Non-Redundancy (6-page abstract)

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Non-Redundancy: A Semantic Reinterpretation of Binding Theory

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Within generative grammar, Binding Theory has traditionally been considered a part of *syntax*, in the sense that some derivations that would otherwise be interpretable are ruled out by purely formal principles. Thus *He$_i$ likes him$_i$* would in standard theories yield a perfectly acceptable interpretation, but it is ruled out by Chomsky's Condition B, which in this case prohibits co-arguments from bearing the same index. We explore a semantic alternative in which Condition B, Condition C, the Locality of Variable Binding of Kehler 1993 and Fox 2000, and Weak and Strong Crossover effects follow from a non-standard interpretive procedure (modified from de Bruijn's interpretation of the □-calculus and Ben-Shalom 1996). Constituents are evaluated top-down under a pair of two sequences, the sequence of evaluation s and the quantificational sequence q. The initial sequence of evaluation always contains the speaker and the addressee (thus if John is talking to Mary, the initial sequence of evaluation will be j^m, as we assume throughout). The bulk of the work is then done by a principle of **Non-Redundancy**, which prevents any object from appearing twice in any sequence of evaluation. We may think of the sequence of evaluation as a *memory register,* and of Non-Redundancy as a principle of *cognitive economy* which prohibits any element from being listed twice in the same register[1]. For reasons of space, we do not compare this proposal to other semantic approaches to Binding Theory, e.g. important works by Jacobson, Keenan, Branco, Butler, Barker & Shan.

1 R-expressions and Condition C

When an R-expression (=proper name, definite description or demonstrative pronoun) is processed, its denotation is added at the end of the sequence of evaluation, as defined in (1) and illustrated in (2):

(1) **Treatment of R-expressions**[2]
If □ is a proper name, a definite description or a demonstrative pronoun, $[[\,[□\ □]\,]]^{w}$ s, q= $[[\,[□\ □]\,]]^{w}$ s, q= $[[□]]^{w}$ s^($[[□]]^{w}$s,q), q

(2) $[[$Ann runs$]]^{w}$ j^m, ø =$[[$runs$]]^{w}$ j^m^a, ø =1 iff a□I_w(runs)

Because individual-denoting expressions are entered in the sequence of evaluation in a fixed order, the arguments of an n-place predicate are systematically found in the last n positions of the sequence of evaluation.

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[1] For conceptual reasons, the elements listed in a memory register should not be objects but *descriptions* thereof. For simplicity we entirely disregard this point, although it has important consequences for (i) the analysis of exceptions to binding theory noted by Reinhart, and (ii) the treatment of quantification. See Schlenker 2003 for discussion.

[2] In the final version of the system, *that*-clauses are also considered as R-expressions, and thus fall under (1). We also use the following (standard) interpretive rule: $[[\,$[that p]$\,]]^{w}$s,q=# iff for some w' in W, $[[$p$]]^{w}$ s, q=#. Otherwise, $[[\,$[that p]$\,]]^{w}$ s, q=□w': w'□W. $[[$p$]]^{w'}$ s, q.

For this reason, it makes sense to define the truth of a predicate at a sequence of evaluation (or rather, at a pair of sequences, for reasons to be discussed in Section 4). When we further incorporate Non-Redundancy to the interpretive rule for atomic predicates, we obtain the following:

(3) **Treatment of Atomic Predicates**
If V is a predicate taking n individual arguments, $[[V]]^{w}s, q=\#$ iff (i) s violates Non-Redundancy[3], or (ii) one of the last n arguments of n is not an individual. Otherwise, $[[N]]^{w} s, q=1$ iff $s_n(q)$□$I_w(V)$, where $s_n(q)$ is the list of the last n elements of s (...properly resolved by q if some of them are formal indices; see (14) below).

In standard generative analyses, Condition C states that *an R-expression cannot be in the scope of a coreferential expression*. Instead of being a primitive, this principle is now derived from the interaction of (1) and (3), as is illustrated in (4) (# is used throughout to denote semantic failure):

(4) $[[\text{Ann [likes Ann]}]]^{w}$ j^m, ø =$[[\text{likes Ann}]]^{w}$ j^m^a, ø =$[[\text{likes}]]^{w}$ j^m^a^a, ø =# because j^m^a^a violates Non-Redundancy.

It can be shown that no violation of Non-Redundancy arises when the second expression is not in the scope of the first, as in *Ann's teacher likes Ann*: if t=Ann's teacher, the second occurrence of *Ann* is evaluated under the sequence j^m^t, which contains t but not a. Interestingly, Non-Redundancy also rules out sentences in which an R-expression is used to denote the speaker or addressee - a desirable result in view of the deviance of *John runs* as uttered by or to John. The derivation proceeds as follows:

(5) $[[\text{John runs}]]^{w}$j^m, ø =$[[\text{runs}]]^{w}$j^m^j, ø =# because j^m^j violates Non-Redundancy.

