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AUXILIARIES AND MAIN VERBS RECONSIDERED *

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In our remarks about the verb complex we would like to take up a relatively old and often treated problem of transformational syntax. We hope to show how one of the most elegant and longlived, though not universally accepted, demonstrations of transformational generative grammar can be profitably reformulated in a semantically based model of grammar, specifically in Natural Generative Grammar. [1] Our approach will be first to sketch and then to discuss the classical transformational analyses of the verb as represented by Chomsky (1957, 1972), Bierwisch (1963), and Jenkins (1972), among others. From our evaluation of these analyses, we believe that the reader will have to conclude that these particular syntactic analyses, which are based on phrase structure grammars and which extensively utilize reordering transformations, do not capture enough of the inherent relationships between the finite verb and its satellites. After that we shall demonstrate how some of these difficulties can be overcome by representing sentences in terms of categorial grammar whose motivation is both syntactic and semantic. Then we shall illustrate a treatment of the verb complex for simple sentences in the Natural Generative Grammar framework, which employs such a categorial syntax. As far as surface constituent structure is concerned, our proposals may be compatible with the not so traditional transformational generative ap-

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[1] Cf. Bartsch and Vennemann (1972, 1973), Bartsch (to appear), Edmondson and Plank (1975).

proach, i.e. Ross's (1969) analysis of auxiliaries as main verbs. [2] In order to exemplify the rules developed here in languages with quite different surface word orders, examples will be taken from English and German, for these are languages that exhibit VO and OV order of elements, respectively. This is not to imply, however, that apart from word order all phenomena being investigated here have completely identical properties in these two languages. For instance, Jenkins (1972: 10–12) observes syntactic differences between German and English modal verbs, and he concludes that modals are main verbs in German though not in English.

As we already alluded to above, the verb complex as an object of study in contemporary grammatical theory is far from being linguistic *terra incognita.* It must be admitted that this particular constituent occupies a central place in the development of formal grammars for natural languages. The analysis of the verb complex offered by Noam Chomsky in *Syntactic Structures* (1957: 110–13), which also appears in a slightly modified form in Chomsky (1965: 106–7, 1972), has served as the basis for the explication of the verb in a great number of transformational grammars. Manfred Bierwisch's *Grammatik des deutschen Verbs* (1963) marks the starting point of generative studies of German syntax. It, too, treats the verb and its accompanying elements.

Chomsky (1957: 111) writes the now familiar expansion of the constituent *Verb* as follows:

(1) $\text{Verb} \rightarrow \text{Aux} + \text{V}$

$\text{V} \rightarrow \textit{hit, run, \ldots}$

$\text{Aux} \rightarrow \text{C (M) } (\textit{have} + \textit{en}) \ (\textit{be} + \textit{ing})$

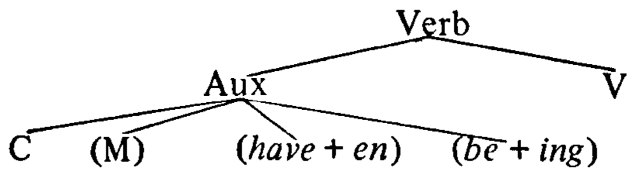
$\text{M} \rightarrow \textit{will, can, \ldots}$

$$\text{C} \rightarrow \begin{Bmatrix} s/\text{NP}_{sg}\_\_ \\ \emptyset/\text{NP}_{pl}\_\_ \\ \text{past} \end{Bmatrix}$$ (i.e. *Number Transformation* Chomsky 1957:111)

Or if written in the form of a tree diagram:

[2] Darden (1973) and Huddleston (1974) provide additional arguments for and refinements of Ross's analysis; Chomsky (1972) and Jenkins (1972) argue against it.

(2)



The transformation (3), *Affix Hopping*, then shifts certain symbols that are independent constituents in deep structure but that end up in surface structure as bound morphemes.

