CHAPTER 1

Prolusion

1.0 Introduction

The general objective of this thesis is to provide a phonological model wherein systems and structures are organised on the basis of linguistic function. The focus is primarily on the syllable (articulation), though the model is extended in general terms to the foot (rhythm) and the tone group (intonation) in Chapter 2. The purpose of this chapter is to provide the context for interpreting later chapters, and to this end is organised in the following way. §1.1 outlines the theoretical resources being adopted; §1.2 outlines, in general terms, the proposals to be expounded more fully in later chapters; and §1.3 summarises the main points.

1.1 Systemic Functional Linguistics

The theoretical resource being adopted here is that of Systemic Functional linguistics. As a functional rather than formal model, Systemic theory conceives of language as a resource for meaning, a network of relationships, rather than as a set of rules (Martin 1992: 3). This section explicates the principal components of the theory, overviews work in Systemic phonology sufficient to understand later chapters, and identifies some of the theoretical uncertainties to be addressed in the proposals of this thesis.

1.1.1 Systemic Theory

The principal formalism of Systemic linguistics, the system network, is used to model the oppositions that constitute the paradigmatic potential at a given level of description. As Martin (1992: 4) explains:

> Systemic linguistics has its roots in Firthian linguistics, and so not surprisingly it is a type of system structure theory. Unlike Firth however, who gave equal status to the concepts of system and structure in his model, systemic linguistics gives priority to system.

The formalism can be illustrated by considering a hypothetical phonological example of an obstruent inventory comprising the consonants /pbfv†∂QDtdszkgxV/. The consonants can be categorised according to feature specifications, as exemplified in the following table.

		labial	laminal	apical	dorsal
stop	voiceless	p	†	t	k
	voiced	b	∂	d	g
fricative	voiceless	f	Q	s	x
	voiced	v	D	z	V

Table 1.1 A Consonant Inventory Categorised By Features

In terms of logical relations, this paradigm of phonological potential identifies each consonant as a *conjunction* of three *exclusively disjunctive* features, being

(1) *either* [labial], [laminal], [apical] *or* [dorsal] (in terms of active articulator), *and*

(2) *either* [stop] *or* [fricative] (in terms of the manner of closure), *and*

(3) *either* [voiceless] *or* [voiced] (in terms of phonation).

Systemic theory represents the logical relations of conjunction and disjunction through network "wiring". System networks model each *set of disjunctive features* as a *system of choice*, represented by (square) brackets, and model the conjunction of the disjunctive features by using braces to signify all the systems that must be selected from (for a given entry condition). This is illustrated by the network of ALIGNMENT, CLOSURE and PHONATION systems in the figure below.

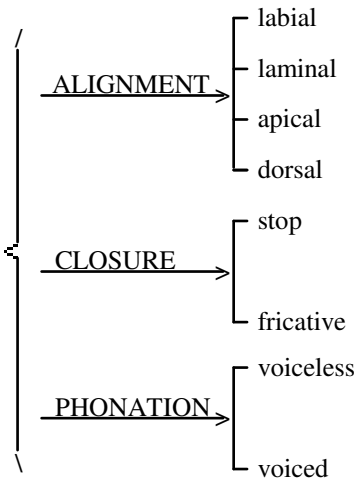

Figure 1.1 Consonantal Potential As System Network

In the figures below, four consonants are each depicted as a conjunction of features selected disjunctively from each of three systems in the network.

