12/13/94

The Development of Binding Theory
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A. "Conditions on Transformations" (1973)

(1)a Advantage was taken __ of Bill
b Bill was taken advantage of __
(2) The plan was argued about __
(3) The dog is believed [__ to be hungry]

(4) Structural condition of Passive:
(X, NP, VY, NP, Z)

(5) *The dog is believed [__ is hungry]

(6) Tensed Sentence Condition (1st version)
No rule can involve X, Y in the structure
...X...[$_{\alpha}$...Y...]...
where α is a tensed sentence

(7)a The candidates each hated the other(s)
b The candidates each expected [the other(s) to win]
c The candidates each expected [that the other(s) would win]
(8)a The candidates hated each other
b The candidates expected [each other to win]
c *The candidates expected [that each other would win]

(9) Passive (i.e., NP preposing) and <u>each</u>-movement obey (6). "...one rule that obviously does not satisfy the condition is Coreference Assignment..." as in (10).
(10) John said that he would leave

(11) The candidates expected to defeat each other

(12) *The men expected the soldier to shoot each other

(13) Specified Subject Condition (1st version)
No rule can involve X, Y in the structure
...X...[$_{\alpha}$...Z...-WYV...]...
where Z is the specified subject of WYV in α
(14) 'Specified subject': "a subject NP that contains either lexical items or a pronoun that is not anaphoric

(15)a The men saw [$_{NP}$ pictures of each other]
b *The men saw [$_{NP}$ John's pictures of each other]

(16)a Who did you see [$_{NP}$ pictures of __]
b *Who did you see [$_{NP}$ John's pictures of]

(17)a It is easy for us to learn Latin
b Latin is easy for us [to learn __]
(18)a It is a waste of time for us for them to teach us Latin
b *Latin is a waste of time for us [for them to teach us __]

(19)a *I saw me
b *I saw us
c *We saw me
d He saw him
e The soldiers shot the officers (among them)
(20) RI: "a rule of interpretation applying to the structure NP-V-NP (among other) [that] seeks to interpret the two NPs as nonintersecting in reference, and where this is impossible...it assigns 'strangeness'. cf. Postal's "Unlike Person Constraint".

(21)a We expect [them to visit me]
b *We expect [me to visit them]
c We believe [I may still win]

(22) In (21)a, c, RI is blocked by SSC and TSC, respectively

(23) [$_{S'}$ What [$_{S}$ did you tell me [$_{S'}$ that [$_{S}$ Bill saw __]

(24) Why doesn't (23) violate SSC and TSC?

(25) COMP you told me [$_{S'}$ [$_{COMP}$ what] Bill saw __]

(26) If S', and not S, is a relevant 'α', then (25), the 1st step in the derivation of (23), doesn't violate either condition. Further, the next step will not violate SSC, since <u>what</u> is already beyond 'Z'. But an escape clause must be built in for the TSC.

(27) No rule can involve X, Y in the structure
...X...[$_{\alpha}$...Z...-WYV...]...
where (a) Z is the specified subject of WYV
or (b) Y is in COMP and X is not in COMP
or (c) Y is not in COMP and α is a tensed S

(28) "...under the analysis proposed here there is no necessity for a rule raising the subject of an embedded sentence to the object position of the matrix sentence..."

(29)a *Who did stories about __ terrify John
b *Who did you expect [stories about __ to terrify John]

(30) Subject Condition
No rule can involve X, Y in the structure
...X...[$_{\alpha}$...Y...]...
where (a) α is a subject phrase properly containing the minimal major category containing Y
and (b) Y is subjacent to X

(31) We expect pictures of each other to be on sale

(32) In (31), <u>each</u>-movement is not blocked by the Subject Condition, as the target is not subjacent to the source.

(33) Problem: RI is blocked in this configuration.
We (I) expected pictures of me to be on sale

(34)a *We persuaded Bill [PRO to kill each other]
b We promised Bill [PRO to kill each other]

(35)a I (we) persuaded Bill [PRO to kill us]
b *I (we) promised Bill [PRO to kill us]

(36) Z is a specified subject with respect to X if it is not 'controlled' by (a category containing) X. (If Z is lexically specified, it is not controlled at all. PRO is controlled in the standard sense. Trace is controlled by its antecedent.)

