ESSEX RESEARCH REPORTS IN LINGUISTICS

Volume 49

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ESSEX RESEARCH REPORTS IN LINGUISTICS

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ON WHAT THERE IS (AND MIGHT NOT BE)

Martin Atkinson

'It seemed unworthy of a grown man to spend his time on such trivialities, but what was I to do?' (Bertrand Russell, 1967, p. 195, on becoming aware of what was to become known as Russell's Paradox)

1. Introduction

Suppose we adopt a derivational approach to the construction of syntactic objects, as schematised in (1):

(1) $SO_1 \rightarrow SO_2 \rightarrow \quad \dots \quad \rightarrow SO_n$
$\quad OP_1 \quad OP_{2,} \quad \dots \quad OP_{n-1}$

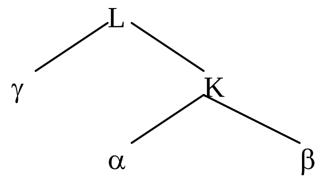
In (1), the OP_i ($1 \leq i \leq n-1$) designate *operations*, accepting a set of syntactic objects, $SO_{i,}$ as input and producing a new set of syntactic objects, SO_{i+1} as output.[1] A fundamental question that can be formulated in this regard is that of the identity of the set of formal *relations*, definable on syntactic objects, to which operations (and, perhaps, other aspects of the production of linguistic objects) have access. To illustrate, assume that syntactic objects comprise labelled trees. It has been customary to suppose 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, interpretive processes, etc. can refer. Candidates for this vocabulary have

[1] I put things like this for the sake of generality. Specific cases will 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 as input and produces a single syntactic object 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, whereas the singulary transformations take a single syntactic object as input and produce a single syntactic object as output. As regards other operations generally assumed within minimalist architecture, see n4 below.

included the binary relations *sisterhood*, *domination*, *precedence*, *c-command*, *m-command*, *government*, among others, 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 other processes. Yet, it is straightforwardly defined, and instantiated by the binary relation in (2) with respect to the simple labelled tree in (3):

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

(3)



Equally, we can formally define a binary relation *c^2-command* as in (4):

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

With respect to (3), then, we would have (5) as the extension of *c^2–command*:

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

Once more, so far as I know, *c^2-command* has not found its way onto the menu of formal relations that syntacticians sample, and a 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. The point, to re-iterate, is that given a specific species of syntactic objects (trees in the above), it is generally possible to define an infinite number of formal relations on them. However, accounts of syntactic phenomena typically rely on only a small subset of this set. In attempting to delimit this subset, we can, of course, simply advert to the vagaries of empirical enquiry, suggesting that the formal relations on which we rely are just those that happen to have proved useful or necessary in describing such-and-such a phenomenon in such-and-such a language. Or we can be more demanding and ask whether there is any *principled* way of proposing a candidate set of foundational formal relations, a set which must, of course, also be subjected to empirical scrutiny.[2]

2. What There Is: A First Step

A way of approaching the topic broached above is introduced by Chomsky (1998, 27), when he proposes that syntactic relations '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.[3] 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 this as amounting to relations having 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!

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[2] 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!

[3] Thus, we are going to be regarding syntactic *operations* as fundamental, with *relations* having a derivative status. It is not at all clear to me what follows from a focus on (i). It is uncontroversial that the interface with the articulatory-perceptual system demands access to a linear ordering, but it is orthodox to regard this relation as playing no role in the narrow syntactic computation (see below for what might be interesting perspectives on this). Candidates for formal relations 'imposed by legibility conditions' operative at the interface with the conceptual-intentional system, are less obvious.

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 must at least contain a binary operation Merge, which is defined as in (6):[4]

(6) 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 (7):

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

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 (8) do 'fall out' of this token of Merge, whereas those in (9) do not:

[4] 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 $(\alpha) = \{\alpha\}$) 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 little to say about the latter shortly. Alongside varieties of Merge, the sort of computational system presupposed here contains the 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, standardly 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. Alternatively, we could regard it as taking a single syntactic object (which includes an appropriate pair of terms) and yielding a single object, with the appropriate changes introduced at the relevant loci. I shall not seek to pursue the properties of Agree in the following discussion. 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 of objects as output.

(8) a. $\{\langle \alpha, \beta \rangle, \langle \beta, \alpha \rangle\}$

b. $\{\langle K, \alpha \rangle, \langle K, \beta \rangle\}$

c. $\{\langle \alpha, K \rangle, \langle \beta, K \rangle\}$

(9) 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 (8) and (9). For the binary relations in (8), it is straightforward to provide a label for them in the context of our token of Merge. Thus, (8a) amounts to the relation of *co-membership*, (8b) corresponds to (*immediate*)-*containment* and (8c) to the converse of (8b), (*immediate*)-*membership-of*. By contrast, while each of the relations in (9) 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 (9a), 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 (9a) neglects to recognise this symmetry, so (9a), unlike (8c), is not induced by Merge. Turning, to (9b), labelling as *identity* is readily available, but this remains the case for any α, β and K; specifically, it remains the case if $K \neq \{\alpha, \beta\}$. So, it is hardly appropriate to see *identity* as directly induced by Merge. Finally, in (9c), we have a binary relation that is neither readily named nor does it owe anything to the presupposed token of Merge.[5]

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[5] 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):

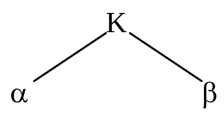
(i) $S' = \{\alpha, \beta, K'\}$

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 (7) do not 'fall out' of this operation, i.e. none of the binary relations in (ii) has this property:

What we have above corresponds almost exactly to Chomsky’s own approach to seeing how relations might ‘fall out’ of the computational system. 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 (10):

(10)



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.[6]

(ii) a. {<α, β>, <β, α>}
b. {<α, K’>, <β, K’>}
c. {<K’, α><K’, β>}

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

(iii) a. {<α, K’>}
b. {<β, K’>}
c. {<K’, α>}
d. {<K’, β>}

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*.

[6] 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.

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 suggestion 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, while acknowledging that immediate domination, the tree-theoretic relation linked to set-theoretic immediate containment is standardly regarded as an irreflexive relation.[7]

We assume, then, following our token of Merge, that *ceteris paribus* the computational system has access to the relational information in (11), where the superscript in $\mathbf{ImmC^r}$ and $\mathbf{ImmT^r}$ indicates the reflexive nature of the relations:[8]

(11) a. **Sis** = {⟨α, β⟩, ⟨β, α⟩}

b. $\mathbf{ImmC^r}$ = {⟨K, K⟩, ⟨K, α⟩, ⟨K, β⟩, ⟨α, α⟩, ⟨β, β⟩}

c. $\mathbf{ImmT^r}$= {⟨K, K⟩, ⟨α, K⟩, ⟨β, K⟩, ⟨α, α⟩, ⟨β, β⟩}

Next, we consider the further token of Merge in (12), giving rise to the extended structure in (3), repeated as (13):

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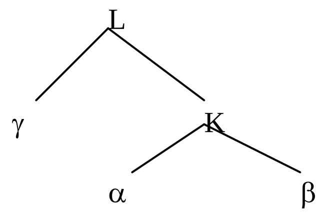
[7] A further minor point is that Chomsky does not, at this stage, mention the converse of *immediate containment*, viz. *immediate membership* or *immediate-term-of*, as also induced by a token of Merge.

[8] 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.

(12) Merge(γ, K) = {γ, K} = {γ, {α, β}} = L

(13)



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 (14):[9]

(14) a. **Sis** = {〈γ, K〉, 〈K, γ〉, 〈α, β〉, 〈β, α〉}

b. **ImmC**^{r} = {〈L, L〉, 〈L, γ〉, 〈L, K〉, 〈γ, γ〉, 〈K, K〉, 〈K, α〉, 〈K, β〉, 〈α, α〉, 〈β, β〉}

3. What There Is: A Second Step

It is important to be clear that the relational information we have in (14a, 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 the relations in (15) 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:

(15) a. {〈L, γ〉, 〈L, K〉, 〈(L, α〉, 〈L, β〉, 〈K, α〉, 〈K, β〉}

b. {〈γ, K〉, 〈K, γ〉, 〈γ, α〉, 〈γ, β〉, 〈α, β〉, 〈β, α〉}

But (15a) corresponds to a *general* notion of *containment* (*domination*), including *immediate containment* (here temporarily supposing this to be irreflexive) for (13), and (15b) is an

[9] From hereon, I shall generally suppress reference to **ImmT**^{r} as it is simply the converse of **ImmC**$^{r.}$ It will reappear to play a significant part in the discussion in Section 5.

extensional specification of the important relation of *c-command* for the same structure, if we adopt the definition of this relation in (16):

(16) α c-commands β in a structure S if and only if 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.[10] 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 (17):

(17) '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 remark justifies some reflection.

[10] The attitude adopted by Chomsky to c-command is puzzling. In a number of sources, e.g (1998, 2005b), he is more or less explicit in maintaining that syntactic computation can proceed without it. The following passage from Chomsky (2005b, 7-8) is revealing: '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 …' I have a number of difficulties with this passage, but the most notable of these is that explication of the probe-goal relationship, fundamental to the operation of Agree, involves decomposing it into an identity relation (cf. n12) and a structural relation, standardly taken to be c-command. With enthusiasm, I shall not attempt to disentangle these issues here! A more general concern is that probe-goal relations seem to me to have a quite different character to set-membership, sisterhood, etc.

First, note that what we are seeing here is, indeed, an extension to the set of 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 the composition of relations, itself characterised as 'elementary.' Is everything as it seems? Before proceeding to investigate this question, it is appropriate to formally introduce composition of relations as in (18):

(18) Given two (binary) relations R and R′ on a set S, we define the composition of R and R′ as:[11]

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

To move immediately to exemplification, let us first consider case (ii) from (17), **Sis** composed with itself, using the simple structure in (13) to illustrate. Instantiating (18) with **Sis** in the role of both R and R′ gives (19):

(19) **Sis***Sis** = {⟨x, y⟩ such that ∃z [⟨x, z⟩ ∈ **Sis** & ⟨z, y⟩ ∈ **Sis**]}

Now, inspection of (14a) yields the outcome in (20):

(20) **Sis***Sis** = {⟨γ, γ⟩, ⟨K, K⟩, ⟨α, α⟩, ⟨β, β⟩}

In the case of ⟨γ, γ⟩, K is such that ⟨γ, K⟩ and ⟨K, γ⟩ belong to **Sis** and γ, β and α play the same role for ⟨K, K⟩, ⟨α, α⟩ and ⟨β, β⟩, respectively. However, it is evident that ⟨L, L⟩ ∉ **Sis***Sis**, since L itself does not enter into the **Sis** relation with anything in (14a). 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

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

example.[12]

So much for identity and the composition of **Sis** with itself; let us next turn to (i) in (17) and examine the composition of $\mathbf{ImmC^r}$ with itself. Again, we can consider this in the context of (13) and (14b), with the outcome in (21):

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

Now, continuing to set aside the oddity of the reflexivity of $\mathbf{ImmC^r}$, an oddity that is inherited by the composition of the relation with itself, we can see that (21) expresses the generalised notion of containment ($\mathbf{C^r}$) or domination for (13). For the converse relation, we obtain (22), which looks appropriate for the important relation *term-of* ($\mathbf{T^r}$):

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

[12] How concerned should we be about this? Well, obviously, we should not celebrate the sloppiness. More importantly, perhaps, it is apparent that the (flawed) notion of identity emerging from this composition of **Sis** with itself is not appropriate for capturing the concept postulated by Rizzi (2002), along with c-command and locality, as comprising the foundational relational vocabulary for the computational system. 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 (perhaps that notion that is 'available independently' (n10)) to that that is partially characterised as the composition of sisterhood with itself. 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. 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.

At this point, it is appropriate to say something about the reference to 'the transitive closure *contain* of *immediately contain*' in Chomsky's (17). The formal definition of transitive closure appears in (23):

(23) 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 (14b) and calculate the transitive closure of this relation on the set $\{L, \gamma, K, \alpha, \beta\}$ what we end up with is (21), i.e. for this case, referring to the transitive closure of R as T(R), we have (24):

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

However, it is easy to demonstrate that the identity in (24) does not generalise, i.e., (25) does *not* obtain for arbitrary binary relations R:

(25) $T(R) = R*R$

This can be illustrated by abandoning Chomsky's assumption regarding the reflexivity of immediate containment. To this end, we can consider an irreflexive relation $\mathbf{ImmC^i}$. The derivation of (13) *via* two applications of Merge now yields (26) as the extension of this relation:

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

Composing this relation with itself gives (27):

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

By contrast, the transitive closure of $\mathbf{ImmC^i}$ is (28):

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

Three observations are appropriate at this point. First, what we have in (27) corresponds to what was referred to earlier (p. 2) as *degree-2 domination*, and it was suggested that this is *not* a relation to which the syntactic computation should have access. Accordingly, here we have a *reason* supporting the suggestion that *immediate containment* is reflexive: if we do not adopt this assumption *and* give ourselves composition of relations, we would need to exclude access to (27) by stipulation, an uncomfortable situation (but see further below).

