Mother Merge and Her Children[1]

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ABSTRACT

This paper examines in detail the proposition that a set of fundamental syntactic relations (domination, sisterhood, c-command, etc) can be founded in the computational operation Merge, itself taken to be fundamental and indispensable. In doing this, it pursues one aspect of minimalist methodology in an unusually rigorous fashion. The outcome of the investigation is that Chomsky's initial approach to this issue, as outlined in 'Minimalist Inquiries,' has a number of unattractive consequences. Alternatives avoiding some of these consequences are explored, and the proposal that asymmetric c-command, rather than general c-command, should be taken as fundamental is considered in detail. It is further argued that claims to *exclude* some well-known relations (e.g. head-specifier) on principled grounds cannot be sustained. Finally, the recent proposal that probe-goal, a restricted variant of c-command, should be accommodated in the set of fundamental relations at the expense of sisterhood is shown to be inadequate.

A fundamental question confronting any theory of grammar concerns the identity of the formal relations to which statements (which may themselves embody operations, conditions, filters, etc) in the theory can refer.

To illustrate, suppose we adopt a derivational approach to the construction of syntactic objects, as schematised in (1):[2]

(1) $$\begin{array}{ccccccc} SO_1 & \rightarrow & SO_2 & \rightarrow & \ldots & \rightarrow & SO_n \\ & OP_1 & & OP_{2,} & \ldots & OP_{n-1} & \end{array}$$

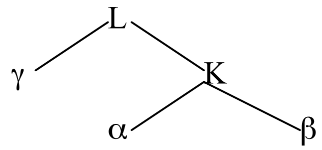
In (1), the OP_i ($1 \leq i \leq n\text{-}1$) designate *operations*, each of which accepts a set of syntactic objects, $SO_{i,}$ as input and produces a new set of syntactic objects, SO_{i+1}, as output.[3] Typically, if OP_i ($1 \leq i \leq n\text{-}1$) applies, it will be necessary for the syntactic objects to which it applies to satisfy certain conditions, conditions that will normally include a set of relational statements.

Suppose, for instance, that syntactic objects are labelled trees. It has been customary to presume that from the infinite set of formal relations that can be defined on such objects, only a small subset provides the vocabulary to which operations, conditions, interpretive processes, etc. can refer. Candidates for this vocabulary have included such binary relations as *identity, sisterhood*, *domination*, *precedence*, *c-command*, *m-command*, *government*, a ternary relation, *intervenes*, etc., but to my knowledge, no one has ever proposed that what we might refer to as *degree-2 domination* provides a condition governing the applicability of operations in a derivation or in other processes. Yet, it is straightforwardly defined in terms of *immediate domination* as in (2):

(2) α *degree-2 dominates* β if and only if there is a γ such that α immediately dominates γ and γ immediately dominates β.

Given this definition, and taking immediate domination to be irreflexive, it is easy to see that the extension of this relation with respect to the simple labelled tree in (3) is (4):[4]

(3)



(4) $\{<L, \alpha>, <L, \beta>\}$

And, of course, what goes for degree-2 domination goes equally for degree-*n* domination for arbitrary *n*.

To take a second case, maintaining the irreflexiveness of immediate domination and presupposing a conventional definition of (general) domination, we can formally define a binary relation *c^2-command* as in (5):

(5) In structure S, α *c^2-commands* β if and only if α does not dominate β, β does not dominate α, and the node that immediately dominates the node that immediately dominates α also dominates β.

With respect to (3), then, we would have (6) as the extension of *c^2–command*:

(6) $\{\langle\alpha, \gamma\rangle, \langle\beta, \gamma\rangle, \langle\alpha, \beta\rangle, \langle\beta, \alpha\rangle\}$

Once more, definition and illustration can be generalised to *c^n-command* for arbitrary *n,* giving us a family of formal relations, no member of which has found its way onto the menu that syntacticians sample, and the major theme of the discussion that follows is to contemplate whether it is possible to come up with principled reasons for why this might be.

To re-iterate, accounts of syntactic phenomena typically rely on only a small subset of the set of formal relations that is, in principle, available. What is this subset and, more intriguingly, why does this subset have the membership it does? In attempting to delimit the subset, we could, of course, simply advert to the vagaries of empirical enquiry, suggesting that the formal relations on which we rely are those that happen to have proved useful or necessary in describing such-and-such a phenomenon in such-and-such a language. A sophisticated version of this strategy can be found in Rizzi (2004, 226), where, starting from phenomena that motivated the introduction of Relativised Minimality (Rizzi, 1990), he suggests 'identity, prominence and locality' as the 'basic ingredients of syntactic computation.' Of these, prominence is defined in terms of c-command and the definition of locality involves reference to both a species of identity and to intervention, this latter also presupposing c-command. However, whatever the fate of Rizzi's fundamental taxonomy, it is important to see that it is at most an answer to the 'what' question formulated above. Supposing c-command, intervention, etc. survive further empirical scrutiny, there is nothing in Rizzi's approach that seeks to answer the 'why' question for these properties.

Interestingly, with his 'basic ingredients' established and presented as all essential in understanding the nature of chains, Rizzi proceeds by supposing that they enjoy a measure of independence, and examines whether there is evidence of them being combined pairwise, with the third one playing no role in explicating specific phenomena. While Rizzi himself does not develop this emphasis, I feel that the strategy he pursues here is quite different to that employed in the initial formulation of Relativised Minimality and the core concept of chain needed in its articulation. His pursuit of pairwise combinations of his fundamental relations is motivated initially by *logical*, as opposed to *empirical* considerations, although having formulated the move, Rizzi is quick to bring empirical observations into the picture. While it may go further than Rizzi would wish, I believe that there is a sense in which his approach provides an answer to the 'why' question for his pairwise combinations, and *post hoc* this can be extended to his construal of chains. These various constructs are the way they are *because* they represent one of the permissible combinations of the underlying relations. The underlying relations themselves, however, remain opaque at this level of enquiry.

The purpose of this paper is to examine whether there is a logical or conceptual route to the *initial* set of basic structural relations. Is there a *principled* way of founding such a set, which must, of course, be also subjected to empirical scrutiny.[5] In this context, it is noteworthy that in a number of papers developing different aspects of the Minimalist Programme, Chomsky (1998, 1999, 2001, 2005a, b, 2006) has offered observations on this issue, and these observations will provide the context for much of what I wish to say. Two initial points about these observations should be borne in mind. First, as we shall see, they have not remained identical through the series of papers, and it may be that some of the modifications Chomsky suggests in his later work are responses to some of the difficulties I will raise for the earlier proposals, although there is no acknowledgement of this. Second, with the exception of Grohmann (2003), I am not aware of any serious discussion of the sort of argument I shall shortly be considering. Given that it embodies a strategy that, if successful, would provide an excellent advertisement for the interest of the minimalist approach, this might be seen as somewhat puzzling.[6]

1. The Firstborn

Chomsky's first version of how syntactic relations might be founded appears in 'Minimalist Inquiries' (1998, 27), when he proposes that they 'either (i) are imposed by legibility conditions, or (ii) fall out in some natural way from the computational process.' A focus on (ii) has affinities with the strong derivational position favoured by, e.g. Epstein *et al* (1998), Epstein and Seeley (1999), and it is this focus that I shall adopt here without argument.[7] If we start from Chomsky's formulation, two issues arise immediately. First, we must have some sense of what 'the computational process' amounts to; second, it is necessary to give some content to the notion of formal relations 'falling out' of this process – and not just falling out, since they must fall out 'in some natural way.' For the purposes of the subsequent discussion, I shall see articulation of these notions as an exploration of the claim that relations have the sort of *principled* basis adverted to above, and I shall pursue some of the consequences of trying to stick to principles, not fashionable perhaps, but good for self-respect!

As far as the computational process is concerned, within approaches sympathetic to the framework that Chomsky and others have developed, it is widely supposed that this contains at least a binary operation Merge, which is defined as in (7):[8]

(7) Merge $(\alpha, \beta) = \{\alpha, \beta\} = K$

As is clear, a token of (binary) Merge involves three syntactic objects, α, β and $\{\alpha, \beta\}$, and we can begin by contemplating what relations on this set, if any, 'fall out' of this token of Merge 'in some natural way.' To this end, we consider the set S in (8):

(8) $S = \{\alpha, \beta, K\}$

Restricting attention to binary relations, there are precisely 512 (= 2^9) of these definable on S, but it is reasonable to suppose that only a small number of these are 'founded' in this token of Merge itself. Thus, it seems appropriate to suggest that the binary relations in (9) do 'fall out' of this token of Merge, whereas those in (10), along with 506 others, do not:

(9) a. $\{\langle\alpha, \beta\rangle, \langle\beta, \alpha\rangle\}$
b. $\{\langle K,\alpha\rangle, \langle K, \beta\rangle\}$
c. $\{\langle\alpha, K\rangle, \langle\beta, K\rangle\}$

(10) a. $\{\langle\alpha, K\rangle\}$
b. $\{\langle\alpha, \alpha\rangle, \langle\beta, \beta\rangle, \langle K, K\rangle\}$
c. $\{\langle\alpha, \alpha\rangle, \langle\alpha, \beta\rangle, \langle\beta, K\rangle, \langle K, \alpha\rangle\}$

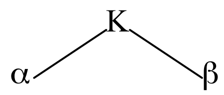
And it is easy enough to see what is driving the intuitions that cleave a distinction between (9) and (10). For the binary relations in (9), it is straightforward to provide a label for them in the context of our token of Merge. Thus, (9a) amounts to the relation of *co-membership*, (9b) corresponds to (*immediate*)-*containment* and (9c) to the converse of (9b), (*immediate*)-*membership-of*. By contrast, while each of the relations in (10) is impeccable *qua* binary relation on S, none of them can be linked in any 'natural' way to the token of Merge we are presupposing. Why is this?