(3) Af + v ⇒ v + Af#

where v = {M, V, *have, be*}

Af = {*s*, ∅, *en*, *ing*}

\# = word boundary

Thus, the task of *Affix Hopping* is twofold. It reorders constituents and specifies the proper surface constituent, i.e. word, structure by means of word boundary insertion.

In his *Grammatik des deutschen Verbs* Bierwisch develops rules for German that perform, on the whole, analogous tasks. Because German allows the possibility of iterated modal verbs,

(4) (a) *Guy Lombardo muss singen können.*
(b) **Guy Lombardo must can sing.*
(c) *Guy Lombardo kann singen können.*
(d) **Guy Lombardo can can sing.*

he is forced to posit a recursive phrase structure rule or, alternatively, a transformation to embed modal verbs. [3] Other features that distinguish Bierwisch's from Chomsky's rules are that Bierwisch's rules are more highly subcategorized and assume a different order of elements. A more detailed evaluation of Bierwisch (1963) may be found in Edmondson and Plank (1975) and Plank (1974).

Both Chomsky and Bierwisch emphasize the principles that stand behind their treatments of the verb complex. Phrase structure rules generate strings of coordinately joined symbols. In English *Affix Hopping*

[3] If *have to* and *be able to* are considered to be modals, then embedding of such verbs might also be necessary in English.

can then jump a constituent, an affix that is, over a neighboring constituent and attach it to that constituent. In German verbal affixes, which are independent deep structure constituents, are transformationally attached to the preceding constituent, with no hopping involved. Thus, discontinuous elements of surface structure, non-finite verbal endings and auxiliaries, are generated as a string of independent formatives in the base and are then rearranged by transformations into a string of dependent constituents. This transformational rearrangement is structure-reducing insofar as formerly independent constituents may merge into one constituent, into one word, that no longer has an internal syntactic structure. It is because non-finite verbal endings are associated in deep structure with auxiliaries rather than with the verbs they belong to in surface structure that one may speak of one constituent, the auxiliary, governing or determining another, the non-finite verb. Bierwisch can thus state the principle underlying his analysis: "Every auxiliary determines the non-finite form of the verb which stands in front of it" (1963:66 – our translation).

If we understand the gist of these analyses correctly, however, Chomsky and Bierwisch have neglected one important aspect of the verbal complex: the internal syntactic structure of the verb and its associated elements – to say nothing about the unnaturalness resulting from attempts to define notions like government or complement-head within a phrase structure system. That the verb complex might contain a hierarchical and not a coordinate structure of constituents all concatenated on the same level of embedding also seems to have occurred to Bierwisch at one place in *Grammatik des deutschen Verbs.* However, he summarily dismisses this possibility since it would entail assigning more structure to the verb complex than he is *a priori* prepared to admit: "It remains to be clarified in the expansion of Aux_a for passive and Aux_b for active sentences whether a hierarchical constituent structure should be assigned to the elements that can occur, i.e. whether instead of simple coordination perhaps one of the following structures should be generated.

(5) *weil der Ball gefunden ((worden sein) soll).*
weil der Ball gefunden (worden (sein soll)).

On the one hand this particular bracketing does not accord with our assumption that in each case the ending of the preceding verb belongs to the following auxiliary verb. And, on the other hand, there is absolutely no evidence for a revised bracketing" (Bierwisch 1963: 71–72 – our translation).

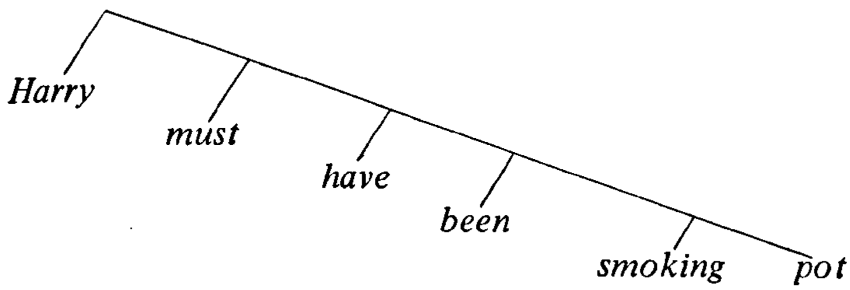
We would now like to contend (a) that it is quite possible and moreover empirically more adequate to write a rule system that generates a hierarchical structure not altogether unlike one of Bierwisch's suggestions and that simultaneously accounts for the observation that non-finite verbal endings are determined by the accompanying auxiliary – 'accompanying' interpreted here not as referring to proximity in linear (deep, surface, or in between) order of formatives –, (b) that only an analysis of the verb complex that derives the linear surface order of constituents from an underlying structure with constituents ordered not linearly but rather hierarchically accounts for a number of significant facts in English and German that go unnoticed, in part at least, in transformational analyses.