2 Anaphoric Pronouns, Condition B and Condition A

When an anaphoric pronoun is processed, some element of the sequence of evaluation is recovered and moved to the end of the sequence, leaving behind an empty cell #[4]. In order to indicate which element is moved, anaphoric pronouns are given *negative indices* such as -1, -2, etc, which indicate *how far from the end of the sequence their denotation is found:*

(6) **Treatment of Anaphoric Pronouns**
If □ is a pronoun pro_{-i}, $[[\,[□\ □]\,]]^{w}$ $s\hat{}d_i\hat{}d_{i-1}\hat{}\ ...\hat{}d_1$, q =$[[\,[□\ □]\,]]^{w}$ $d_m\hat{}...\ \hat{}d_i\hat{}d_{i-1}\hat{}\ ...\hat{}d_1$, q=$[[□]]^{w}$ $s\hat{}\#\hat{}d_{i-1}\hat{}\ ...\hat{}d_1\hat{}d_i$, q

Consider the sentence *(Ann says that) she$_{-1}$ runs*. After *Ann says that* is processed, the sequence of evaluation contains a in its last position, yielding for various values of w':

(7) $[[\text{she}_{-1}\text{ runs}]]^{w'}$ j^m^a, ø=$[[\text{runs}]]^{w'}$ j^m^#^a, ø =1 iff a□$I_{w'}$(runs)

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[3] Within the present system, Non-Redundancy should be defined as follows: s violates Non-Redundancy iff s contains the same element *other than #* in at least two positions.
[4] When tense is taken into account, the device of empty cells can be eliminated. The qualification '*other than #*' can then be eliminated from fn. 2. See Schlenker 2003.

However, in *Ann likes her$_{-1}$,* where *her$_{-1}$* 'tries' to corefer with Ann, a failure is predicted because the predicate *like* ends up being assessed under a sequence of evaluation which contains a non-individual, namely #, in its penultimate positions. By clause (ii) of (3), this is disallowed - intuitively, an n-place predicate cannot be evaluated with respect to a sequence which contains an empty cell in one of its last n positions:

(8) $[[\text{Ann likes her}_{-1}]]^{w}\ j\hat{}m,\emptyset = [[\text{likes her}_{-1}]]^{w} j\hat{}m\hat{}a,\emptyset = [[\text{likes}]]\ ^{w} j\hat{}m\hat{}\#\hat{}a,\emptyset = \#$
because one of the last 2 elements of $j\hat{}m\hat{}\#\hat{}a$ is not an individual.

This derives Reinhart & Reuland's version of Condition B, which states that *two co-arguments of a predicate may not corefer* (...unless a reflexive pronoun is used; see the next section). This account has well-known deficiencies, in particular for the treatment of, say, **John believes him$_{-1}$ to be clever,* which cannot mean that John believes that John is clever. We are forced to posit that in such cases *him$_{-1}$* is (despite appearances) an argument of *believes*. The details are admittedly tricky.

Why can a coreferential interpretation of (8) be achieved when *her* is replaced with *herself*? We assume that the reflexive pronoun *herself* is composed of two parts: (i) *her$_{-1}$,* which is a garden-variety anaphoric pronoun, and (ii) *-self*, which is an operator that reduces the arity of the predicate. This yields a version of Condition A if *-self* is constrained to apply to the closest predicate. We then obtain the following interpretation:

(9) a. Ann likes herself
a'. Logical Form: Ann self-likes her$_{-1}$
b. $[[\text{a'}]]\ ^{w} j\hat{}m,\ \emptyset = [[\text{self-like him}_{-1}]]\ ^{w} j\hat{}m\hat{}a,\ \emptyset = [[\text{self-like}]]\ ^{w} j\hat{}m\hat{}\#\hat{}a = 1$
iff $a \in I_w(\text{self-like})$, iff $\langle a, a\rangle \in I_w(\text{like})$.

3 The Economy of Variable Binding

Why can *Peter said that he likes him* not mean that Peter said that Peter likes Peter? In standard syntactic accounts, the explanation is not trivial, for although *him* is too 'close' to *he* to corefer with it (as this would violate Condition B), it is not obvious why *him* cannot corefer with *Peter*, which is further away. This problem does not arise in the present framework. An initial sequence $j\hat{}m$ becomes $j\hat{}m\hat{}p$ after *Peter* is processed. Hence if *he* is to refer to Peter, it must bear the index -1. After *he$_{-1}$* is processed, the sequence becomes $j\hat{}m\hat{}\#\hat{}p$. Therefore if *him* is to refer to Peter, it has no choice but to bear the index -1. After *him$_{-1}$* is processed, *like* is then assessed under a sequence of evaluation $j\hat{}m\hat{}\#\hat{}\#\hat{}p$, which yields a failure because one of the last two elements (namely #) is a non-individual. This is the correct result. When the first and the second pronoun are not co-arguments, as in (10), no failure arises, but we predict that if both pronouns refer to Peter, the second *he* must bear -1 (and cannot bear -2):