Second, from a different perspective, we may feel that the irreflexive (28) is a more attractive reflection of the traditional notion of general domination than is (21). But, in order for (28) to 'fall out' of the derivational process, we can now see that it is not sufficient to rely simply on the irreflexiveness of immediate containment along with composition of relations; it will be necessary to enrich the mechanisms by which we extend our fundamental set of relations to include the transitive closures of such relations.[13] And to do this, without simultaneously *excluding* composition of relations as a general extension mechanism, would admit the undesirable (27).

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

[13] 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 role in syntactic argumentation.

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. Thus, an *interim* conclusion might be that the reflexivity of immediate containment yields two advantages: (i) the composition of the relation with itself is appropriate for generalised containment, *modulo* 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 pp. 16-21 below).

The third composition to which Chomsky's (17) directs us is $\mathbf{Sis}*\mathbf{C^r}$, and we now turn to consideration of this, again taking the simple structure in (13) for illustrative purposes. The two relations we are composing are (14a) and (21) repeated as (29a, b) with $\mathbf{C^r}$ for $\mathbf{ImmC^r}*\mathbf{ImmC^r}$:

(29) 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 (30):

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

And, of course, this corresponds exactly to the extensional specification of the traditional notion of c-command ($\mathbf{CCom^r}$) for (13), as indicated in (15b).[14] At this stage, then, it appears that there is substantial justification for a process that seeks to ground the set of formal

[14] 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 $\mathbf{CCom^i}$.

relations available to syntactic computation in the derivational process itself, along with a single principled extension that relies on the availability of the composition of relations.

4. Becoming Difficult

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?[15] 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 (17) 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

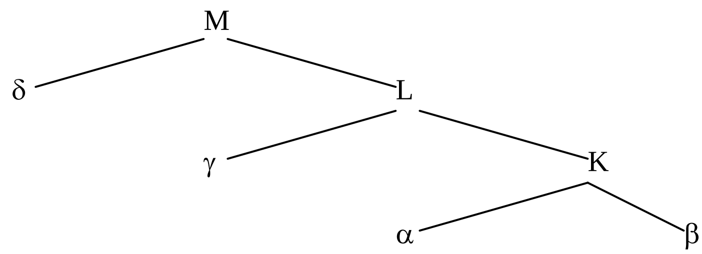
[15] Note that this is a different question from that briefly discussed in n12. There, the exclusion of the root from the defined relation was set aside.

fundamental misunderstanding regarding the goals of the Minimalist Programme, 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 5, I shall briefly return to this aspect of Grohmann's 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.

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 (13) the composition of reflexive immediate containment ($\mathbf{ImmC}^{\mathbf{r}}$) 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 may be what is crucial here, but it is easy to see that matters are not as straightforward as this.

Consider the structure in (31), involving a third application of Merge:

(31)



Obvious considerations give us (32) as the extensional specification of $\mathbf{ImmC}^{\mathbf{r}}$ for (31):

(32) **ImmC^r^** = {⟨M, M⟩, ⟨M, δ⟩, ⟨M, L⟩, ⟨δ, δ⟩, ⟨L, L⟩, ⟨L, γ⟩, ⟨L, K⟩, ⟨γ, γ⟩, ⟨K, K⟩, ⟨K, α⟩, ⟨K, β⟩, ⟨α, α⟩, ⟨β, β⟩}

Next, consider the composition of this relation with itself, as in (33):

(33) **ImmC^r^*ImmC^r^** = {⟨M, M⟩, ⟨M, δ⟩, ⟨M, L⟩, ⟨M, γ⟩, ⟨M, K⟩, ⟨δ, δ⟩. ⟨L, L⟩, ⟨L, γ⟩, ⟨L, K⟩, ⟨L, α⟩, ⟨L, β⟩, ⟨γ, γ⟩, ⟨K, K⟩, ⟨K, α⟩, ⟨K, β⟩, ⟨α, α⟩, ⟨β, β⟩}

We can see immediately that (33) does *not* correspond to the traditional notion of *containment* (*domination)* for (31) – missing from it are the 'remote' cases of ⟨M, α⟩ and ⟨M, β⟩. And we can also observe that these omissions can be dealt with by a further iteration of relational composition, composing (32) with (33). 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 (33), 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.[16]

One 'possible way' in which the fundamental relations can be composed involves consideration of immediate containment (and containment) composed with sisterhood.[17] So, reverting to the simpler structure in (13) as illustration, consider **ImmC^r^*Sis.** This yields (34):

[16] 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 **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 **ImmC^r^**, rather than relying on relational composition, the difficulty under discussion, if that is what it is, does not arise, a conclusion that obtains irrespective of whether *immediate containment* is taken to be reflexive or not. The *ceteris paribus* clause referred to in n8 could also come into play here, with independent considerations of locality leading to a quite different set of considerations.

[17] What this example shows is that the relations under consideration are not symmetrical under composition, i.e. in general R*R′ ≠ R′*R.

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

Alternatively, we can start from $\mathbf{C^r}$, in which case, we derive (35):

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

We can see that both of these give us what are partial disjunctions of the component relations – they exclude the reflexive pairs that appear in $\mathbf{ImmC^r}$ and $\mathbf{C^r}$. Thus, 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. More 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 an inappropriate relation.

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 (36):

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

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 $\mathbf{C^i}$ irrespective of whether this latter is understood in terms of compositions or transitive closures. Thus, for (13), and generally, we have the identity in (37):

(37) $\mathbf{C^i{*}}\text{S}\mathbf{is} = \mathbf{C^i}$

In the context of the strategy under consideration, these conclusions perhaps serve to reinforce the reservations that have already been voiced about adopting $\mathbf{ImmC^r}$ as opposed to $\mathbf{ImmC^i}$.

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* (13), this composition yields (38) for $\mathbf{CCom^r}$, the version of c-command based on reflexive (immediate) containment:

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

This strange mixture of (partial) identity, (partial) immediate domination and asymmetric c-command that we see in (38) is not a relation that suggests itself as useful in syntactic computation, and the difficulty raised in connection with (35) 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($\mathbf{ImmC^i}$? For (13), we have (39):[18]

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

Composing this relation with itself now yields the empty set, a benign outcome, we might suppose, insofar as it does not extend our set of formal relations in the direction of the empirically unjustifiable:

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

[18] Of course, (39) corresponds to the relation of *asymmetric c-command* for (13), an issue to which I shall shortly return.

Again, then, we have a conclusion that suggests that the assumption that (immediate) containment is reflexive may not be innocent, leading, as it does, to a proliferation of binary relations for which the computational system has no use.

For the remainder of this section, I wish to focus on the contrast between $\mathbf{ImmC^r}$ and $\mathbf{ImmC^i}$, a contrast we have seen to have a number of consequences, which are summarised in (41):

(41) 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 $\mathbf{ImmC^i}$ with itself *never* yields appropriate binary relations. However, T($\mathbf{ImmC^i}$) always yields $\mathbf{C^i}$.

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

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

Thus, we are faced with trying to assess the relative weights of (41a), which maybe favours Chomsky's own adoption of $\mathbf{ImmC^r}$, (41b), which perhaps tips the balance towards $\mathbf{ImmC^i}$ and (41c), which, at this stage, is possibly best viewed as neutral. I now wish to propose that there are at least three reasons for why this assessment should lead us in the direction of adopting **ImmC$^{\mathbf{i}}$** as the basic structural relation 'falling out' of a token of Merge.

First, we take seriously the proposition, axiomatic in Bare Phrase Structure, that linguistic objects, specifically those linguistic objects that enter into the relations we are concerned with here, are themselves *sets* of features. Thus, the reflexivity of immediate containment appears to commit us to the proposition that a linguistic object is immediately contained in itself. Now, this sort of proposition has received considerable attention in the historical development of logic and set theory, and, in fact, is the source of Russell's Paradox.[19] There would appear, then, to be reasons for being suspicious about the reflexivity of immediate containment that extend beyond the considerations examined earlier.

What are the options in the face of this concern? We could maintain that immediate containment is not intended to correspond to the $\in$ of set theory. But it is not at all clear what other construal is available and that Chomsky himself has no such alternative in mind is indicated by his remark (2001) that 'The operation [Merge] yields the relation $\in$ of membership …'[20] Alternatively, we could abandon the reflexivity assumption for immediate containment, immediately removing any threat to coherence posed by Russell's Paradox.[21]

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[19] For anyone not familiar with Russell's Paradox, the intelligibility of a set belonging to itself commits us to the coherence of a set not belonging to itself. This in turn enables us to consider the set of all those sets that do not belong to themselves, i.e. the set X in (i):

(i) $X = \{A \text{ such that } A \notin A\}$

In connection with (i), we pose the question: does $X \in X$? Suppose that it does; then $X \notin X$. because of the defining predicate in (i), and we have a contradiction. Alternatively, suppose that $X \notin X$. It follows from (i) that $X \in X$, so again we have a contradiction. However, now things are much worse than this, since what we see is that either of the assumptions open to us leads to contradiction – this is a paradox.

[20] See also the reference to set-membership in the passage from Chomsky (2005b) cited in n10.

[21] I must acknowledge here that the path from the reflexivity of immediate containment to Russell's Paradox is not one that must be taken. Thus, we might suppose that the 'language of formal relations' does not include negation. In this case, while the proposition $X \in X$ is part of this system, $X \notin X$ is unformulable and Russell's paradox does not arise. A consequence of this that might be attractive from the perspective of the next issue raised in the text is that it would remove the possibility of defining asymmetric c-command in terms of c-command and negation.

Second, 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 structures that are unordered in a syntactic derivation may be linearly ordered for the perceptual-articulatory interface. 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. 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.

Finally, it may be significant that the familiar c-command (**Ccom^{r}**) arising from Chomsky's adoption of **ImmC^{i}** includes pairs that are also related under sisterhood. The identity in (42) makes the relevant set-theoretic relations explicit:

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

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, the availability of **CCom^{r}** is required; if there are not, not only is it 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 the scales tip fairly firmly in the direction of **ImmC^{i}** and the relations that can be defined in terms of it. The cost of adopting this conclusion is the 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.

5. On what there might not be

If we restrict the access of the computational system to formal relations along the lines described in previous sections, there may be important consequences for a range of relations that have played significant roles in linguistic theorising, but which can be argued to *not* 'fall out' of the computational process in ways which should, by now, be familiar. Thus, the remarks at the end of the previous section provide reasons for supposing that the *general* notion of c-command, emerging from adoption of $\mathbf{ImmC^r}$ and the informal definition in (16), is one such relation. Addressing non-availability directly, Chomsky (2001) offers (43):

(43) 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 …'

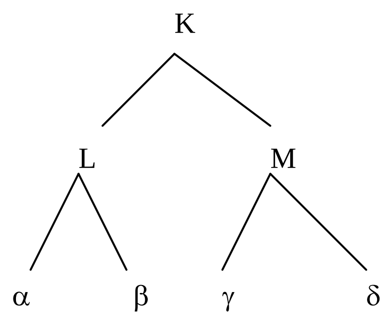
These claims are of fundamental importance in two ways. First, the formal relation of government has played a massive role in the development of Principles and Parameters Theory. But government is defined in terms of m-command, and if m-command does not exist for the computational system, nor does government.[22] 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 are dealt with in the context of this

[22] In fact, Chomsky's reference to m-command, apparently identifying it with the 'head-to-SPEC' relation in this passage is not accurate. 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 was viewed as attractive.

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.

To briefly engage the technicalities raised in (43), consider the structure in (44), where we can 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, itself headed by α with complement β:

(44)



The structure in (44) results from the three applications of Merge in (45):

(45) a. Merge (γ, δ) = {γ, δ} = M

b. Merge (α, β) = {α, β} = L

c. Merge (L, M) = {L, M} = {{α, β}, {γ, δ}}

The operations in (45) induce the immediate syntactic relations in (46), now, following the discussion of the preceding section, taking immediate containment to be irreflexive, an assumption that has no consequences for the discussion that follows:

(46) 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 (47):

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

$\mathbf{CCom^i}$ is given by (48):

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

With the above in place, we return to Chomsky’s remarks in (43) in the context of (44). 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 (46) – (48) shows that this is, indeed, the case for the relations whose extensions appear there, but at this stage, we must reintroduce the converse of $\mathbf{ImmC^i}$, namely $\mathbf{ImmT^i}$. This, with its transitive closure $\mathbf{T^i}$ (term-of), appears in (49):

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

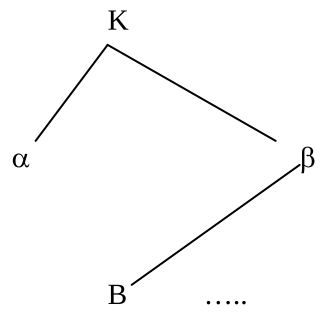
Now, if we calculate the composition of $\mathbf{T^i}$ and **Sis**, we get (50):

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

And, of course, what we see in (50) is an occurrence of ⟨γ, L⟩. Does this show that Chomsky's initial claim in (43) is incorrect? For me, this turns out to be a surprisingly obscure question. To start to get a grasp of the difficulties, let us first attend to the second claim in (43), viz. that '[t]here is a relation R(SPEC, H), namely c-command.' In (44), the specifier-head relationship is instantiated by the pair ⟨L, γ⟩ and (48) 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, 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 ⟨L, γ⟩. Now, if c-command is accessible to the computational system, this ought to imply that *all* members of the relation are party to this accessibility. Thus, for (48), we would expect to find syntactic processes engaging the pairs ⟨L, δ⟩, ⟨M, α⟩ and ⟨M, β⟩, as well as ⟨L, γ⟩, but this appears to be most unlikely. Alternatively, we would again to be committed to picking and choosing from among the extension of an available relation just those members that we appear to need, and, at a different level, this is another instance of the sort of difficulty already raised in connection with Grohmann's (2003) selecting and discarding in the set of formal relations emerging via tokens of Merge and composition. In short, such a strategy invites the question: *why* does ⟨L, γ⟩ gets to engage the computational system, whereas the other members of $\mathbf{CCom^i}$ in (48) do not?