As regards (10a), it is, of course, the case that α is an immediate member of K, but so is β, and Merge is, in the relevant respects, symmetrical with respect to α and β. The binary relation in (10a) neglects to recognise this symmetry, so (10a), unlike (9c), is not induced by this token of Merge. Turning, to (10b), labelling as *identity* is readily available, but this remains the case for any α, β and K; specifically, it remains the case if K ≠ {α, β}. So, it is hardly appropriate to see *identity* as directly induced by this token of Merge. Finally, in (10c), we have a binary relation that is neither readily named nor does it owe anything to the presupposed token of Merge.[9]

What we have above corresponds almost exactly to Chomsky's own approach to seeing how relations might 'fall out' of the computational system.[10] He says (*op. cit.*, 31): 'Merge takes two objects α and β and forms a new object K(α, β) [= K above – MA]. The operation provides two relations directly: *sisterhood* which holds of (α, β), and *immediately contain*, which holds of (K, α), (K, β), and (K, K) (taking it to be reflexive).' Three observations are immediately appropriate.

First, terminologically, Chomsky refers to the relevant relations using a mixture of traditional, tree-geometric and set-theoretic labels. Thus, it is standard to assert that α and β are sisters but that K immediately *dominates* (rather than immediately contains) α and β in a structure such as (11):

(11)



From now on, I will eschew the set-theoretic purity of Bare Phrase Structure and follow Chomsky in relying on this mixed terminology and associated representations, unless the set-theoretic perspective becomes crucial, as it will on at least one occasion.[11]

Second, in what I take to be a minor oversight, Chomsky neglects to signal the symmetry of sisterhood.

The third observation may be more significant. This draws attention to the proposal that the relation of immediate containment be viewed as *reflexive*, a suggestion that is then instantiated incorrectly in Chomsky's listing of the extension of this relation: if immediate containment is to be regarded as reflexive, on the set {α, β, K} it should comprise {⟨K, K⟩, ⟨K, α⟩, ⟨K,β⟩, ⟨α, α⟩, ⟨β, β⟩}. Let us simply note this for now, and proceed with this assumption of reflexivity, acknowledging that *immediate* *domination*, the tree-theoretic relation linked to set-theoretic immediate containment, is, on occasions, regarded as a reflexive relation, i.e. nodes in trees immediately dominate themselves.[12]

Following our token of Merge, we assume, then, that *ceteris paribus* the computational system has access to the relational information in (12), where the superscript in **ImmC**^{r} and **ImmT**^{r} indicates the reflexive nature of these relations:[13]

(12) a. **Sis** = $\{\langle\alpha, \beta\rangle, \langle\beta, \alpha\rangle\}$

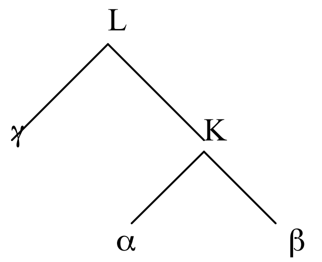
b. **ImmC**^{r} = $\{\langle K, K\rangle, \langle K, \alpha\rangle, \langle K, \beta\rangle, \langle\alpha, \alpha\rangle, \langle\beta, \beta\rangle\}$

c. **ImmT**^{r}= $\{\langle K, K\rangle, \langle\alpha, K\rangle, \langle\beta, K\rangle, \langle\alpha, \alpha\rangle, \langle\beta, \beta\rangle\}$

Next, we consider the further token of Merge in (13), giving rise to the extended structure in (3), repeated as (14):

(13) Merge(γ, K) = $\{\gamma, K\} = \{\gamma, \{\alpha, \beta\}\}$ = L

(14)



Applying the reasoning used so far, we conclude that, following these two applications of Merge, subsequent steps in a derivation have access to the relations in (15):[14]

(15) a. **Sis** = $\{\langle\gamma, K\rangle, \langle K, \gamma\rangle, \langle\alpha, \beta\rangle, \langle\beta, \alpha\rangle\}$

b. **ImmC**^{r} = $\{\langle L, L\rangle, \langle L, \gamma\rangle, \langle L, K\rangle, \langle\gamma, \gamma\rangle, \langle K, K\rangle, \langle K, \alpha\rangle, \langle K, \beta\rangle, \langle\alpha, \alpha\rangle, \langle\beta, \beta\rangle\}$

2. The Extended Family

It is important to be clear that the relational information we see in (15a, b) is *all* the computational system has access to on current assumptions. The restricted nature of this information is striking. Specifically, we can observe that, with respect to the structure in (14), the relations in (16) apparently do not 'fall out' of the operation of this component of the computational system if 'falling out' is restricted in the manner introduced to this point, and, as a consequence of this, the system will not have access to this information as the derivation continues:

(16) a. $\{\langle L, \gamma\rangle, \langle L, K\rangle, \langle(L, \alpha\rangle, \langle L, \beta\rangle, \langle K, \alpha\rangle, \langle K, \beta\rangle\}$
b. $\{\langle \gamma, K\rangle, \langle K, \gamma\rangle, \langle \gamma, \alpha\rangle, \langle \gamma, \beta\rangle, \langle \alpha, \beta\rangle, \langle \beta, \alpha\rangle\}$

But (16a) corresponds to a *general* notion of *containment* (*domination*), including *immediate containment* (here temporarily supposing this to be irreflexive) for (14), and (16b) is an extensional specification of the important relation of *c-command* for the same structure, if we adopt the definition of this relation in (17):

(17) α c-commands β in a structure S if and only if (i) α does not dominate β; (ii) β does not dominate α; (iii) the node immediately dominating α in S also dominates β.

Now, it is not implausible to suppose that the computational system needs to have access to these relations.[15] If they haven't 'fallen out' of tokens of Merge directly, how might we nonetheless justify them? The *desiderata* are obvious: (i) we wish to *extend* the set of formal relations beyond those that 'fall out' of the operation Merge itself; (ii) we wish to do this in a *principled* way, so that the notion of 'falling out in some natural way' retains some credibility. Chomsky continues the passage cited above as in (18):

(18) 'Suppose we permit ourselves the elementary operation of composition of relations. Applying it in all possible ways, we derive three new relations: (i) the transitive closure *contain* of *immediately contain*; (ii) identity = sister(sister), and (iii) c-command (= sister(contain)).'

This passage justifies some reflection.

First, note that what we are seeing here is, indeed, an extension to the set of available syntactic relations, an extension that has been identified as desirable. Furthermore, it appears that this extension is principled to the extent that it relies on having access to no more than the composition of relations, itself characterised as 'elementary.'[16] Is everything as it seems? Before proceeding to investigate this question, it is appropriate to formally introduce composition of relations as in (19):

(19) Given two (binary) relations R and R′ on a set S, we define the composition of R and R′ as:[17]

$R{*}R' = \{\langle x, y\rangle \text{ such that } \exists z\, [\langle x, z\rangle \in R \;\&\; \langle z, y\rangle \in R']\}$

To move immediately to exemplification, let us first consider case (ii) from (18), **Sis** composed with itself, using the simple structure in (14) to illustrate. Instantiating (19) with **Sis** in the role of both R and R′ gives (20):

(20) $\mathbf{Sis}{*}\mathbf{Sis} = \{\langle x, y\rangle \text{ such that } \exists z\, [\langle x, z\rangle \in \mathbf{Sis} \;\&\; \langle z, y\rangle \in \mathbf{Sis}]\}$

Now, inspection of (15a) yields the outcome in (21):

(21) $\mathbf{Sis}{*}\mathbf{Sis} = \{\langle \gamma, \gamma\rangle, \langle K, K\rangle, \langle \alpha, \alpha\rangle, \langle \beta, \beta\rangle\}$

In the case of $\langle \gamma, \gamma\rangle$, K is such that $\langle \gamma, K\rangle$ and $\langle K, \gamma\rangle$ belong to **Sis** and γ, β and α play the same role for $\langle K, K\rangle$, $\langle \alpha, \alpha\rangle$ and $\langle \beta, \beta\rangle$, respectively. However, it is evident that $\langle L, L\rangle \notin \mathbf{Sis}{*}\mathbf{Sis}$, since L itself does not enter into the **Sis** relation with anything in (15a). Chomsky, therefore, is incorrect in his suggestion that **Sis*Sis** yields identity over the complete set, since the root of any structure will always have the properties of L in this simple example.[18]

So much for identity and the composition of **Sis** with itself; let us next turn to (i) in (18) and examine the composition of $\mathbf{ImmC^r}$ with itself. Again, we can consider this in the context of (14) and (15b), with the outcome in (22):

(22) $\mathbf{ImmC^r{*}ImmC^r} = \mathbf{C^r} = \{\langle L, L\rangle, \langle L, \gamma\rangle, \langle L, K\rangle, \langle L, \alpha\rangle, \langle L, \beta\rangle, \langle \gamma, \gamma\rangle, \langle K, K\rangle, \langle K, \alpha\rangle, \langle K, \beta\rangle, \langle \alpha, \alpha\rangle, \langle \beta, \beta\rangle\}$

Now, noting the continued adoption of the reflexivity of $\mathbf{ImmC^r}$, a property inherited by the composition of the relation with itself, we can see that (22) expresses the generalised notion of (reflexive) containment ($\mathbf{C^r}$) or domination for (14). For the converse relation, we obtain (23), which, setting aside whether we are comfortable with all terms being terms of themselves, looks appropriate for the important relation (*reflexive*) *term-of* ($\mathbf{T^r}$):

(23) $\mathbf{ImmT^r{*}ImmT^r} = \mathbf{T^r} = \{\langle L, L\rangle, \langle \gamma, L\rangle, \langle K, L\rangle, \langle \alpha, L\rangle, \langle \beta, L\rangle, \langle \gamma, \gamma\rangle, \langle K, K\rangle, \langle \alpha, K\rangle, \langle \beta, K\rangle, \langle \alpha, \alpha\rangle, \langle \beta, \beta\rangle\}$

At this point, it is appropriate to say something about the reference to 'the transitive closure *contain* of *immediately contain*' in Chomsky's (18). The formal definition of transitive closure appears in (24):

(24) the transitive closure of a binary relation R on a set S is the minimal transitive relation R' on S that contains R.