(10) Peter said that he$_{-1}$ thinks he$_{-1}$ is competent
a. OK
b. *

The reasoning is the same as before: after *Peter* and the first *he$_{-1}$* have been processed, the sequence of evaluation is j^m^#^p. If the second *he* bore index -2, *is-competent* would be evaluated under a sequence j^m^#^p^#, which would yield a semantic failure (because the last element is a non-individual). No problem arises if the second *he* bears index -1, since in that case *is-competent* is evaluated under the sequence j^m^#^#^p. This observation can be generalized, and derives the principle of *variable binding economy* of Kehler 1993 and Fox 2000: binding dependencies must be 'as short as possible' to achieve a given interpretation.

Kehler and Fox proposed this principle to account for Dahl's 'many pronouns' puzzle (Fiengo & May 1994). The puzzle is that in structures such as (11), ellipsis resolution does not allow *his* to be read as 'sloppy' if *he* is itself read as 'strict', as shown by the unavailability of (11)d:

(11) Peter said that he$_{-1}$ thinks he$_{-1}$ is competent, and Oscar did too ~~say that he$_{-1}$ thinks he$_{-1}$ is competent~~

a. ^{Ok}sloppy - sloppy: Oscar said that Oscar thinks Oscar is competent

b. ^{Ok}sloppy - strict: Oscar said that Oscar thinks Peter is competent

c. ^{Ok}strict - strict: Oscar said that Peter thinks Peter is competent

d. *strict - sloppy: Oscar said that Peter thinks Oscar is competent

The generalization (Fiengo & May 1994) is that *if an elided pronoun is resolved as strict, all the elided pronouns that are in its scope must be read as strict too*. We derive this result by assuming that (i) syntactically, the elided verb phrase is a literal copy of its antecedent (and it thus includes the same indices, as in (11)), and (ii) semantically, an elided anaphoric pronoun may optionally bring to the end of the sequence of evaluation the value of its unelided counterpart. (11)a is obtained when the semantic interpretation of the elided Verb Phrase proceeds without making use of (ii), yielding the sequence 'history' j^m □ j^m^o □ j^m^#^o □ j^m^#^#^o. When only the second elided pronoun makes use of (ii), the beginning of the sequence history is the same, i.e. j^m □ j^m^o □ j^m^#^o. But when the second pronoun is processed, it turns j^m^#^o into j^m^#^#^p by substituting 'at the last minute' the value of its unelided counterpart, i.e. p, for o; this yields (11)b. When the first pronoun makes use of (ii), j^m^o is turned into j^m^#^p (again by substituting 'at the last moment' p for o); whether or not the second *he* makes use of (ii), the final sequence is j^m^#^#^p, yiedling (11)c. Having exhausted the interpretive possibilities, we see that (11)d cannot be derived, which accounts for Dahl's puzzle.

4 Quantification, Weak Crossover and Strong Crossover

4.1 The Treatment of Quantification

For theory-internal reasons, we are forced to stipulate that quantifiers manipulate the quantificational sequence rather than the sequence of evaluation (note that so far the quantificational sequence has been entirely idle). Otherwise we would wrongly predict that *Peter likes everyone* cannot mean that Peter likes everyone *including himself*, because *everyone* would trigger the appearance of d in the sequence of evaluation, for each d which is a person. Thus *likes* would be evaluated under sequences of the form j^m^p^d, and for d=Peter Non-Redundancy would be violated. To avoid this undesirable result, we stipulate that quantifiers introduce elements in a different sequence, the quantificational sequence. The syntactic 'trace' that a quantifier leaves in its original position after moving to its scope site has the role of *introducing in the sequence of evaluation an index that cross-references the relevant element of the quantificational sequence*, as in (12), where the index 1 cross-references the first element of the quantificational sequence:

(12) $[[\text{everyone } [t_{-1} \text{ runs}]]]^{w}$ j^m, ø=1 iff for each d, $[[t_{-1} \text{ runs}]]^{w}$ j^m, d=1 iff for each d, $[[\text{runs}]]^{w}$ j^m^1, d=1, iff for each d, $(j\hat{}m\hat{}1)_1(d) \square I_w(\text{runs})$, iff for each d, $d \square I_w(\text{runs})$, since $(j\hat{}m\hat{}1)_1(d)$ is the last element of j^m^1, properly resolved by d, i.e. it is simply 1-membered list d.