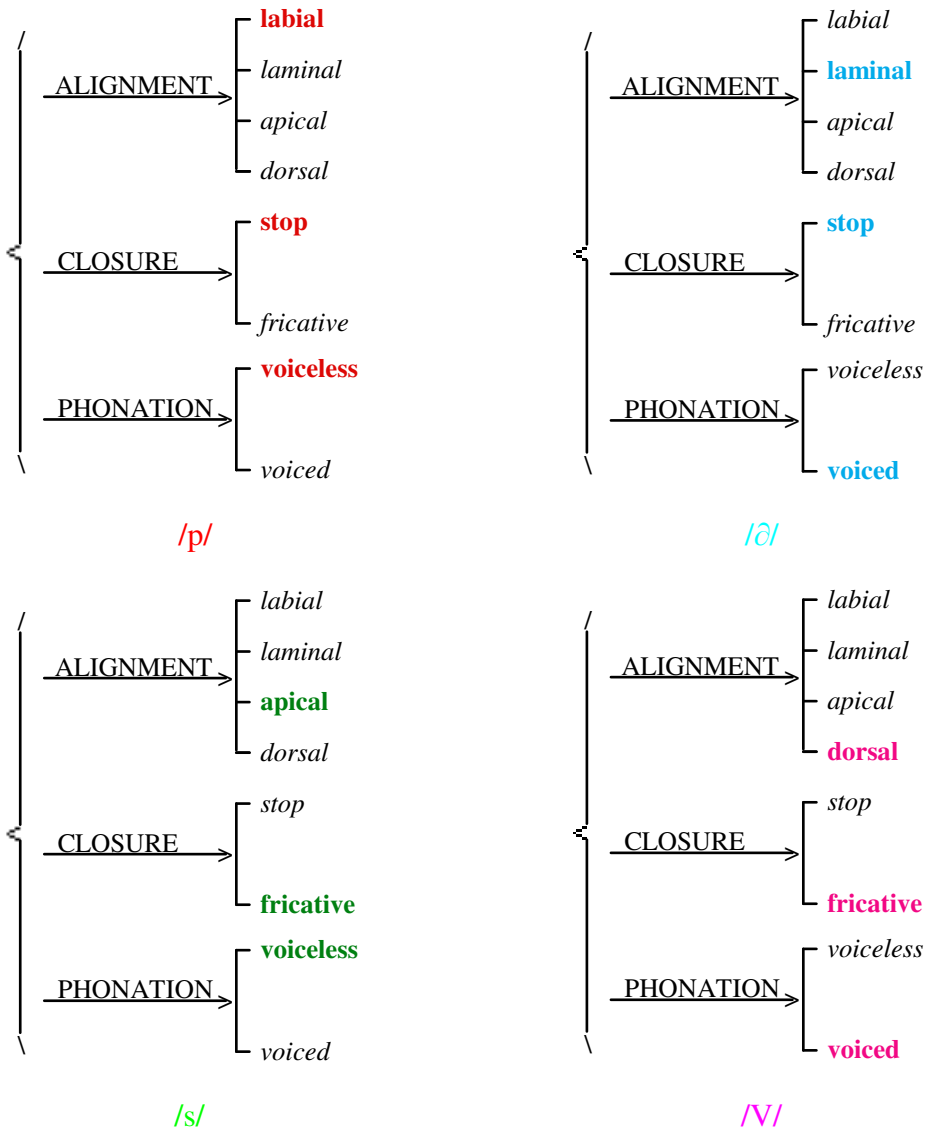

Figure 1.2 A System Network Selected For /p/ /∂/ /s/ and /V/

The system of paradigmatic options represents linguistic potential. The relation between system and structure is explained by Martin (1992: 4-5):

> Following Hjelmslev (1961), paradigmatic relations are mapped onto potential and syntagmatic relations onto actual; thus **system** is described in terms of paradigmatic oppositions, **process** in terms of syntagmatic structure. System and process are related through the important concept of **realisation**... realisation formalises the **instantiation** of system in process.

This relation can be illustrated by the instantiation of the oppositions from the above consonant system in the realisation of /teksts/[1] as the following syntagmatic structure:

[1] Throughout this thesis, etic square brackets [] will be used to represent articulatory categories unspecified for phonological function, and emic slashes // will be used to represent functional categories of articulatory categories.

t	e	k	s	t	s
apical		dorsal	apical		
stop		stop	fricative	stop	fricative
voiceless		voiceless			

Systemic linguistics follows Hjelmslev (1961) in modelling language in terms of a *content* plane and the *expression* plane, with an arbitrary relation between them (Martin 1992: 15, 20; Matthiessen 1989: 12). The model is elaborated, however, by stratifying the content plane into *discourse*[1] (above) and *lexicogrammar* (below), and by placing the phonological stratum, as the expression plane, below lexicogrammar. The relation of lower to higher strata is one of realisation: discourse is realised by lexicogrammar, which is realised by phonology (Matthiessen 1989: 11). This stratal organisation is schematised below.