(37)a *They appealed to John [PRO to like each other]
b They appeared to John [t to like each other]

(38)a We appealed to John [PRO to like us]
b *We appeared to John [t to like us]

(39) The hard work is pleasant for the rich [PRO to do t]

(40) It-replacement ('tough-movement') in (39) should violate SSC since PRO is not controlled by The hard work.

(41) 'PRO replacement': the 1st step in the derivation of (39) is: It is pleasant for the rich [the hard work to do t]

(42) *John seems to the men [t to like each other]
(This is actually Chomsky's initial argument for traces.)

(43) *Which man did they expect [t to kill each other]

B. "Conditions on Rules of Grammar" (1976)

(44)a The men like each other
b *The men want [John to like each other]

(45) Reciprocal interpretation assigns an appropriate sense to sentences of the form NP...each other (and is constrained by the conditions).

(46)a The men like them
b The men want [John to like them]

(47) Disjoint reference (DR) assigns disjoint reference to a pair (NP, pronoun) (and is constrained by the conditions).

(48)a John seems [t to like Bill]
b *John seems [Bill to like t]

(49) "...the relation between NP and the trace that it controls [is] a special case of bound anaphora..." That relation is constrained by the conditions. The conditions thus are conditions on surface structure applying to anaphora. (I have illustrated SSC. TSC is the same.) For examples like (37)-(38) above, Chomsky continued to assume the (1973) definition of 'specified subject'. In retrospect, it is clear that such a complication was unnecessary. Rather, instead of the transparent subjects not counting as Z, they would count as X.

(50) The rules of anaphora relate surface structures (enriched to include traces) to LF. Perhaps more generally, surface structure determines LF.

(51) John thought that Bill liked him (cf. (10) above)
(52) (51) is not a problem, as it does not involve a rule of sentence grammar at all. [The problem, of course, is "He thought that Bill liked John". The problem comes home to roost immediately below.]

(53)a Who said Mary kissed him
b Who said he kissed Mary
c Who did he say Mary kissed (Wasow's 'Strong Crossover')

(54)a John said Mary kissed him
b John said he kissed Mary
c He said Mary kissed John

(55) for which person x, he said Mary kissed x

(56) Taking a variable to function as a name, (53)c then reduces to (54)c.

C. "On Binding" (1980)

(57) (Certain cases of) SSC and TSC are reformulated as the Opacity Condition:
If α is an anaphor in the domain of the tense or the subject of β, then α cannot be free in β, β = NP or S'.
The conditions are now strictly on anaphors themselves, not on rules, and "Tense and Subject are 'operators' that make certain domains opaque." [But what about RI?]

(58) Which men did Tom think Bill believed [t saw each other]

(59) In the earlier theories, each other was assumed to take Which men as its antecedent. Aside from the semantic impropriety of that, the conditions would have blocked it. Now each other is coindexed with t and it is not free in any opaque context. [Question: Could an analogous move have been made before?]

(60) *They told me [what I gave each other]

(61) (60) illustrates a certain 'redundancy' in the Opacity Condition: it is excluded by both the SSC part and the TSC part. Hence, Chomsky broke it apart into two separate conditions, (62)a,b, with (62)b, the Nominative Island Condition, a narrower version of TSC involving only subjects of finite clauses. (62)a, as before, involves only non-subjects, in the simple examples at least.

(62)a If α is in the domain of the subject of β, then α cannot be free in β.
b A nominative anaphor cannot be free in S' containing S.

(63) They expected [that [[pictures of each other] would be on sale]]

(64) (63) violated TSC, evidently incorrectly, but does not violate NIC; each other is not in a nominative position.