Now, it is clear that if we start from the specification of $\mathbf{ImmC^r}$ in (15b) and calculate the transitive closure of this relation on the set $\{L, \gamma, K, \alpha, \beta\}$ what we end up with is (22), i.e. *for this case*, referring to the transitive closure of R as T(R), we have (25):

(25) $T(\mathbf{ImmC^r}) = \mathbf{ImmC^r} * \mathbf{ImmC^r} = \mathbf{C^r}$

Accordingly, it is not inaccurate for Chomsky to use the transitive closure of reflexive immediate containment as an alternative to the composition of this relation with itself *in this case*. However, it is easy to demonstrate that the identity in (25) does not generalise, i.e., (26) does *not* obtain for arbitrary binary relations R:

(26) $T(R) = R*R$

This can be readily illustrated by abandoning Chomsky's assumption regarding the reflexivity of immediate containment. To this end, we can consider the irreflexive variant of immediate containment, $\mathbf{ImmC^i}$, and. the derivation of (14) *via* two applications of Merge now yields (27) as the extension of this relation:

(27) $\mathbf{ImmC^i} = \{\langle L, \gamma\rangle, \langle L, K\rangle, \langle K, \alpha\rangle, \langle K, \beta\rangle\}$

Composing this relation with itself gives (28):

(28) $\mathbf{ImmC^i}*\mathbf{ImmC^i} = \{\langle L, \alpha\rangle, \langle L, \beta\rangle\}$

By contrast, the transitive closure of $\mathbf{ImmC^i}$ on the set $\{L, \gamma, K, \alpha, \beta\}$ is (29):

(29) $T(\mathbf{ImmC^i}) = \{\langle L, \gamma\rangle, \langle L, K\rangle, \langle L, \alpha\rangle, \langle L, \beta\rangle, \langle K, \alpha\rangle, \langle K, \beta\rangle\}$

Three observations are appropriate at this point. First, what we have in (28) corresponds to what was referred to earlier as *degree-2 domination*, and it was suggested that this is *not* a relation to which the syntactic computation should have access – from the current perspective, it should *not* be emerging from the process we are engaged in. Because it does, we might maintain, then, that here we have a *reason* supporting the suggestion that *immediate containment* is reflexive: if we do not adopt this latter assumption *and* give ourselves composition of relations, we would need to exclude access to (28) by stipulation, precisely the situation we are seeking to avoid (but see further below).

Second, if we wish to maintain that the irreflexive (29) is a more attractive reflection of the traditional notion of general domination than the reflexive (22), we shall need to enrich the mechanisms by which we extend our fundamental set of relations to include the transitive closures of such relations.[19] And, of course, such enrichment will only yield the desired outcome if we simultaneously exclude composition of relations from applying in this case, an unacceptable stipulation, we might suppose.

Finally, we should note that *for this particular case*, with immediate containment regarded as reflexive, Chomsky's reference to 'transitive closure of *immediately contain*' in (17) can be properly regarded as purely descriptive, i.e. it does not commit him to embracing transitive closure, over and above composition of relations, as a way of extending the relational information available to the computational system.[20]

Overall, then, an *interim* conclusion might be that the reflexivity of immediate containment, explicitly adopted by Chomsky, yields two advantages: (i) the composition of the relation with itself is appropriate for generalised containment, setting aside any concerns about reflexivity itself; (ii) this is achieved without subscribing to an enrichment of the system by embracing transitive closures as an additional way of extending the fundamental set of relations (but see below).

The third composition to which Chomsky's (18) directs us is $\mathbf{Sis}{*}\mathbf{C^r}$, and we now turn to consideration of this, again taking the simple structure in (14) for illustrative purposes. The two relations we are composing are (15a) and (22) repeated as (30a, b):

(30) a. $\mathbf{Sis} = \{\langle\gamma, K\rangle, \langle K, \gamma\rangle, \langle\alpha, \beta\rangle, \langle\beta, \alpha\rangle\}$
b. $\mathbf{C^r} = \{\langle(L, L\rangle, \langle L, \gamma\rangle, \langle L, K\rangle, \langle L, \alpha\rangle, \langle L, \beta\rangle, \langle\gamma, \gamma\rangle, \langle K, K\rangle, \langle K, \alpha\rangle, \langle K, \beta\rangle, \langle\alpha, \alpha\rangle, \langle\beta, \beta\rangle\}$

The composition of these two relations yields (31):[21]

(31) $\mathbf{Sis}{*}\mathbf{C^r} = \{\langle\gamma, K\rangle, \langle\gamma, \alpha\rangle, \langle\gamma, \beta\rangle, \langle K, \gamma\rangle, \langle\alpha, \beta\rangle, \langle\beta, \alpha\rangle\}$

And, of course, this corresponds exactly to the extensional specification of the traditional notion of c-command (**CCom$^{\mathbf{r}}$**) for (14), as indicated in (16b).[22] At this stage, then, it appears that there is substantial justification for a process that seeks to ground the set of formal relations available to syntactic computation in the derivational process itself (specifically, Merge), along with a single 'principled' extension that relies on the availability of the composition of relations. The reflexiveness of immediate containment is required as an auxiliary assumption in arriving at this conclusion. Unease might be justified to the extent that composition of relations is not itself grounded in any more fundamental aspects of the system.

3. Troublesome Offspring

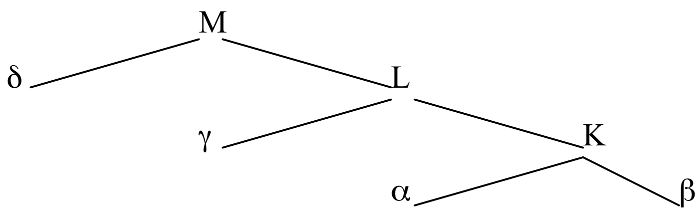
I now wish to move to consider a number of what seem to me to be fairly fundamental difficulties that the optimistic conclusion of the previous section must confront. The first has already been hinted at above in my discussion of identity, where I pointed out that the literal application of composition to **Sis** with itself yields a relation that is not quite identity – it gives us something we might designate as 'identity excluding the root.' The question that must now be posed is: what function does *this* composed relation have in syntactic computation?[23] In posing this question, I am simply seeking to maintain the need for a *principled* approach to the set of basic syntactic relations: if the proposals we favour yield a large set of formal relations from which we pick and choose, any sense of principle becomes opaque, and I take it that Chomsky's reference, in the passage cited in (18) to 'applying [composition of relations] *in all possible ways*' (my italics – MA) is a recognition of this agenda.

In the context of the above, it is somewhat surprising to find a recent discussion of Grohmann (2003) riding roughshod over these considerations. Having set out the two stages that I have described in the two previous sections (without noting the difficulty I mention concerning the root), he says (p. 4) of *identity* that '[it] does not seem to serve any obvious grammatical function, so that we can safely discard it (as well as a number of other superfluous relations that arise from a consequent application of composition – as would be expected, given that it would result in a vast array of structural relations).' These remarks, suggesting that picking and choosing from the available options is the way to proceed, seem to me to betray a rather fundamental misunderstanding regarding minimalist goals, a suspicion that is reinforced by Grohmann's subsequent attempt to use the ideas under consideration here to 'establish a relation' between a specifier and a head. In section 4, I shall briefly return to this aspect of his discussion, but at this stage I am merely at pains to point out the uncomfortable similarities between *stipulating* a set of syntactic relations from the outset and *stipulating* this set from within the possibilities made available *via* composition operating on a base founded in tokens of Merge.[24]

Setting what I take to be Grohmann's misconception aside, let us then consider the consequences of taking Chomsky's 'all possible ways' seriously. One area where a problem arises that has already been skirted focuses on the differences between iterated composition of relations and transitive closures in the derivation of general containment. It was noted in the previous section that in the case of (14) the composition of reflexive immediate containment ($\mathbf{ImmC^r}$) with itself yields the transitive closure of the same binary relation, and it was also observed that this identity does not generalise. From this earlier discussion, it might have seemed that reflexivity of the underlying relation is crucial here, but it is easy to see that matters are not as straightforward as this.