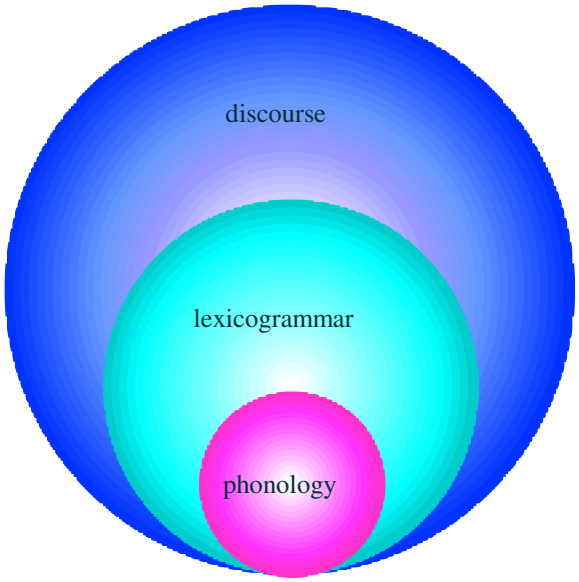

Figure 1.3 Linguistic Strata[2]

[1] Martin (1992) prefers the term *discourse semantics*, Matthiessen (1989) and Halliday (1994) prefer *semantics*. Herein *discourse* is preferred, the term *semantics* being considered redundant, since *both* content plane strata, discourse and lexicogrammar, are resources for meaning.

[2] After Martin and Matthiessen (1991). Martin (1992: 20-1):

> [T]he strata are presented as concentric [sic] circles, which helps to capture the sense in which discourse semantics addresses patterns of lexicogrammatical patterns and lexicogrammar in turn addresses patterns of phonological ones…This projection also has the advantage of backgrounding the content/expression duality deriving from Hjelmslev…Somewhat more sympathetic then to Firth than to Hjelmslev, the model can be read as three meaning making levels, with the meanings made by smaller circles progressively recontextualised by larger ones.

Within two strata, lexicogrammar and phonology, systems and structures are organised along a scale of rank, wherein higher ranked units are typically[1] composed of lower ranked items. For English, a lexicogrammatical rank scale consisting of clause, group/phrase, word and morpheme, and a phonological rank scale consisting of tone group, foot, syllable and phoneme have been proposed (Matthiessen 1989: 34). For an explication of *ranked constituency* versus *immediate constituency*, see Halliday (1994: 17-36).

Most importantly, Systemic theory conceives of language as organised on the basis of three *metafunctions*: the *ideational* — subsuming *experiential* and *logical* — the *interpersonal* and the *textual*. Matthiessen (1989: 18-19):

> The **ideational** metafunction…provides the speaker with the resources for interpreting and representing 'reality'. There are two ideational subtypes, the experiential metafunction and the logical one. The former…construes experience in terms of particular components and subcomponents…eg the transitivity structure of the clause…The latter…operates in terms of very general relations such as modification. It is the mode of organisation for creating complexes of various kinds…chains of interdependent elements.
>
> The **interpersonal** metafunction provides the speaker with the resources for creating and maintaining social relations with the listener, eg by assigning speech rôles such as questioner and (intended) answerer and by intruding into the speech situation by giving or demanding comments on what's being said.
>
> The **textual** metafunction enables the speaker to present ideational and interpersonal information; it provides him or her with the resources for contextualising the information. Examples include assignments of thematic prominence and informational prominence as news.

The metafunctional organisation of language can be illustrated by analysing the sentence[2] we are all in the gutter but some of us are looking at the stars. First, in terms of the logical[3] metafunction, it can be analysed as two interdependent clauses of equal status, and so paratactically related in a clause complex. Parataxis is indicated by numeric characters; hypotaxis, or dependency, by Greek alphabetic characters. Further, the second clause *extends* the meaning of the first clause, as indicated by the '+' sign in the function structure below. For a comprehensive description of logico-semantic relations between clauses, see Halliday (1994: 215-73).

