

# Modularity, Dependency and the Description of a Syntactic and a Phonological Category

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## Abstract

This study explores the possibility of interpreting the substance of both syntax and phonology in terms of a set of monovalent modules that constitute a network of transformational expansions emanating from a common core. In syntax, the exploration is restricted to the substance manifested in the basic semantic relations coding and forming sentences. Such relations represent the category of case and are paradigmatically described in terms of modules representing directional orientation and location. These modules are monovalent and interact in dependency relations reflecting the relative preponderance of the locational and directional substance characterizing such relations. Analogous structure is proposed for the paradigmatic composition of the phonological substance manifested in individual phonological segments. Assuming the tenets of component-based phonology, the study develops a restricted system of modules enabling the alignment of the paradigmatic description of both manner and place of articulation distinctions and internally of both vocalic and consonantal places distinctions. Dealing with the ultimate modules of both phonology and syntax, interpreted as inter-connected in a network of expansion from a common substantial core, the study points to new areas of parallel paradigmatic structure in these two domains of language.

## Keywords

Syntax, Phonology, Dependency, Description of Paradigmatic Constituents

## 1. Introduction

One of the first and most central presentations within the tradition of linguistic

theory, which analyses phonological or syntactic domains and categories, including the smallest atoms of these, in term of what in this article will be referred to as unary modules and proposes to let these modules interact in dependency/government relationships is the work of [Anderson and Jones \(1974\)](#). The fundamental thesis of this work is that with both unary modules and dependency available, relative salience, a recurrent property of both paradigms and syntagms in phonology, receives a straightforward interpretation as single valued modules interacting in dependency relationships directly express the varying prominence of phonological parameters. The two key concepts module and dependency are rooted in work of the 1950s and 1960s. The unary module (used by Anderson and Jones to represent paradigmatic structure only) is a development of the phonological distinctive feature<sup>1</sup>. The unary module, first used to describe phonological paradigms, is either present or absent and thus never binary nor multivalued unlike the distinctive feature of the classical distinctive feature systems such as [Jakobson et al. \(1952\)](#), [Chomsky and Halle \(1968\)](#) or [Ladefoged \(1971\)](#). The adoption of dependency (the other key concept besides module) is a continuation of Anderson's work in case-based syntax ([Anderson, 1971](#)), in which dependency directly expresses the unique head-hood of verbs in sentences. Anderson's use of dependency follows the work of [Tesnierre \(1959\)](#) and [Hayes \(1964\)](#), who argue for and adopt dependency to represent syntactic structure because dependency directly expresses head-dependent relations without invoking non-terminal constituent categories such as NP, N', VP, V'. Instead, the dependency-based tree representations of syntagms express such categories in terms of levels of subjunction and direction of governance. Since dependency directly captures unique heads of strings as in verb-headed case grammar, [Anderson and Jones \(1974\)](#) adopt dependency to represent the structure of phonological syntagms, and following its applicability in the syntagmatic domain extend its use to phonology, where in combination with unary modularity it characterises the internal structure of paradigms. In syntax, the notional paradigmatic description of the parts of speech (verb, noun and adjective/adverb ([Anderson, 1997, 2006, 2011](#))) has also benefitted from the application of unary modularity and dependency, just as modularity and dependency have been used to describe the paradigmatic structure of grammatical categories associated with the parts of speech as evidenced by the investigation of [Böhm \(1993\)](#).

The application of unary modularity and dependency to both the phonological and the syntactic domains—syntagmatically as well as paradigmatically—has prompted the proposal of a theory of structural analogy, which asserts that parallel formal structure at the two domains' underlying levels should be promoted and that unique structures not following from idiosyncrasies of the two do-

<sup>1</sup>Referring to the smallest atoms as modules rather than components, as is common in dependency/government-based phonology, is motivated by the observation that the relation between what Anderson and Jones (and supporters of multi-tiered phonology) term components allegedly also exists between collections of components and larger and more general categories or modules of grammar.

mains' alphabets should be avoided (Anderson, 1986a, 1986b, 1997, 2011)<sup>2</sup>. The difference in alphabet of the two domains evidently imposes limits on the extent of the proposed analogy. This difference has naturally led to a precision of what substance underlies each domain as shown by Anderson's comprehensive work on the substance of language (Anderson, 2011). Fundamentally, the alphabets of syntax, what is referred to as its grammaticalisations, involve entities and rules encompassed by notional or semanticity, and the alphabets of phonology, its phonologicalisations that is, entities and rules encompassed by and reflecting the energy of in- and out-going airstreams which serve a contrastive phonological function or enable the formation of recurrent systematic sound structure.

The proposal of alphabetical modules in the two domains of syntax and phonology is the topic of this paper. Two sets of modules will be proposed. The first set is syntactic and serves to describe the paradigmatic structure of the members of the category of case. The second set is phonological and functions as atoms describing partly the place of articulation of phonological segments and partly the units identifying the general paradigmatic organisation of phonological segments. A thesis concerning linguistic structure will be regarded as essential in the proposal of these two sets of modules. This involves the general claim that the substance of each domain is reflected in all its parts and elements through an interconnectedness of modules linked in a network of expansion and refinement. This interconnectedness involves that a given atomic module can be either an expansion or the source of an expansion, where *expandee* represents a substantive refinement of *expander* and *expander* reversely represents a substantive reduction of *expandee*. With this thesis of interconnectedness, the substance of the syntactic domain is bifurcated, so its two central expansional refinements manifest the non-functional lexical and the functional grammatical sub-domains. The proposal of a syntactic set of modules will concern the category of case of the functional grammatical sub-domain. As in Anderson's work, case is here considered a sentential category, whose members, the case relations, code the fundamental semantic roles of arguments. The proposal of a set of syntactic modules will specifically concern the paradigmatic structure of these case relations. The thesis of interconnectedness and expansion has its roots in phonology (as will be discussed below) and in the present proposal will be used to develop a systematic relationship between internal hierarchies of phonological segments as well as a novel relationship between individual atomic modules of such hierarchies. These hierarchies and modules reflect the pervasion of phonologically fundamental periodicity and constriction and ultimately the substantive energy

<sup>2</sup>Alphabet here refers to (cf. Hjelmslev, 1961; Anderson, 2011) the constitutional elements of levels, which are parts of planes. Thus, at the segmental level of phonology, phonological segments constitute a syntagmatic alphabet and the set of distinctive features or modules a paradigmatic alphabet. In conjunction with the alphabets of the supra-segmental level, segments and features make up the phonological plane. The alphabets of syntactic levels are, for example, the parts of speech or the grammatical categories associated with these and the paradigmatic atoms describing such alphabetical constituents. In conjunction, these levels' alphabets make up but do not exhaust the syntactic plane.

of in- or out-going air defining this domain. Describing two categories, one syntactic and one phonological, in terms of dependency and modularity potentially supports the structural analogy assumption. Whether the legitimacy of this assumption is confirmed (or discomfort with it is increased) by the proposals presented here will be considered where appropriate.

The limits imposed by a relatively short presentation such as the present one entail that each proposal will appear relatively short and without discussion of its consequences in all parts and corners of its domain. The hope is that the key tenets will be clear despite the use of a limited amount of evidence in support of each proposal.

## 2. Inter-Connectedness and Expansion

The processes of expansion envisaged to underlie the system of modular atoms in both syntax and phonology, and also more generally modules of grammar, is rooted in an interconnectedness found between atoms of phonological paradigms. Both Anderson and Ewen (1987) and specifically van der Hulst (1994, 2005, 2020) have pointed out that atoms of one segment-internal hierarchy reappear in a more or less different form in other segment-internal hierarchies. Thus  $|V|$ , maximum periodicity, of the categorial gesture (gesture is the term for segment-internal hierarchy used by both Anderson and Ewen and van der Hulst) is manifested in the articulatory gesture as the unary modules  $|a|$ ,  $|u|$ , and  $|i|$ , representing respectively open aperture, gravity/roundness and frontness/acuteness. The interconnectedness appears from  $|a, u, i|$  sharing varying degrees of periodicity with  $|V|$  ( $|V|$  sharing most with  $|a|$ , the two being principally the same), whilst the expansion is manifest in e.g.  $|i|$  representing specifically frontness and  $|u|$  specifically roundness. In the same way,  $|C|$ , the other basic module of the categorial gesture representing consonantal stoppage/constriction, can be said to have specific manifestations in the articulatory gesture. Reusing the modules  $|a, u, i|$ , this is retraction, gravity/dorsality and coronality respectively. Again, the modules in addition to these positional properties also represent and share lack of periodic output and varying stoppage as manifestations of  $|C|$ . Van der Hulst, who has developed a detailed system building on expansional interconnectedness, advocates for a radical system of modules operating with only  $|C|$  and  $|V|$  (see references above), which receive different interpretations depending on the gesture they occur in, but without  $|C|$  and  $|V|$  transforming into other modules.