Consider the structure in (32), involving a third application of Merge:

(32)



Obvious considerations give us (33) as the extensional specification of $\mathbf{ImmC^r}$ for (32):

(33) $\mathbf{ImmC^r} = \{\langle M, M\rangle, \langle M, \delta\rangle, \langle M, L\rangle, \langle \delta, \delta\rangle, \langle L, L\rangle, \langle L, \gamma\rangle, \langle L, K\rangle, \langle \gamma, \gamma\rangle, \langle K, K\rangle, \langle K, \alpha\rangle, \langle K, \beta\rangle, \langle \alpha, \alpha\rangle, \langle \beta, \beta\rangle\}$

Next, consider the composition of this relation with itself, as in (34):

(34) $\mathbf{ImmC^r}*\mathbf{ImmC^r} = \{\langle M, M\rangle, \langle M, \delta\rangle, \langle M, L\rangle, \langle M, \gamma\rangle, \langle M, K\rangle, \langle \delta, \delta\rangle. \langle L, L\rangle, \langle L, \gamma\rangle, \langle L, K\rangle, \langle L, \alpha\rangle, \langle L, \beta\rangle, \langle \gamma, \gamma\rangle, \langle K, K\rangle, \langle K, \alpha\rangle, \langle K, \beta\rangle, \langle \alpha, \alpha\rangle, \langle \beta, \beta\rangle\}$

We can see immediately that (34) does *not* correspond to the traditional notion of *containment* (*domination)* for (32) – missing from it are the 'remote' cases of $\langle M, \alpha\rangle$ and $\langle M, \beta\rangle$. And we can also observe that these omissions can be dealt with by a further iteration of relational composition, composing (33) with (34). But the difficulty I am raising here is not dealt with by this further step: the point is that composition of relations operating on the basic information 'falling out' of the derivation of (31) yields (34), and a *principled* approach to the available set of relations should commit us to there being computational processes that need to have access to a containment/domination relation that excludes 'remote' pairs of items. To my knowledge, no such relation has played a role in syntactic argumentation.[25]

We have already considered the composition of sisterhood and containment (**Sis*C^r^**) in discussing how c-command might arise as a legitimate formal relation. However, composition of relations is not symmetrical, i.e., in general, the identity in (35) does *not* obtain for arbitrary binary relations, R and R′:

(35) $R * R' = R' * R$

In principle, then, $\mathbf{C^r{*}Sis}$ gives us another 'possible way' of composing basic relations, and if the strategy we are pursuing is correct, this should yield a recognisable syntactic relation, possibly c-command or possibly something else. To investigate this, we revert to the simpler structure in (14) as illustration. We first consider $\mathbf{ImmC^r{*}Sis}$. This yields (36):

(36) $\mathbf{ImmC^r{*}Sis} = \{\langle L, K\rangle, \langle L, \gamma\rangle, \langle \gamma, K\rangle, \langle K, \gamma\rangle\langle K, \beta\rangle,\langle K, \alpha\rangle, \langle \alpha, \beta\rangle, \langle \beta, \alpha\rangle\}$

Alternatively, we can start from $\mathbf{C^r}$, in which case, we derive (37):

(37) $\mathbf{C^r{*}Sis} = \{\langle L, K\rangle, \langle L, \gamma\rangle, \langle L, \alpha\rangle, \langle L, \beta\rangle, \langle \gamma, K\rangle, \langle K, \gamma\rangle\langle K, \beta\rangle,\langle K, \alpha\rangle, \langle \alpha, \beta\rangle, \langle \beta, \alpha\rangle\}$

We can see that both of these extensions amount to partial disjunctions of the component relations – they exclude the reflexive pairs that appear in $\mathbf{ImmC^r}$ and $\mathbf{C^r}$.

If we were to seek a phrase describing the relation in (36), we would need to resort to something along the lines of 'sisterhood or non-reflexive immediate domination.' In short, a particular non-reflexive pair belongs to one of these composed relations if and only if it belongs to one of the relations entering the composition. Most importantly, however, these outcomes do not appear to have any role in syntactic argumentation, and we can see that Chomsky's reference to 'all possible ways' leads to what appears to be an inappropriate relation.[26]

Continuing to focus on the same compositions, the outcome is different, and possibly interestingly different, if we suppose that it is irreflexive $\mathbf{ImmC^i}$ that is induced by Merge. For this case, we get (38):

(38) $\mathbf{ImmC^i{*}Sis} = \{\langle L, K\rangle, \langle L, \gamma\rangle, \langle K, \alpha\rangle, \langle K, \beta\rangle\} = \mathbf{ImmC^i}$

Accordingly, here, the composition does *not* extend the set of formal relations, with **Sis** behaving as a right identity element for $\mathbf{ImmC^i}$ under composition, and this conclusion generalises to $\mathbf{C}^{\mathrm{i}}$ irrespective of whether this latter is understood in terms of compositions or transitive closures. Thus, for (14), and generally, we have the identity in (39):

(39) $\mathbf{C^i{*}Sis} = \mathbf{C^i}$

I suggest that this is noteworthy if only because it indicates that in this case the proliferation of bizarre and useless syntactic relations is halted early, an encouraging outcome, we might suppose, if the goal is to specify and justify a small set of such relations.

A final example that leads to a similar outcome considers the composition of c-command with itself, clearly a legitimate relation if we have free access to relational composition (*pace* Grohmann's perspective mentioned earlier). Continuing to illustrate *via* (14), this composition yields (40) for $\mathbf{CCom^r}$, the version of c-command based on reflexive (immediate) containment:

(40) $\mathbf{Ccom^r{*}Ccom^r} = \{\langle\gamma, \gamma\rangle, \langle K, K\rangle, \langle K, \alpha\rangle, \langle K, \beta\rangle, \langle\gamma, \beta\rangle, \langle\gamma, \alpha\rangle, \langle\alpha, \alpha\rangle, \langle\beta, \beta\rangle\}$

This strange mixture of identity excluding the root, (partial) immediate domination and asymmetric c-command that we see in (40) is not a relation that suggests itself as useful in syntactic computation, and the difficulty raised in connection with (36) and (37) looms again here.

What happens if we pursue a version of c-command, $\mathbf{CCom^i}$, based on $\mathbf{C^i}$, where the latter has to be understood as T($\mathbf{ImmC^i}$)?[27] For (14), we have (41):

(41) $\mathbf{CCom^i} = \mathbf{Sis{*}C^i} = \{\langle\gamma, \alpha\rangle, \langle\gamma, \beta\rangle\}$

First, note that what we see here is the extension of *asymmetric* c-command for (14), an issue to which I will return shortly. For present purposes, however, we observe that composing $\mathbf{Ccom^i}$ with itself now yields the empty set, a benign outcome, insofar as it does not extend our set of formal relations in the direction of the empirically unjustifiable:

(42) $\mathbf{CCom^i{*}CCom^i} = \Phi$

Again, then, we have a conclusion that suggests that the assumption that (immediate) containment is reflexive, juxtaposed with extension *via* composition might not be innocent, leading, as it does, to a proliferation of binary relations for which the computational system has no use. Furthermore, there are indications that the adoption of irreflexive immediate containment avoids some of these difficulties.

For the remainder of this section, I wish to focus on this contrast between $\mathbf{ImmC^r}$ and $\mathbf{ImmC^i}$, a contrast we have seen to have a number of consequences, which are summarised in (43):

(43) a. The composition of $\mathbf{ImmC^r}$ with itself yields what might be regarded as an appropriate outcome for $\mathbf{C^r}$ in simple (depth-2) cases. However, for more complex cases, this iterated composition provides inappropriate (in the sense

of unused) binary relations. By contrast, the composition of **ImmC^i** with itself *never* yields appropriate binary relations. However, T(**ImmC^i**) always yields **C^i** .

b. Whereas the composition **ImmC^r *Sis (**or **C^r*Sis)** produces inappropriate binary relations, **Sis** functions as a right identity element when composed in this way with **ImmC^i** (or **C^i**), as a consequence of which these compositions do not extend the available set of binary relations in unwanted directions.

c. Composition of **CCom^r** with itself also produces an unwelcome extension to the set of available binary relations. This is not the case for the composition of **CCom^i** with itself, which takes us immediately to the empty set, although we must acknowledge that **CCom^i** corresponds not to general c-command, but to asymmetric c-command.

Thus, we are faced with trying to assess the relative weights of (43a), which maybe favours Chomsky's own adoption of **ImmC^r** against (43b) and (43c), which perhaps tip the balance towards **ImmC^i**. I now wish to propose that there are at least two independent reasons for why this assessment should lead us in the direction of adopting **ImmC^i** as the basic structural relation 'falling out' of a token of Merge.

First, it is noteworthy that **CCom^i** (asymmetric c-command) plays a very significant role in Kayne's (1994) Linear Correspondence Axiom, a principle he uses in his efforts to understand how linear order is determined for structures that are organised only in terms of hierarchy. Supposing, for the sake of argument that something along the lines advocated by Kayne is correct, it follows that the computational system must provide some asymmetric relation as a precondition for linearisation to proceed, and this is the case irrespective of whether linearisation is regarded as 'syntactic' or as part of the mapping to PF. The availability of asymmetric c-command responds to this requirement, and it might be viewed as very significant that a formal relation emerging (fairly) directly from the fundamental operation of Merge is precisely what is needed for this implementation. Indeed, here we see what I take to be a rather clear instance of what it would mean for the tenets of the Minimalist Programme to be vindicated – a formal relation required by the perceptual-articulatory interface emerges ‘naturally’ from the computational system. Good design with bells on!.

Second, it may be significant that the familiar c-command (**Ccom**$^{\mathbf{r}}$) arising from Chomsky’s adoption of **ImmC**$^{\mathbf{r}}$ includes pairs that are also related under sisterhood. The identity in (44) makes the relevant set-theoretic relations explicit:

(44) $\mathbf{CCom^r = CCom^i \cup Sis}$

The question posed by this identity is that of whether there exist any syntactic operations that require reference to c-command and which are *indifferent* as to whether the c-command in question is instantiated by items manifesting asymmetric c-command or sisterhood. If there are such operations, they would provide evidence for the importance of **CCom**$^{\mathbf{r}}$; if there are not, not only is **Ccom**$^{\mathbf{r}}$ not required, but its availability, with the redundancy that this implies, might be viewed as a potential embarrassment to the minimalist approach.