There are several well-known tests for constituent structure, pronominalization, *Gapping, Clefting,* and *Pseudo-Clefting* being among them. Remember that Ross (1969) uses evidence from pronominalization to argue that *Aux* is not a proper constituent, as Chomsky (1957, 1965, 1972) assumes (cf. tree diagram (2)). On the assumption that material which is replaced by *which* or *that* is a constituent in sentences such as (6) Ross arrives at a surface constituent structure such as (7).

(6) *They say that Harry must have been smoking pot,*

$$\left\{\begin{array}{l}\textit{which}\\ \textit{and that}\end{array}\right\}\quad\left\{\begin{array}{l}\textit{he must have been smoking.}\\ \textit{he must have been.}\\ \textit{he must have.}\\ \textit{he must.}\end{array}\right.$$

(7)



Bypassing for the moment the issue what syntactic categories the constituents in structures such as (7) belong to, we adduce further evidence from *Pseudo-Clefting* in support of constituent structures like (7) and unlike (2). [4] Stockwell et al. (1973:521), among others, observe that "pseudo-clefting ... depends on the assumption that what is clefted is a constituent". Consequently, constituents coordinately joined should not be separable by *Pseudo-Clefting.* Consider, for instance, the sentences with coordinate, and hence sister, constituents. [5]

(8) (a) *Smith sang and danced.*
(b) *What Smith did was sing and dance.*
(c) **What Smith sang and did was dance.*
(d) **What Smith did and danced was sing.*

With this test it should be possible to check Bierwisch's reflections about the internal structure of the verb complex. If that part of the sentence is made up of coordinate sister constituents as in the verb phrase of (8a), then *Pseudo-Clefting* will yield only ungrammatical results. Let us regard the clefted variants of the following German and English sentences. [6]

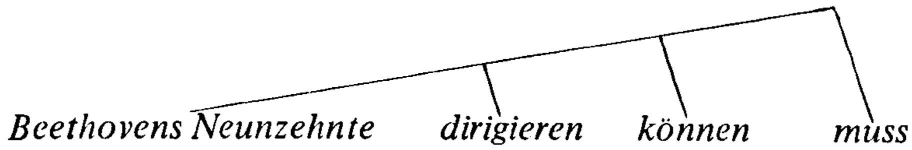
(9) (a) *Schmidt muss Beethovens Neunzehnte dirigieren können.*
(b) *Was Schmidt muss, ist Beethovens Neunzehnte dirigieren können.*
(c) *Was Schmidt können muss, ist Beethovens Neunzehnte dirigieren.*
(d) *Was Schmidt dirigieren können muss, ist Beethovens Neunzehnte.*

(10) (a) *Smith has to be able to conduct Beethoven's Nineteenth.*
(b) *What Smith has to (do) is be able to conduct Beethoven's Nineteenth.*
(c) *What Smith has to be able to (do) is conduct Beethoven's Nineteenth.*
(d) *What Smith has to be able to conduct is Beethoven's Nineteenth.*

[4] Edmondson and Plank (1975) discuss more fully other tests of constituent structure.
[5] Obviously, the *Coordinate Structure Constraint* in the formulation by Ross (1967) or Schachter (1974) predicts the unacceptability of (8c) and (8d).
[6] Here we treat the semi-modals, *have to* and *be able to*, like true modal verbs and ignore the differences pointed out by Jenkins (1972) and Hakutani and Hargis (1972).