In this way we divide quantification into two separate steps: (i) first, *everyone* introduces d in the quantificational sequence, for each individual d, and then (ii) the trace t_{-1} triggers the appearance in the sequence of evaluation of an index that cross-references d. On a technical level, it can be checked that the correct results are obtained by postulating the interpretive rules in (13) for quantifiers and traces, and by defining $s_n(q)$, i.e. the n-resolution of the sequence of evaluation s given q, as in (14):

(13) a. $[[\,[\,[\text{every } n]\ e]\,]]^{w}$ s, q=# iff (i) for some individual x, $[[n]]^{w}$ s, q^x=#, or (ii) for some individual x satisfying $[[n]]^{w}$ s, q^x=1, $[[e]]^{w}$ s, q^x=#. Otherwise, $[[\,[\,[\text{every } n]\ e]\,]]^{w}$ s, q=1 iff for each individual x satisfying $[[n]]^{w}$ s, q^x=1, $[[e]]^{w}$ s, q^x=1.
b. $[[\,[t_{-i}\ \square]\,]]^{w}$s, q= $[[\,[\square\ t_{-i}]\,]]^{w}$s, q= $[[\square]]^{w}$s^(|q|+1-i), q

(14) If n>|s|, $s_n(q)$=*; if n≤|s|: $(d_m\hat{}\ \ldots\hat{}d_n\hat{}\ \ldots\hat{}d_1)_n(q) = d_n(q)\hat{}\ \ldots\hat{}d_1(q)$, where for each $i \square [[1, n]]$ $d_i(q)=d_i$ if $d_i \square \mathbb{N}$ and $d_i(q)$=the d_i^{th} coordinate of q if $d_i \square \mathbb{N}$

4.2 Weak and Strong Crossover Effects

So far the introduction of the quantificational sequence was motivated solely by theory-internal reasons. Interestingly, however, our stipulations derive so-called 'Crossover' effects, which prohibit a quantificational element from moving past a pronoun that it attempts to bind. We start with 'Weak Crossover' effects, which obtain when the offending pronoun does not c-command the trace of the quantifier, as in (15)a, whose Logical Form is (15)a' after *everyone* has moved to its scope position:

(15) a. ??His mother likes everyone
a'. Everyone [[his_{-i} mother] [likes t_{-1}]]
b. $[[a']]^{w}$ j^m, ø=1 iff for each d, $[[\,[\text{his}_{-i} \text{ mother}] \text{ likes } t_{-1}]]^{w}$ j^m, d=1

No matter what the index of his_{-i} is, his_{-i} cannot retrieve d because d is in the 'wrong' sequence: it is in the quantificational sequence, whereas his_{-i}

can only retrieve elements of the sequence of evaluation. However if the trace t_{-1} had been processed 'before' *his*$_{-i}$ *mother,* i.e. in a position that c-commands it, there would have been no such problem:

(16) [[everyone [t_{-1} likes his$_{-1}$ mother]]]^{w} j^m, ø=1 iff for each d,
[[t_{-1} likes his$_{-1}$ mother]]^{w} j^m, d=1,
iff for each d [[likes his$_{-1}$ mother]]^{w} j^m^1, d=1

At this point there is an element (the index 1) in the sequence of evaluation that cross-references d. *his*$_{-1}$ can access this element and thus indirectly come to denote d, as is desired.

Why is the violation in (15)a relatively mild, thus earning it the title of a *Weak* Crossover violation? We argue that this is because the structure allows for a repair strategy, which is to treat the pronoun *his* as if it were a trace. By contrast, in a Strong Crossover configuration such as **He likes everyone* (whose logical form is *everyone [he likes* t_{-1}*]*, where the pronoun c-commands the trace of the quantifier), treating the pronoun *he* as if it were a trace t_{-1} yields a violation of Non-Redundancy: when the object trace is processed, two occurrences of the index 1 will appear in the same sequence of evaluation, because both will cross-reference the same element d of the quantificational sequence. This is illustrated in (17):

(17) a. He likes every man.
a'. Actual LF: [Every man] [he likes t_{-1}]
a". Attempted Repair: [Every man] [t_{-1} likes t_{-1}]
b. [[a"]]^{w} s, ø=# iff for some x such that [[man]]^{w} s, x=1, [[t_{-1} likes t_{-1}]]^{w} s, x =#, iff for some x such that [[man]]^{w} s, x=1, [[likes t_{-1}]]^{w} s^1, x =#, iff for some x such that [[man]]^{w} s, x=1, [[likes]]^{w} s^1^1, s=#.
The latter condition is always met because s^1^1 violates Non-Redundancy. Hence a" yields a semantic failure.

Our analysis thus derives in a new way Chomsky's old insight that Strong Crossover violations are Weak Crossover effects that also violate Condition C - for us, Non-Redundancy.

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