Overall, then it seems to me that there are non-trivial reasons for adopting **ImmC**$^{\mathbf{i}}$ and the relations that can be defined in terms of it. The cost of this step is concomitant adoption of transitive closure as an addition to the mechanisms that extend the fundamental set of relations, an adoption that is necessary in order to have available a proper notion of containment/domination. Whether the inclusion of transitive closure in this way itself leads to unattractive consequences has not been considered here.

4. Contraceptive Successes?

In n24 above, I drew attention to the two aspects of the fundamental question that motivates the discussion of this paper: we are seeking answers not only for why a specific formal relation R appears to be necessary for syntactic computation, but also for why a distinct relation R′ does *not* have this property. Thus, the remarks at the end of the previous section may provide reasons for supposing that the *general* notion of c-command, emerging from adoption of **ImmC**$^{\mathbf{r}}$ and informally defined in (17), is one such relation. Addressing non-availability directly, Chomsky (2001, 6) offers (45):

(45) If computation keeps to these austere conditions, it cannot rely on a head-to-SPEC relation R(H, SPEC); the relation called "m-command" in earlier work. There is no such relation. There is a relation R(SPEC, H), namely c-command; but no relation R(LB, H) where LB is the label of SPEC …'

These claims are of fundamental importance in a number of ways.

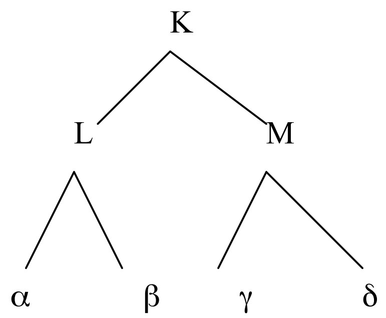
First, the formal relation of government has played a massive role in the development of Principles and Parameters Theory. But government is defined in terms of m-command, and if m-command does not exist for the computational system, nor does government.[28]

Second, the framework developed in Chomsky (1995) depends crucially on the computational system having access to a 'head-to-SPEC' relation, as agreement and Case assignment (checking) are dealt with in the context of this relation. If there is no such relation, it follows that the Chapter 4 framework of Chomsky (1995) has to be revised. Arguably, the unavailability of the 'head-to-SPEC' relation provides one of the principal motivations for the major technological shift from the checking domain approach of Chapter 4 of Chomsky (1995) to the complement domain framework, with the operation Agree achieving the outcomes of 'checking' *in situ*, of Chomsky (1998) and later work.

Finally, there are those (e.g. Koopman, 2005) who maintain that empirical considerations can be invoked to indicate that an *in situ* approach to agreement is inadequate. She sees such an approach as linked to uncertainty as to whether 'the Spec head relation [can] even be formalised' (*op. cit.*, 1). If Chomsky is being targeted as the source of the uncertainty here, the shot clearly misses, as the passage in (45) indicates - Spec-head is a member of the extension of c-command, which here is being taken as available.[29] It is important to draw a clear distinction between Head-spec and Spec-head, and to take account of the fact that the traditional asymmetry of, say, subject-verb agreement is properly captured by treating it as a process that is 'initiated' by properties of the head (verb) and 'satisfied' by properties of the subject. If the subject is in specifier position at the point in a derivation where this process takes place, as in Chapter 4 of Chomsky (1995), this will require reference to a Head-spec relation. There is cause to try to clarify just what is being claimed here.

To briefly engage the technicalities raised in (45), consider the structure in (46), where we assume that α is the label of L and γ is the label of M and K (more traditionally, γ is the head of the structure, with δ as its complement and L as its specifier, this latter headed by α with complement β:

(46)



The structure in (46) results from the three applications of Merge in (47):

(47) a. Merge $(\gamma, \delta) = \{\gamma, \delta\} = M$
b. Merge $(\alpha, \beta) = \{\alpha, \beta\} = L$
c. Merge $(L, M) = \{L, M\} = \{\{\alpha, \beta\}, \{\gamma, \delta\}\} = K$

The operations in (47) induce the immediate syntactic relations in (48). Following the discussion of the preceding section, we take immediate containment to be irreflexive, an assumption that has no consequences for the discussion that follows:

(48) a. $\mathbf{ImmC^i} = \{\langle K, L\rangle, \langle K, M\rangle, \langle L, \alpha\rangle, \langle L, \beta\rangle, \langle M, \gamma\rangle, \langle M, \delta\rangle\}$
b. $\mathbf{Sis} = \{\langle L, M\rangle, \langle M, L\rangle, \langle \alpha, \beta\rangle, \langle \beta, \alpha\rangle, \langle \gamma, \delta\rangle, \langle \delta, \gamma\rangle\}$

With $\mathbf{ImmC^i}$, it is necessary to rely on its transitive closure to move to $\mathbf{C^i}$ and this is given in (49):

(49) $T(\mathbf{ImmC^i}) = \mathbf{C^i} = \{\langle K, L\rangle, \langle K, \alpha\rangle, \langle K, \beta\rangle, \langle K, M\rangle, \langle K, \gamma\rangle, \langle K, \delta\rangle, \langle L, \alpha\rangle, \langle L, \beta\rangle, \langle M, \gamma\rangle, \langle M, \delta\rangle\}$

$\mathbf{CCom^i}$ is given by (50):

(50) $\mathbf{CCom^i} = \mathbf{Sis*C^i} = \{\langle L, \gamma\rangle, \langle L, \delta\rangle, \langle M, \alpha\rangle, \langle M, \beta\rangle\}$

With the above in place, we return to Chomsky's remarks in (45) in the context of the structure in (46). First, he appears to be saying that there is no relation available to the computational system that enables it to access $\langle\gamma, L\rangle$, 'the head-to-SPEC relation.' Inspection of (48) – (50) shows that this is, indeed, the case for the relations whose extensions appear there, but at this stage, we reintroduce the converse of $\mathbf{ImmC^i}$, namely $\mathbf{ImmT^i}$. This, with its transitive closure $\mathbf{T^i}$ (term-of) applied to (46), appears in (51):

(51) a. $\mathbf{ImmT^i} = \{\langle L, K\rangle, \langle M, K\rangle, \langle\alpha, L\rangle, \langle\beta, L\rangle, \langle\gamma, M\rangle, \langle\delta, M\rangle\}$
b. $\mathbf{T^i} = \{\langle L, K\rangle, \langle\alpha, K\rangle, \langle\beta, K\rangle, \langle M, K\rangle, \langle\gamma, K\rangle, \langle\delta, K\rangle, \langle\alpha, L\rangle, \langle\beta, L\rangle, \langle\gamma, M\rangle, \langle\delta, M\rangle\}$

Now, if we calculate the composition of $\mathbf{T^i}$ and **Sis**, we get (52):

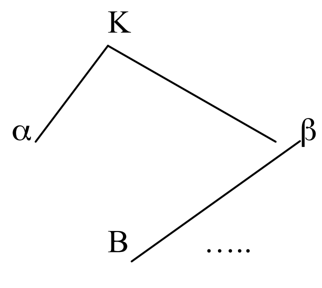
(52) $\mathbf{T^i*Sis} = \{\langle\alpha, M\rangle, \langle\beta, M\rangle, \langle\gamma, L\rangle, \langle\delta, L\rangle\}$

And, of course, what we see in (52) is an occurrence of $\langle\gamma, L\rangle$.

To get a grasp of what this means for the first claim in (45), let us first attend to the second claim that appears there, viz. that '[t]here is a relation R(SPEC, H), namely c-command.' In (46), the specifier-head relationship is instantiated by the pair $\langle L, \gamma\rangle$ and (50) indicates that this pair is, indeed, a member of $\mathbf{CCom^i}$. Note, however, that it is not the case that the specifier-head relation *is* c-command, as Chomsky's wording might be seen as suggesting – rather, that relation is *instantiated* by a pair that *belongs* to c-command, and it is the relation of c-command, and, presumably, its extension (cf. n31), that is made available by the processes discussed in this paper. Nothing we have considered suggests that there is an accessible relation that is *exhausted* by $\langle L, \gamma\rangle$. Now, if c-command is accessible to the computational system, this ought, then, to imply that *all* members of the relation are party to this accessibility. Thus, for (50), we would expect to find computational processes engaging the pairs ⟨L, δ⟩, ⟨M, α⟩ and ⟨M, β⟩, as well as ⟨L, γ⟩, and recalling the earlier brief discussion of the role of asymmetric c-command in linearisation, we might be attracted by the suggestion that this is, indeed, the case. The alternative that from an extension that includes four pairs, the system accesses only one raises, at a different level, the sort of difficulty already raised in connection with Grohmann's (2003) selecting and discarding from within the set of formal relations emerging via tokens of Merge and composition. In short, such a strategy for c-command invites the question: *why* does ⟨L, γ⟩ get to engage the computational system, whereas the other members of $\mathbf{CCom^i}$ in (50) do not?