Returning briefly to Grohmann (2003), it is noteworthy that the account he offers also raises the above difficulty at this level. 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. 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 **Sis*ImmC**^{r} in the system of notation used in this paper, supposing, for concreteness, that Grohmann adopts Chomsky's reflexivity assumption for immediate containment, an issue on which he does not comment. Now, Grohmann wishes to maintain that his Extended Sister 'generates an additional relation' between α and B in the simple partial structure in (51):[23]

(51)



For (51), **Sis*ImmC**^{r} is partially calculated as (52):

(52) **Sis*ImmC**^{r}= $\{\langle\alpha, \beta\rangle, \langle\alpha, B\rangle, \langle\beta, \alpha\rangle, \langle\alpha, ..\rangle, \ldots\}$

The important observation about (52) is that while it does contain $\langle\alpha, B\rangle$, *it also contains other pairs of objects*, and it might be argued that if our approach is to be principled, these pairs as instantiations of available relations should also play a role in syntactic argumentation. To repeat, a *relation* comprises its extension, and the strategy pursued by Grohmann of

[23] Grohmann sees his purpose 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).

‘generating’ a relation and then helping himself to just one member of that relation is, at worst, simply inappropriate and, at best, invites the question: why do syntactic processes *not* engage other pairs of syntactic objects comprising the relation. Now, in (52), Grohmann can get rid of ⟨α, β⟩ and ⟨β, α⟩ by adopting $\mathbf{ImmC^i}$, but this leaves his relation including ⟨α, ..⟩ alongside ⟨α, B⟩, i.e. what Grohmann’s manoeuvre has achieved is the derivation of a type of local 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. This, I take it, is not quite what is intended, and Grohmann must, therefore, be committed to choosing from an available relation just those pairs that matter to him.

We now return to (50), and the difficulties facing Chomsky’s position on the non-availability of the head-to-SPEC relation are all too obvious. First, we repeat the observation that, in the context of (44), ⟨γ, L⟩ is a member of a relation that can be derived on the basis of Merge and relational composition, viz. **T*Sis**. At this point, we could imagine saying that this does not indicate the availability of the head-to_SPEC relation, as other members of **T*Sis** are clearly not of interest to the computational system. But this is exactly the situation we have with $\mathbf{CCom^i}$, where availability of the relation appears to amount to us being able to choose from the extension of the relation just those pairs that are of importance to the computational system. Accordingly, I conclude that on the basis of the above considerations, no case has been made for the non-availability of the head-to-SPEC relation.

Furthermore, it is easy to see that Chomsky’s final case in (43) fails on the basis of similar considerations. Once more using (44), this case focuses on the pair ⟨α, γ⟩, and, again, it is easy to derive an apparently legitimate relation that includes this pair. Thus, consider the two-step composition $\mathbf{T^i*(Sis*C^i)}$ with respect to (44). As $\langle L, M\rangle \in$ **Sis** and $\langle M, \gamma\rangle \in \mathbf{C^i}$, we can assert that $\langle L, \gamma\rangle \in \mathbf{Sis*C^i}$. But $\langle \alpha, L\rangle \in \mathbf{T^i}$, so $\langle \alpha, \gamma\rangle \in \mathbf{T^i}(\mathbf{Sis*C^i})$.

Concluding, then, I do not believe that the arguments have been advanced to formally underwrite the rejection of a number of key relations from the syntactic repertoire. [24] Coupled with the conclusions of Section 4, casting 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. I believe that the case that has been made for the computational system having access to $\mathbf{CCom}^{i}$, asymmetric c-command, rather than the standard $\mathbf{CCom}^{r}$ has merit, but set against the uncertainties that have emerged, it may be best to regard this as an outcome that is independent of whether the attempt to provide a principled account of available relations is defensible or not.

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[24] If we introduce a binary relation **Label** into the discussion, exploiting the fact that merger itself produces pairs of objects, one of which is the label for the other, many other complications arise. However, having followed enthusiastically sought to follow Russell in wasting time on trivialities, and probably bested him in identifying *genuine* trivialities, I can justify no more of this, and must turn my attention to truly non-trivial issues surrounding Quality Assurance!

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SYNTACTIC AND LEXICAL APPROACHES TO UNBOUNDED DEPENDENCIES[1]

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1. Introduction

Probably all approaches to syntax recognize that syntactic phenomena result from interaction of the properties of lexical items and syntactic rules, principles or constraints. Theories of syntax and specific analyses differ in how much work is done by the former and how much by the latter. In this paper, I will look from this perspective at unbounded dependency constructions, constructions which contain a gap and some higher structure which can be seen as licensing it. That there are a variety of such constructions has been known since Chomsky (1977). Chomsky proposed that all these constructions involve the movement of a *wh*-element followed in some cases by its deletion. In Chomsky (1981) it was proposed that they involve movement of either an overt or an empty *wh*-element, and since Chomsky (1986), it has been assumed that they involve movement to Spec CP. Soon after the appearance of Chomsky (1977), it was proposed within Generalized Phrase Structure Grammar (GPSG) (Gazdar 1981) that these constructions all involve SLASH categories, and the same position has been developed within Head-driven Phrase Structure Grammar (HPSG) (Pollard and Sag 1987, 1994). In Lexical Functional Grammar (LFG), it has been proposed that they all involve functional uncertainty.[2] Thus, various frameworks have ways of accommodating what these constructions have in common. However, the constructions differ from each other in a variety of ways, and these differences also need to be accommodated. In this paper, I will compare the syntactic approach to such constructions developed in some detail in recent HPSG (Sag 1997, Ginzburg and Sag 2000), and the lexical approach is that assumed but not really developed within

Minimalism. I will argue that there is no reason to think that the lexical approach is simpler than a syntactic approach and that its reliance on phonologically empty heads may be a reason for scepticism about it.

The paper is organized as follows. In section 2 I spell out how theories and analyses may be more lexical or more syntactic. In section 3, I highlight some of the properties of unbounded dependency constructions. Then, in section 4, I sketch the syntactic approach to such constructions that has been developed in recent HPSG, and in section 5, I consider the lexical approach which is assumed within Minimalism. Finally, in section 6, I offer some concluding remarks.

2. Syntactic and lexical approaches to syntactic phenomena

In this section, I will illustrate the way that theories of syntax and specific analyses differ in how much work is done by the properties of lexical items and how much by syntactic rules, principles or constraints, paying particular attention to HPSG and Minimalism.

HPSG is an eclectic framework, which has taken ideas from a number of frameworks. Many of its ideas stem from GPSG. However, it differs from GPSG in a number of ways, and one of the most important means that the lexicon is more important and the syntax less important for HPSG. This difference concerns head-complement structures. GPSG assumes a different immediate dominance (ID) rule for each different combination of a head and complement(s), one for a verb taking an NP complement, another for a verb taking a PP complement, and so on. Gazdar *et al*. (1985) propose 49 such rules. To ensure that heads have the correct complements, they propose a feature SUBCAT, whose value is an arbitrary integer. The head in each head-complement rule has a different value for SUBCAT and lexical items that can appear in a structure licensed by the rule have the same value. To take a simple example, we might have the ID rule in (1) for a simple transitive V’.

(1) V’ $\rightarrow$ H^0[SUBCAT 1], NP

Then to ensure that that right verbs appear in structures licensed by this rule we need to assign these verbs and no others the feature specification [SUBCAT 1].

What we might call classical HPSG, the framework presented in Pollard and Sag (1987, 1994), assumes a very different feature SUBCAT, one whose value is a list of *synsem* objects, combinations of syntactic and semantic information. The first member of the SUBCAT list indicates what sort of subject an expression requires and the remainder indicate what complements it takes. With this feature it is possible to accommodate any head-complement combination with a single immediate dominance rule. This simply needs to license structures of the following form:

(2) [SUBCAT <[1]>]

[SUBCAT <[1], [2], ... [n]>]   [2]   ...   [n]

Beginning with Pollard and Sag (1994, chapter 9), most HPSG work has assumed that what sort of subject an expression requires is encoded in a SUBJ feature while what complements it takes is encoded in a COMPS feature. Within this approach, head-complement structures have the following form:

(3)

[SUBJ < [1] >
COMPS <>]

[SUBJ < [1] >
COMPS < [2], ... [n] >]   [2]   ...   [n]

Again, there is no difficulty in providing a single immediate dominance rule. As presented in Pollard and Sag (1994), classical HPSG has just six immediate dominance schemata, one for head-complement structures and five for other phrase types. This is a much simpler syntactic system than that of GPSG. It is made possible by more complex lexical categories. It follows that the lexicon is more important for HPSG than GPSG. It is not surprising, therefore, that the nature of the lexicon has been an important concern for HPSG. See e.g. Pollard and Sag (1987, chapter 8) and Koenig (1999).

In more recent HPSG work, it has been argued that the classical HPSG picture is too simple. Instead of six phrase types, each with an associated schema, it assumes complex hierarchies of phrase types with associated constraints. The motivation for this more complex system comes mainly from unbounded dependency constructions and will be discussed below.

Lexical functional grammar (LFG) also seems to assume a fairly complex syntactic system with a variety of fairly specific phrase structure rules.

What about Minimalism? This has a syntactic system that is simpler even than that of classical HPSG. As outlined in Chomsky (2001), it has just three mechanisms: MERGE, AGREE and MOVE.[3] MERGE combines two expressions to form a larger expression with the same label as one of them (Chomsky 1995: 244). AGREE involves a probe, which is a feature of some kind usually on a head, and a goal, which the head c-commands. At least normally, the probe is an uninterpretable feature and the goal has a matching interpretable feature. The goal also has some uninterpretable feature, which renders it ‘active’, i.e. capable of entering into a syntactic dependency. AGREE deletes the uninterpretable features of probe and goal. MOVE applies where a probe is associated with a so-called EPP feature. It makes a copy of the goal and merges it either with the head that bears the probe feature or with the phrase it heads. Given the simplicity of this system, the properties of lexical items and especially the properties of phonologically empty functional heads are of fundamental importance for Minimalism. One might think, then, that the nature of the lexicon would be a central concern. Surprisingly however, it seems to have received very little attention. Chomsky (1995a: 235) suggests that the lexicon provide an 'optimal coding' of lexical idiosyncrasies but does not develop any real proposals as to what this might mean. We will say more about this below.

3. Some data

Before we can consider how the distinctive properties of the various unbounded dependency constructions might be accommodated, we need to highlight some of these properties.

Perhaps the most basic division within unbounded dependency constructions is between those in which the higher structure which can be seen as licensing the gap contains an overt filler constituent and those in which it does not. *Wh*-interrogatives always contain such a constituent, relative clauses sometimes do and sometimes do not, and non-finite clauses associated with *enough* and *too* never do.[4] The following illustrate:

(4)a. Who did Kim talk to?
b. the man [(who) Kim talked to]
c. Kim is important enough/too important [(*who) to talk to]

In *wh*-interrogatives and relative clauses, the overt filler is a *wh*-element. However, the two constructions involve different wh-elements. Consider the following:

(5)a. What/which did Kim talk about?
b. the man [which/*what Kim talked about]

The *wh*-interrogative in (5a) may contain either *what* or *which*, but *which* is elliptical and is only possible if the context makes it clear how it is to be understood. The relative clause in (5b) on the other hand only allows *which* and not *what*. (*What* is possible in some non-standard varieties.) In fact English has three types of *wh*-element. Consider the following:

(6) What a genius Kim is!

This is an exclamative. The sequence *what a* is only possible in exclamatives and cannot occur in a *wh*-interrogative or a relative clause. Notice also that there is no subject-auxiliary inversion here even though this is a main clause. Obviously, this is unlike *wh*-interrogatives.

Both *wh*-interrogatives and relative clauses can be finite or non-finite. In the case of relatives this is quite important because finite and non-finite relatives differ in what sort of *wh*-expressions they may contain. In a finite relative, the *wh*-expression can be either an NP/DP or a PP, but in a non-finite relative it can only be a PP. Thus, we have the following data:

(7)a. the man [who we rely on]
b. the man [on whom we rely]
(8)a. a man [on whom to rely]
b. *a man [who to rely on]

A non-finite relative may also be introduced by *for*, as in (9).

(9) a man [for us to rely on]

Unlike (8a), this contains an overt subject.

Most English unbounded dependency constructions do not allow an overt filler to co-occur with a complementizer. However, there are at least two constructions which do allow this. One is a construction highlighted by Ross (1967: 223), in which a filler is followed by *though*. The following illustrates:

(10) [Handsome though Dick is] I'm still going to marry Herman.

Though is in fact obligatory here, as the following shows:

(11) *[Handsome Dick is] I'm still going to marry Herman.

The other construction which allows an overt filler and a complementizer is also highlighted by Ross (1967: 223), and has come to be known as the comparative correlative or the comparative conditional. The following illustrates:

(12) The more books (that) I read, the more (that) I understand.