The approach of the present investigation assumes such a transformation and therefore is less radical. Expansional interconnectedness involves here that modules of a primary hierarchy reappear in other (non-primary) hierarchies in a form which as a result of an expansion exhibits substantive refinement, at the same time as it shares substantive features with the expanding module. Below it will become clear that phonologically expansional interconnectedness involves  $|C|$  and  $|V|$ , on the one hand, and the expansions  $|t| |a| |w|$  on the other, in combination with a di-

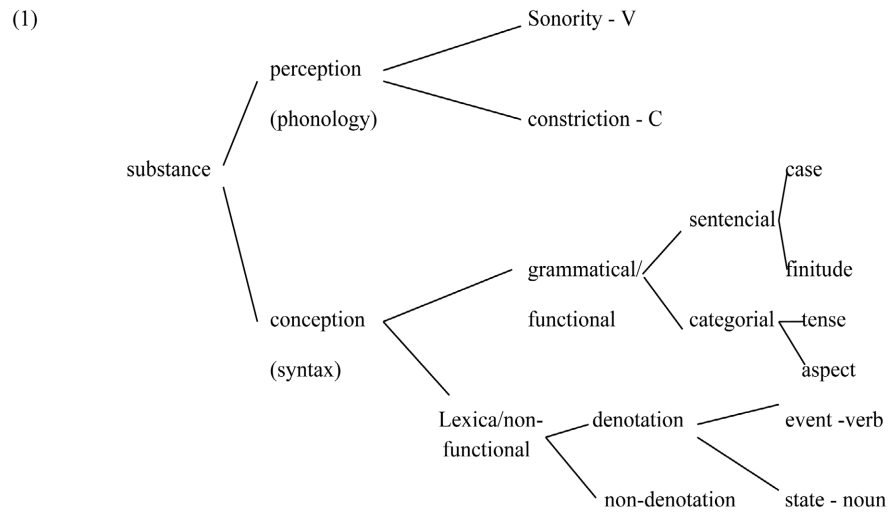
vision into phonologically motivated units, the segment-internal gestures. But such interconnectedness and expansion also imply that |C| and |V| have expanded from a common source. As modules representing the fundamental properties, maximal periodicity and presence of stoppage/constriction, |V| and |C| constitute central elements of the energy defining the in-or outgoing airstream of speech. This is what above was described as the underlying substance of phonology. In other words, phonological substance has two fundamental expansions, |C| and |V|, and this substance expands into hierarchical and phonetic modules (as will be dealt with below), the first organising modules in gestures and the second resulting in a phonetic system of modules allowing for the contrasts expressed in the paradigms of phonological segments<sup>3</sup>.

The modules of syntax, just like the basic modules |C| and |V| of phonology, also enter into a network of expansions and interconnectedness. The fundamental distinction presented above between the non-functional lexical and the functional grammatical domains constitutes a manifestation of basic and fundamental conception, the substance of syntax. As in the phonological domain, each of these modular manifestations has further modular expansions. The functional grammatical module has a sentential expansion covering categories forming or characterising sentences, the categories of case and finitude. Crudely, the non-functional lexical modular manifestation involves a category exhibiting reduced denotative meaning and a category associated with principally denotative conditions<sup>4</sup>. The focus of attention here is the category of case in the functional grammatical division of conception. Therefore, the lexical expansion will only be characterised as a network containing nouns and verbs and semantic primitives, the former as parts of a denotative module and the latter as manifestations of a module with reduced denotation and logically defined entities. Evidently, this is a crude description of categories encompassed by semanticity, but it will suffice for the present purpose of demarcating the place of the category of case and its inter-relation with nouns and verbs in the network of expansions. The division into functional and non-functional is vital and stresses how the function of syntactic entities is considered as important as categories like N', V'. In Chomskyan universalist grammar (cf. e.g. Chomsky, 1993), the latter categories are primary and functional entities structurally derived from them (see discussion below in §3). By advocating for a primary role also for functional categories, a pattern of interconnectedness involving expansions can be expressed in the two domains of syntax and phonology (conception and perception) as in the diagram below<sup>5</sup>:

<sup>3</sup>With the structural and the phonetically based modules, it is also possible to represent the phonology of stress, tone and intonation. See Anderson and Ewen, 1987, and for a description of tone the brief sketch in footnote 18 and Staun (to appear).

<sup>4</sup>The question of where this leaves names/proper nouns is left open here. For extensive discussion, see Anderson (2007).

<sup>5</sup>Conception covers anything encompassed by notionality or semanticity within the boundary of sentences. Perception covers anything encompassed by phonology. Frequently, the term articulation is used instead of perception. It is left open here which term is the better. Preferring perception, allows for the possibility of referring to two “ceptual” domains.



This does not show the organisational structure characterising phonology and manifested paradigmatically as gestures (but see (14) below). Nor is an analogous network of structure shown to exist within the domain of syntax. Potentially, such structure exists for noun and verb despite syntax and phonology differing fundamentally in substance. That this possibility exists follows from noun and verb having two kinds of structure in common with phonological V and C, vowel and consonant (see [Anderson, 2011](#)). The first kind is syntagmatic and not directly relevant except for showing kinship between the two kinds of categories. Verb and V both head strings and noun and C are governed by transitivity restrictions when they combine with these heads in sentences and syllables respectively. In phonology, the transitivity restrictions surface in the dichotomy of open and closed syllables. In syntax, the transitivity restrictions surface in the division into mono-transitive, ditransitive or complex transitive verbs. The second kind of community between V and C and noun and verb is paradigmatic and directly relevant for establishing internal sub-hierarchies. V and C not only individually represent vowels and voiceless stop consonants, but also constitute modules, which in combinations involving dependency relationships make up the internal structure of, for example, sonorant consonant types such as nasal, liquid or semi-vowel. The same holds for verb and noun when interpreted as monovalent modules. As modules, V and N individually represent nouns and verbs, but they can also combine in dependency relationships and represent the paradigmatic structure of adjectives/adverbs or clines involving degrees of e.g. nouniness such as it is manifested in verbal and nominal participial gerunds ([Anderson, 2011](#); [Staun, 2021](#)). However, despite these shared properties, verbs and nouns lack a sub-hierarchical network like the gestures of phonological segments unless evidence proves that rules only apply to or completely delete a part of the internal material of nouns and verbs<sup>6</sup>. Instead, the presence of meto-

<sup>6</sup>The presence of nouniness clines actually supports such a structural organisation. An example of such a cline is the gradual decline of noun-status in the underlined material in *Bill's construction of the house was a surprise*, *Bill's/his constructing the house was a surprise*, *Bill constructing the house was a surprise*.

nymical and metaphorical meanings and meanings conveyed by information structure characterise the categories of syntax. Thus, in the same way as |V| and |C| in phonology vary according to exact gestural membership, categories of conception will vary semantically according to the literal or figurative expectations defined by the language situation, just as the context of these categories including the informational content determined by positional structure in sentences adds semantic variety<sup>7</sup>.

The inter-connected expansion advocated here is rooted in an interplay between modules of phonological paradigms, in particular modules describing segment category and modules describing place of articulation. Their status as single-valued modules permits such an interplay requiring stable homogeneity rather than variable categorial status (binary or multi-valued) of the objects undergoing transformational expansion<sup>8</sup>. By analogy with phonology, the inter-connected expansion is extended to apply to elements of syntax. Just like |C| and |V| are fundamental expansions of phonology or perception (both segmentally and supra-segmentally), noun and verb are expansions of syntax or conception but via steps of expansion reflecting the complexity of the substance of this domain. Interconnected expansion appears directly from the relation between phonological |V| and the components |i|, |u| and |a|. The former represents headhood in phonological strings, the latter describe the phonetic details of inventories of phonological vowels.

Relations between elements of syntagmatic alphabets, both perceptual and conceptual, support the proposed expansional relationship between modules of paradigms. Some but not complete support is found in two types of phonological splits. The first type is the process whereby a bound variant is turned into a regular phoneme due to the loss of allophonic context with umlaut induced by *i* or *j* in Germanic languages as a typical example (Jakobson, 1931; Lass and Anderson, 1975). The second type is the process in which one phoneme gives rise to two new phonemes illustrated by the non-allophonic split of Middle English /u/ into /ʊ/ and /ʌ/ (see Minkova, 2014; Lass, 1999). Evidently, these two processes fail to correspond fully with modular expansion as proposed here. Not only fail the splits unmistakably to be phonetic refinements, but the match is also incomplete since in the first instance only one allophone becomes phonemic with preservation of the source, whilst in the second instance two new phonemes arise, but without preservation of the source phoneme. Despite lack of complete corres-

<sup>7</sup>Pragmatic meaning following from illocutionary force or implication or social relations between users of language (of e.g. power) are also relevant, but typically extend above the level of sentence and therefore not mentioned here. Arguably, the topic/comment dichotomy of information structure also extends beyond the sentence. Since it is also part of the meaning at sentence level and affects the type of structure chosen it is included here.