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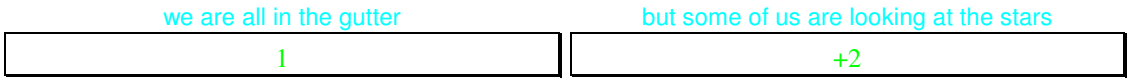
[1] The exception occurs in *rankshift*, where a higher ranked unit such as a clause or prepositional phrase is embedded in a lower ranked unit (see Halliday 1994: 188). For example, in the following (Shakespearean) nominal group, a defining relative clause is embedded as Qualifier:

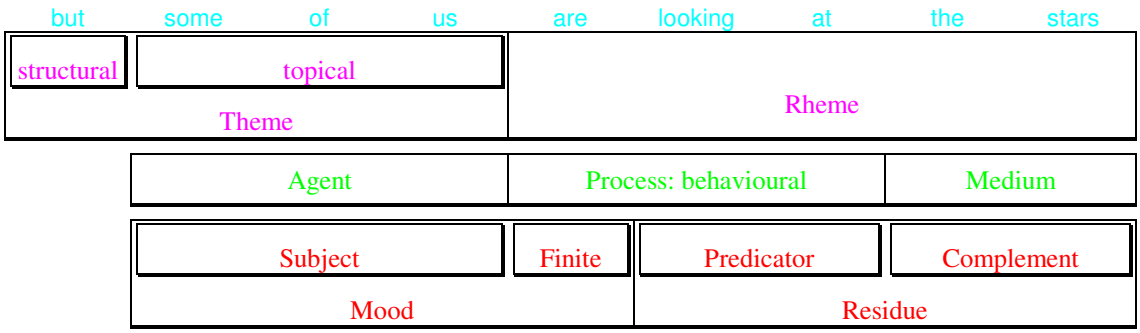
a	custom	more honoured in the breach than the observance
Deictic	Thing	Qualifier

[2] Oscar Wilde: *Lady Windermere's Fan* (Act III).

[3] Halliday (1994: 193) distinguishes logical structures from those of the other metafunctions as being univariate rather than multivariate. A univariate structure is one 'generated by the recurrence of the same function: α is modified by β, which is modified by γ [and so on]', whereas a multivariate structure is 'a constellation of elements each having a distinct function with respect to the whole'.



The remaining metafunctions can be illustrated by analysing just the second of these clauses, as below.



This multi-layered metafunctional analysis provides three perspectives on the organisation of the clause. The textual organisation is presented in terms of *Theme* and *Rheme*; the experiential in terms of *processes*, *participants* and *circumstances*; the interpersonal in terms of *Mood*, subsuming *Subject* and *Finite*, and *Residue*, subsuming *Predicator* and *Adjunct*. For a comprehensive description of clause analysis, see Halliday (1994: 37-175).

It has also been proposed that different metafunctions favour different modes of structural realisation. Martin (1992: 10):

> Halliday's (1979) suggestion is that experiential meanings predispose particulate forms of realisation, interpersonal meanings prosodic ones and textual meanings periodic ones. He relates this suggestion to Pike's construal of language as particle, wave and field, arguing, with Pike, that the same linguistic phenomena usually have to be viewed from a number of complementary angles in order to be fully understood.[1]

Modes of phonological structure, along with what will be called *phonological texture*, are central to this thesis, as will be outlined below. For Halliday (1994: 334), the

[1] Pike (1982: 12-3) draws attention to the use of particle, wave and field as perspectives for interpreting human experience:

> Within tagmemic theory there is an assertion that at least three perspectives are utilised by homo sapiens. On one hand, he [sic] often acts as if he were cutting up sequences into chunks — into segments or particles…On the other hand, he often senses things as somehow flowing together as ripples on the tide, merging into one another in the form of a hierarchy of little waves of experience on still bigger waves. [These two perspectives, in turn, are supplemented by a third — the concept of field in which intersecting properties of experience cluster into bundles of simultaneous characteristics which together make up the patterns of his experience.]

texture of a piece of discourse arises linguistically[1] from the structural and non-structural resources of the textual metafunction. That is, texture is achieved through thematic (Theme/Rheme) and information (Given/New)[2] structures, and by the nonstructural resources of *cohesion*, namely *reference*, *ellipsis and substitution*, *conjunction*, and *lexical cohesion*.[3] (Halliday (1994: 308-39) presents a comprehensive discussion of cohesion.)