Here the complementizer is optional and probably not acceptable to all speakers.[5]

Hopefully, the preceding paragraphs make it clear that there is a complex body of data here, which poses a challenge to any theory of syntax which aspires to provide descriptively adequate analyses of syntactic phenomena.[6]

4. A syntactic approach

In this section, I will outline the syntactic approach to unbounded dependency constructions that has been developed in recent HPSG. First, however, I want to sketch the rather different approach to certain constructions proposed in earlier work. This is essentially a lexical approach of the kind assumed within Minimalism.

Pollard and Sag (1994) discuss English relative clauses in some detail and propose that they involve a number of empty relativizers. One takes the following form:

(13)

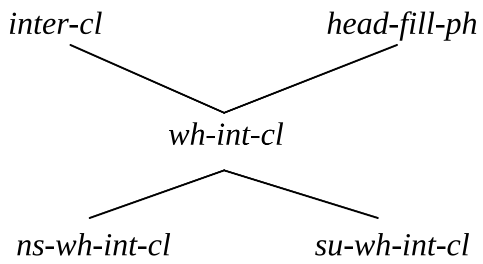
$$
\left[\begin{array}{ll}
\text{LOCAL} & \left[\begin{array}{ll}
\text{CAT} & \left[\begin{array}{l}
\text{HEAD}\left[\text{MOD N'[TO-BIND}\,|\,\text{REL}\,\{[1]\}]:\left[\begin{array}{l}\text{INDEX}\,[1]\\ \text{RESTR}\,[3]\end{array}\right]\right]\\
\text{SUBCAT} < [\text{LOC}\,[4], \text{INHER}\,|\,\text{REL}\,\{[1]\}],\\
\qquad\qquad \text{S}[\mathit{fin}, \mathit{unmarked}, \text{INHER}\,|\,\text{SLASH}\,\{[4]\}]:[5]>
\end{array}\right]\\
\text{CONTENT} & \left[\begin{array}{l}\text{INDEX}\,[1]\\ \text{RESTR}\,\{[5]\}\cup[3]\end{array}\right]
\end{array}\right]\\
\multicolumn{2}{l}{\text{NONLOCAL}\,|\,\text{TO-BIND}\,|\,\text{SLASH}\,\{[4]\}}
\end{array}\right]
$$

Here, the MOD feature indicates that the maximal projection of this element modifies an N’ and the feature TO-BIND|REL {[1]}] ensures that the relative feature on the filler is not replicated on the mother. The SUBCAT features indicates that this element requires a specifier with a relative feature and a complement which is a finite clause with no complementizer but with a SLASH feature whose value includes the local feature structure of the specifier. The CONTENT feature ensures that the content of this element brings together the content of the modified N’ and the relative clause. Various principles of HPSG ensure that the combination of N’ and relative clause has the same content. Finally, the feature NONLOCAL|TO-BIND|SLASH {[4]} ensures that the SLASH feature of the complement is not replicated on its mother. This category is complex, but each aspect of it has a purpose. It gives some idea of what is involved in giving an explicit analysis of relative clauses. Of course, it is possible to avoid complexity by declining to provide an explicit analysis, but this is no great achievement.

More recent HPSG work has abandoned this lexical approach and turned to a syntactic approach. As noted above, whereas classical HPSG has just six phrase types, each with an associated schema, the more recent framework assumes complex hierarchies of phrase types with associated constraints. The motivation for these hierarchies is exactly the same as the motivation for complex hierarchies of lexical types assumed within HPSG since Pollard and Sag (1987). In both cases, the hierarchies allow properties that are shared between different types of expession to be spelled out just once. Within this approach, Sag (1997) develops a detailed analysis of English relative clauses and Ginzburg and Sag (2000) provide a detailed analysis of English interrogatives (spelled out in a 50 page appendix). I will try to give a flavour of these analyses in the following paragraphs.

Central to Ginzburg and Sag's analysis of interrogatives are the following phrase types:

(14)



Here we have a type *wh-interrogative-clause*, which is a subtype of the types *interrogative-clause* and *head-filler-phrase*, and which has two subtypes *non-subject-wh-interrogative-clause* and *subject-wh-interrogative-clause*. The type *interrogative-clause* is subject to constraints which require it to have certain semantic properties. The type *head-filler-phrase* is subject to a constraint which we can represent as follows:

(15)

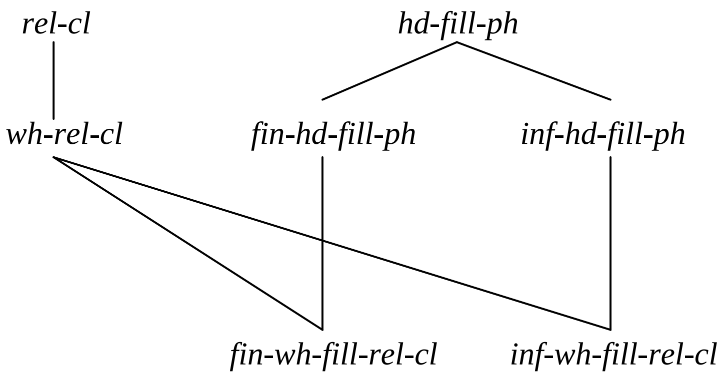
$$\textit{head-fill-ph} \rightarrow \begin{bmatrix} \text{SLASH}\,\{\} \\ \text{DTRS} < [\text{LOC}\,[1]], [2]\begin{bmatrix} \textit{phrase} \\ \text{HEAD}\,\textit{v} \\ \text{SLASH}\,\{[1]\} \end{bmatrix} > \\ \text{HD-DTR}\,[2] \end{bmatrix}$$

This is a conditional statement. It ensures that a head-filler phrase is SLASH {} and has a head daughter which is a phrase headed by a verb and a non-head daughter whose LOCAL value is the local feature structure within the value of SLASH on the head daughter, which is a phrase headed by a verb. The type *wh-int-cl* is subject to constraints which among things require the filler to be an interrogative *wh*-phrase. The type *ns-wh-int-cl* is subject to a constraint which ensures that the subject of a such a clause is preceded by an auxiliary if and only if it is a main clause. We do not need to consider the constraint on the type *su-wh-int-cl*.

These types and constraints provide an account of some of the central features of *wh*-interrogatives and do so in a way that captures the similarities between *wh*-interrogatives and both other kinds of interrogative and other unbounded dependency constructions.

Turning to Sag's analysis of relative clauses, the following types play an important role:

(16)



The type *rel-cl* is subject to the following constraint:

(17) $rel\text{-}cl \rightarrow \left[\text{MOD}\,[\text{HEAD}\ noun]\right]$

This simply ensures that a relative clause modifies a nominal constituent. The type *wh-rel-cl* is subject to the constraint in (18).[7]

(18)

$$wh\text{-}rel\text{-}cl \rightarrow \begin{bmatrix} \text{HEAD}\,[\text{MOD NP}_{[1]}] \\ \text{DTRS} < [\text{REL}\,\{[1]\}], [\,] > \end{bmatrix}$$

This ensures that a *wh*-relative clause modifies an NP with the index that appears in the value of the REL feature on the *wh*-phrase. In other words, it ensures that the NP agrees with the relative *wh*-word, acounting for data like the following:

(19)a. the man/*men [who we think ___ admires Kim]
b. the man/men [whose mother we think ___ admires Kim]

(19b) shows that it is the relative *wh*-word and not the filler that the NP agrees when the two are not the same. *Whose* can be either singular or plural and hence the NP can also be either. The types *fin-hd-fill-ph* and *inf-hd-fill-ph* are required to be finite and non-finite, respectively. The type *fin-wh-fill-rel-cl* is subject to the constraint in (20).

(20) *fin-wh-fill-rel-cl* → $[\text{DTRS} < [\text{HEAD}\; noun \vee prep], [\,] >]$

This ensures that the filler in a finite *wh*-filler relative clause is nominal or prepositional, and not, for example, adjectival as is possible in a *wh*-interrogative.[8] The type *inf-wh-fill-rel-cl* is subject to the following constraint:

(21) *inf-wh-fill-rel-cl* → $[\text{DTRS} < \text{PP}, [\,] >]$

This ensures that the filler in a non-finite *wh*-filler relative clause is a PP, allowing (8a) but not (8b).

This approach captures the main properties of relative clauses with an overt filler. Relative clauses with no overt filler are not assumed to have a phonologically empty filler and hence are just clauses with certain kinds with a SLASH feature. We will not go into the details here.

It should not be too hard to develop analyses along the same lines for other unbounded dependency constructions. In fact, Borsley (2004) develops an analysis of the comparative correlative construction. We noted earlier that this is unusual in that the filler may be followed by a complementizer. This suggests that the constraint on head-filler phrases should be reformulated as follows:

(22)

$$\textit{hd-fill-ph} \rightarrow \begin{bmatrix} \text{SLASH}\,\{\} \\ \text{DTRS} < [\text{LOC}\,[1]], [2]\begin{bmatrix} \textit{phrase} \\ \text{SLASH}\,\{[1]\} \end{bmatrix} > \\ \text{HD-DTR}\,[2] \end{bmatrix}$$

There is no [HEAD *v*] specification here. This will allow a head-filler phrase headed by a complementizer. But what about all the cases where the filler cannot be followed by a complementizer? We can assume that these all involve types which are subtypes of a type *standard-head-filler-phrase*, which is itself a subtype of *head-filler-phrase* and is subject to the following constraint:

(23) *standard-hd-fill-ph* → [HD-DTR [HEAD *v*]]

Though-clauses such as that in (9) will also involve a type which is a subtype of *head-filler-phrase* but not *standard-head-filler-phrase*. This type will be subject to a constraint requiring *inter alia* that it is [HEAD *c*], in other words that it is headed by a complementizer.

These analyses are complex, and no doubt some would suggest that they are stipulative. However, this suggestion is worthless in the absence of a demonstration that a less stipulative analysis is possible. As we will see below, there is absolutely no reason to think that a lexical analysis of the kind assumed but not developed within Minimalism would be any less stipulative.[9]

5. A lexical approach

We can now consider the lexical approach to unbounded dependency constructions assumed but not really developed within Minimalism. It is fairly clear that a worked out version of this approach will involve a large number of generally empty C-elements. It is also clear that some early proposals for a typology of complementizers are quite inadequate. For example, Rizzi (1990: 67) suggests 'a first approximation' to such a typology involving two binary features: [+/–wh] and [+/–pred]. He proposes that *wh*-questions involve a [+wh, −pred] C, *wh*-relatives a [+wh, +pred] C, *that*-relatives a [−wh, +pred] C, and finite argument clauses a [−wh, −pred] C. There is no basis here for distinguishing between finite and non-finite relatives, no account of exclamatives or all the other constructions mentioned earlier. Note also that the pred feature is rather inadequate. Essentially, [+pred] identifies a CP as a modifier, but as we have seen, we need to know not that a CP is a modifier but what sort of constituent it modifies.[10] In more recent work, Rizzi (1997) argues for a 'split CP' analysis with a richer set of C-elements which may co-occur in certain ways. However, he does not develop a detailed analysis.[11]

A detailed analysis needs to ensure (a) that the C-elements take the right kind of complement, (b) that they have the right kind of specifier, (c) that they either attract or do not attract an auxiliary, and (d) that their maximal projection either does or does not modify a nominal constituent of a certain kind. Limiting our attention to *wh*-interrogatives and relative clauses, we might have eight C-elements with the properties, specified in the following table:

C-element	Form	Complement	Specifier	Aux-attraction	N'-modification
main-finite-*wh*-interrogative	e	finite TP	int-*wh*-DP/ PP/AP/AdvP	yes	no
subordinate-finite-*wh*-interrogative	e	finite TP	int-*wh*-DP/ PP/AP/AdvP	no	no
non-finite-*wh*-interrogative	e	non-finite null-subject TP	int-*wh*-DP/ PP/AP/AdvP	no	no
finite-*wh*-relative	e	finite TP	rel-*wh*-DP/ PP	no	yes
finite-empty-spec-relative	(that)	finite TP	empty-rel-DP	no	yes
non-finite *wh*-relative	e	non-finite null subject TP	rel-*wh*-PP	no	yes
non-finite-empty-spec-relative-1	e	non-finite null subject TP	empty-rel-DP	no	yes
non-finite-empty-spec-relative-2	for	non-finite overt subject TP	empty-rel-DP	no	yes

Obviously, we would have a much larger table if we considered the full range of constructions.

Let us consider how one might ensure that the C-elements have these properties. It is not clear to me what account of complement selection is assumed within Minimalism. However, whatever account is assumed elsewhere could be adopted here.

Turning to the specifiers, we know that they arise through movement, and we noted in section 2 that movement presupposes the operation of AGREE. Thus, these elements and their specifier constituents undergo AGREE. This means that the specifier constituents of each C-element must have an interpretable feature and the C-element itself must have a matching uninterpretable feature.[12] There are some problems here. First, notice that the first of the finite relative C-elements requires there to be some interpretable feature shared by DP and PP but not by AP or AdvP. It is not obvious that there is such a feature. Second, the fact some C-elements can have an empty DP as a specifier but not an overt DP means that an empty DP must have some interpretable feature that is not shared by an overt DP. Again it is not obvious that there is any such feature. It seems that the minimalist view of movement is committed to the idea that it affects semantically defined classes of constituents. This seems a dubious proposition.