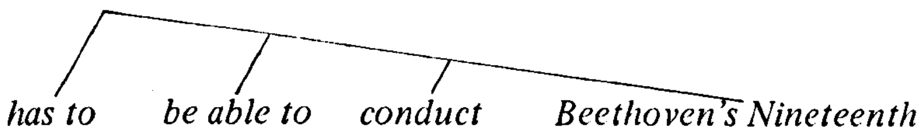
Attempts at clefting other elements all appear to lead to ungrammatical results. Under the assumption that only constituents may appear to the right of the copula, it becomes clear what the internal structure of these examples must be. For the German case:

(11)



and for English:

(12)



As a comparison of tree diagrams (12) and (7) shows, *Pseudo-Clefting* supports the constituent structure of the English verb phrase assumed by Ross (1969).

Thus, we see (a) that there is a very regular and systematic structure revealed among verbal elements that is not generated by the phrase structure rules suggested by Chomsky (1957, 1965) and Bierwisch (1963), (b) that the order of elements and structures of English and German are mirror images of one another. This latter regularity occurs so widely in the world's languages [7] that important generalizations are going unexpressed if the grammatical theory does not attempt to relate such observations. In Natural Generative Grammar (henceforth NGG), as we shall see, such a generalization can be expressed rather easily. The syntax of this model, however, rests not on a phrase structure grammar but on a categorial grammar.

Certain varieties of categorial grammar and phrase structure grammars of the type found in the base component of the *Aspects*-model are both similar and different. Bar-Hillel (1964) has shown them to be weakly equivalent inasmuch as they have the capacity to generate the same set of terminal symbols. The two, however, may assign to the terminal strings different structural descriptions. Categorial grammars in particular have

[7] Cf. Greenberg's (1963:85) Universal 16: "In languages with dominant order VSO, an inflected auxiliary always precedes the main verb. In languages with dominant order SOV, an inflected auxiliary always follows the main verb".

several interesting properties that are especially useful for treating the verb complex. First of all, syntactic structures are represented not as configurations of constituents with no relationship between the formatives other than linear order and dominance but rather as function-argument or operator-operand structures that are of semantic relevance. Depending upon what categories are taken as basic, the sentence *Peter snores* would not be rendered syntactically as the string of concatenated independent elements *Peter + snores* but as *Peter*, a function, applied to *snores*, its argument, which is written as *(Peter (snores))*. As both Chomsky and Bierwisch have noted, in the verb complex the auxiliaries and modals will have to be represented as the 'determining' elements, the particular non-finite verbal forms being the 'determined' elements. A categorial system with its basic function-argument relationships can, we contend, explicate such grammatical complement-head structures in a much more natural fashion than a phrase structure grammar.

A second advantage of the categorial system we make use of is that it can very easily capture the generality in expressions that are mirror images of each other. One could argue, then, that although Ross's (1969) analysis of the verb phrase adequately represents the hierarchical constituent structure, word order regularities across different languages are beyond the scope of his theory of grammar. As functor-argument structures in grammatical representations other than surface representations are not linearly but only hierarchically ordered in NGG, one can equally well write the argument to the left or to the right of its function. Therefore, English *must come* and German *kommen muss* could be represented at an underlying level by the same kind of expression (*come'* (*must'*)), with the finite auxiliary *must'* as the argument of the function *come'*, which is realized at the surface as an infinitive. [8] The proper surface order of elements could then be derived by some independently motivated principle of universal grammar such as Bartsch and Vennemann's *Principle of Natural Serialization:* [9]

[8] Primed elements represent the disambiguated meaning of material to be lexicalized later.
[9] Bartsch and Vennemann (1972:131–139) discuss the *Principle of Natural Serialization* in more depth.