Returning briefly to Grohmann (2003), it is noteworthy that the account he offers can also be regarded as engaging this issue. Having introduced immediate containment and sisterhood as the 'primitive' relations, he continues (p. 4): 'The most natural extension of the two primitive relations is arguably the single application of composition to these two relations only. The only additional relation that arises is the result of the function (immediately-contain(sister)), which I call *Extended Sister*.' Just why this should be the 'most natural extension' and why it is the 'only additional relation that arises' are questions that could be posed for Grohmann, but what I am concerned with here is a different matter.[30] First, observe that his immediately-contain(sister), in order to achieve what is intended, corresponds to sister(immediately-contain) in Chomsky's usage and to $\mathbf{Sis{*}ImmC^i}$ in the system of notation used in this paper. Supposing Grohmann assumes immediate containment to be irreflexive, the relation he defines is just very local asymmetric c-command![31] Now, Grohmann wishes to maintain that his Extended Sister (= very local asymmetric c-command) 'generates an additional relation' between α and B in the simple partial structure in (53):[32]

(53)



For (53), **Sis*ImmC^{i}** is partially calculated as (54):

(54) **Sis*ImmC^{i}**= $\{\langle\alpha, B\rangle \ldots.\}$

The important observation about (54) is that while it does contain $\langle\alpha, B\rangle$, *it will also contain other pairs of objects.* Specifically, if we add C to (53) as a sister of B, an immediate consequence will be that $\langle\alpha, C\rangle \in$ **Sis*ImmC^{i}**. Thus, Grohmann's notion of 'generating' a relation between specifier and head is not realised, unless he sees it as appropriate to help himself to just those members of the emerging relations that he needs. What Grohmann's manoeuvre has achieved is the 'generation' of local asymmetric c-command, obtaining between a specifier and the head of which it is the specifier and the same specifier and the complement of the head of which it is the specifier. As indicated above, these pairs with their asymmetric relations might be of importance in the context of linearisation, but this is not Grohmann's concern.

We now return to (52), and the difficulties facing Chomsky's position on the non-availability of the head-to-SPEC relation are obvious. Not only does the system have access to $\langle\gamma, L\rangle$ - head-to-SPEC in this particular case - but it also has access to $\langle\alpha, M\rangle$, $\langle\beta, M\rangle$ and $\langle\delta, L\rangle$. Of course, what we have here is no more than the converse of the local asymmetric c-command favoured by Grohmann, and it could equally (and redundantly) serve in the context of linearisation. From the present perspective, however, the important conclusion is that reference to the head-to-SPEC relation appears to be possible, and the contrary view expressed by Chomsky in (45) is wrong.

Furthermore, it is easy to see that Chomsky's final case in (45) fails on the basis of similar considerations. Once more using (46), this case focuses on the pair $\langle\alpha, \gamma\rangle$, and, again, it is easy to derive an apparently legitimate relation that includes this pair. Thus, consider the two-step composition **T^{i}*(Sis*C^{i})** with respect to (46). As $\langle L, M\rangle \in$ **Sis** and $\langle M, \gamma\rangle \in$ **C^{i}**, we can assert that $\langle L, \gamma\rangle \in$ **Sis*C^{i}**. But $\langle\alpha, L\rangle \in$ **T^{i}**, so $\langle\alpha, \gamma\rangle \in$ **T^{i}**(**Sis*C^{i}**).

Overall, then, I do not believe that adequate arguments have been advanced to formally underwrite the rejection of a number of key relations from the syntactic repertoire.[33] Coupled with the conclusions of Section 3, which cast some doubt on whether there is a principled extension to the set of basic relations contingent on tokens of Merge, this indicates some uncertainty regarding the outcome of the strategy examined in this paper. In this context, it is of interest that in his most recent papers, Chomsky (2005b, 2006) has adopted a rather different starting point in the genesis of available formal relations, and I shall now briefly examine what he has to say in this connection.

5. Perhaps We Should Adopt

The shift to which I refer above, while perhaps hinted at in Chomsky (2005a, 14), is explicitly formulated in Chomsky (2005b, 7-8), where we find:

(55) 'We therefore have two syntactic relations: (A) set-membership, based on Merge, and (B) probe-goal relations. Assuming composition of relations, (A) yields the notions *term-of* and *dominate*. These seem to be the minimal assumptions about the available relations. If we add "sister-of," then composition will yield c-command and identity (the latter presumably available independently). Whether c-command plays a role within the computation to the C-I interface is an open question. I know of no clear evidence that it does, so will keep to the relations that seem unavoidable, set-membership and probe goal.'

This passage prompts a number of observations.

First, we note two options, one where **Sis** is excluded from the set of fundamental syntactic relations, and a second where it is included. This second, of course, corresponds to the framework explored extensively above, but it is unclear to me that it can be rejected without calling the foundation of the whole strategy into question. Recall that we started from the position that a token of Merge induces a small set of relations, and earlier I suggested that there were good reasons for this set including **Sis**, reasons which presumably Chomsky saw as substantial in including **Sis** in his own initial taxonomies. To now exclude **Sis** is to indulge in the sort of picking and choosing that we have sought to avoid: if Merge makes available immediate containment, reflexive or irreflexive, and **Sis,** and we are supposing that fundamental relations inherit their credentials from the credentials of Merge as necessary for, and definitive of, language-like systems, we cannot lightly discard **Sis** on the basis of poorly understood concerns about the need for the computational system to have access to c-command.[34]

Second, supposing that despite the above reservation, we adopt the first option. Then, it is clear that the uncertainties and unclarities that this paper has focused on don't arise, setting aside the issue of whether 'set membership,' explicitly referred to here in these terms, is reflexive or irreflexive. Set membership is the only set-theoretic relation emerging from tokens of Merge, and we can extend straightforwardly via composition of relations to yield general domination and term-of.

Third, and perhaps most importantly, we now meet the idea that probe-goal joins the inventory of syntactic relations and does so without engaging the parentage of Merge. A first pass at this suggestion yields puzzlement for rather obvious reasons. Consider, for instance, what Chomsky (1998, 37-38) has to say about the probe-goal relation:

(56) 'Matching is a relation that holds of a probe P and a goal G. Not every matching pair induces Agree. To do so, G must (at least) be in the domain D(P) of P and satisfy locality conditions'

What is being claimed here is that there is a set of necessary conditions that must hold of a pair $\langle\alpha, \beta\rangle$ if they are to instantiate the probe-goal relation, this being a prerequisite for the operation of Agree. Setting these out more explicitly and referring to the relevant relation as PG, we have (57), where SC is a structural condition:[35]

(57) PG (α, β) if and only if:
(i) Match (α, β) and
(ii) SC (α, β)

Of course, what (57) invites is an explication of the relations Match and SC. For the former, we have (Chomsky, 1998, 38) ‘matching is feature identity,’ and we might suppose that this is a notion of identity that is referred to in (55) as ‘available independently’ (cf. n18). What of SC? In ‘Minimalist Inquiries,’ we find (*ibid*): ‘D(P) is the sister of P,’ thereby restricting a legitimate goal to the complement domain of a probe, and ‘locality reduces to “closest c-command”.’ But if ‘closest c-command’ is required in the definition of a legitimate probe-goal relationship, the position advocated by Chomsky in (55) looks unsustainable.

A bit more perspective on the dilemma raised here, if that is what it is, comes from Chomsky (2006, 6), where he says:

(58) ‘Restricted to heads (probes), c-command reduces to minimal search. The standard broader notion can be defined in terms of dominance and sisterhood … But it is not clear that this extension beyond minimal search – a natural computational principle – is necessary.’

The intention is clear enough. C-command, generally defined, will permit heads and non-heads to be c-commanders (cf. the reference to ‘scopal relations’ in n34, where important cases of these relations obtain between pairs of maximal projections). It is intelligible, however, to consider a restricted type of c-command in which the c-commander is always a head, and to suggest that only this sub-type of c-command plays a role in syntactic computation. I have two types of concerns about this suggestion.

First, as I understand it, there remain additional conditions on a pair of items if they are to comprise a probe-goal pair. These will involve relational statements, and the pedigree of the relations appearing in these statements will require examination.

The second is that while ‘minimal search’ may, indeed, sound like a ‘natural computational principle,’ it is no more than a label, and it seems to me that once we seek to ascribe content to it, we soon confront familiar c-command. The path to this conclusion is straightforward, and Chomsky’s own words will serve to frame the argument. He says (2006, 15): ‘Consider a single phase of the schematic form

{P, XP} where P is the phase head, C or v*. P assigns its inflectional features to the label L of XP, T or V. These labels than probe XP to find the *closest* matching goal.' (my italics - MA).[36] Thus, Chomsky supposes that a measure is definable on XP, so that, given two potential goals, G_1 and G_2, for probe P, the measure will tell us that G_1, say, is closer to P than is G_2. But what is this measure? By assumption, both $\langle P, G_1\rangle$ and $\langle P, G_2\rangle$ instantiate the probe-goal relation if we ignore distance, but what we now see the need for is some way of indicating that G_1 *intervenes* between P and G_2 and there is nothing in the probe-goal relation itself that provides this information. Of course, with access to c-command, we can formulate a definition such as (59), where the dots are to be replaced by whatever non-metric conditions are required for a pair to be probe-goal candidates:

(59) G_1 intervenes between P and G_2 if and only if …. and:
(a) P c-commands G_1
(b) G_1 c-commands G_2

Equivalently, an appropriate sense of 'closest' can be defined as in (60):

(60) G is the closest goal for P if and only if … and:
(a) P c-commands G
(b) there is no H such that … , P c-commands H and H c-commands G

In both (59) and (60), the (a) clause can be replaced by a clause referring to the restricted probe-goal relation. However, this is not so for the (b) clauses, precisely because they require reference to a relation between potential *goals*. Overall, then, it appears that without the specification of a metric that will deal with intervention, Chomsky's attempt to eschew reference to c-command (and sisterhood) is at best incomplete.

6. Time For Bed

In conclusion, I would like to suggest first that the strategy that I have subjected to fairly detailed examination here is a fine example of what is involved in taking the fundamental aspects of the minimalist programme seriously. This programme urges that the question of why things are the way they are should always be on the agenda. Supposing Merge has the special status, disputed by some, that entails that it does not itself provoke a why question, we can ask what, if anything, follows about the availability of specific formal relations by linking this availability to tokens of Merge. I believe that it is of interest that this strategy can be articulated at all and pursued with moderately concrete outcomes.