What about the movement of auxiliaries to C? Any element that can appear in T can move to C in certain constructions, hence there is no problem about characterizing the elements that can move to C. There is a problem, however, about characterizing the elements that can move T. It has sometimes been suggested that auxiliaries are distinguished from lexical verbs by the fact that they do not assign a theta role, but this idea seems untenable. On the one hand, lexical verbs like *rain* and *snow* do not appear to assign any theta roles. On the other hand, *dare* is an auxiliary, as shown by (24a), but assigns a theta role to its subject, as shown by the ungrammaticality of (24b).

(24)a. Dare we go there?
b. *There dare not be a fly in the soup.

Again, then, we seem to have a problem.

Finally, what about the modification of a nominal constituent? As far as I can see, the analysis would need to incorporate something like the HPSG approach. That is, the relative C-elements will need to have a feature indicating what sort of nominal constituent their maximal projections modify and its value will have to be determined by the relative *wh*-word. Notice that we need something more than a sharing of phi features between the C-element and its specifier. (19b), repeated here as (25), shows that the specifier and the relative *wh*-word may have different phi features.

(25) the man/men [whose mother we think ___ admires Kim]

Here the specifier is singular but the relative *wh*-word may be plural. Notice also that we do not want a C-element to generally have the same phi features as its specifier. If it did, a *wh*-interrogative with a plural specifier would itself be plural. The following shows that this is wrong:

(26) [Which men did this] is/*are unclear.

Again, then, it is not a simple matter to ensure that C-elements have the right properties.

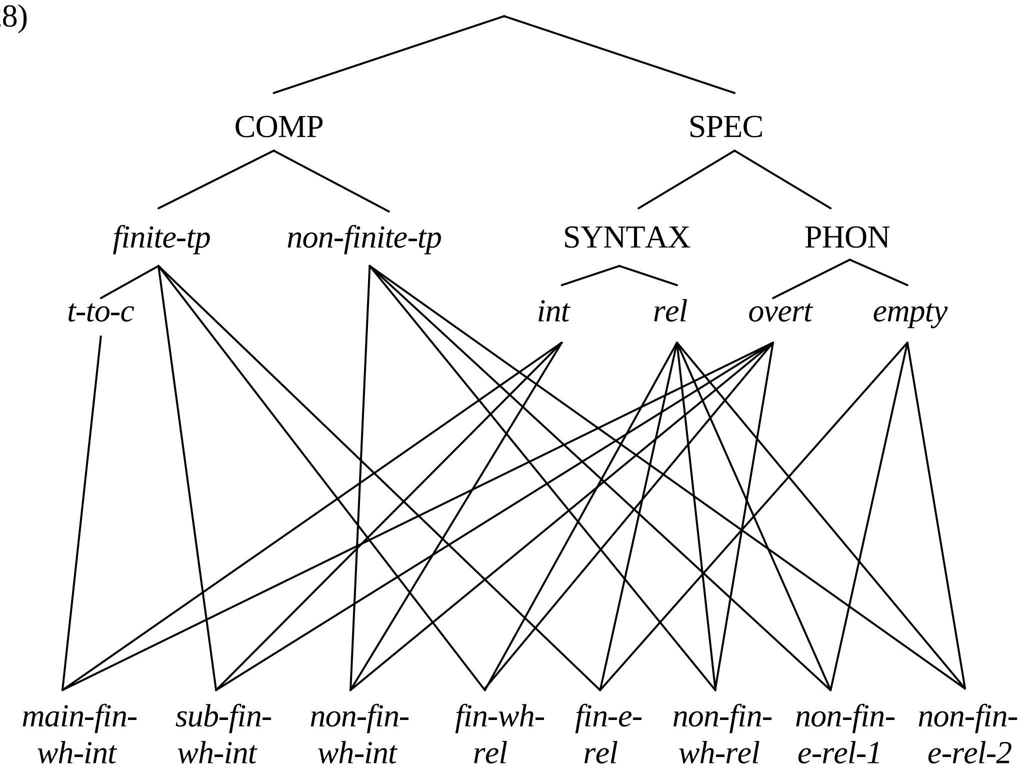
Let us assume that the various problems that we have just highlighted can be overcome and that the various C-elements can be assigned features that will ensure that they have the right properties. Two things are clear. First, each C-element will have a quite complex set of features. Second, various C-elements will have features in common because they have properties in common. Four of the C-elements take a finite TP complement and hence will share some feature or features, and the other four take a non-finite CP complement and hence will share some other feature or features. The three interrogative C-elements will share some feature or features because they allow the same specifier categories. The five relative C-elements will share some feature because they all take a relative specifier. Only one of the C-elements here attracts an auxiliary, but there will clearly be others with this property given examples like the following, where the auxiliary is in bold:

(27)a. Only in Colchester **could** such a thing happen.
b. Kim is in Colchester, and so **is** Lee.
c. Such **is** life.
d. The more Bill smokes, the more **does** Susan hate him.
c. **Had** I been there, I would have seen him.

See Huddleston and Pullum (2002: 94-97) for further examples and discussion.[13] Thus, there are generalizations to be captured here.

The observation that the feature makeup of lexical items is complex and that there are various generalizations is hardly a novel one. It has been a central concern for HPSG since Pollard and Sag (1987). As indicated above, Pollard and Sag propose complex hierarchies of lexical types to allow properties that are shared between different words to be spelled out just once. This seems to be what we need here. We might propose something like the following:

(28)



Here, upper case letters are used for independent dimensions of classification and lower case italics for lexical types. C-elements are classified in terms of what kind of complement they take and what kind of specifier they require, and specifiers are classified in terms of their syntactic properties and their phonological properties, i.e. whether they are overt or empty. We have seven non-maximal types: *finite-tp*, *non-finite-tp*, *t-to-c*, *int*, *rel*, *overt*, *empty*. These will be associated with various features as follows:

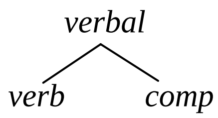
Type	Features
finite-tp	features that ensure that a head takes a finite TP complement
non-finite-tp	features that ensure that a head takes a non-finite TP complement
t-to-c	features that ensure that an auxiliary is moved to C
int	features that ensure that a head requires an interrogative specifier
rel	features that ensure that a head requires a relative specifier and has a maximal projection agreeing with the rel value of the specifier
overt	features that ensure that specifier has some phonology
empty	features that ensure the specifier has no phonology and that it is a DP[14]

I am assuming here that a C-element will not attract an auxiliary if it lacks certain features and hence that there is no need for a type for C-elements that do not attract an auxiliary. The maximal types that correspond to the eight C-elements will inherit various features from their supertypes. They will some features of their own. *Fin-e-rel* will have features indicating that it optionally takes the form *that*, and *inf-e-rel-2* will have features indicating that it takes the form *for*. All the others will be associated with the information that they are phonologically empty. In addition, *inf-e-rel-2* must be specified as licensing an overt subject, *fin-wh-rel* as taking a DP or PP specifier, and *inf-wh-rel* as taking a PP specifier. However, most features of the eight C-elements will be inherited from some supertype.

Thus, it may be possible to provide a broadly satisfactory lexical approach to unbounded dependencies given hierarchies of lexical types of the kind proposed within HPSG. It looks, then, as if we have a choice between hierarchies of phrasal types and hierarchies of lexical types. What can we say about this choice? The first point to make is that there is no reason to think that the lexical approach is any less stipulative than the syntactic approach. It involves different sorts of stipulations, but there is no reason to think that it requires any fewer stipulations. It seems to me that the main difference is that the syntactic approach involves a classification of overt constituents and the lexical approach a classification of mainly phonologically empty elements. There is obviously no doubt about the existence of the elements that the syntactic approach classifies, but there is doubt about the existence of the elements that the lexical approach classifies. They are in fact rejected by most theoretical frameworks. It seems reasonable to say that the burden of proof is on those who want to claim that they exist. Let us consider some arguments that might be advanced for their existence.

Someone might argue that since some of these constructions are headed by a complementizer, it is simplest to assume that they all are. It might be argued that the HPSG position that they are headed either by a complementizer or by a verb is more complex. However, Sag (1997: 457) proposes that one of the values of the feature HEAD which encodes part-of-speech information, is a type *verbal* with the subtypes *verb* and *comp* (complementizer). In other words he proposes the following:

(29)



This allows us to say that these constructions are headed by a *verbal* element, which is no more complex than saying that it is headed by a *comp* element.

Someone might also argue that there must be a position between a filler and the following subject because it can be filled by an auxiliary. There are, however, analyses of pre-subject auxiliaries in which they do not occupy a C position. See e.g. Warner (2000: 194-201). It is often argued that the idea that pre-subject auxiliaries are in a C position, explains why a pre-subject auxiliary is impossible when an overt complementizer appears. Thus, as the following show, a conditional clause may contain *if* or a pre-subject auxiliary but not both.

(30) $\left\{\begin{array}{l}\text{If I had seen Lee}\\ \text{Had I seen Lee}\\ \text{* If had I seen Lee}\end{array}\right\}$ I would have talked to him.

However, the situation is not that simple here. A pre-subject auxiliary is impossible in a subordinate *wh*-interrogative even though there is no overt complementizer, as (29) illustrates:[15]

(31) I wonder $\left\{\begin{array}{l}\text{what Lee is doing}\\ \text{* what is Lee doing}\end{array}\right\}$

We also have a pre-subject auxiliary co-occurring with what some would see as a complementizer in examples like the following:

(32)a. Kim is more intelligent [than was his father]
b. Lee is a committed anarchist [as is his brother]

Even if there seems to be some real advantage to claiming that pre-subject auxiliaries and complementizers are in the same position, there are ways of making this claim that do not involve the postulation of phonologically empty complementizers. See Kathol (2002).

It seems to me that the case for the empty heads that the lexical approach assumes is not very compelling. In absence of strong arguments for these heads, a syntactic approach of the kind developed in HPSG seems preferable.[16]

6. Concluding remarks

In this paper, I have compared the syntactic approach to unbounded dependency constructions developed within recent HPSG with a lexical approach of the kind assumed but not developed within Minimalism. I have shown that the latter requires a large number of mainly phonologically empty C-elements, each with a complex feature makeup. Generalizations about their feature makeup can be captured if they are assigned to various lexical types, with which shared properties are associated. It seems, then, that we have a choice between hierarchies of phrasal types in a syntactic approach and hierarchies of lexical types in a lexical approach. I have suggested that there are reasons for favouring a syntactic approach. Of course, I have not been comparing like with like since while detailed HPSG analyses have been developed for certain unbounded dependency constructions, there seem to be no such minimalist analyses. Ginzburg and Sag (2000: 1) remark that 'Only when comprehensive grammar fragments are commonplace will it become possible to meaningfully compare available frameworks for grammatical description'. It is hard to see how anyone could disagree with this. However, at present there seem to be no minimalist grammar fragments. It is to be hoped that such fragments will be developed soon. If none are forthcoming, uncharitable types may draw some negative conclusions.[17]

NOTES

1. I am grateful to Andrew Radford for helpful comments on an earlier version of this paper. Any bad bits are my responsibility.

2. There has been little discussion of the relative merits of the different approaches to unbounded dependencies. However, Levine and Sag (2003a, b) provide a number of arguments for the superiority of a SLASH-based approach to a movement based approach.

3. Probably the framework that is closest to Minimalism is categorial grammar, some forms of which have just three mechanisms: functional application, functional

composition and type-raising. Minimalism also appeals to certain ‘economy’ conditions. For critical discussion of such conditions see Johnson and Lappin (1999) and Potts (2002).

4. *Easy-to-please* complements allow an overt filler just in case the adjective is used attributively. The following illustrate:

(i) This is an easy violin [on which to play sonatas]

(ii) * This violin is easy [on which to play sonatas]

5. Some varieties of English also allow an overt complementizer after a *wh*–phrase. See Seppänen and Trotta (2000) and Zwicky (2002).

6. To an outsider, Minimalism does not appear to be a framework that aspires to provide descriptively adequate analyses of syntactic phenomena. Although it has been in existence for ten years, there do not seem to be any analyses as detailed as those of Sag (1997) and Ginzburg and Sag (2000).

7. Sag (1997) has a feature NON-HD-DTRS instead of the feature DTRS of Ginzburg and Sag (2000). Here and subsequently I have revised Sag’s constraints to use DTRS instead of NON-HD-DTRS.

8. Chomsky (1977: 87) remarks that ‘questions but not relatives can have *wh*-movement of adjective phrases, but this distinction will obviously follow from the rule of relativization ...’. It is quite unclear to me what he has in mind here.

9. There is also no reason to think that a lexical analysis is more explanatory. Chomsky’s (1998) remark that the minimalist programme ‘encourages us to distinguish genuine explanations from “engineering solutions” – a term I do not mean in any disparaging sense’ is just spin.

10. The situation is rather different on the head-raising analysis of relative clauses proposed by Kayne (1994) and Bianchi (2000). On this analysis, the ‘head’ of a

relative clause is not a modified constituent but a moved constituent. For Bianchi nominals containing a relative clause have structures like the following:

(i) $[_{DP}$ the $[_{CP}$ $[\text{picture}]_i$ [that Bill liked t_i]

(ii) $[_{DP}$ the $[_{CP}$ $[\text{picture}]_i$ $[[\text{which } t_i]_j$ Bill liked t_j]

In (i) *picture* has been from object position within the relative clause. In (ii) *which picture* has been moved from object position and then *picture* has been moved to a higher position. Various problems for this approach are identified in Borsley (1997, 2001). Even if this approach can be made to work, there is no reason to think that it would involve a simpler set of C-elements.