$$(13)\ (\text{Operator}\ (\text{Operand})) \begin{cases} \Longrightarrow [[\text{Operand}]\ \text{Operator}]] \text{ in VO languages} \\ \Longrightarrow [\text{Operator}\ [\text{Operand}]] \text{ in OV languages}^{10} \end{cases}$$

The third advantage of categorial grammars is that the syntax and semantics may be expressed by parallel function-argument relationships. If a sentence has a syntactic form (a(b)), then the meaning may be calculated by applying the meaning of 'a' as a function to the meaning of 'b'. Just as the syntax of complex expressions is constructable from its syntactic parts, so too can the meaning of a complex expression be written as a function constructed from the meaning of its parts. This property, recently called *Frege's Principle* by Cresswell (1973:75–9), is a strong argument for a categorial system, if only to the extent that natural languages abide by this principle.

The three advantages for representing the verb complex in a categorial system are then (a) the syntax specifies sets of function-argument relationships, and not strings of independent elements, (b) there need be no inherent order of elements at some underlying level of grammatical representation, (c) a categorial system obeys *Frege's Principle.*

A categorial system is important in NGG because the underlying semantic representation of sentences in the course of deriving surface forms are translated into such a syntax. At the deepest level semantic representations are formulated in terms of a properly extended predicate logic, PEPL. Specifically, such representations have the form of a propositional nucleus embedded in the scope of operators for tense, modality, mood, etc., where modality is to be taken broadly to include deontic notions such as permission and obligation, epistemic concepts, ability and possibility relative to certain circumstances. These nonpropositional factors together with factors about the speech situation determine for whom, at what time, in what world (real world, dream world, etc.) the application of the propositional nucleus as a function to these factors results in a true proposition or a felicitous speech act. If α_i stands for the value of the nonpropositional operators, e.g. tense, modality, etc., and β for the propositional nucleus, and a_0 the utterer, b_0 the hearer, p_0 the place of

[10] Parentheses indicate nonserialized hierarchical structures and brackets serialized linear structures.

utterance, t_0 the time of utterance, etc. (these latter factors denoting the contribution of the context of use of the utterance), then $(\alpha_i(\beta))\,(a_0,\, b_0,\, p_0,\, t_0,\, \ldots)$ can be assigned a truth value and may, for a mood like "indicative", be considered a felicitous assertion or be rejected as a felicitous assertion. Since the major thrust of this paper concerns how the signs of PEPL and the categorial syntax are to be manipulated, we will say nothing more about the interpretation of such signs here and refer the reader to the relevant paragraphs in Edmondson and Plank 1975.

In Edmondson and Plank 1975 we have argued that the semantic representation underlying the sentence *Smith has to be able to conduct Beethoven's Nineteenth* is (14):

(14) $(\mathrm{Ind}(\mathrm{Pres}(\ \boxed{O}\ (\langle A\rangle\ (\mathit{conduct}'_{P2}(\mathit{Smith}'_T, \mathit{Beethoven's\ 19th}'_T)_S)_S)_S)_S)_S$

$\boxed{O}$ indicates necessity by obligation, $\langle A\rangle$ possibility by ability.[11] The symbol *Ind* is the illocutionary force indicator for assertions. In its scope are the tense operator *Pres* and the modal operators. All these apply to the propositional nucleus, which consists of *conduct'*, the two-place predicate, and the terms, *Smith'* and *Beethoven's Nineteenth'*. This entire expression consists of operator-operand (function-argument) structures and is not linearly ordered. To arrive at a surface representation for (14) three rule types are needed (cf. (15)).[12]

(15)

Representation is the syntax of a properly extended predicate logic, PEPL

↑

⟨ Constituent Bldg. ⟩

↓

Representation in a categorial syntax

⟨ Morph. and Lexicalization ⟩

↓

Representation of the surface constituent structure in a categorial syntax

↓

⟨ Serialization ⟩

[11] We will not attempt to interpret $\boxed{O}$ and $\langle A\rangle$ semantically because of the many problems attending them.

[12] (15) does not represent a complete picture of the components in NGG. The phonological component and semantic interpretation have been omitted.