(65) Who do they think [$_{S'}$ [$_{COMP}$ t'] Bill will see t]

Suppose we continue to associate nonnegative integers with NPs as their indices, now reserving the integer 1 for arbitrary reference, what was called *arb* above. Assume that each movement rule assigns indices as described above; cf. (4). This convention gives a partial indexing in surface structure, with no conflict of indices. Turning to the interpretive component, let us assume that indexing applies to the full sentence "from top to bottom" to assign indices to the remaining NPs; an index is assigned to NP only when all NPs that *c*-command or dominate it have been indexed.

Indexing is assigned in part by rules of construal: Control in the case of [$_{NP}$ *e*], Reciprocal in the case of *each other*, and Bound Anaphora in the case of pronouns in certain idioms (e.g. *John lost* his *way*, *John blew* his *cool*, *John hurt* himself). The last rule, which I will not discuss here, is very similar to the Reciprocal rule; see references cited earlier and Helke (1971) for the basic idea. We will refer to the items indexed by rules of construal as *anaphors*. It remains to assign indices to nonanaphors: lexical NP and pronouns apart from the bound idioms.

Take the index of each nonanaphor to be a pair (r, A), where r is the *referential index* and A the *anaphoric index*. The referential index is an integer; the anaphoric index a set of integers. Proceeding still from top to bottom, suppose we reach the nonanaphoric NP α. If α has already been assigned the index i by a movement rule, take i to be its referential index; otherwise assign it some new referential index $i \geq 2$. Take the anaphoric index A of α to be $\{a_1, \ldots, a_n\}$, where a_j is the referential index of some NP *c*-commanding α (A maximal). Omitting null anaphoric indices, we will now have such representations as (109):

(109) John$_2$ told Bill $_{(3,\{2\})}$ about him$_{(4,\{2,3\})}$

We will interpret the anaphoric index $A = \{a_1, \ldots, a_n\}$ of α to mean that α is disjoint in reference from each NP with referential index a_i. Thus, *him* in (109) is disjoint in reference from *John* and *Bill*, and if *John* were to replace *him* (or *Bill*) in (109), the two occurrences of *John* would be disjoint in reference. Of course, "disjoint reference" in this context has to do with intended reference; actual reference is outside the scope of grammar. On coreference of lexical and pronominal NPs, see Lasnik (1976).

The rules of Control, Reciprocal, and Bound Anaphora make reference to the referential index of the *c*-commanding NP. Applying these rules and the rule of index-assignment for nonanaphors systematically from "top to bottom", we fully index the sentence under consideration. It remains to add details and clarification,[4] but this will suffice as a general framework.

Turning now to the binding conditions, we may think of them as deleting certain indices from the anaphoric index of a pronoun, thus in effect blocking certain cases of disjoint reference and permitting reference to be free. The binding rules hold of anaphors and pronouns, not lexical NPs; thus, pronouns are like lexical NPs in the manner of their indexing, and like anaphors in that they fall under binding conditions. It follows, then, that disjoint reference will hold between *John* and the embedded subject in (110a) whether the latter is lexical or a pronoun, but in (110b) only if it is a lexical NP:

(110) a. John expected [NP to win] (NP = *John* or *him*)
b. John expected [that NP would win] (NP = *John* or *him*)

To unify the discussion of anaphors and pronouns for the binding conditions, let us call i the *designated index* of α, α an anaphor or pronoun, if i is the anaphoric index in the case of a pronoun or the referential index in the case of an anaphor. Thus, if the index of α is (r,A), the designated index is A; and if the index of α is r, the designated index is r. We can now generalize the technical notion "free" defined above:

(111) Suppose that α has the designated index j and i is an integer such that $i = j$ or $i \in j$. Then α is *free*(i) in β if there is no γ in β with index i that *c*-commands α.

The index i is necessarily referential; the case $i = j$ is the case of an anaphor, and the case $i \in j$ the case of a pronoun. We can now restate the binding conditions as rules that modify the designated index, as follows:

(112) Suppose that α has the designated index j and is free(i) in β (β = NP or Ŝ)
where (a) α is nominative
or (b) α is in the domain of the subject of β, β minimal.
Then $j \rightarrow 0$ if j is an integer, and $j \rightarrow (j\text{–}\{i\})$ if j is a set.