11. Chung and Kim (2003) develop an HPSG analysis of the kind of data that Rizzi is concerned with, which makes no use of empty heads.

12. Chomsky (1998: 44) discusses *wh*-movement and suggests that a *wh*-phrase has ‘an interpretable feature [Q], which matches the uninterpretable probe [Q] of a complementizer’. Assuming Q has something to do with questions, this might be appropriate for *wh*-interrogatives, but of course it is also necessary to accommodate relative clauses and exclamatives.

13. Some transformational work has seen subject-auxiliary inversion as the product of certain criteria, e.g. the WH-criterion (Rizzi 1994), and the Neg-criterion (Haegeman 1995). The facts suggest that a number of different criteria are necessary.

14. Although the empty specifier in a relative clause is a DP, this is probably not always the case. A comparative construction such as that in the following will probably involve an empty AP specifier within Minimalism:

(i) Kim is taller than Lee is.

Thus, it is probably necessary to distinguish different types of empty specifier.

15. Andrew Radford has pointed out to me that a pre-subject auxiliary is possible in a subordinate *wh*-interrogative in instances of 'semi-indirect speech'. The fact remains, however, that this is not possible in an ordinary subordinate *wh*-interrogative and that this is not because the C position is filled.

16 There may be real evidence for empty heads elsewhere. Thus, after careful consideration of the alternatives, Bender (2001) argues that missing copula sentences in African American Vernacular English as in (i) must involve a phonologically empty form of the copula.

(i) You in trouble.

17. It is often suggested that certain metatheoretical considerations favour Minimalism over the alternatives. Thus, for example, Chomsky (2001: 8–9, note 29) suggests that 'the radically simplified form of transformational grammar that has become familiar ('Move α' and its variants) is a kind of conceptual necessity, given the undeniable existence of the displacement phenomena'. The emphasis on such arguments is presumably not unrelated to the lack of real empirical achievements, For critical discussion of such arguments see Postal (2003).

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CHOMSKYAN SYNTACTIC THEORY AND LANGUAGE DISORDERS

Harald Clahsen

1. Introduction

Chomsky's theory of generative grammar regards human language as a cognitive system that is represented in a speaker's mind/brain with a grammar as its core element. The theory has seen substantial revisions over time (Chomsky 1957, 1965, 1981, 1995, 2000), and several researchers have employed concepts and notions from different versions of Chomskyan theory in their studies of language impairments. The aim of this chapter is to present an overview of some prominent generative accounts of language impairments. Relevant concepts and notions from Chomskyan theory will be briefly mentioned, but for more detailed background information, the reader is referred to one of the many introductions to Chomskyan syntax (see e.g. Haegeman 1991, Radford 2004).

Why should anybody who wants to study language impairments in children or adults care about linguistic theory, more specifically, about Chomskyan generative syntax? One obvious reason is that linguistic theory provides the descriptive tools for analyzing the object of inquiry, i.e. language, and that employing these tools will lead to descriptively more precise characterizations of language disorders. A case in point comes from the study of Williams Syndrome (WS), a genetically-determined disorder with general cognitive deficits and a relative strength in language. Until recently linguistic studies of WS were not available, and the language of people with WS was characterized in intuitive terms, e.g. as 'verbose' (Udwin & Yule 1990), exibiting 'morphosyntactic difficulties' (Thal et al. 1989), and showing an 'unusual semantic organization' (Bellugi et al. 1994). This has changed in the last few years as research on WS has adopted a linguistically more informed approach and produced detailed profiles of linguistic strengths and weaknesses of people with WS across a range of languages; see, for example, Clahsen & Alamazan (2001: 746ff.) for WS in English, and the contributions in Bartke & Siegmueller (2004) for WS in other languages.

Another potential advantage of a linguistic approach to language disorders is that it introduces a new way of looking at impaired language which is not readily available from traditional clinical taxonomies. This is particularly true for Chomskyan theory which regards the human language faculty as a modular cognitive system that is said to be autonomous of non-linguistic cognitive systems such as vision, hearing, reasoning, or memory. The core of the human language faculty is a mental grammar which is broken down into various components (lexicon, phonology, morphology, syntax). This view of human language makes it possible to investigate language impairments as selective *within-language* deficits. In the past, most generative studies of language disorders have dealt with aphasia and Specific Language Impairment (SLI), i.e. with relatively pure language impairments in which other cognitive systems appear to remain intact. More recently, however, several researchers have begun to investigate a wider range of acquired and developmental disorders from this perspective, including Williams Syndrome (Clahsen & Almazan 1998) and Down's Syndrome (Ring & Clahsen 2005).

This chapter will focus on production studies of agrammatic aphasia and SLI. In addition, I will briefly outline how the study of broader impairments, in this case Down's Syndrome, may benefit from a generative perspective.

2. Agrammatic Aphasia

Agrammatism in aphasia has traditionally been defined as a disorder of language production which mainly affects function words, i.e. bound grammatical morphemes (e.g. inflectional affixes) and free-standing functional morphemes (auxiliaries, determiners, etc.) while content words, the major lexical categories (nouns, verbs, adjectives) remain intact. Agrammatic production is often characterized as 'telegraphic speech' consisting mainly of content words and frequent omissions of grammatically required bound and free functional morphemes (*boy kiss girl*); see e.g. Goodglass (1968), Marshall (1986), Leuninger (1989), Jarema (1998). However, much research has shown that agrammatic patients also have specific comprehension problems, e.g. in sentences in which functional grammatical morphemes are critical for interpretation.

Several researchers have made attempts to characterize agrammatic production in terms of Chomskyan theory. The earliest account comes from Kean (1979) who relied on Chomsky & Halle's (1968) model of generative phonology and proposed an underlying deficit at the level of phonological representation for agrammatism. Kean highlighted the fact that agrammatism affects both bound morphemes, e.g. inflectional affixes, and free-standing functional morphemes, e.g. auxiliaries and determiners, and that in semantic and syntactic terms the elements that are omitted in agrammatic production are rather heterogeneous and difficult to characterize. What they all share, however, is that they are phonological clitics in terms of Chomsky & Halle's theory. The basic distinction Kean employs is between phonological words, i.e. units relevant for word-stress assignment, and phonological clitics, that are irrelevant for stress assignment. For example, the word *kissing* is represented as [#[#kiss#] ing#] with the phonological word, but not the phonological clitic (= ing#), being marked by boundary symbols on the left and on the right edge (=#kiss#), thereby identifying a domain for stress assignment. According to Kean, this level of representation provides for a straightforward distinction between elements that remain intact in agrammatism (=phonological words) and those that are affected (= phonological clitics).

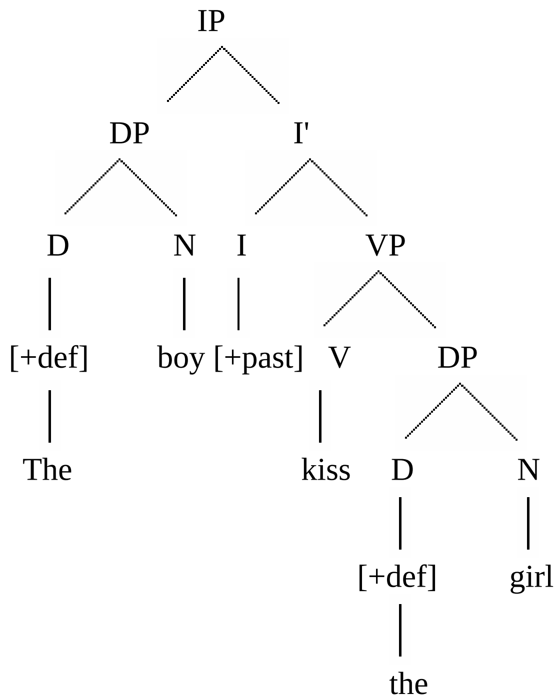
Feature and trace deletion

A well-known *syntactic* account of agrammatism comes from Grodzinsky (1990) who adopted Chomsky's (1981) Government-and-Binding (GB) theory. Grodzinsky proposed separate accounts for production and comprehension in agrammatism.

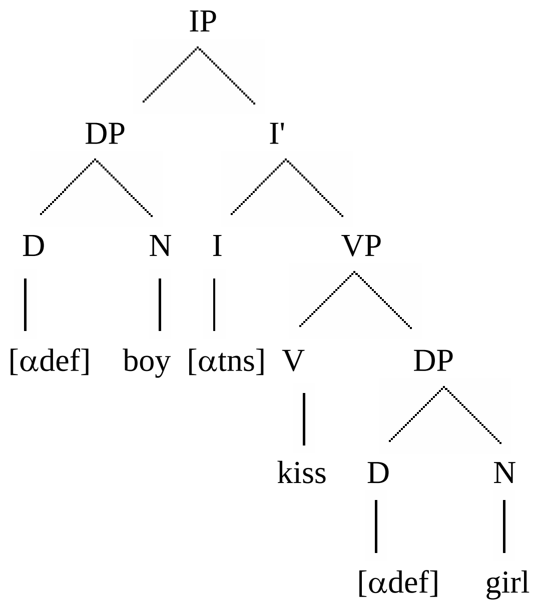
With respect to agrammatic comprehension, Grodzinsky focused on difficulties agrammatic patients experience in the comprehension of passive sentences and other constructions which according to Chomsky (1981) involve syntactic movement. Consider, for example, passive sentences such as *The fish is eaten by the man* in which the passive participle *eaten* cannot assign objective case to its internal argument (= *the fish*) resulting in movement of this argument to the subject position where it can be assigned nominative case. Object-to-subject movement is said to leave behind a phonologically silent copy of the object (= trace) that is coindexed with the moved object and is assigned a thematic role by the verb ([*The fish*]$_i$ *is eaten* [t]$_i$ *by the man*). Grodzinsky (1990) found that agrammatic patients have difficulty comprehending passive sentences and other constructions involving movement traces but not corresponding simple active sentences that do not involve syntactic movement. Conseqently, he argued that agrammatic patients construct syntactic representations for comprehension that do not contain any movement traces, the so-called Trace-Deletion Hypothesis. Although this accounts for the agrammatics' comprehension difficulties with passives and other syntactic phenomena involving traces, the Trace-Deletion Hypothesis has been subject to much criticism and generative accounts of agrammatic comprehension have been much refined in recent years (see e.g. Hickok & Avrutin 1995, Beretta & Munn 1998, Grodzinsky 2000).

With respect to agrammatic production, Grodzinsky's (1990) idea was that the specific values of the features associated with functional categories are lost or deleted in agrammatism. This Feature-Deletion Hypothesis was presented in terms of Chomsky (1981) in which functional categories need to be specified for a set of abstract grammatical features. The functional category Infl for example, is specified for features such as Tense ([PresTns] or [PastTns]), which determine the temporal value of the sentence. The functional category D(eterminer), on the other hand, which requires a nominal complement, is associated with features such as number, gender, definiteness. Grodzinsky claimed that although categories such as Infl or D are present in agrammatism, their internal features are deleted. Consider, for illustration, the syntactic representation of the sentence *The boy kissed the girl* in normal standard English (= (1a)) and in agrammatic English (= (1b)).

(1)a.



b.



Grodzinsky (1990: 56) argued that the crucial property of (1b) is that the internal feature specifications of the two functional categories D and INFL are left unspecified with respect to definiteness and tense. As a consequence, English-speaking agrammatics leave the functional category slots empty, which results in telegraphic sentences such as *boy kiss girl*.

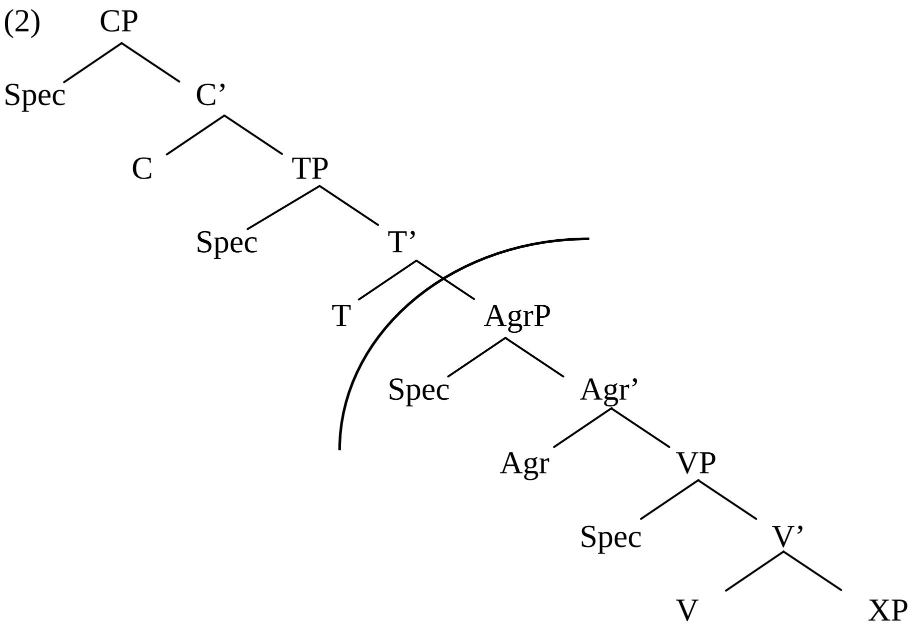
One problem for this account is that much research on agrammatic production has indicated that not all functional elements are equally affected. For example, coomplementizers are comparably well retained (e.g. Goodglass 1976; Menn & Obler 1990), and regular noun plurals yield less difficulty than possessive marking in English-speaking aphasics (Gleason 1978), even though in phonological terms it is the same segment (= -*s*). Moreover, a series of studies across a range of languages have produced evidence that tense marking is more impaired than subject-verb agreement in agrammatic production (e.g. Friedmann & Grodzinsky 1997, 2000, Benedet et al. 1998, Kolk 2000, Wenzlaff & Clahsen 2004). Friedmann & Grodzinsky (1997), for example, testing Hebrew- and Arabic-speaking subjects on sentence repetition and oral sentence completion tasks, found that subject-verb agreement was almost intact with error rates of less than 10%, whereas tense marking was severely impaired.