$\langle\,\rangle$ = rule components, $\square$ = levels of representation (We assume the model theoretical semantics for PEPL to be known and thus we call representations in this language semantic representations.)

The first or constituent building rules group together elements that belong together in the ultimate surface structure. The morphological or lexicalization rules can then tailor the surface constituents, i.e. 'words', to the specific language. For instance, the operator *Fut* can remain a constituent and be realized in English and German as an auxiliary or it can be reduced to a verbal affix as in French. In English and German the constituents derived from the sentence operators for *Indicative* and *Present* are reduced to bound morphemes, represented here as markers on the verb, as in these languages *Ind* and *Pres* are always realized as bound forms. In the morphological-lexicalization component expressions of the logical language are replaced by lexemes of natural language. The last rule type serializes the hierarchically arranged constituents of the categorial system into a language specific linear order. Once again the three types of rules are (a) constituent building rules, (b) morphological and lexicalization rules, (c) serialization rules.

Having generally sketched the strategy of a derivation in NGG, we now turn to actually formulating some specific rules. As we have already observed, the constituent building rules must reform the sentence operators for mood, tense, modality and aspect into operands of the verb. For sentence (16a):

(16a) *Peter snores.*

(16b) $(\mathrm{Ind}\ (\mathrm{Pres}\ (\mathit{snores}'_{\mathrm{P1}}\ (\mathit{Peter}'_{\mathrm{T}})_{\mathrm{S}})_{\mathrm{S}})_{\mathrm{S}})$

the semantic representation (cf. (16b)) might be written as *Ind, Pres* applied to the propositional nucleus *Peter snores'*. The constituent building rules can then assign *Pres* the position of operand of *snores'* and *Ind* as the operand of the complex *snores'* applied to *Pres* as in (17):

(17) $\{\mathit{Peter}'\{\{\mathit{snores}'\ (\mathrm{Pres})\}\ (\mathrm{Ind})\}\}$

The braces indicate constituent boundaries and parentheses mark off the operands in the respective constituents. Similarly in (18):

(18) *John loves Mary.*
$(\mathrm{Ind}\ (\mathrm{Pres}\ (\mathit{loves}'_{\mathrm{P2}}\ (\mathit{John}'_{\mathrm{T}}\ ,\ \mathit{Mary}'_{\mathrm{T}})_{\mathrm{S}})_{\mathrm{S}})_{\mathrm{S}})$

the constituent building rules successively reposition the sentence operators so that they become operands of the complex verb, working from the innermost operator to the one with greatest scope, cf. (19).

(19) $\{John' \{\{\{Mary' (loves')\}\ (\text{Pres})\}\ (\text{Ind})\}_S\}$

In general, constituent building may be expressed for the kind of verb phrase considered here by rule (20).

$$(20)\quad (\alpha_1 \ldots (\alpha_k(\beta_{Pn}(x_1, \ldots, x_n))) \ldots {}_S) \rightsquigarrow$$
$$\{x_1 \ldots \{\ldots\{\{\{x_n(\beta_{Vn})\}(\alpha_k)\}(\alpha_{k-1})\}\ldots(\alpha_1)\}_S$$

α_i = sentence operator

β_{Pn} = n-place predicate

β_{Vn} = n-place verb

x_i = term

$\rightsquigarrow$ = rewrite in constituents

This rule captures the important principle that the auxiliaries and modals govern the nonfinite verbs (i.e. are their arguments) in the categorial representations. [13] Failure to realize the operation of this principle, we think, has lead Cresswell (1973:198) in *Logics and Languages* to say that "the surface tense system of English and its relation to a deep structure of the kind we have been outlining is horribly complex." Rule (20) also derives the correct hierarchical constituent structure for the examples (9) and (10). *Beethoven's Nineteenth* is first grouped together with *conduct*, then *conduct Beethoven's Nineteenth* with *be able to*, and then *be able to conduct Beethoven's Nineteenth* with *have to*.