Where Halliday models text forming resources as an opposition between grammatical structure and (nonstructural) cohesion, Martin (1992)[4] models text forming resources as a stratal opposition between lexicogrammar and discourse, defining it as (ibid: 26):

> …the ways in which discourse structures generated by these [metafunctionally-organised discourse] systems interact systematically with lexicogrammatical structures…

Martin (ibid: 384) also involves phonology in the creation of texture by including the subsystems of TONE CONCORD and TONE SEQUENCE (Halliday 1994: 306-7) as text forming resources contributing to texture. One of the purposes of this thesis is to demonstrate how this notion of texture can be applied throughout the phonological stratum, as will be explained below after a skeletal overview of selected work in Systemic phonology.

1.1.2 Systemic Phonology

Systemic phonology developed from Firthian Prosodic Analysis but differs in giving priority to system.[5] Halliday (1992: 106-7):

> Note that in Firthian system-structure theory the entry condition is specified syntagmatically, whereas in a system network it is specified paradigmatically: entry to one system depends on selecting a certain term in (at least one) other.

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[1] There is also a contextual contribution to texture, Halliday & Hasan (1976: 26):

> Texture results from the combination of semantic configurations of two kinds: those of register and those of cohesion.

[2] See the following discussion of Systemic phonology.

[3] Halliday (1985a: 288):

> [I]n order to construct discourse we need to be able to establish additional relations within the text that are not subject to these [structural] limitations; relations that may involve elements of any extent, both smaller and larger than clauses, from single words to lengthy passages of text; and that may hold across gaps of any extent, both within the clause and beyond it, without regard to the nature of whatever intervenes. This cannot be achieved by grammatical structure; it depends on a resource of a rather different kind. These non-structural resources for discourse are what are referred to by the term cohesion.

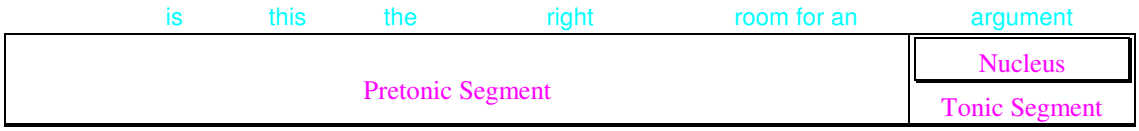
[4] See Martin (1992: 401-4) for a clarification of the different perspectives on cohesion — and their motivation — taken by Halliday and Martin.

[5] For an account of the development of Systemic phonology from Firthian Prosodic Analysis, see Tench (1992: 1-15).

Halliday (1967: 12) recognises a phonological rank scale of, in descending order, tone group[1], foot, syllable and phoneme for English[2] such that each higher ranking unit consists of one or more complete units of the rank immediately below.[3]

Halliday (ibid: 18) proposes three independent systems of intonational choice for spoken discourse: *tonality*, the 'number and location of tone group boundaries', *tonicity*[4], the 'placing of the tonic syllable', and *tone*, the 'choice of primary and secondary tone'.

The tone group comprises two elements of structure: an optional *pretonic segment* followed by an obligatory *tonic segment*, each of which may consist of one or more complete feet (ibid:12-3).[5] The tonic segment begins with the *tonic nucleus*, the location of *tonic prominence*: the foot (and syllable) carrying the major pitch movement of a given tone choice (Halliday 1985b: 53). Tone group structure is illustrated below[6] for the instantiation (others are possible) of is this the right room for an argument? as //2 is / this the / right / room for an / argument //:[7]



Unlike other phonological units in English, the tone group corresponds to — realises — a unit of the content plane: the *information unit* (Halliday 1994: 295). The

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[1] Cf the *colon* of Classical Prosody: 'one of the members or sections of a rhythmical period, consisting of a sequence of from two to six feet united under a principal ictus or beat' (Macquarie 1991: 356).