<sup>8</sup>The process of expansion advocated here requires the element of transformation to have one uniform value. Neither binary nor multi-valued features possess this stability and therefore they are excluded from such a process. This is in line with Anderson and Jones' (1974) first proposal, which posits unary atoms of phonology because such atoms in combination with dependency relationships express the recurrent property of saliency.

pondence with modular expansion, the joined mechanism of such syntagmatic phonological processes supports the hypothesis of expansion of modules in paradigms.

In fact, substantial if not full support for a relationship of expansion appears from entities of syntagmatic alphabets within the domain of the lexicon. In present-day English *bone* can be a verb with at least two distinct but clearly related meanings, viz. “provide with bones” or “remove bones from” and a third but now outdated meaning, viz. “seize”, “apprehend”. In present-day English *bone* is also a noun, and this is the only attested use in Old English. Thus, verbal meanings are all later lexicalisations (attested from around 1500), at the same time as the noun denoting entity is preserved. These expansions of *bone* share denotative features with the source noun but also represent denotative refinements and, as in some phonological splits, expansions and source of expansions co-exist just as in other splits two bifurcations arise from a source in this lexical example. Thus, unlike phonological evidence, lexical evidence shows all the proposed elements of paradigmatic expansion: preservation of source, bifurcation and expansional refinement.

The same cannot be said of the expansion involving the development of new alphabetical categories from other existing categories in the well-known process of grammaticalisation. Unlike in the lexical example, grammaticalisation is not unambiguously one of refinement, but as a language systematisation process more in line with the phonological examples<sup>9</sup>. In semantic terms, it involves bleaching creating de-semanticised categories with increased grammatical status. The development of auxiliaries from full-verbs is one example of this as illustrated by the English auxiliary *do*, (Kroch, 1989), and the de-lexicalisation and specialised use of French *pas* used as a supporting particle to the negation *ne* in present-day French is another example (Hopper and Traugott, 2003). But the development of alphabetical categories with increased grammatical status from other categories arisen as a result of grammaticalisation is also an option as in the development of epistemic from deontic or ability modal meanings (cf. Traugott and Dasher, 2005). Such instances involve refinements of grammaticalisations (or re-grammaticalisations) rather than de-semanticisations. As such they both involve refinement and preservation of source, but bifurcation is not obvious in this alphabetical development. If only partially, re-grammaticalisation, like phonological splits, then supports the expansion contended to exist between modules of paradigms.

Apart from supporting the expansional hypothesis of paradigmatic modules, phonological splits, lexicalisations and the development of new members of grammatical categories also represent processes which are often interpreted as diachronic. Expansion is here regarded as representing an inter-connectedness between members of alphabets in paradigms and syntagms, (and between modules of grammar), something which is underlined by the co-existence of ex-

<sup>9</sup>Language systematisation is here used as a cover term for the processes in both phonology and syntax which create new alphabets.



pander and expandee. It is possible that there exist diachronic relations between these modular members of alphabets (or more general modules of grammar). An evolutionary approach will not be pursued, but evidence suggests that it may also hold for the modules relevant to describe the grammatical category of case. This category and its description with an approach of interconnected modules will be the topic of the following section.

### 3. Modularity and Case

Let us assume that the core elements of syntax are lexical items including single words and morphemes as well as multi-word idioms and fixed phrases. What defines syntax is that these items accrue meaning from structural properties like word order, hierarchy, government and concord as well as a set of grammatical categories associated with them. Among these, the category of case, as an expansional element of conception, specifically the grammatical/functional sub-part of this, has the role of encoding arguments their semantic roles and ensure the identification of these coded roles in a variety of ways so that sentence formation takes place at each sub-or superordinate sentence level. As a sentential category, case also enables the syntactic demarcation of event and state elements of the sentence and arguments individually, including their dependents, by identifying the collective semantic role of these elements with dependents, just as it is essential for the classification of embedded sentences as complements, adverbials or modifiers. Case distinguishes human language from animal communication by adding a systematic and recurrent code mediated by any one of several grammatical vehicles such as adpositions, inflections, linear order. Case is an essential element of the conceptual domain of language providing the basic skeletal code of grammatical relations in sentences, a code adding meaning beyond that provided by the simple listing of elements or by exclamations. Case is thus not an inflectional category of nouns only, but manifested, in among other ways, by inflectional suffixes on nouns, pronouns and adjectives depending on the language in question.

#### 3.1. The Sentential Category of Case

As an expansional module of the grammatical functional part of conception, case fulfills the conditions holding for other grammatical categories of this sub-domain such as, for example, the category of tense. Thus, the category of case has a restricted number of members, the case relations; these members share a notional property, that of encoding arguments semantic roles in sentences, and they exclude each other mutually so that one case relation occurs only once per sentence and one argument can bear only one case relation (see [Fillmore, 1968](#); [Sørensen, n.d.](#)). The last condition is not complied with by all case grammarians. Anderson, for example, ([Anderson, 1977, 1997, 2006](#)) accepts multiple case relation assignments both in sentences and in arguments.

As a sentential category, the category of case is fundamental for the formation of basic sentence structure. Thus, the roles coded by the category of case are

considered more basic than structural categories such as NP, VP or their x-bar projections N' and V'. Instead, the role of the latter is to describe the grammatical material that these case relations code in the sentence. In the terminology used by many European linguists (Hjelmslev, 1961; Dik, 1981; Bache and Davidsen-Nielsen, 1997), the case relations represent function and the structural categories, like NP, PP, describe the form or the grammatical material of such functions. A different approach characterises the work developed from the 1960s to 1980s (and later) by Chomsky and the many followers of his theory of universal grammar (see Chomsky, 1965, 1981, 1993 and introductions like Haegemann, 1994; Cook and Newson, 2007; Radford, 2016). In Chomsky's words, "phrase structure rules...generate...D-structures that express semantically relevant grammatical functions and relations" (Chomsky, 1981: p. 67). The term used for these relations is theta-roles ( $\theta$ -roles) such as e.g. agent, patient, goal assigned by either the sisterhood condition or the theta condition, the former stating that roles are assigned directly by the structural heads to complements and the latter that roles are assigned compositionally by a more complex structure involving sisters of the structural head. Just as the case relations in the case grammar proposed here, any  $\theta$ -role occurs only once per sentence and one argument can bear only one  $\theta$ -role<sup>10</sup>.

A fundamental distinction when identifying the case relations of sentences is the division between participant and circumstantial arguments of the sentence. Following such accounts as Anderson (1977, 2006, 2011), Lyons (1968, 1977), Huddleston and Pullum (2002), participants are arguments that license verbs as e.g. monovalent or bivalent (or in other ways) and as such are obligatory elements of a sentence, which becomes ill-formed if one or more licensed participant arguments are absent (elliptic constructions excluded). By contrast, circumstantial arguments are optional elements, do not license a verb and can be added to or deleted from a sentence without affecting its transitivity and well-formedness. Frequently, circumstantial arguments are referred to as adverbials or adjuncts denoting the time, place, circumstance, reason, intention etc. of what participants predicate (see e.g. Lyons, 1968; Anderson, 1977; Quirk et al., 1985) and can be added to sentences principally in indefinite numbers. The present proposal of syntactic structure concerns participant arguments only, simply to limit the discussion to what is essential for well-formed sentences. The element in a sentence fulfilling the role of topic as well as any one of a variety of functions which refer to what the "verb does" such as agent, experiencer, source, positional marker, patient, empty element etc., i.e. what typically in functional ac-

<sup>10</sup>Identifying functions in terms of structure as proposed in theta-theory misses the general principle that different construction types can bear the same function, i.e. that there is no one to one relation between construction and function. Additionally, a functional approach not only assigns a fundamental role to the semantic relations between arguments, but also views phrase structure as consisting of semantically relevant governors/heads and modifiers. The central role assigned to function and the meaning expressed by functional relations reflects also the view of language expressed as early as Jakobson in 1930s (Jakobson, 1961), Bühler (1934) and Shannon and Weaver (1949), that although structure is important in communication, semantic roles and meaning are fundamental.

counts is referred to as subject is also considered a participant. But it should be stressed that unlike elements complementing the verb, the element of subject does not fulfill a requirement of the verb except the role as the other necessary element of the nexus relation identifying an independent sentence (Jespersen, 1937)<sup>11</sup>.