We have already mentioned, however, that not all constituents of the categorial syntax can be allowed to survive as independent formatives in the surface structure. The morphological rules must reduce some constituents to marking indices. If we write marking indices in angled brackets and constituents in parentheses and braces, then some of the morphological rules of English and German might be formulated as in 21.

[13] Edmondson and Plank (1975) and Edmondson (1975) outline the interaction of negation with a rule schema such as (20). Problems of categorial syntax are treated in somewhat more detail in Plank 1974, 1975.

(21) Some morphological rules
(a) ((... α′) Ind ⟨ I ⟩) → (... α′ ⟨ Ind, I ⟩)
(b) ((... α′) Pres ⟨ I ⟩) → (... α′ ⟨ Pres, I ⟩)
(c) ((... α′) $\boxed{\diamond}$) → ((... α′ ⟨ INF ⟩) $\boxed{\diamond}$)
(d) ((... α′) Prog) → ((... α′ ⟨ ING ⟩) *be′*)

⟨ ⟩ = marking index
I = markers (including among other things person and number)
$\boxed{\diamond}$ = modality formatives

If α′ is a formative in the immediate operator of *Ind*, then the marking index of *Ind* is carried over onto α′ and *Ind* itself is reduced to a marking index. The rule for *Pres*, (21b), is completely parallel to (21a). These rules have essentially the same effect as those developed by Chomsky and Bierwisch except that they operate on semantically motivated function-argument structures and not over linear strings of concatenated independent formatives.

In closing let us sketch the relevant details in the derivation of the test sentence *Smith has to be able to conduct Beethoven's Nineteenth.*

(22a) (Ind(Pres($\boxed{O}$ ($\diamond$A (*conduct*$'_{P^2}$(*Smith*$'_T$, *Beethoven's 19th*$'_T$$)_S)_S)_S)_S)_S$)

(22b) [Semantic representation]
{*Smith′*{{ {{ {*Beethoven's 19th′* (*conduct′*)}
$\diamond$A} $\boxed{O}$} Pres} Ind ⟨ I ⟩}}

(22c) [By means of constituent building rule 20]
{*Smith′*{ { { {*Beethoven's 19th′* (*conduct′*)}
$\diamond$A} $\boxed{O}$} Pres ⟨ Ind, I ⟩}}

(22d) [By rule for *Ind*, (21a)]
{*Smith′*{ { {*Beethoven's 19th′* (*conduct′*)}
$\diamond$A} $\boxed{O}$ ⟨ Pres, Ind, I ⟩} }

(22e) [By rule for *Pres*, (21b)]
{*Smith′*{ { {*Beethoven's 19th′* (*conduct′*)}
$\diamond$A ⟨ INF ⟩} $\boxed{O}$ ⟨ Pres, Ind, I ⟩}}

(22f) [By rule for modal formatives, (21c)]
{*Smith′*{ { {*Beethoven's 19th′* (*conduct′* ⟨ INF ⟩)}
Ø 1 2
$\diamond$A ⟨ INF ⟩} $\boxed{O}$ ⟨ Pres, Ind, I ⟩}}
3 4

[By rule for modal formatives, (21c)]

Lexicalization and serialization according to natural serialization then yield the surface forms for English, Ø–4–3–2–1, or for German, Ø–1–2–3–4.[14]

Summarizing the advantages of this grammar model for treating the verb complex, we note that:

(a) It can incorporate an explicit semantics. The syntax is accessible to evaluation in terms of some formal device for calculating the meanings of complex expressions, e.g. model theory.

(b) It directly derives the internal hierarchical structure of the complex verb from semantically relevant structures.

(c) Most importantly, it directly expresses dependency relations observed by Chomsky and Bierwisch but which they cannot formalize in a natural fashion in their grammar model. "It is always easier to describe a sequence of independent elements than a sequence of mutually dependent ones." *Syntactic Structures* (1957:41).

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[14] The finite verbs in main clauses of German are not serialized by this principle, probably due to the influence of topicalization; subjects in English also deviate from natural serialization, probably for similar reasons.

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