Case (a) of (112) is the NIC and case (b) is Opacity. When α is an anaphor and is nominative or in an opaque domain, and is free(i) in NP or Ŝ, then i must be its referential index and it is changed to 0. When α is a pronoun and is nominative or in an opaque domain, and is free(i) in NP or Ŝ, then i is removed from its anaphoric index. Note that if α is a nominative pronoun, then rule (112) deletes all indices from its anaphoric index, leaving the latter null; and if α is a pronoun in an opaque domain, then (112) deletes from its anaphoric index the referential indices of all NPs outside of this domain, so that α is not necessarily disjoint in reference from any such NP. For example, consider (113):

(113) John$_2$ told Bill$_{(3,\{2\})}$ [Ŝ PRO$_3$ to visit him]

In (113), *John* (with null anaphoric index omitted) and *Bill* have been indexed by the assignment rule for nonanaphors, and PRO has been indexed by the rule of Control. Turning next to *him*, as a nonanaphor it is assigned the index $(4, \{2,3\})$. Since *him* is free(2) in Ŝ but not free(3) in Ŝ and is in the domain of the subject of Ŝ, *him* undergoes rule (112), which removes 2 from its anaphoric index, leaving *him* with the index $(4, \{3\})$. Thus, *him* in (113) is understood as disjoint in reference from PRO (hence *Bill*) but not necessarily disjoint in reference from *John*.

Suppose we define the notation $[j\text{–}i]$ as follows:

(114) $[j\text{–}i] = (j\text{–}i)$ if j is an integer and $(j\text{–}\{i\})$ if j is a set.

Then we can restate (112) as follows:

(115) Suppose that α has the designated index j and is free(i) in β (β = NP or Ŝ),
where (a) α is nominative
or (b) α is in the domain of the subject of β, β minimal.
Then $j \rightarrow [j\text{–}i]$.

It remains only to add that NP$_0$ is not permitted in LF, where 0 is the referential index. This is the case of an inadmissible free variable, an anaphor that is not properly bound.

D. **Lectures on Government and Binding** (1981)

(1) *Who do you think [that [t left]]
(2) In (1), t is not 'properly governed'. The theory of anaphora is not at issue. We are thus fre to treat the trace of wh-movement as a name (rather than an anaphor) in accord with the treatment of strong crossover: *Who$_i$ does he$_i$ think Mary likes t$_i$.

(3) The OB system treated PRO as an anaphor. This was too weak in that it didn't entail that PRO occurs only in ungoverned positions, and too strong in that 'long distance control' as in (4) would be incorrectly excluded by SSC.
(4) They thought I said [that [[PRO to feed each other] would be difficult]]

(5) In OB there is a sort of redundancy between the theories of Case and binding. They both pick out the subject of infinitives as special, but by totally different means.

(6) In OB the two configurations relevant to binding theory - subject of a finite clause and c-command domain of a subject - are in no way related.

(7) The OB indexing conventions are complicated. (See Section C above.)

(8) α is bound by β if and only if α and β are coindexed and β c-commands α.
(9) α is free if and only if it is not bound.

(10) α is a governing category for β if and only if α is the minimal category containing β and a governor of β, where α = NP or S.

(11)A An anaphor is (A-)bound in its GC.
B A pronominal is (A-)free in its GC.
C An R-expression (fully lexical NP, or variable) is (A-) free.

(12)a *John$_i$ believes [(that) himself$_i$ is clever]
b *They$_i$ believe [(that) each other$_i$ are clever]
c *Mary$_i$ is believed [(that) t$_i$ is clever]

(13)a John$_i$ believes [himself$_i$ to be clever]
b They$_i$ believe [each other$_i$ to be clever]
c Mary$_i$ is believed [t$_i$ to be clever]

(14) *John$_i$ believes [him$_i$ to be clever]
(15) John$_i$ believes [(that) he$_i$ is clever]

(16)a Mary believes [them to be clever]
b *Mary believes [(that) them are clever]

(17) Infinitivals (at least some of them) are not barriers to government, either for Case assignment (16) or for establishment of governing category (12)-(15); cf. (5) above.