Similar contrasts were found for English, German, Spanish, and Dutch. These findings are challenging for an account in which *all* functional categories (Grodzinsky 1990) are said to be affected. In Chomsky (1981) both tense-marked verb forms and subject-verb agreement forms involve the specification of grammatical features of the functional Infl, and hence according to Grodzinsky (1990) should both be affected in agrammatic production. The same is true for Ouhalla's (1993) proposal that in agrammatic speech, functional categories are completely missing. If this was correct, then the contrasts mentioned above, for example, between tense-marking and subject verb agreement marking are left unexplained. Likewise, in Chomsky & Halle (1968) both the past-tense *-ed* and the 3rd sg. affix *–s* are phonological clitics, and should therefore be equally affected if Kean's (1979) idea was correct that phonological clitics are impaired in agrammatic production. This prediction does not seem to hold, however, as the results mentioned above indicate. In short, the problem with these early generative accounts is that they fail to explain the subtle dissociations seen in agrammatic speech.

Tree-Pruning

Several researchers have employed the hierarchy of functional projections posited in GB-theory to account for agrammatic production deficits (Hagiwara 1995, Friedmann & Grodzinsky 1997, 2000, Lee 2003). Here our focus will be on the so-called Tree-Pruning Hypothesis (TPH, Friedmann & Grodzinsky 1997, 2000) which explains the structural selectivity of the agrammatic production deficit in terms of Pollock's (1989) split-Infl hypothesis according to which the category Infl is split into the functional categories TP (= Tense Phrase) which is located above AgrP (= Agreement Phrase). Given this framework, the Tree Pruning Hypothesis claims that in agrammatism any syntactic node from TP upwards becomes unavailable, i.e. pruned in their terms, yielding phrase-structure representations without TP or any other functional category above TP as illustrated in (2).

(2)



This account does not only explain why subject-verb agreement is preserved (since AgrP is lower than TP) whereas tense marking is impaired in agrammatic production; the TPH also predicts impairments in the production of wh-questions, embedded clauses and other CP-related phenomena in agrammatism, due to the unavailability of the CP-layer. Friedmann (2001) presents some evidence for this prediction from a series of repetition and elicited production tasks with 14 agrammatic patients in which she found that the patients had difficulty repeating or producing sentences containing embedded complement clauses, object-relative clauses, and *wh*-questions, while at the same time, they had no difficulty repeating or producing sentences with untensed complements (e.g. *.John saw the woman dance*) and yes-no questions (without subject-verb inversion). Friedmann points out that these contrasts are compatible with the TPH, as the impaired phenomena all involve the CP-domain (which is unavailable for agrammatic production), and the non-impaired ones do not.

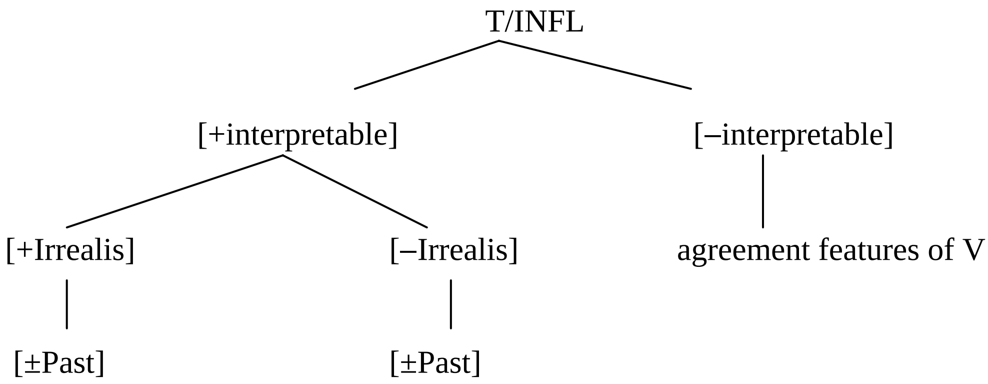
The TPH has been criticized, however, both from a theoretical perspective and on empirical grounds. Tree-pruning presupposes AgrP and TP as separate functional categories as well as a fixed hierarchy of functional categories for CP-TP-AgrP-VP. Chomsky (2000), however, has pointed out that agreement and tense are fundamentally different syntactic concepts, with tense being an interpretable feature of the syntactic category T, and agreement not forming a functional category of its own. Instead, *Agree* is conceived of as an operation that establishes a structural relationship between, for example, the person and number features of a clausal subject and the corresponding uninterpretable features of a finite verb, which are checked by T. Thus, if T is pruned in the agrammatic phrase-structure tree (which according to the TPH accounts for impaired tense marking), *Agree* should not be able to operate because the host for a verb’s person and number features (= T) has been deleted. This means that an impairment of tense should co-occur with impairments in agreement thus making it hard for the TPH to explain the observed selective impairment in tense marking.

On an empirical level, the TPH predicts that impairments in tense should coincide with impairments of CP-related phenomena. Friedmann & Grodzinsky (2000: 93) explicitly state that ‘nodes above TP do not exist in agrammatic representation’. Likewise, Hagiwara (1995) predicts that there must not be any patient who can handle the elements in C(omp), but not those in T. Wenzlaff & Clahsen (2004, 2005) investigated a group of seven German-speaking agrammatic patients with respect to these predictions examining (among other phenomena) tense marking and the so-called verb-second constraint which requires German main clauses to have a finite verb in CP. Verb-second in adverb-initial sentences such as those tested by Wenzlaff & Clahsen (2005) is clearly CP-related as it involves finite verb raising to C(omp) into a structural domain (= CP) that is definitely higher than TP. And yet in sentence-completion tasks, the patients had overall low accuracy scores for tense marking and all but one patient showed chance-level performance, while for verb-second the opposite pattern was found, overall high accuracy levels and all but one patient performed significantly above chance level (see Wenzlaff & Clahsen 2005: 40f). These results indicate that (contrary to what the TPH predicts) tense deficits in agrammatism are not linked to impairments with the verb-second constraint; see also Penke (1998, 2000) for converging evidence that verb-second is largely preserved in German-speaking agrammatics.

Underspecification of T/INFL

Wenzlaff & Clahsen (2004, 2005) proposed an interpretation of agrammatism in terms of Chomsky's (1995) Minimalist Program claiming that in agrammatism the syntactic category T/INFL is unspecified for tense, with other features unimpaired. This account adopts the distinction between interpretable features, i.e., features relevant for semantic interpretation, and non-interpretable ones that are irrelevant for interpretation. According to Chomsky (1995), non-interpretable features must be checked and deleted in the course of the derivation, while interpretable features need not enter into checking relations. Wenzlaff & Clahsen's account rests on two crucial assumptions, (i) that T/INFL contains uninterpretable agreement features along with interpretable tense and mood features, and (ii) that among the interpretable features of T/INFL, mood distinctions (between realis and irrealis forms) are primary and tense distinctions (between past and non-past forms) secondary, as illustrated in (3).

(3)



T/INFL is the host of verb finiteness features and as such not only contains agreement and tense, but also mood features, which distinguish between indicative ([–Irrealis]) and subjunctive or conditional ([+Irrealis]) finite verb forms. Mood and tense features are interpretable whereas agreement features of verbs are non-interpretable, i.e. irrelevant for the semantic interpretation of verbs. Within the interpretable features, mood distinctions are taken to be more basic than tense oppositions; mood marking is more common across languages than tense marking, and acquired earlier by children. Given these assumptions, the Tense Underspecification Hypothesis claims that agreement features and mood distinctions are maintained, while the secondary distinction between [+Past] and [–Past] is lost.

The empirical evidence for this account comes from a series of experiments investigating a group of seven German-speaking agrammatic patients with respect to subject-verb agreement, tense and mood marking. Wenzlaff & Clahsen examined these phenomena in sentence-completion tasks (to test for production deficits) as well as in grammaticality judgment tasks to determine which agrammatic symptoms extend to other modalities. It was found that all aphasic patients performed at high accuracy levels for mood and agreement in the sentence completion and the grammaticality judgment tasks. By contrast, tense was impaired in the aphasic patients and in both tasks. These results are consistent with the notion of an underspecification of T/INFL in agrammatism. Moreover, the finding that the grammaticality judgment and the sentence-completion tasks yielded parallel results and that no significant task effects were found indicates that T/INFL underspecification is a central representational deficit in agrammatism which cannot only be seen in production, but also in other modalities; see Burchert et al. (2005) and Varlokosta et al. (2005) for recent extensions of the T/INFL underspecification account.

3. Specific Language Impairment

SLI is defined as a delay or a disorder of the normal acquisition of grammar in the absence of neurological trauma, cognitive impairment, psycho-emotional disturbance, or motor-articulatory disorders (see Leonard 1998, Levy & Kavé 1999, Clahsen 1999 for review). Several researchers have employed concepts and notions from Chomskyan theory in their attempts to characterize the morphosyntax of individuals with SLI and how it differs from that of typically-developing children. Some accounts have posited relatively broad impairments in the underlying syntactic representations of SLI individuals to capture the kinds of difficulties individuals with SLI experience in morphosyntax. Other accounts have attempted to identify specific linguistic markers of SLI rather than providing a complete grammatical characterization.

One of the earliest accounts of SLI that posited a relatively broad syntactic deficit (Clahsen 1989, 1991) claimed that the Control-Agreement Principle (Gazdar et al. 1985) is impaired in the grammars of SLI individuals. In Gazdar et al.’s theory, this principle is responsible for matching grammatical features of different syntactic categories within a sentence, as required for subject-verb or object-verb agreement, gender and number concord, structural case marking, and other kinds of syntactic dependencies. Another idea was that the system of *functional categories* (CP, IP, DP, etc.) is particularly vulnerable in these individuals (Eyer & Leonard 1995, Guilfoyle, Allen & Moss 1991, Leonard 1995, 1998). The third account of that ilk is van der Lely and colleagues' *Representational Deficit for Dependent Relations* (RDDR) hypothesis which claims that individuals with SLI have 'a deficit with building non-elementary complex syntactic dependencies between constituents' (van der Lely & Stollwerck 1997: 283). What is common to these approaches is that they all posit relatively broad syntactic impairments.

Challenging for these kinds of accounts are findings indicating selective rather than broad impairments/delays in SLI grammars. Consider, for example, results from a recent study of structural case marking (Eisenbeiss et al. 2006) which examined large samples of production data from five German-speaking SLI children and five control children who were matched to the SLI children on the basis of their MLU (= mean length of utterance). It was found that both the control and the SLI children achieved high accuracy scores for all kinds of structural case marking, i.e. for nominative subjects, accusatives on direct objects and complements of prepositions, and for datives on indirect objects, and that they overgeneralized structural case markers to exceptions, i.e. when lexical case marking was required in the adult language. For subject-verb agreement marking, on the other hand, the same SLI children (with the exception of one child who was not available for the earlier study) performed considerably worse with low accuracy scores relative to their MLU-levels (Rothweiler & Clahsen 1994). Structural selectivity of this kind is hard to explain by any of the three syntactic deficit accounts mentioned above, as in terms of Chomsky (1981) both case and agreement involve functional categories and a 'syntactic dependency' between grammatical features (= feature checking/valuing). Thus, if any of these mechanisms were affected in SLI, we should see impairments for both structural case marking and agreement.

Another family of accounts of SLI has aimed at identifying linguistic markers of SLI, i.e. those aspects of the linguistic system that are most consistently affected across different individuals, different age groups and different languages. Several researchers working from this perspective have relied on Chomskyan theory. The following will provide a brief overview of these accounts with a focus on tense, agreement, and case marking in SLI.