### 3.2. Case Relation and Case Module and the Analysis of Some Fundamental Sentence Types

The simplest sentential structure is one consisting of a verb plus one participant argument (imperatives are only on the surface simpler). In English, this can be illustrated with:

(2)

London sleeps

Bob hesitated

The door slammed

Bob is reading

From a case point of view, these predications consist of one case relation, identified by the state element of each sentence (typically a nominal construction) which in a declarative and non-interrogative predication is arranged so (in English) it precedes the event and verb-element. Notionally, the arguments in (2) cover a variety of roles: locative, agent, patient and could represent other roles, and code these irrespective of whether their meaning is metonymical or metaphorical. As pointed out above, the metaphorical and metonymical meanings can influence semanticity associated with both functional and non-functional modules of syntax, but do not alter the coding of the fundamental case role of an argument. Case in all of (2) codes the nominative relation. Before we proceed and interpret this case relation in terms of actual paradigmatic case modules (and consider the distinction between case relation and case module), let us see what other participant relations are required and fulfill the requirements of the verb. In English two types of single participant arguments can follow the verb (for the moment examples like *Bob lives in/went to Sactown* are left out of consideration although they contain post-verbal participant arguments, but see below):

<sup>11</sup>The exocentric nexus relation is rarely used in present-day linguistics (for some discussion see Lyons, 1968, 1977). Jespersen's view that the subject-predicate relation is of this kind, where predicate refers to anything but the subject, is rarely put to any use. Instead, the subject is interpreted as less integrated in the sentence by fulfilling the position of the topic of the sentence (as opposed to the comment) and as such an element fulfilling an essential role in text structure. Its status as structurally less integrated in sentences also follows from a view of sentences as verb-headed with emphasis on complemental transitivity. The latter focus assigns the subject an external role in the sentence analogous to but not completely the same as that of adjuncts, which do not enter into a nexus relation with other elements of the sentence, and parallel to the role played by the onset in phonological syllables (see Anderson, 2011 for discussion). In the universal grammar developed by Chomsky and his followers, the subject is interpreted as *specifier*, a constituent merging with a projection of some head to form a HP, i.e. a head-phrase. Complements in a sentence, by contrast, do not participate in this kind of assimilation, see e.g. Radford, 2016 for discussion.

(3)

- |                              |                            |
|------------------------------|----------------------------|
| a.                           | b.                         |
| Bob read the book            | Bob is a burger specialist |
| Bob slammed the door         | Bob is full of love        |
| The bottle contained alcohol | The bottle shook loos      |
| Bob loves burgers            | Bob appears to be a saint  |

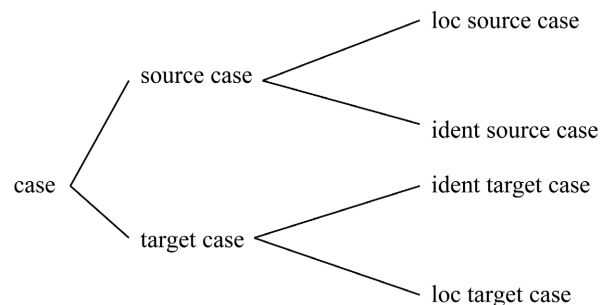
Post-verbally, case codes accusative objects in (3.a) and—on the assumption that adjectives are not verbs—nominative complements in (3b), the latter normally occurring after linking or intensive verbs like *be*, *seem*, *appear* etc. typically describing static situations. Predications in which the verb has two complements (participants), in which the verb is referred to as ditransitive (or tri-valent), unlike the verbs (3a) which are classified as monotransitive (or bi-valent), fall into the two types in (4).

(4)

- |                                   |                             |
|-----------------------------------|-----------------------------|
| a.                                | b.                          |
| Bob gave Ruth a burger            | Bob called Ruth his darling |
| Bob taught Ruth The Lord’s Prayer | Bob made Ruth happy         |
| Bob made Ruth a cake              | Bob made Ruth a cook        |

In (4a) case codes dative objects and accusative objects (in that order) and accusative objects and accusative complements (in that order) in (4b), assuming here a non-complement clause interpretation of the latter (see e.g. Haegemann, 1994; Radford, 2016 for a different analysis)<sup>12</sup>. To account for these coded relations in these prototypical sentences, the following network of modular expansions is proposed:

(5)



Conceptually, the modules represent the location and transitional movement of elements, including specifically either the source or the target of such a transition. In this capacity, the system of expansions resembles a localist approach describing both concrete and abstract situations in locational and directional terms

<sup>12</sup>Because it can be paraphrased as a sentence (Ruth is his darling, Ruth is happy etc.), the post-verbal material in (4b) is analysed in some theoretical frameworks as a verbless clause and considered structurally analogous to the underlined complement clauses in *the student saw the lecturer leave the hall*, *the students have never known the lecturer to criticise anyone* with overt verbs. Although this solution is also possible within the present system resulting in a complement clause functioning as an accusative object with a Nom and Nom complement in it, the absence of an overt verb in (4b) is here taken to support a non-sentential interpretation.

such as that of [Anderson \(1977, 1997, 2011\)](#), whose basic case relations, absolutive (nominative), locative, source and goal individually or in combination may describe the basic relational code of arguments. In the present proposal, however, unlike in Anderson's localist framework, case relations and case modules are distinct. The former, as pointed out earlier, are members of a grammatical category, which is fundamental for the formation and coding of sentences, and the latter describe the internal (paradigmatic) structure of the members of this grammatical category. In modular terms using the system in (5), the case relations established earlier will look as follows minimally:

(6)	Nom	Acc	NomC	AccC	Dat
	case	targ	source	targ	targ loc

Before elaborating on these assignments, which clearly preclude unique identification of the basic case relations as they appear in (6), a few points about the system of modules in (5) are in order. [case] rather than [loc] constitutes the expansional source even though the system of modules is stipulated to reflect locational and directional notions. In this respect, [case] corresponds to Anderson's [abs(olutive)]. [case] represents the default case relation Nom (as does [abs] in Anderson's framework), which is assigned directional properties by the other potential verb-headed case relations within the same sentence. Nom is assigned the feature [case] simply because, as a relation which can occur alone, it minimally indicates the presence of the category of case, i.e. that the coding identifying sentence formation has taken place. [case], unlike Andersonian [abs], adds no 'holistic' interpretation to an element. Holisticness is not here taken to be fundamental, notionally, for the basic skeletal code involved in the formation of sentences, no matter its relevance elsewhere as discussed by [Anderson \(1977\)](#). An element can be interpreted as holistic or non-holistic, but this does not affect the case role of an element, since a holistic or non-holistic interpretation can depend on the presence/absence of progressive aspect in the verbal constituent. This point will be taken up briefly below.

The modules participating in the process of expansion are unary and as such can be either present or absent. As the phonological modules, they may individually constitute an entity at a syntagmatic alphabetical level or in combination make up or describe the internal structure of such an entity. When they individually constitute a case relation, case module and case relation overlap as in (8). But module is distinct from case relation or, put differently, the modules are not modelled on the case relations like the modules |C| and |V| of phonology are modelled on consonant and vowel or the modules |N| and |V| of syntax are modelled on noun and verb. Case relation is distinct from case module for two reasons. First, the case relation is a functional element taking its semantic value from the context of constituents it interacts with. Second, the case relation is subject to the incompatibility constraint excluding it from occurring more than once per sentence and sentence argument. The latter constraint is notionally determined since multiple occurrence obscures the communicative content, and potentially

creates contradictory semanticity<sup>13</sup>. By contrast the module is not constrained and as non-functional, lacking a semantic role, it is not governed by transitivity restrictions. Instead, the case modules can combine in an array of multiple modules describing the internal structure of case relations, a combination which can involve dependency to reflect the relative prominence of source, target and location. In fact, multiple case assignments have long constituted an integrated part of Anderson's work on the description of sentence arguments. Böhm (1993) has adopted this approach and additionally argued that asymmetric relations exist between case relations in paradigmatic case arrays like in the paradigmatic structure of phonology. But the fact that case arrays collectively are governed by transitivity restrictions speaks in favour of keeping case relation and case module distinct<sup>14</sup>. Modules describe the internal structure of case relations, which license verbs and fulfill transitivity restrictions. Case modules and not case relations enter into a network of expansions, just like modules of phonological paradigms enter a network of expansion and are free to occur multiply even in government/dependency relations.