Second, I must concede that these outcomes have also been inconclusive in a number of ways, with unforeseen uncertainties emerging along the way, itself a good thing in my view. However, I believe that the case that has been made for the computational system having access to asymmetric c-command (**CCom**$^{\mathbf{i}}$) rather than the standard **CCom**$^{\mathbf{r}}$ has sufficient merit to justify further reflection and enquiry. Of course, this case itself goes back to the question of whether immediate containment is properly viewed as irreflexive or reflexive, and perspectives from outside the main line of argument have been offered in support of the former.

It is one thing to offer an account, convincing or not, for the appearance of a specific relation in the set on which language appears to rely. It is another to propose reasons for why this or that relation is excluded from this set, and it seems to me that (a) the minimalist approach urges that these demands be contemplated simultaneously and (b) this has, perhaps, not been well understood by some (e.g. Grohmann, 2003). What may be of greater immediate importance is that it has proved possible to construct arguments suggesting that Chomsky's attempts to formally underwrite the *exclusion* of some relations that have played important descriptive roles in the work of the last 30 years or so are not successful.

Finally, I have raised issues that seem to me to call into question the manoeuvre of removing *sister-of* from the fundamental set of relations, thereby losing access to all varieties of c-command that permit heads and non-heads to be c-commanders, and ascribing foundational status to the probe-goal relation. This manoeuvre is, it seems to me, inconsistent with one of the main principles that has been prominent throughout the above discussion – picking and choosing is not allowed – and takes out a debt to articulate the notion of minimal search without resorting to something equivalent to closest c-command.

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Notes

[1] With apologies to Bertolt Brecht. This paper is a somewhat modified and extended version of Atkinson (2006). The additions to the earlier paper are of two types. First, I have sought to be more explicit as to what I take to be the purpose and significance of the discussion, since it seems that there was some scope for misunderstanding this aspect of the earlier work; second, I have included some discussion and evaluation of Chomsky's (2005b, 2006) suggestion that the probe-goal relation can be taken as 'basic,' an issue that was merely mentioned in a footnote in the earlier paper.

[2] In the discussion that follows, since it will be framed entirely within the minimalist framework, I shall continue to adopt such a derivational perspective. I would, however, contend that the foundational issues the paper pursues can, and should, be raised in the context of alternatives such as the model-theoretic approach outlined in Postal (2003), although the starting point of the deliberations would be different, and the significance of any outcomes would be presented in a different idiom.

[3] I put things like this for the sake of generality. Specific cases will, of course, display only limited aspects of this generality. Thus, within Bare Phrase Structure (Chomsky, 1994, 1995), the operation of binary merger takes a pair of syntactic objects, each of them a set, as input and produces a single syntactic object, also a set, as output. Or, from a different age, the generalised transformations of the earliest transformational grammars (Chomsky, 1957) have the same character as binary merger at an appropriate level of abstraction, although the objects to which they apply are not sets but strings under structural descriptions, whereas the singulary transformations from the same era take a single syntactic object, again a string under a structural description, as input and produce a single syntactic object as output. As regards other operations generally assumed within minimalist architecture, see n8 below.

[4] Some of the consequences of regarding immediate domination as reflexive or irreflexive will be examined in what follows.

[5] Two apologies before I get going. First, what follows is pretty elementary for anyone who is familiar with the calculus of formal relations; second, the absence of the sort of empirical observations that linguists trade in is conspicuous throughout! I'm sure that most linguists would sign up with enthusiasm to the position Chomsky (1998, 14) outlines as '… conceptual arguments can be given either way, but they carry little weight. The questions are empirical.' However, it is to be observed that this manifesto appears in a discussion of the introduction of the *lexical array* into the architecture of the theory. The only empirical argument that I am familiar with for this construct is identical to one that Chomsky (*op. cit.*, 19) cites for phases and relies centrally on the principle that given a choice in a derivation, Merge will always be preferred to Move. As close followers of the story will know, this Merge-over-Move Principle and its role in accounting for a range of empirical phenomena is far from uncontroversial (see, for instance, Boeckx and Grohmann, 2007), and in circumstances such as these, where the empirical often shades into the conceptual and often displays an alarming lack of robustness, I would like to suggest that reliance on the conceptual is not always a recipe for insignificance.

[6] The reasoning to this conclusion is straightforward. Setting aside scepticism such as that elaborated by Postal (2003), some combinatorial *operation* or other enjoys the special status of being regarded as conceptually necessary in minimalist approaches – I'll eschew the 'virtual' that often appears as an additional modifier of 'necessary' here! If we can argue that such an operation itself induces certain formal relations, it is a small step to suggest that these relations inherit the credentials ascribed to the operation itself. To the extent that these relations are those that appear to be useful in constructing accounts of this or that grammatical phenomenon, the minimalist approach receives a measure of support.

[7] Thus, following n6, we are regarding syntactic operations, specifically those that make up 'the computational process,' as fundamental, with *relations* having a derivative status. Note that this emphasis immediately distinguishes the approach from that of Rizzi briefly mentioned above, where the 'basic ingredients of syntactic computation' are themselves relations. It is not clear to me that much follows from a focus on (i), and this obscurity may itself be linked to fundamental uncertainties regarding the nature of interfaces, particularly that (those?) with the conceptual-intentional system. It is, however, common to suppose that the articulatory-perceptual system demands access to a total linear ordering, but it is also standard to regard this relation as playing no role in the narrow syntactic

computation (Nunes, 1999; Richards, 2004). See below for what might be some interesting perspectives on this.

[8] For the purposes of this discussion, I have contemplated adopting the name Form-Set for this operation, since this is what Merge achieves and it is, perhaps, a more natural term to rely on for the unary case (Merge (α) = $\{\alpha\}$) briefly considered by Chomsky (2005a, b) in his speculations on the evolutionary origins of number. However, I've decided to stick with the term that is commonly used. Of course, Chomsky himself (2001) distinguishes Set-Merge from Pair-Merge, and I shall have a (very) little to say about the latter shortly. Citko (2005) introduces, and seeks to justify, something she refers to as Parallel Merge, claiming that its existence is expected within a system that does not embrace arbitrary constraints. It seems to me that Citko's position can only be sustained if we abandon the set-theoretic nature of Bare Phrase Structure and that Chomsky (2006, 6, n12) is along the right lines when he remarks that Parallel Merge 'requires new operations.' Without suggesting that there are defensible accounts of the phenomena Citko relies on in her defence of Parallel Merge within a more constrained framework, I shall set Parallel Merge aside here.
Alongside varieties of Merge, the sort of computational system presupposed here contains an operation Agree, which can be construed in different ways. Setting aside the complication of Multiple Agree (Hiraiwa, 2005), we could, for instance, see Agree as taking a pair of syntactic objects, usually referred to as *probe* and *goal*, and producing a modified pair of objects, these modifications amounting to the valuation (for phonological purposes) and deletion (for semantic purposes) of unvalued features. Even within this perspective, there are alternatives. For instance, the objects in question might be single features or sets of features comprising members of traditional grammatical categories – is T a probe because it contains φ-features with certain characteristics, or are the relevant φ-features themselves independent probes? See Sigurðsson and Holmberg (2006) for an empirical perspective on this issue. Alternatively, we could regard Agree as taking a single syntactic object (which includes an appropriate pair of terms) and yielding a single object, with the specified changes introduced at the relevant loci. I shall not seek to pursue the detailed properties of Agree in the following discussion, although it will be in the background in Section 5. Spell-Out (or Transfer in some later work) is a further syntactic operation that, again, has distinct properties, taking a single syntactic object as input and producing a pair (or, perhaps, a triple) of objects as output.
While the status of these additional operations is of some interest, in the context of the evolutionary speculations that recursion, instantiated by Merge, is what is crucial to the Narrow Language Faculty (Hauser, Chomsky and Fitch, 2002; Pinker and Jackendoff, 2005 for a dissenting voice), it would take us too far afield to pursue this interest here.

[9] The idea that set-theoretic operations such as Merge can induce a linked set of binary relations generalises. Consider, for instance, Pair-Merge, applied to the syntactic objects α and β to yield the ordered pair $<\alpha, \beta>$ (= K'). Once again, this invites us to consider binary relations on the 3-member set, S' in (i):

(i) $S' = \{\alpha, \beta, K'\}$

In this case, the lack of symmetry in the operation entails that the analogues of the symmetric (with respect to α and β) relations on (8) do not 'fall out' of this operation, i.e. none of the binary relations in (ii) has this property:

(ii) a. $\{<\alpha, \beta>, <\beta, \alpha>\}$
b. $\{<\alpha, K'>, <\beta, K'>\}$
c. $\{<K', \alpha><K', \beta>\}$

What we have in place of these is the set of one-member binary relations in (iii):

(iii) a. $\{<\alpha, K'>\}$
b. $\{<\beta, K'>\}$
c. $\{<K', \alpha>\}$
d. $\{<K', \beta>\}$

If we are to name these, we will need to resort to something along the lines of the clumsy *first-object-in*, *second-object-in*, *containment-as-first-object* and *containment-as-second-object*.

[10] In 'Derivation by Phase' (Chomsky, 1999, 2), there is an even briefer statement: 'Merge yields two natural relations: Sister and Immediately-Contain (IC).'

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[11] In the cited passage, Chomsky designates the pairs of items entering a relation by using familiar parentheses rather than the conventional angled brackets. In what follows, I shall use the latter throughout.