Optional Tense

The most widely known proposal of this kind is the Extended Optional Infinitives (EOI) hypothesis of Rice, Wexler and collaborators. The initial version of the EOI hypothesis (Rice et al. 1995, Rice & Wexler 1996) claimed that the functional category T(ense) is not obligatory in SLI children's grammars and that difficulties with tense marking constitute 'a clinical marker' for SLI. Rice et al. (1995) found, for example, that English-speaking children with SLI omitted, in obligatory contexts, 70% of the 3rd sg. *-s* forms and 78% of the past tense *-ed* forms - significantly more than non-impaired controls did. They also reported that the finite verb forms of *BE* and *DO* produced by the SLI children were most often correctly inflected. In addition, the SLI children did not use non-finite forms of auxiliaries when finite forms were required; for example, they did not produce sentences such as *He be sleeping*. The same pattern of errors was seen for past-tense forms, i.e., if the children used a past-tense form, it appeared in a past-tense context. Rice et al. noted that the common property of the 3rd sg. *-s* and the past-tense *-ed* is that they encode tense, and that both appear to be equally problematic for SLI children. Their idea that T is optional in SLI children's grammars accounts for the fact that the children alternate between using bare verb stems and tensed-marked verb forms in obligatory contexts for finite verbs, and that if a tense-marked form is used, it is correctly inflected. In more recent work, Rice (2003) presented analyses of longitudinal data showing a selective delay of the development of tense markers in children with SLI relatively to unimpaired children. Rice showed that although other grammatical morphemes, e.g. the plural *–s* in English, develop within normal limits, SLI children start using tense markers at a later age than unimpaired children, and that even after several years do not achieve the same high accuracy scores as unimpaired children.

Although the idea that T is optional in the SLI grammar accounts for the pattern of results found in the SLI children studied by Rice et al., it does not seem to hold cross-linguistically. For languages such as German and Greek in which (unlike in English) tense and agreement marking can be clearly distinguished, tense marking was found to be almost error-free in children with SLI, whereas the same children showed significantly lower accuracy scores for subject-verb agreement (Clahsen et al. 1997, Clahsen & Dalalakis 1999). Moreover, these studies reported a fair number of true agreement errors in SLI children, which according to the EOI hypothesis should be non-existent. There are even English SLI data which are problematic for the original version of the EOI hypothesis. Given that nominative subject case is assigned by Agr(eement) in English, the EOI hypothesis predicts that SLI children should not produce any subject case errors, as agreement was said to be unimpaired. However, as shown in several studies, English-speaking pre-school children with SLI do in fact produce many non-nominative subjects (Leonard 1995, Loeb & Leonard 1991, Schütze 1997). In response to these challenges, the original version of the EOI hypothesis has been revised. The current version (Wexler et al. 1998) claims that both tense and agreement are selectively delayed in SLI.

The Agreement/Tense Omission model

In order to explain that both tense and agreement are affected in SLI, this account draws on the assumption that the functional categories Agr and T both contain a D-feature that needs to be checked against the D-feature of the subject-DP to satisfy the Extended Projection Principle (Chomsky 1995). Wexler (1998) claimed that the grammars of typically-developing children (when they are in the 'optional-infinitives stage') are subject to a developmental constraint, the so-called Unique Checking Constraint (UCC), according to which formal features can only be checked once. UCC prevents a D-feature on the subject-DP from checking more than one D-feature on functional categories, thus forcing either Agr or T to be omitted.

Wexler et al. (1998) propose a two-factor account according to which SLI children sometimes leave T/Agr unspecified. This account allows for four options:

(i) full specification of tense and agreement,

(ii) underspecified tense and agreement,

(iii) underspecified tense only,

(iv) underspecified agreement only.

Wexler et al. argue that these possibilities can all be found in data from English-speaking SLI children. Option (i) underlies instances in which children get subject case, tense and agreement marking right and produce adult-like utterances. Sentences in which neither T nor Agr are specified (i.e., option (ii)) may have a null subject or a subject in the default (objective) case and a bare verb stem, e.g. *(him) fall down*. Option (iii), when Agr is specified and T is unspecified, covers cases of correct nominative subject case and uninflected bare verb forms, such as **he bite me*. Finally, option (iv), unspecified Agr and specified T, is for incorrect non-nominative subjects in sentences with tense-marked verbs, e.g. **me falled in grave*. In this way, Wexler et al. (1998) capture the optional occurrence of finite and non-finite verb forms and of nominative and non-nominative subjects in the speech of English-speaking pre-school children with SLI.

One problem of the Agreement/Tense Omission model is that it does not explain the distribution of case and finiteness markings in older English-speaking SLI subjects. Clahsen et al. (1997) found that the group of 10 to 13 year old children with SLI they studied had 100% correct nominative case marking, past tense marking correctness scores of around 80%, but chance level scores for the 3rd sg. *-s*. To derive the correct case marking from Wexler et al.'s typology, one would have to say that, for these SLI children, Agr is always specified. If this is the case, however, then the low correctness scores of the 3rd sg. *-s* remain unexplained. Moreover, if Agr was tied up with nominative case, as argued by Wexler et al., one would expect to find more instances of non-nominative subjects in sentences in which T is present but Agr is not than in sentences with the reverse distribution. Schütze & Wexler (1996) reported data from unimpaired children in which this contrast did in fact hold. In the SLI data, however, there is no such contrast. Clahsen et al. (1997) found that the SLI children did not produce any non-nominative subject, even in the 311 sentences that contained a verb form that was specified for tense but not for agreement. The lack of non-nominative subjects in sentences with past-tense verb forms (**me falled in grave*) in these data is not what one would expect from Wexler et al.'s typology.

The Agreement-Deficit account

The idea of a grammatical agreement deficit in SLI has been couched in terms of Chomsky's (1995) theory of formal features (Clahsen et al. 1997). Recall that Chomsky distinguishes interpretable features, i.e., features relevant for semantic interpretation, from non-interpretable ones that are irrelevant for interpretation. Agreement features of verbs (and adjectives) form a natural class in Chomsky's system of formal features in that they are non-interpretable and need to be checked off in the course of the derivation. The agreement deficit hypothesis claims that these features are specifically affected in SLI. This account is not meant to provide a complete characterization of the language problems of people with SLI. Clearly, several linguistic phenomena which have been observed to cause difficulty for SLI subjects fall outside of what is covered by an impairment of agreement, for example, impaired comprehension of reversible passive sentences and reflexive anaphors (van der Lely 1996, van der Lely & Stollwerck 1997), difficulties with tense marking (Rice et al. 1995), and other functional elements (Leonard 1998).

The agreement deficit account has received empirical support from a range of SLI data indicating that subject-verb agreement causes difficulty for SLI subjects across different languages and different age groups, and even for children for whom tense marking functions normally, see Clahsen & Dalalakis (1999) for review. On the other hand, the reverse pattern, i.e. impaired tense and intact subject-verb agreement marking does not seem to exist in SLI. Moreover, structural case marking for direct and indirect objects, i.e. a phenomenon outside the domain of agreement features of verbs (and adjectives), was found to be unimpaired in SLI (Eisenbeiss et al. 2006).

Chomsky (1995) distinguishes between two separate components of the language faculty, a lexicon of stored entries and a computational system of combinatorial operations and principles to form larger linguistic expressions. Given this distinction one may think of two possible sources for the problems that SLI subjects have with grammatical agreement. The first possibility would be an impairment of the computational system such that agreement features would be supplied from the lexicon, but not be properly checked, because the particular computational mechanism that normally checks agreement features is missing from the SLI grammar. The effect of this would be that agreement features of verbs cannot be deleted in the course of the derivation and have to be ignored for the purposes of interpretation. Consequently, an SLI child would be free to use any person and number form of a given verb yielding many agreement errors. This, however, is not what we typically find in SLI data. Even though SLI children do indeed produce agreement errors (see e.g. Clahsen et al. 1997), it is true that most of the occurring finite verb forms are correctly marked for agreement and that verbs which do carry an agreement inflection have a subject with correctly matching person and number features; this suggests that abstract (computational) knowledge of agreement is unlikely to be missing completely.

Another possibility is that an impairment of agreement affects the lexicon. In languages with rich agreement paradigms, effects of this can be seen most clearly. For SLI in Greek, for example, Clahsen & Dalalakis (1999) found that 2^{nd} sg. and 2^{nd} pl. contexts accounted for most of the agreement errors, whereas for other combinations of person and number features (e.g. in 1^{st} sg., 1^{st} pl. and 3^{rd} pl. contexts) correctness scores were much higher (= 80% to 90%). For SLI German, several studies have shown particularly low accuracy scores and many errors in cases in which the 2^{nd} person singular suffix *-st* is required in the adult language (Rothweiler & Clahsen 1994, Bartke 1998). For Italian, Leonard et al. (1992) found that with respect to 3rd pl. subject-verb agreement suffixes, the SLI children's mean percentage of correct usage in obligatory contexts were significantly lower than for MLU controls (49.9% vs. 82.3%), whereas for 3rd sg. forms the SLI children achieved the same high correctness score (= 92.7%) as the MLU controls. For Hebrew-speaking children with SLI, Dromi et al. (1998) reported significantly more agreement errors for SLI children than for MLU-matched unimpaired children in one verb class (binyan), whereas in the three other binyanim they studied, the SLI children achieved similar correctness scores as MLU-matched controls. These findings suggest that agreement is not completely absent in SLI, but that the adult agreement paradigm seems to be incomplete with problems focusing on particular forms or verb classes. These cases are likely to be the result of incomplete acquisition of the morphological paradigm of subject-verb agreement. The consequence of that is that agreement features are not always fully specified on verbs taken from the lexicon and that an SLI child may produce non-finite (default) forms or incorrect agreement markings when a verb is taken from the lexicon without any agreement features or with an incomplete feature set.

4. Down’s Syndrome

Concepts from Chomskyan theory have recently also been applied to developmental disorders such as Down’s Syndrome and Williams Syndrome in which language impairments coincide with more general cognitive delays and deficits (see e.g. Clahsen & Almazan 1998, Perovic 2004, Ring & Clahsen 2005). Here our focus is on DS.

Down's syndrome (DS) is a congenital neurodevelopmental disorder resulting from the triplication of (part of) chromosome 21, with an approximate incidence of 1 in 800 live births (Lubec 2002). Several previous studies have indicated that language abilities are relatively more impaired than other areas of cognition in this population (Fowler, Gelman & Gleitman 1994, Miller 1996, Mervis & Bertrand 1997, Tager-Flusberg 1999, Clibbens 2001), and that within the language system, morphosyntax is more impaired than other linguistic domains (see Miller 1988, Fabretti et al. 1997, Schaner-Wolles 2004). Several studies have also reported asynchronous patterns of linguistic development in DS, e.g. enhanced levels of lexical skill relative to reduced levels of morphosyntax (Miller 1988, Chapman et al. 1991, Kernan & Sabsay 1996, Vicari et al. 2000, among others). Moreover, there are studies of DS that discovered patterns of morphosyntactic skill that are qualitatively different from those observed in normally developing children (Fabretti et al. 1997). Taken together, these results suggest the possibility of within-language impairments in people with DS.

Two recent studies have employed Chomkyan theory to characterize language impairments in DS. Perovic (2004) was the first to report an unusual pattern of performance in the comprehension of anaphoric pronouns in four English-speaking adolescents with DS. She found (near) perfect accuracy scores in sentences with non-reflexive pronouns and reduced accuracy scores of around 60% for sentences with reflexives for her DS participants, which led her to suggest 'a specific syntactic deficit' in DS.

Ring & Clahsen (2005) presented results from a somewhat larger study investigating anaphoric binding and passivization in 8 adolescents diagnosed with DS and, for control purposes, groups of 5, 6, and 7-year old children whose chronological ages were matched to the mental ages of the impaired participants but who had no known learning impairments. For anaphoric binding, Ring & Clahsen (2005) replicated Perovic's results showing that for reflexive pronouns the DS participants performed significantly worse than the controls, whereas on non-reflexive pronouns they achieved the same high accuracy scores as the controls. With respect to active and passive sentences, Ring & Clahsen found that the DS participants' accuracy scores for actives were significantly higher than for passives and that the DS participants gave significantly more reversal responses than the controls, i.e., they incorrectly took the first NP they heard as the agent argument.

Ring & Clahsen (2005) offered a syntactic interpretation of these findings, adopting accounts of binding and passivization from Chomskyan syntax. Specifically, they followed Reuland (2001) who showed that the binding properties of reflexive pronouns follow from independently needed conditions on A-chains, as both the reflexive and the antecedent are in argument positions, share the same syntactic features, and the antecedent c-commands the reflexive, whereas the interpretation of non-reflexive pronouns is determined by semantic principles. Moreover, A-chain formation is also involved in the derivation of passive sentences, in order to syntactically link the nominal expression in subject position to its underlying object position. Ring & Clahsen claim that A-chain formation is impaired in DS, which not only accounts for their difficulties interpreting sentences with reflexives but also for the relatively low accuracy scores in comprehending passive sentences.

Clearly, research on developmental disorders has only fairly recently begun to employ notions and concepts from linguistic theory, and more empirical studies are required before any strong conclusions can be drawn. The two studies mentioned on DS, for example, raise several questions, which have to be left to future research. Does the impairment affect other syntactic constructions that involve A–chains, e.g. raising constructions (*John seems to be a nice guy*), *to* infinitives (*John is believed to be a nice guy*) or unaccusatives (*The book arrived yesterday*)? Does the impairment extend to other syntactic dependencies, e.g. A'-chains, as required for wh-questions or relative clauses? Are the DS people's difficulties with passives and reflexives more readily explicable in terms of broader (non-linguistic) deficits? Although these questions have to be left open, the studies mentioned above illustrate that a Chomskyan perspective can be helpful in characterzing language impairments, even in people who have other known impairments outside the domain of language.

ACKNOWLEDGEMENTS

I am grateful to Sonja Eisenbeiss, Claudia Felser, Andrew Radford, and Stavroula Stavrakaki for helpful comments on an earlier draft.

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