The nodes in (5)—following from expansion—reflect explicitly the gradual sophistication and refinement of expandees. Each node represents a property shared with the expanding node plus an extra property making the nodes following from expansion progressively more complex notionally. Thus, for example, [loc target case] is an expansion of [target case], which is an expansion of [case], each step representing a refinement. The case module labels in (5) are complex. To make them operational, simpler labels will be helpful, in particular the following will be used instead of the complex ones in (5):

(7)	<i>complex label</i>	<i>simple label</i>
	[source case]	[source]
	[target case]	[target]
	[loc source case]	[L-source]
	[ident source case]	[I-source]
	[ident target case]	[I-target]
	[loc target case]	[L-target]

Let us now return to the initial module assignments in (6) and first to the case relation Nom. Frequently, Nom co-occurs with one or more other case relations. In prototypical agent-patient predications this other case relation is the target of the action described by the verb and performed by the Nom element. Hence [case] in (5) requires amplification, simple [case] occurring twice in a sentence

<sup>13</sup>The incompatibility constraint holds also for other grammatical categories such as tense and finitude. In English, for example, the members present and past of the category of tense cannot occur simultaneously but can combine with aspect to express present and past meanings, just like finite and non-finite, the members of finitude, never co-occur in a sentence.  $\theta$ -roles are restricted by the theta criterion (Chomsky, 1981) constraining any  $\theta$ -role to be assigned to one argument at the most and any argument to bear one and only one  $\theta$ -role. Whilst also covering these constraints, the incompatibility criterion additionally specifies that any case relation occurs only once per sentential string of participant arguments.

<sup>14</sup>The exception is such instances where a case relation is described in terms of just one case module.

does not allow for the contrast (and conflicts with the incompatibility criterion), and [case] in (5) expands into [target] and [source]. Since conceptually the system of expansions is loco-transitional reflecting in particular the location and directional movement of entities, [case] first expands into target and source, i.e. intensifications with focus on locational origin and locational goal respectively (for a comment on why [case] and not [loc] is the more basic see above). Individually, [source] and [target] are characteristic of prototypical transitive sentences like *Bob slammed the door* in (3a) with *Bob* as [source] and *the door* as [target]. But in examples with subdued agentivity, [source] is less prominent and in such instances [case] interacts with [source] and as the weak end of a cline of either agentivity (or targethood) bleaches the agentive element. *Bob loves burgers* illustrates this. Nom minimally is [case], but if necessary (in order to describe similar arguments in the same way) such properties as described by Nom in prototypical mono-transitive predications also occur in Nom only predications, [case] is assisted by [source] as in the argument *Bob* in *Bob is running*. Even Nom only predications like *The door slammed* can be described in terms of [source] and [case] but with the former completely dependent, which also characterises such sentences as *Bob received a present*. The detailed specifications in terms of case modules that begin to emerge look then as follows:

- (8)      *Bob slammed the door*  
            [**source; case**]                    [**target; case**]  
            *Bob loves Burgers*  
            [**case: source**]    [**target; case**]  
            *Bob is running*  
            [**source; case**]  
            *The door slammed*  
            [**case; source**]

The representations in angled brackets involve dependency/government relationships between monovalent modules. In an asymmetric dependency relationship, marked linearly by a semicolon, a module (or more than one module) governs and is preponderant over one or more other modules with the former occurring before the semicolon and the latter after the semicolon<sup>15</sup>. A dependency/government relationship can also be symmetric in which the modules are mutually dependent or governing, a relationship expressed linearly with a colon. The use of dependency relations between [case] and [source] in (7) indicates a scale of degree with case at one end and source at the other end. Absence of agentivity is [case], full presence of agentivity is [source]. Internally in case relations, dependency interprets the relative salience of a conceptual core involving location and directional movement (allative or ablative), just as dependency relationships can interpret relative nouniness (as expressed in English participial

<sup>15</sup>An arrow notation can express the same relationship in perhaps a more intuitively obvious way with the arrow pointing towards the governed element and away from the governor. Thus, say, [source; case] alternatively may be expressed as [source→case]. Similarly, mutually governing elements will be represented by a double-headed arrow.







stances illustrating this contrast involve those in (13) (see e.g. Anderson, 1977):

- (13) a. Bob sprayed paint on the wall  
b. Bob sprayed the wall with paint  
c. Bob jammed a pencil into the jar  
d. Bob jammed the jar with a pencil

of which b. and d. have holistic readings since the immediate post-verb arguments of these sentences fully extend the location they refer to. However, the holistic reading is less obvious or absent if the verb of (13b) expresses progressive aspect, *was spraying*, whilst (13d) in the progressive signals repetitive jammings. The unstable holistic readings and the fact that it is uncertain that both post-verbal arguments can be regarded as participant argument (both *Bob sprayed paint* and *Bob sprayed on the wall* are acceptable) will here be taken as evidence that such pairs do not constitute clear-cut examples of two participant arguments. As such, they fall outside the domain of the present investigation.

### 3.3. Closing Points

This sketch of a module-based account of the basic semantic code of sentences (as provided by the category of case as part of the functional-grammatical module of syntax) evidently requires elaboration. In particular, it lacks an account of circumstantial arguments and embedded sentences, just as a detailed account of phrase structure and its functional elements of heads and modifiers is absent. Essentially, it highlights how a limited number of case relations describe participant arguments in terms of modular expansions on the model of inter-connectedness between modules of phonological paradigms. The modules are connected in a network of expansions reflecting the conceptual substance of location and movement of entities, in particular the movement to and from positions, which conceptually, both in a concrete and an abstract way, underlies the category of case. The two alphabets of case relations and case modules that serve to characterise participant arguments are thus distinct. Unlike in other work on the category of case such as that of Anderson, the two are differentiated because case relation, unlike case module, is a functional entity taking its value from its interaction with other arguments, and case relation, unlike case module, determines the transitivity pattern of verbs. The status as distinct from case relation means that the network of expansions, which in detail specify location and directional movement, involves only modules (and not case relations), in contrast to phonology in which expansional connectedness includes both paradigmatic and syntagmatic entities. Dependency assists the modular interpretation of the case relations. In particular, it helps show how, conceptually, participant arguments exhibit relative emphasis of the location and the directional movement of entities in a concrete and an abstract way. Thus, dependency applies equally to the expansional modules within the domains referred to with the general terms, conceptional and perceptual substance. As expected, there is no strict analogy of structure between the modules

within the two domains. Significantly, the network of gestures characterising phonological paradigms is absent within the domain of conception. Not only lacks the network of case modules such an organisation, but this absence also holds for the modular expansions of the non-functional-grammatical module of syntax. |N| and |V| of the latter, modelled on nouns and verbs, have thus far not been shown to possess such a “gestural” network of structure. In phonology, such organisational structure is prominent and has a great impact on the interpretations of modules. The following section will look further into these possible interpretations.

#### 4. Modularity in Phonology

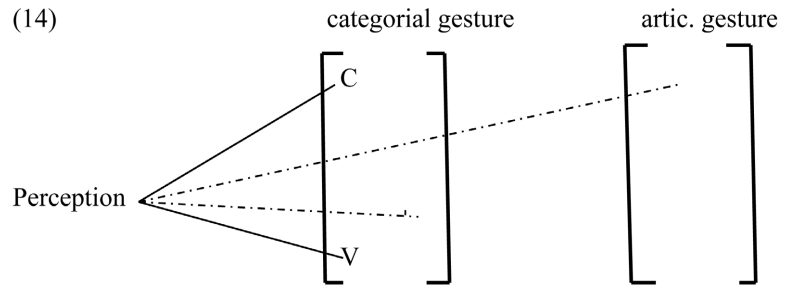
As a linguistic domain based on the substance of egressive or ingressive energy, perception and hence phonology expands into constriction and periodicity, two fundamental elements of such energy. Constriction and periodicity are reflected in the fundamental unary modules |C| and |V| in dependency phonology (see references above) and CV in (radical) CV-phonology (see also references above)<sup>16</sup>. But syntagmatic entities in phonology are also internally structured in subdivisions that are phonologically motivated by e. g. lenition and debuccalisation processes (see Lass and Anderson, 1975; Lass, 1976a, 1976b; Anderson and Ewen, 1987; van der Hulst, 2020). This internal structure distinguishes not just individual segments, but is also a feature of constituents larger than segments (hence the term “syntagmatic entity”)<sup>17,18</sup>. What this means is that syntagms fundamentally distinguished by the expansion into |C| and |V| are also encompassed by a structural elaboration creating a gestural composition so perception, or phonology, has fundamentally two manifestations<sup>19</sup>. Thus, the system which emerges as a consequence of the syntagms’ double composition, phonetic and structural/gestural, appears as in (13) showing the composition of individual segments (the gesture of initiation is left out here), where solid lines represent the phonetic and broken lines the gestural expansions:

<sup>16</sup>The precise definition of |C| and |V| is maximal constriction/presence of acoustic zeros and complete aperture/maximal periodicity respectively. As will be discussed below, in the articulatory gesture this fundamental distinction receives a different interpretation, allowing ultimately |C| and |V| to represent the tonal atoms H and L (high tone and low tone), see also footnote 18.

