction between pronominals and anaphors. The former distinction is not incorporated into the binding conditions of Chomsky (1981), but its importance has emerged from work on English (Reinhart, 1983), and on Japanese and Chinese (Aoun, 1986).

A very interesting account of circularity which makes an additional distinction in types of pronominals is given in Higginbotham (1988), who outlines three types of coindexing relationships for pronouns: argument anaphora, bound anaphora, and unbound anaphora. They are exemplified in order below:

- (59) John_i loves his_i mother.
 (60) [Every student]_i did her_i homework.
 (61) If John had bought [a car]_i, it_i would have been black.

(We have used the familiar coindexing mechanism here, but Higginbotham opts for drawing arrows, presumably because of the fact that coreference is not involved in either his bound or unbound anaphora.) This breakdown of types of 'anaphora' is unique and is in conflict with the more common

breakdowns in Kamp (1981), Heim (1982), and Reinhart (1987), as well as this paper, in which examples like (60) and (61) are lumped together.

Higginbotham now uses the following account to exclude circular readings. An assignment function f gives referents for each pronoun. For a circular sentence such as:

- (62) His wife saw her husband.

Higginbotham's system yields the following equations:

- (63) $f(\text{his}) = \text{husband of } f(\text{her})$
 $f(\text{her}) = \text{wife of } f(\text{his})$

But this information is insufficient; it cannot eliminate the reference to f from the semantics for (62). Therefore, any husband-wife pair a and b can fill in for the values of $f(\text{his})$ and $f(\text{her})$. So (62) fails to be a closed sentence, and the interpretation involving coreference is inaccessible.

Let us consider how Higginbotham's account would fare with our example (4) in the text above, repeated here:

- (4) * [her_i childhood friend's wife]_i.

(4) would yield the following equation:

- (64) $f(\text{her}) = \text{the wife of the childhood friend of } f(\text{her})$

That is, the referent of *her* is a function (the function the wife-of-the-childhood-friend-of) of itself, as in:

- (65) $f(x) = g(f(x))$

We believe that this predicts that when the circumstances permit a unique solution to the equation, we ought to get acceptable results. A linguistic example might be:

- (66) * [His_i country's last Shah]_i died in 1980

Since only one country (Iran) has a shah, reference ought to be fixed. Yet this sentence is odd and the NP subject is no better than the NP in (4) above. Simple reference with respect to some fixed world, then, won't do. Perhaps we need to interpret Higginbotham's account intensionally. That is, in other possible worlds, other countries might also have shahs and uniqueness would not be guaranteed. At the very least this suggests that Higginbotham's present account needs to be sharpened. We will, therefore, leave aside further consideration of this account and return to developing our own, which distinguishes only two types of pronominals, bound and free.

We can now offer a tentative condition (which we will later reject) on free

pronominals that replaces the i-within-i condition and that should be taken as a part of the binding theory.

(67) *Condition on free pronominals* (tentative):

No free pronominal is coreferential with an NP containing it.

The condition on free pronominals in (67) is a constraint against circular readings. Brody (1982) has likewise offered a constraint against circular readings which does not have the flaw of the particular pragmatic explanation in Higginbotham & May (1981), but which turns out to be empirically inadequate on other grounds. We will here benefit from Brody's observations and come to a final statement of a prohibition against circular chains.

Brody considers sentences like the following, which Jacobson (1980) first discussed (and which have been discussed by many since, including Haik (1983) and Higginbotham (1988)):

(68) * [His_i wife]_j saw [her_j husband]_i.

The striking point here is that (68) fails with the indicated interpretation, whereas each of the pronouns may usually take as its antecedent an R-expression in the same structural position as the one containing the other pronominal:

(69) His_i wife saw John_i.

(70) Mary_j saw her_j husband.

So in (68) neither the link marked by i-indexation nor the link marked by j-indexation is ungrammatical by itself; it is the conjunction of the two links which is problematic. The source of the problem is, once more, circularity. And our tentative condition on free pronominals in (67) is unable to account for the failure of (68). If we are to persist with (67), then, we must modify it accordingly.

Brody, building on Jacobson (with modifications) rather than Higginbotham and May in this regard, proposes to derive the condition against circular readings from a rule substituting the antecedent for the pronominal during the derivation of a semantic representation. Substitution will terminate (that is, be finite) in the case of (69) and (70), but not in the case of (68). Hence a well-formed semantic representation cannot be derived in a finite number of steps. We reject the substitution method for determining circularity since pronouns do not always have linguistic antecedents. Such pronouns, then, would be irreducible by substitution and would be marked as ungrammatical by this method – whereas in fact they can easily be grammatical. Furthermore, it is not clear to us that the theory of grammar should permit transformations (even if they are rules applying in LF) copying unbounded strings across an essential variable. Finally, in her comments on Brody's paper, Kempson (1982) points out that the result of eliminating the

pronominals does not always have the same meaning as the original sentence, thus further threatening Brody's account.