[12] A further minor point is that Chomsky does not, at this stage, mention the converse of *immediate containment*, viz. *immediate membership* or *immediate-term-of*, as also induced by a token of Merge.

[13] This somewhat neurotic reference to other things being equal is in recognition of the fact that in a broader discussion, taking account of a more comprehensive set of considerations, this might not be the case, since *locality* factors might begin to reduce the information to which the system has access at a particular stage in a derivation.

[14] From hereon, I shall generally suppress reference to $\mathbf{ImmT^r}$ as it is simply the converse of $\mathbf{ImmC^r}$. It will reappear to play a significant part in the discussion in Section 4.

[15] The attitude adopted by Chomsky to c-command is ambivalent, a matter to which I shall return in Section 5. For now, we merely need to note that the procedure he goes on to outline in 'Minimalist Inquiries' *is* intended to yield c-command as a legitimate syntactic relation.

[16] This is not to advocate seduction by the rhetoric. Composition of relations has *nothing* to do with the dynamics of the presupposed computational system.

[17] In the passage cited in (18), Chomsky uses only parentheses and has no explicit symbol for composition corresponding to * in (19).

[18] How concerned should we be about this? Well, obviously, we should not celebrate the sloppiness. More importantly, perhaps, it is apparent that the (incomplete) notion of identity emerging from this composition of **Sis** with itself is not appropriate for capturing the concept proposed by Rizzi (2004), along with prominence and locality, as comprising the foundational relational vocabulary for the computational system (see above). Specifically, we can consider the case of the notion of identity required by the definition of chain in the copy theory of movement, observing that whenever the pair α and β constitutes a chain, we do *not* have $\langle\alpha, \beta\rangle \in$ **Sis*Sis**, where this composition is defined on the structure to which the chain belongs. It appears, therefore, that the system needs access to a quite different notion of identity, and it is instructive that Chomsky (2005b, 7-8), having rehearsed the derivation of identity we are currently considering, notes that it is 'presumably available independently.' Or consider the relation Match, which, along with a structural condition of c-command (and possible reference to intervention, but see Atkinson, 2001), constitutes a prerequisite to the application of the operation Agree in Chomsky (1998) and a wide range of subsequent discussions (see Section 5 for matters touching on this). Match is an identity relation that again does *not* generally obtain between items that are sisters of each other. Furthermore, in this case it does not demand complete identity between syntactic objects (construed as sets of features) but only partial identity with respect to 'relevant' features. There is a good deal of fundamental obscurity here in my view (see Atkinson, *op. cit.* for extended discussion), but what is clear is that **Sis*Sis** is irrelevant to these identity matters. Finally, setting the flaw raised in the text aside, we must ask whether there is *any* role in the computational system for identity understood as **Sis*Sis**. If there is not, this poses a fundamental problem for the approach under consideration: if the computational system uses only *some* of the relations that composition makes available, what determines the membership of this set? An alternative way of putting this question is: just how *principled* is the extension Chomsky is advocating? There will be more to say about this as the discussion proceeds.

[19] Transitive closure can be defined in a standard way in terms of set union and composition, so does not have to be taken as primitive. However, set union, which would have to be taken as primitive in this case, operating freely on a given set of binary relations, will quickly yield relations that play no conceivable role in syntactic argumentation.

[20] At this point we should observe that in 'Derivation by Phase' (Chomsky, 1999, 2), the *only* procedure mentioned for extending the set of relations based directly on Merge is transitive closure. The passage cited in n10 above continues: 'Allowing ourselves the operation of transitive closure, we derive the relations Contain, Identity, and C-command.' Now, it is the case that T(**Sis)** *includes* the

(incomplete) identity relation emerging from **Sis*Sis.** However, it also includes the original members of **Sis**, so it is quite inappropriate to equate this outcome with any sort of identity. Furthermore, as we shall be seeing in a moment, c-command *requires* definition in terms of composition, and it cannot be seen as emerging from any application of transitive closure to a 'more basic' relation. It appears, then, that Chomsky's (1999) remarks on this matter are simply inaccurate. 'Beyond Explanatory Adequacy' (Chomsky, 2001, 5-6) has: 'The operation [Merge] yields the relation ∈ of membership, and assuming iterability, the relations dominate (contain) and term-of. The derived relation c-command (= sister of contain) functions at SEM (e.g. for binding theory), but perhaps not within N[arrow]S[yntax].' It seems to me that in order to make sense of this, we need to identify 'iterability' with 'composition of operations.' I shall return to the uncertainty regarding c-command in Section 5.

[21] To reinforce the point made in the previous footnote, what we have in (31) cannot be regarded as the transitive closure of *anything* for the simple reason that it is not a transitive relation.

[22] I refer to $\mathbf{CCom^r}$ here because I shall subsequently wish to consider some of the consequences of seeing c-command as based on $\mathbf{C^i}$, i.e. I will focus on the properties of $\mathbf{CCom^i}$.

[23] Note that this is a different question from that briefly discussed in n18. There, the exclusion of the root from the defined relation was set aside.

[24] To be as explicit as possible here, I take it that if we have a set S comprising formal syntactic relations that appear to be necessary in the explication of empirical phenomena, this triggers the key minimalist question: why are there *just these* relations in S? And this question has two aspects. For relation $R \in S$, why is $R \in S$? And for relation $R' \notin S$, why is $R' \notin S$? Grohmann appears to be concerned only with the former of these.

[25] Of course, the difficulty, if genuine, iterates embarrassingly as structures involve more and more depth. Thus, a fourth token of Merge of the type considered so far will yield two compositions of $\mathbf{ImmC^r}$ with itself, one involving two tokens and the other three, neither of which corresponds to what we want for general containment/domination. Furthermore, it can be noted that if we give ourselves transitive closure of $\mathbf{ImmC^r}$, rather than relying on relational composition, the difficulty under discussion does not arise, a conclusion that obtains irrespective of whether *immediate containment* is taken to be reflexive or not. The *ceteris paribus* clause appearing in n13 could also come into play here, with independent considerations of locality leading to a quite different set of considerations.

[26] It's easy enough to see that bizarreness doesn't stop at (36) and (37) for (14). Thus, Chomsky's 'all possible ways' encourages us to consider, say, $\mathbf{(ImmC^r*Sis)*Sis}$, yielding the extension in (i):

(i) $\{\langle L, \gamma\rangle, \langle L, K\rangle, \langle \gamma, \gamma\rangle, \langle K, K\rangle, \langle K, \alpha\rangle, \langle K, \beta\rangle, \langle \alpha, \alpha\rangle, \langle \beta, \beta\rangle\}$

This needs to read along the lines of 'non-reflexive containment or identity excluding the root.' Of course, here we see why Grohmann is anxious to exclude 'superfluous relations' from his 'vast array.' However, my view is that he is not permitted to do this, and the appearance of the 'vast array' is a clear indication that something has gone wrong.

[27] Recall that the composition of irreflexive immediate containment with itself produces the extension of degree-2 domination, an unacceptable outcome, we are supposing.

[28] In fact, Chomsky's reference to m-command, apparently *identifying* it with the 'head-to-SPEC' relation in this passage is not accurate. Given familiar definitions, m-command, includes in its extension a pair comprising a head and its specifier, but, of course, it also includes the same head and its complement. Indeed, it was this symmetry in m-command, and its derivative relation, government, with respect to complement and specifier that paved the way for the unification of Case assignment and was viewed as attractive. Importantly for what follows, the availability of the relation entailed the availability of the *extension* of the relation.

[29] In the next section, I will briefly consider a position that does not embrace the availability of c-command. Obviously, within this position, Spec-head is not available, but Koopman has no reference to these later speculations..

[30] In particular, why, using Grohmann's notation, immediately-contain (sister) should be 'more natural' than sister (immediately-contain) is mysterious.

[31] On reflexivity, he says (*op. cit.* 11, n3): 'Chomsky assumes that immediately contain is reflexive … an assumption that does not seem relevant for present purposes.' As I hope to have shown rather clearly in this paper, the question of whether immediate containment is taken to be reflexive or not is a rather fundamental one in pursuing the issues that interest Grohmann.

[32] Grohmann presents his goal as that of defining relations that 'establish relevant checking configurations to licence grammatical properties' (p. 3). Within this brief, his intention is to 'generate' a relation 'between a specifier and a head of the same projection.' (p. 4).

[33] It may be observed that in order to produce the counterexemplification of this section it has been necessary to rely on the fundamental relation *term-of* and the difficulties could be avoided if we restricted the set of relations founded in Merge to exclude *immediate term-of*. This may be the case, but, given our starting point, it would be entirely unprincipled and stipulative. Note further that Chomsky himself continues to include *term-of* in his foundational relations, as in (55) cited below.

[34] In fact, I would go so far as to suggest that here the conceptual arguments are somewhat weightier than those with some empirical content. Further, observe that Chomsky himself, while attracted by the suggestion that the role of c-command in binding theory may not be clear in the computation to the conceptual-intentional interface, nor even at that interface itself, sees 'scopal relations' as 'possible instances of c-command in the broader sense.' (2006, 6).

[35] Here I set aside any concerns on the nature of probes and goals, individual features, sets of features or 'bundles' of features comprising lexical items (cf. n8 above). Furthermore, standard formulations required both P and G to be 'active' and this complication is also ignored here.

[36] Here, we see a formulation of the feature inheritance proposal, first proposed in Chomsky (2005b) and strengthened by an attractive conceptual argument from Richards (2007) in this later paper. In work in progress, I set out reasons for being cautious about this particular development, but its status is immaterial to the main issues being explored in this paper.