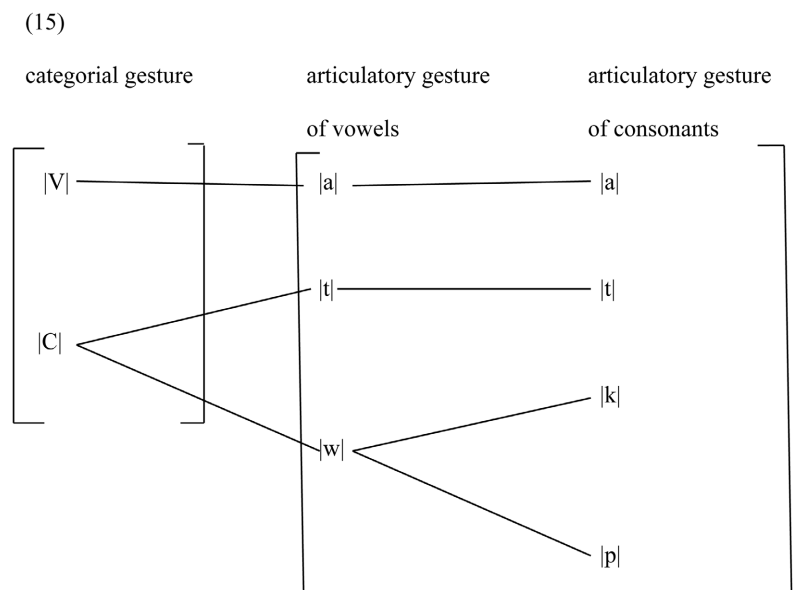
<sup>17</sup>The |C| and |V| modules and their expansions here only contrast meaning. But they will also be used to account for the constituents of intonational phonology (see footnote 18). Thus, they can either express lexical meaning, as in tone languages, or pragmatic meaning or grammatical meaning signaling illocutionary force or meaning of the kind typically conveyed by modality.

<sup>18</sup>Since |C| and |V| also represent high tone (H) and low tone (L) as argued below, the six pitch accent types H\*, L\*, L+H\*, L\*+H, H+L\*, H\*+L posited by Beckman and Pierrehumbert (1986) for American English (asterisk indicates that a tone is central) can be represented as follows using dependency structures: L+H\* is V <C, L\*+H is V >C, H+L\* is C <V and H\*+L is C >V where the arrow indicates direction of government which together with linear order identify and distinguish these bi-tonal accents. H\* and L\* are C and V individually. For a different interpretation of pitch accents in terms of |C| and |V|, in particular nuclear pitch accents, see Staun (to appear), which represents a possible new path to follow for the description of H and L tones.

<sup>19</sup>For a different subdivision within the theory of feature geometry, see Clements (1985), McCarthy (1988), Clements and Hume (1995).



Modular expansion of perception, whether phonetic or gestural, is then in the first instance twofold. The phonetic expansion in the categorical gesture involves a division into |C| and |V| representing the basic sound types, consonants and vowels respectively. Modular expansion inside the articulatory gesture involves both |C| and |V| and transforms these modestly or more radically. The extension into the articulatory gesture builds on the observation, which is fundamental for this proposal, that |V| and the articulatory |a|-component represent identical properties. Anderson and Ewen's |a|-component (Anderson and Ewen, 1987) belongs in the articulatory gesture and represents maximal lowness/openness in the vowel space. |V| in their interpretation is maximal periodicity and lowness/openness creates maximal periodicity; hence the close affinity between |V| and |a| and the interpretation that they fundamentally represent the same property. For this reason, |V| expands as |a| in the articulatory gesture as is apparent from (15) below. Similarly, |C| has expansional extensions reflecting both vocalic and consonantal place properties but with a more radical phonetic effect. The interpretation of |C| and |V| depends then on their gestural sojourn with |V| expanding least and |C| transforming most. In this respect, the present account has properties in common with CV-phonology (see references above), in which the value of |C| and |V| follows from the gesture that hosts these two modules.



But it is controversial that the source of the modular expansion in the articulatory gesture of vowels is not just |V| but also |C|. The response to an objection that all articulatory vowel expansions must start from a |V|-source is that a |C|-source reflects the geometry of the vowel space (see [van der Hulst, 1988](#) for a discussion). This geometry is such that, given e.g. chain shifts (cf [Anderson, 1980, 2013](#)), |a| is opposed to |t| and |w| or, to describe the relation in another way, |t| and |w| are non-|a|, whereas, geometrically, neither |a| and |t| are non-|w| nor |a| and |w| non-|t|<sup>20</sup>. In the categorial gesture, non-|a| corresponds to |C| because |V| and |a| are principally the same. Thus in (15), |t| and |w| are expansions of |C|. Such a system of modules allows also for the expression of representational markedness if unmarked is associated with, among other properties, few expansional paths (see below for some discussion and references). Moreover, this geometry allows the paradigmatic structure of pitch accents to be described in terms of two atoms |C| (high tone) and |V| (low tone). Because |C| is geometrically expanded as |t| and |w|, both representing high vowels whose rate of vocal cord vibration corresponds to that of high tone, |C| is an appropriate atom for high tone in a pitch accent description. Similarly, since the geometrical expansion of |V| is |a| representing low vowels whose rate of vocal vibration corresponds to that of low vowels, |V| is an appropriate atom for low tone in a pitch accent description (for the link between tone and vowel height, see [Lehiste, 1976](#) and for an analysis of tones in terms of atoms high and low [Pierrehumbert, 1980](#) and general presentations such as [Ladd, 2008](#)). But the geometry suggested here and expressed in (15) is a prerequisite for positing |C| and |V| as high and low tone atoms respectively.

The primary modular expansions in the categorial gesture represent opposite phonological categories, in particular a voiceless stop and an open unrounded /a/. The categorial gesture hosts not only these basic sound types, but it is also the gesture containing other manner of articulation types. Such types have been the focus of detailed descriptions, including their participation in lenition clines, and accounted for in terms of dependency/government relations between |C| and |V| (see [Anderson and Jones, 1977](#); [Anderson and Ewen, 1987](#)). Instead of reviewing these well-established categorial descriptions, the following outline will concentrate on the other modular expansions in (15).

|V| and |C| reappear in the articulatory gesture describing the place of articulation of phonological segments. |V| appears as |a|, a modular transformation adding lowness and undergoing no further expansion, which is an option but not a requirement and available for place specifications of both vowels and consonants. |C|, by contrast, has two modular expansions, in particular |t| and |w| relevant for the description of vowels, of which the latter expands further into |p| and |k|, both relevant for the description of consonantal place of articulation. Since these modules serve as descriptors of both vocalic and consonantal place,

<sup>20</sup>This geometry is what makes the triangular vowel space, as presented in e.g. *Dependency Phonology*, “rest” horizontally on the |a|-point and neither on the |t|-nor on the |w|-point.

their definitions should be interpreted with a view to the constraints imposed by a segment's categorial specification. The following definitions are thus broad and general.

(16)

t	maximal degree of coronal stricture
w	gravity and maximal degree of non-coronal stricture
a	maximal aperture and periodicity
k	post-coronal constriction
p	pre-coronal constriction

As in expansional processes outlined so far, the definitions increase in phonetic sophistication as the modules undergo expansion. Thus while |C| refers to stricture, |t| and |w|, as transformational sister modules of |C|, refer specifically to coronal and non-coronal stricture respectively. Similarly, |p| and |k|, transformational products of |w|, represent pre- and post-coronal strictures, both of which are more sophisticated forms of stricture than specified by |w| reflecting gravity in general.

The modules in (16) reflect the phonetic rather than the geometric (gestural) side of perception. Phonetic covers here both acoustic and, predominantly, articulatory properties. Articulatory refers neither to completely active nor to completely passive properties. Instead, it is assumed that displaced articulators are uncommon. Thus, the definitions reflect that phonological contrasts in the alveolar region involve the coronal active articulator, just like contrasts in the velar region involve the dorsal active articulator and the contrasts in the labial region involve the lower lip. Because they are general, these definitions are unable to account for subtle phonetic contrasts. The presence of categorial representations makes up for this lack of specific detail. But more importantly, as was an essential thesis in Anderson and Jones' first proposal, invocation of dependency relationships compensates for such reduced sets of modules. Dependency reflects the recurrence of varying phonetic properties within the domain of phonological perception. The following section will demonstrate with a few examples how dependency can express this among place of articulation contrasts using the modules listed in (16).