(18) *John$_i$ believes [Mary to like himself$_i$]
(19) John$_i$ believes [Mary to like him$_i$]

(20) *He$_i$ believes [(that) John$_i$ is clever]
(21) *He$_i$ believes [Mary to like John$_i$]

(22)a *We$_i$ heard [their stories about each other$_i$]
b We$_i$ heard [some stories about each other$_i$]

(23) α is a governing category for β if and only if α is the minimal category containing β, a governor of β, and a SUBJECT accessible to β.
(24) SUBJECT = AGR in a finite clause; NP of S in an infinitival; NP of NP in an NP.

(25) Does (24) successfully address (6)? Chomsky suggests that it does, in that SUBJECT of α is the most prominent nominal element of α, taking INFL (which contains AGR) as the head of S. [But notice it cannot be the head of NP that counts as SUBJECT of NP, or (22)b will be ruled out alongside (22)a.]

(26) They$_1$ expected [that[[pictures of each other$_1$] would be on sale]]
(27) They$_1$ expected [that[[pictures of each other$_1$]$_2$ AGR$_2$ would be on sale]]

(28) μ is accessible to β iff β is in the c-command domain of μ and assignment to β of the index of μ would not violate (29).
(29) *[$_\gamma$...δ...], where γ and δ bear the same index.
(30) i.e., μ is accessible to β iff β is in the c-command domain of μ and μ is not coindexed with any category properly containing β.

(31) *John$_1$ thinks [that [himself$_1$ AGR$_1$ will win]]

(32) They$_1$ think [it$_2$ AGR$_2$ is a pity [that pictures of each other$_1$ are hanging on the wall]$_2$]
(33) *They$_1$ think [it$_2$ AGR$_2$ bothered each other$_1$ [that S]]

(34) They$_1$ think [it$_2$ AGR$_2$ is a pity [that pictures of them$_1$ are hanging on the wall]$_2$]
(35) They$_1$ expected [that[[pictures of them$_1$]$_2$ AGR$_2$ would be on sale]]
(36) Problematically, anaphors and bound pronouns are <u>not</u> in full complementary distribution. (37) is a further illustration.
(37)a They read [each other's books]
b They read [their books]

(38) John tried [PRO to leave]

(39)a *I like PRO
b *Susan spoke to PRO
c *John believes [PRO to be intelligent]
d *John's belief [PRO to be intelligent]
e *John believes [PRO is intelligent]

(40) Proposal: PRO is a pronominal anaphor [see (38)], hence, it must obey both (11)A and (11)B. That is, it must be both bound and free in its governing category. If it has a governing category, this is a contradiction, therefore it must have no GC. This (almost) entails that it must be ungoverned, the descriptive generalization covering (39). This deduction is standardly called the PRO theorem. It has the effect of permitting long distance control, by virtue of divorcing control from binding theory. See (3).
(38) "...PRO is like overt pronouns in that it never has an antecedent within its clause or NP. PRO also resembles anaphors in that it has no intrinsic referential content but is either assigned reference by an antecedent or is indefinite in interpretation, lacking specific reference."

(39) *[Pictures of each other$_1$]$_2$ AGR$_2$ are on sale
(40) *[Pictures of PRO$_1$]$_2$ AGR$_2$ are on sale
(41) Addendum to (23): A root sentence is a GC for a governed element.

(42) (11)A-C are purely syntactic: they filter out structures based solely on their formal properties. Do we need any associated semantics?

(43) "John like him" can't mean that John likes himself.
(44) *John$_1$ likes him$_1$
(45) John$_1$ likes him$_2$

(46) If two NP's have distinct indices then...

(47) They like him

(48) ...then they are disjoint in reference.

(49) *We$_1$ like myself$_2$
(50) →We$_1$ like myself$_1$

(51) If two NPS have identical indices, then they are coreferential.

(52) We$_1$ think [I$_?$ will win]

(53) The problem is that NP's have at least three referential relations: disjointness; identity; overlap. But two numerical subscripts are either identical or distinct. See (7). (52) is the cost of addressing (7) in the way that LGB does.