At this point we have seen at least two attempts at accounting for the ungrammaticality of circular readings which rely on the notion of non-finiteness. Higginbotham and May (1981) offered an account based on infinite loops (refuted in Brody, 1982, and see the discussion of (4) in Section 2); Brody (1982) offered a substitution account that leads to infinite steps (refuted immediately above in this paper). It would appear that circular readings are ungrammatical because of an explicit prohibition in the grammar. We will now attempt a precise statement of this prohibition in the form of a condition on circular chains. Then we will show that if one can find a way to establish the desired referential link without going via the circular chain, the result is grammatical. This final demonstration (in (73)–(74)) shows beyond a doubt that the proper statement of the condition studied in this paper must be a formal linguistic one and does not follow from any notions of infinite loops or the like.

We here adopt the condition on referential dependencies proposed in Higginbotham and May (1981), but we interpret this condition as a constraint on the dynamic interpretation of discourse. Following their example, we will write $X \rightarrow Y$ to indicate that X is anaphorically dependent on Y. In other words, Y is the antecedent of X. The arrow is used to suggest that this relation is rather different from coreference, which is a reflexive, symmetric, and transitive relation. We further write $X > Y$ to indicate that X contains Y. A chain $X^1 * X^2 * \dots * X^n$ (where * is either $>$ or \rightarrow) indicates a pattern of dependencies. We can now offer our final formulation of the binding constraint against circularity.

(71) *Conditions on circular chains*:

A chain $X^1 * X^2 * \dots * X^n$ is circular just in case $X^i = X^j$ where $i \neq j$ and both X^i and X^j are members of the chain. Sentences containing circular chains are ungrammatical.

Circular readings are indicated by circular chains and ruled out by the grammar. For example, in (68) we have the following circular chain of dependencies:

(72) his wife $>$ his \rightarrow her husband $>$ her \rightarrow his wife

Our old condition (67) (which is a special case of the i-within-i condition) follows from (71) in this way: $X > Y \rightarrow X$ (X contains a free pronoun Y which has X as its antecedent). Thus no free pronominal may be coreferential with an NP containing it. And no violation of the i-within-i condition as it pertains to reference of free pronominals is compatible with (71).

A crucial point in this account is that exactly the same readings which are forbidden by the condition on circular chains become acceptable in case a

non-circular way can be found to establish the referential links. For instance, the sentence:

(73) My wife likes her husband.

is acceptable because *my* does not have to find its referent in the object NP since the speaker functions as the (non-linguistic) antecedent. We can set up the following non-circular chain:

(74) her husband > her → my wife > my → speaker

Similarly, we note that (68) is fully acceptable in a context where the speaker tries to answer the question:

(75) Whose wife saw her husband?

and points at a man saying:

(76) HIS wife saw her husband.

(Capitals in (76) indicate a stress peak.) Again, the reference is determined deictically, rather than circularly. So the sentence has a good interpretation.

Using conditions on indices, on the other hand, makes it impossible to do justice to this important point, since such conditions rule out readings rather than ways in which these readings come about. First and second person pronouns are always interpreted deictically; third person pronouns may be interpreted deictically. We note that demonstratives are also interpreted deictically. This explains the possibility of seemingly circular interpretations, as in the notorious Liar paradox sentences, such as:

(77) This statement is false.

This is a lie.

The speaker of this sentence is a liar.

While paradoxical for those who want to establish the truth-value of these sentences, the reference of the NPs *this* or *this statement* to the statement of which they are part is not problematic. And the reference of the NP *the speaker of this sentence* to the speaker is not problematic. In fact, it is the very availability of the (deictic) referential connection that causes the paradox to arise. The reason such link is permitted appears to be that the demonstrative pronoun receives its interpretation directly from the context of the utterance. One could say more about the ways in which demonstrative and personal pronouns are interpreted in discourse; for our purposes it suffices to note that the i-within-i condition as it pertains to referential indices is a consequence of a constraint on antecedents of personal pronouns.

5. CONCLUSIONS

The i-within-i condition is a false generalization. Instead, the phenomena attributed to it which do not involve referential circularity are due to a variety of unrelated constraints (many of them admittedly poorly understood – but, nevertheless, clearly distinct from the i-within-i condition).

It is an open question whether or not indices assigned by reference, predication, agreement, and the head-phrase relationship have any properties in common. The issue of referential circularity is, however, not an open one: grammar does not allow it. Our Condition on Circular Chains in (71) is a statement of a constraint against referential circularity. In order for this condition to be incorporated into binding theory, a distinction must be made between free and bound pronominals and, further, non-overt operators for all modifiers must be represented in LF.

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