## 5. The Phonological Modules and Some Place Contrasts

A stop system found in e.g. English such as /p t k b d g/ will be assigned the following place of articulation specifications given the definitions in (16) (where the voicing difference is expressed in the categorial gesture):

(17)	/p b/	/t d/	/k g/
	p	t	k

Adding /f v/, /s z/ is straightforward, /f v/ being |p| articulatorily and /s z/ |t| in the articulatory gesture with the stop/fricative distinction again maintained in the categorial gesture. Expanding the phoneme inventory with /θ ð/ and /ʃ ʒ/, as in most varieties of English, requires combinations of articulatory modules.

Since /ʃ ʒ/ are postalveolar and more retracted than /s z/, /ʃ ʒ/ will require both |t| and |k|, whereas the more forward articulation of /θ ð/ (compared to /s z/) requires a combination of |t| and |p| for dental /θ ð/. These representations are shown in (18):

$$(18) \quad \begin{array}{ccc} /θ ð/ & /s z/ & /ʃ ʒ/ \\ |t,p| & |t| & |t, k| \end{array}$$

The combination of the modules |t, k| interprets /ʃ ʒ/ as a mixture of coronality and velarity, whereas /θ ð/ get interpreted as a combination of labiality and coronality. It is possible to invoke more structured representations if labiodentals are considered a combination of labiality and coronality, rather than simply |p|, as shown by the asymmetric government/dependency relations in (19):

$$(19) \quad \begin{array}{cccc} /f v/ & /θ ð / & /s z/ & /ʃ ʒ/ \\ |p;t| & |t;p| & |t| & |t, k| \end{array}$$

The predominant |p| reflects the greater labiality of /f v/ and the subordinate |p| exposes the stronger presence of coronality in /θ ð /. Which representation (with or without dependency structures) is chosen with these phonological modules depends on the phonetic detail required, and on what other phonological contrasts occur in the language in question. For example, either simple |p| combined with a complex categorial representation, or |p;t| is appropriate for /f v/, the former in fact covering those varieties of English where /θ ð/ become /f v/ on condition the categorial representation for fricatives is maintained<sup>21</sup>. In a language which also has /ϕ β/, a representation involving both |p| and |t| is a prerequisite for /f v/. Similarly, the representation for palatoalveolar /ʃ ʒ/ may vary depending on whether the language also contains phonemic palatals. Insistence on expressing phonetic detail would result in structured combinations of |t| and |k|, as shown below:

$$(20) \quad \begin{array}{cc} /ʃ ʒ/ & /j/ \\ |t;k| & |k;t| \end{array}$$

But |t,k| for /ʃ ʒ/ as in (19) would also suffice if it is left to the categorial gesture to distinguish between fricative and sonorant consonant.

As further illustration of the potential of these articulatory modules, consider a string of contrasts occurring within the same series, i.e. phoneme types with identical specifications in the categorial gesture. The string occurs in Australian Aranda (cf. Ladefoged and Maddieson, 1996; Maddieson, 1992). This stop series is shown in (21):

<sup>21</sup>In the articulatory gesture, the change of //θ ð/ to /f v/ will then simply involve the deletion of the |t|-component. The process is parallel to the modular reduction characteristic of vowel merging processes such as the low back merger in American English (Labov et al., 2005; Staun, 2010). This process merges the lexical set with /ɑ/ (|a| in dependency terms) represented by e.g. *hot, lot, cot* with the lexical set with /ɔ/ (|a;w| in dependency terms) represented lexically by e.g. *caught, nought, sought*. The result of this merger is phonologically /ɑ/ (|a| in dependency terms) for both lexical sets (with the possible exception of set members with post-vocalic /r/) so that e.g. *cot* and *caught* are homonymous. As in the change of /θ ð/, this merger involves in dependency terms the deletion of one module, viz. |w|.

(21)

<i>Aranda</i>	bilabials	dentals	alveolars	post- alveolars	palato- alveolars	velars
	/p/	/t/	/t/	/t/	/tθ/	/k/
	p	t,p	t	t;k	k;t	k

With the modules available here, dental in this series will be interpreted as a combinations of |t| and |p| without the use of dependency, whereas the distinction between postalveolars and palato-alveolars can be maintained by |t| governing |k| in the former and |k| governing |t| in the latter. These structural reversals reflect how these two types of place of articulation contrasts occupy relative locational positions between alveolars and velars. A quite famous series of contrasts involving seven place contrasts among nasals, which is found in Malayalam (cf. Ladefoged, 1971; Ladefoged and Maddison, 1996) is also manageable with the modules proposed here:

(22)

*Malayalam*

bilabials	dentals	alveolars	post- alveolars	sub- apicals	palatals	velars
/m/	/n/	/n/	/n/	/ɲ/	/ɲ/	/ŋ/
p	p,t	t	t;k	t:k	k;t	k

By invoking a symmetric |t:k| for sub-apicals, the complex series between alveolars and velars can be represented in a way that maintains the phonological differences among the nasals in this language.

A few words are in order about the place modules' capacity to handle vowel space contrasts. The contention of the system presented here is a |a| versus |t|/|w| pattern since |t| and |w| originate in |C|, whereas |a| is a development of categorial |V|. That |t| and |w| are non-|a| (rather than |t| and |a| being non-|w| or |a| and |w| being non-|t|) emphasises the attested significance of the high versus low division as demonstrated specifically in vowel height scales and chain shifts (see Anderson, 1980; Anderson and Ewen, 1987; Anderson 2013). However, the distinction between front and back is still allowed for, but this vowel-module geometry underlines the fact that what is relevant is whether the high versus low difference is in the front or in the back position.

|t|, |w| and |a| individually represent the three almost universal vowels /i/, /u/ and /a/. Front vowels are then combinations of |t| and |a| and back vowels are described in terms of |a| and |w| as in classical dependency phonology (Anderson and Ewen, 1987), in which the components are |i|, |u|, |a| rather than |t|, |w| |a|). The fact that |t| and |w| are non-low has meant that some phonologists regard them as inadequate specifiers of /i/ and /u/ individually, describing high vowels but not specifically high front and high back respectively. But the transformation of |C| into articulatory |t| and |w| allows both for place, constriction and rounding so |t| is identified with /i/ and |w| with /u/. As is apparent from (16), |t| represents maximal coronal stricture and |w| maximal grave non-coronal stricture. In combination with a categorial vowel representation, this is suffi-



ciently accurate to identify /i/ and /u/ respectively. As illustration of how the modules |t| and |a| can account for the four vowel heights among the series of tense front vowels in Danish (for the speakers who still distinguish between /e:/ and /ɛ:/) (cf. Ladefoged, 1971; Ladefoged and Maddieson, 1996), as in *mile* “sand dune”, *mele* “flour” (v.), *mæle* “voice”, *male* “paint” (v.), the following representations are appropriate:

- (23)    /i:/        /e:/        /ɛ:/        /æ:/  
           |t|        |t;a|      |a;t|      |a|

In (23) the non-peripheral vowels are depicted in terms of asymmetric dependency relationships such that |t| is preponderant in closer /e:/ and |a| preponderant in more open /ɛ:/, thus reflecting the relative periodic output and constriction of these vowel qualities<sup>22</sup>.