(54) John$_i$ is too stubborn [PRO$_i$ to talk to Bill]
(55) John$_i$ is too stubborn [Op$_i$ [PRO$_{i/*i}$ to talk to $\underline{t}_i$]
(56) The control interpretation of (55) is excluded by Condition C, in the manner of Strong Crossover. Chomsky cites (57)-(58) as further evidence, but they seem more like counter-evidence (esp. (58)).
(57) (*)They are too stubborn for each other to talk to
(58) (*)They are easy for each other to talk to

(59) An expletive and its associated argument must be condexed to establish the appropriate Case and agreement relation. But such a structure seems to violate Condition C:
(60) There$_i$ is a man$_i$ in the room
(61) There^i is a man^i in the room
(62) Binding theory cares only about <u>sub</u>scripts.

(63) [Which book that John$_i$]$_j$ read did he$_i$ like $\underline{t}_j$
(64) *He$_i$ liked [every book that John$_i$ read]
(65) *Who thinks that he$_i$ read [which book that John$_i$ likes]
(66) "...these examples provide prima facie evidence that the binding theory applies at s-structure, a conclusion that I will now adopt."

E. <u>Knowledge of Language</u> (1986)

(67) Why doesn't (55) violate Condition C even on the non-control interpretation of PRO?
(68) An R-expression is A-free (in the domain of the head of its maximal chain).

(69) An alternative account of existential constructions, based on 'expletive replacement' driven by Full Interpretation:

(70) A man$_i$ is $\underline{t}_i$ in the room [where $\underline{t}$ is an A-movement trace, hence not a variable].

(71) Binding theory applies at LF, and <u>not</u> at S-structure. [But cf. (66). Sorting out this apparent contradiction is one of the major goals of current 'minimalist' theorizing.]

(72) (repeated from (37))
a They read [each other's books]
b They read [their books]

(73) "...the relevant local domain is different in some respect for anaphors and pronominals....this difference should fall out as an immediate consequence of the difference in their nature - namely, that anaphors must be bound whereas pronominals must be free - without any need to stipulate any further difference in the binding theory conditions for these two categories of expressions."

(74) The following definitions and licensing conditions concern an expression E with indexing I. The indexing I and a pair (α,β) are <u>compatible</u> with respect to the binding theory if α satisfies the binding theory in the local domain β under the indexing I. A 'complete functional complex' (CFC) is a projection of a head including all grammatical functions compatible with that head.

(75) I is <u>BT-compatible</u> with (α,β) if:
(A) α is an anaphor and is bound in β under I
(B) α is a pronominal and is free in β under I
(C) α is an r-expression and is free in β under I

(76) Licensing condition for a category α governed by a lexical category γ in the expression E with indexing I:
For some β such that (i) or (ii), I is BT-compatible with (α,β):
(i) α is an r-expression and (a) if α heads its chain or
(b) otherwise
(a) β = E
(b) β is the domain of the head of the chain of α
(ii) α is an anaphor or pronominal and β is the least CFC containing γ for which there is an indexing J BT-compatible with (α,β)

(77) "...for an anaphor or pronominal, the licensing condition amounts to saying that the relevant governing category for α is the minimal one in which binding theory could have been satisfied under some indexing."

(78) Both major instances of non-complementarity, (72) and (26)-(27), are now accommodated. But there is an apparent cost: we have lost the TSC/NIC:

(79) a *John$_i$ believes [(that) himself$_i$ is clever]
b *They$_i$ believe [(that) each other$_i$ are clever]

(80) Chomsky's solution to this problem takes us full circle: the constraint on anaphora here should reduce to a constraint on movement (rather than vice versa). Chomsky suggests that the movement constraint (the ECP) at work in (81) is also relevant in (79) assuming that in LF, anaphors undergo movement to be in some appropriate very local relation with their antecedents.

(81) *Mary$_i$ is believed [(that) $\underline{t}_i$ is clever]

(82) Note that this approach has the desirable effect of reducing some of the 'redundancy' in the treatment of (81). Given that it already violates ECP and the 'last resort' condition on A-movement, we would like it <u>not</u> to also violate Condition A.