Since the proposal of Anderson and Jones (1974), it is well established that modularity of the type proposed here in the form of monovalent components combines intuitively with dependency because dependency interprets the varying salience of linguistic substance. In the vowel space, invocation of dependency reflects relative periodicity and constriction and as just pointed out and can express five vowel heights if both asymmetric and symmetric dependency relationships are used. Invoking dependency to interpret place contrasts among consonants is less obvious. Whilst say |i| and |a| represent opposite points on a scale of periodicity/constriction, no two obvious end points exist for the consonantal place scale. Instead, two sub-scales are relevant both involving |t|, alveolarity, as a fixed end point: one specifies degrees of anteriority with |p| contrasting with |t| and another scale degrees of dorsality with |k| contrasting with |t|. This subdivision of what e.g. Ladefoged (1971) describes in terms of one multi-valued feature ‘articulatory place’ is motivated by markedness ranking. End points are designated by one component, each representing unmarked place values among consonants. The double role of |t| as an end point of two scales reflects the special status of coronals (see Paradis and Prunet, 1991; Rice, 1999a, 1999b; Staun, 1996). Although it is not clear from the singular use of |t|, (which is representationally no simpler than more marked |p| and |k|), this status appears from the less complex paths of expansions shown in (15), in which |t| is directly linked with |C| without an intervening node (for representational markedness, see Anderson and Ewen, 1987; Anderson and Durand, 1988; de Lacey, 2006). For advocates of representational markedness, not only the number of modules but also the nature and structure of their mutual interaction contribute

<sup>22</sup>In (23) /æ:/ is represented as single |a|. Other accounts such as Staun (1996) contends that the vowels in (23) participate in a five-way contrast in which the lexical set containing e.g. *larm* “noise”, *karm* “ledge”, *sart* “feeble”, *Marht* (proper name) constitutes maximal aperture/periodicity, i.e. is |a| representationally. Adding /a/ to the list of contrasts requires the introduction of a symmetric dependency relation for /ɛ/. Thus with five contrasts, the cline will take this form: /i:/ (|t|), /e:/ (|t;a|), /ɛ:/ (|t;a|), /æ:/ (|a;t|), /a:/ (|a|). Compared to the list of contrasts in (22), this cline assigns relative aperture to more steps, but does not change the fundamental property of what is involved in degrees of vowel height.

to the markedness ranking. The pattern of module expansions, which is a central proposal of the present report, belongs in the same category of representation. Representational markedness is then extended as well as supported by the relations of what here has been termed expansion that exist between the modules of phonological paradigms. A straighter and more simple line of expansion will, *ceteris paribus*, indicate unmarked status. This simplicity is characteristic of coronals, whose status as unmarked is well-documented.

Evidently, this sketchy description of the perceptual side of language substance leaves out considerable detail. What it shows is that on the assumption that |V| and |C| constitute the basic modules of perception a very restricted system of basic primes can be posited aligning not only the categorial modules with the articulatory modules, but also the place of articulation module of vowels with that of consonants. This alignment is a result of the fact that |V| and |C| undergo restricted expansional transformations which are adjusted to the geometrical module (gesture) hosting the phonetically defined modules. Finer phonological distinctions than supplied by the modules themselves are expressed by appeal to inter-modular dependency as in [Anderson and Jones's \(1974\)](#) original proposal, because dependency captures the recurrent property of perceptual salience. That |V| and |C| also apply at the level above segments is well-established, |V| forming the head of rhymes, syllables and feet and |C| constituting slots flanking syllable heads. As it is closely dependent on periodicity, tone in particular a tonological gesture will also be an expansional module in which |V| and |C| serve the function of atomic modules. The system developed here trivially demonstrates unmarked status for |V| and |C|, vowels and consonants. But as pointed out earlier, |C| and |V| can define tonal properties, in particular high and low tone respectively. The reuse of |C| and |V| in the tonological gesture then not only supports the close interaction of modules in a network of expansions, but also reflects the fundamentally unmarked status of high and low as atomic constituents in the description of tone (see e.g. [Pierrehumbert, 1980](#)). It remains to be established how the geometrical module of initiation should be accounted for. It is possible that a third module complementing |V| and |C| is necessary to allow for initiatory properties.

## 6. Closing Remarks

Basically, language substance as envisaged here consists of a module of conception and a module of perception, the former constituting semanticity and syntax, the latter constituting phonology. Modular structure describes each domain, both the large and most encompassing planes (and parts thereof) and the alphabets of levels distinguishing each domain. Modular structure is modelled on a network of inter-connectedness existing between the smallest atoms of phonology. This structure surfaces in |C| and |V| of the categorial gesture reappearing in a refined form as |t|, |a|, |w| in the articulatory gesture. Similarly, |C| and |V|, like |t|, |a| and |w|, are expansions of a more general module. This is substantive

perception, which not only has phonetically realized |C| and |V| but also phonologically based segmental and extra-segmental gestures as expansions. Analogously, within the domain of conception there exist two fundamental expansions, the grammatical-functional and the grammatical-lexical domains. Via steps of expansion, the category of case is part of the functional branch, with its constitutional case relations coding the fundamental semantic roles of arguments. Like in perception, case relations have internal structure and like in this domain unary modules interacting in dependency relationships serve to describe such structure. The relation between case nodules and case relation deviates from that holding between phonological segment and phonological module. Case relation represents a functional value and determines transitivity. Case module represents a substantive property of location and directional movement of arguments and has no direct impact on transitivity. By contrast, the phonological modules |C| and |V| can individually constitute consonant and vowel, which are restricted by transitivity in phonological syntagms, at the same time as they reflect the fundamental properties of in- and outgoing energy. The close affinity in phonology between segment and module also surfaces in the segment-internal hierarchical network, in which modules operate in phonological classes. Parallel hierarchical structure is absent in conceptually based syntax. Neither case relations nor fundamental noun and verb of the grammatical-lexical domain exhibit internal hierarchical structure parallel to that of gestures in phonology. Instead, both categories vary semantically, just like |C| and |V| vary perceptually, according to context, connotation and possible literal and non-literal interpretations.

The present report has concentrated on the account of two alphabets: an account of the category of case and an account of the articulatory gesture of phonological segments. Both domains are described in terms of a set of unary modules inter-connected in a network of expansional transformations. Despite case relations being defined notionally, specifically reflecting location and directional movement, the source of expansion of the network of case modules is simply case. Locational/directional meaning surfaces only clearly in bi-argument propositions. Such propositions prompt source and target modular expansions of case, just as intensive and double-complement propositions add extra notional variety and new modules to the expansional network in the form of identity source and identity target modules and locative source and locative target modules. On the model of multi-argument propositions, single arguments in intransitive (mono-argument) propositions are assigned the same array of modules as parallel arguments in bi-argument propositions. Crucially, case modules describe the paradigmatic structure of such arguments, a description which can involve the relative prominence—expressed in terms of dependency relationships—of one or the other module when a notional cline such as relative prominence of source calls for representation.

The source of expansion of the alphabets of phonology is |C| and |V|, or ultimately, the energy of in- and out-going air (the substance of perception), which expands as |C| and |V|. Unlike in the grammatical/functional domain, the para-

digmatic modules can individually or in combination represent whole entities or constitutional hierarchies of such entities, i.e. segments or gestures. Structurally, this has two consequences. First gestures constitute expansions just like |C| and |V|. Second, the expansions vary according to which articulatory gesture, vocalic or consonantal, they occur in. The expansions |t|, |a|, |w| are found in both, but in the articulatory gesture of consonants |w| expands further as |p| and |k|. With this expansion, it is possible to allow for all place of articulation contrasts. Invocation of dependency relationships makes this possible on condition that |t| interacts either with |p| or with |k| but not with both simultaneously, nor that these two interact with one another. By reusing |t|, |a| and |w|, the place description of consonants is aligned with that of vowels. The applicability of dependency to consonantal place solidifies this alliance and furthermore shows how coronality is specially ranked with respect to markedness by restricting interaction.

This report confirms the well-established claim that analogy of structure exists between the alphabets of phonology and the alphabets of syntax. On the basis of a documented interconnectedness of expansion among ultimate modules in phonology, this analogy is extended to encompass component parts of either domain. Thus, a network of expansion among ultimate modules also defines categories of syntax just as general and first level categories reflect the same interconnectedness. The idiosyncrasies of the two domains restrict the extent of analogy. Most notably, conceptual substance fails to show internal hierarchical structure of fundamental members of alphabets. Absence of rules operating within or applying to such hierarchies precludes such structure. Instead, tropes and connotation cut across the members of conceptual alphabets adding an extensive variety of notionalty. By contrast, in perceptual substance hierarchical structure is manifested in the alphabets of phonological segments, the alphabets fathering the expansional network of interconnectedness. A network of expansion of this kind in both “ceptual” domains invites questions such as: does this expansional network reflect a natural progression in language evolution? This report has refrained from considering such questions. It is possible that universalist presentations like that of Maddieson (1992), Ladefoged and Maddieson (1996) support that phonological modules develop along a path not unlike that of the perceptual network of expansion. Whether the same can be said about elements of conception is far from certain. Evidence of how sentence structure evolves in child language may suggest (Tallerman, 2012) that the network characterising the functional module of case reflects the progression in the development of basic sentence structure.

This report also confirms the applicability of dependency. Dependency relationships apply in the paradigmatic structure of either domain and reduce the need for ultimate alphabetical modules. This restricting effect is supported by the recurrent property of salience distinguishing both alphabets in phonology and syntax. The presence of salience makes it possible to transfer the workload of differentiation from modules to well-defined relations between modules. A pivotal

property in this transference is the proposal of single valued modules. Without modules remaining monovalent such a relocation would not be possible.

## Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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