[2] Van Leeuwen (1982) proposes for English a number of ranks above the tone group; similarly Pike (1955/67), Fox (1973), Tench (1976; 1990: 246-98), Brown (1977), Coulthard & Brazil (1979), and Monaghan (1985: 375); Halliday (1994: 10) makes passing reference to tone group complexes. Matthiessen (1987) proposes for Akan, and McGregor for Gooniyandi, a rank scale of tone group, phonological word, syllable and phoneme; Prakasam (1992) proposes for Telugu a hierarchy of utterance, tone group, piece, foot, formative, syllable and segment. Martinec (1995, 1997, 1997a) proposes three wave hierarchies for English phonology that include seven levels of rhythmic accent waves (the foot being the lowest level), two levels of intonation waves (tone sequence and tone group) and two sonority waves (syllable and phoneme).

[3] Unlike lexicogrammar, phonology has no rankshift (Halliday 1967: 12).

[4] The function of tonicity is to highlight *the element under focus (culmination of New)*, mark anything following as Given, and create the potential for tone (Halliday 1985b: 60)

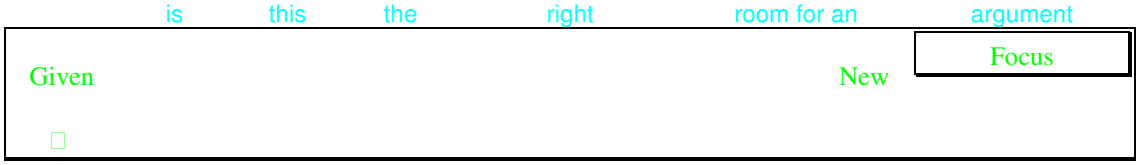
[5] See Van Leeuwen (1992: 231-62) for a Systemic treatment of the tone group as a rhythm group.

[6] Spoken by Michæl Palin to John Cleese in the comedy sketch *Argument* from the BBC TV program *Monty Python's Flying Circus*.

[7] In Halliday's notation (1967: 14), // indicates tone group boundary, / indicates foot boundary, indicates a silent beat, underline indicates the tonic syllable, … indicates a pause and an initial numeral records the tone choice for the tone group. Tone 2 is 'rising'(see further in the discussion).

information unit therefore does not correspond to any specific grammatical unit, though the clause is the default — though not necessarily the most common — correlation (ibid: 295-6).

The information unit is a structure of the textual metafunction comprising two elements of structure: an obligatory *New* element, and an optional *Given* element (ibid: 296). The *information focus* is carried by element of the tone group having tonic prominence; the tonic foot defines the culmination of what is New and marks where the New element ends, though there is often[1] no *phonological* marking of where it begins (ibid).[2] The information structure of //2 is / this the / right / room for an / argument // can thus be represented as follows:



Typically, the Given element precedes the New, but it is possible for Given to follow New, and in such cases, any feet following the tonic foot in the tone group are marked as expressing Given information (ibid: 297). The tone group and information structure of the instantiation (others are possible) of an eye for an eye and we all go blind as //5 an / eye for an / eye and we / all / go / blind // illustrates this:

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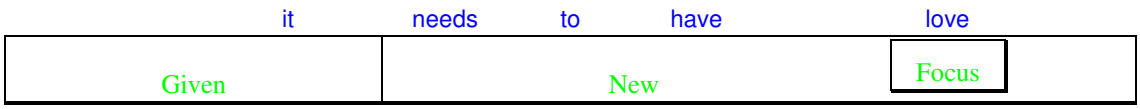
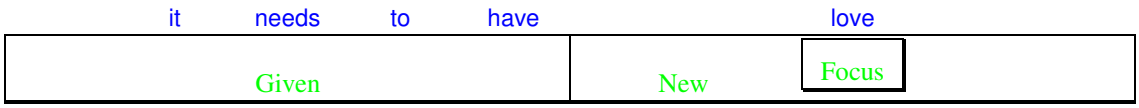
[1] Halliday (1994: 297) points out that variation in rhythm can be indicative of Given-New structure. In I'll tell you about silver. // it / needs to have / love // the salience of needs indicates that it is the beginning of the New:

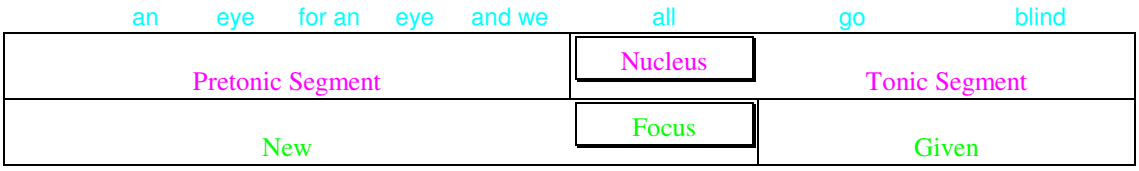


However, in I'll tell you what silver needs to have. // it needs to have / love // the word needs is part of the initial proclitic foot, indicating that it is Given, being mentioned in the preceding clause:



[2] Martin (1992: 396) provides one way of locating the lexicogrammatical extent of New information:

> The domain of the New is restricted to the group or group complex whose last salient syllable is tonic.



The third system of the tone group is that of TONE. For British English, Halliday (1967: 16-7) proposes a primary tone system of five simple tones and two compound tones, as well as secondary tone systems for the pretonic and tonic segments. The simple primary tone choices are, as defined by pitch movement, *fall* (tone 1), *rise* (tone 2), *level~low rise* (tone 3), *fall-rise* (tone 4) and *rise-fall* (tone 5). The compound tones are tone 13 (tone 1 followed by tone 3) and tone 53. A tone group with a compound tone is treated as a single unit rather than a sequence of two tone groups because, in such instances, no pretonic options are available for the tone 3 (Halliday 1994: 303).

Where tonality and tonicity express textual meaning, the principal meaning expressed by the tone system is interpersonal: that of KEY (ibid: 302), which in concert with the grammatical system of MOOD, realises SPEECH FUNCTION categories (Halliday 1985b: 57). For a comprehensive exposition of Key, see Halliday (1967).

Whereas Key is the meaning of tone as a system of paradigmatic oppositions, syntagmatic configurations of specific tones, however, can express logical and cohesive relations between information units. Two strategies Halliday (1994: 306-7) identifies in this regard are those of TONE CONCORD and TONE SEQUENCE.[1]

Tone concord, two or more instances of the same tone in sequence, is the unmarked realisation of two (grammatical) groups in the logico-semantic relation of paratactic elaboration, or apposition (ibid). The tone sequence 4-1 is the unmarked realisation of two clauses (β^α) in a structural relation of hypotaxis; the tone sequence 3-1 is the unmarked realisation of two clauses in a structural relation of parataxis; and the tone sequence 1-1 is the unmarked realisation of two clauses related cohesively.

Halliday and Hasan (1976) also ascribe a *contrastive* cohesive function to tone 4, and a *cumulative* cohesive function to tones 1 and 3. More specifically, tones 1 and 4 can function cohesively when used to highlight a cohesive element of the grammar (op cit: 271):

> But if the cohesive relation itself is to be brought into focus of attention, this is marked in the usual way by tonic prominence. This takes the form of the tonic either of tone 1 (falling), if the general sense is CUMULATIVE, or (perhaps more frequently) of tone 4 (falling-rising), if the general sense is CONTRASTIVE.

whereas only tones 3 and 4 can carry cohesive force in their own right (ibid: 272-3):

> Very frequently, however, the tone [4] alone shows that the item in question is cohesive; the cohesion consists just in the contrast with some preceding item…The FALLING tone, TONE 1, if it is used in the context of a cohesive element,

[1] See also Tench (1992: 161-74).

> has the sense of 'and there's something more'...Unlike tone 4, tone 1 does not by itself carry any cohesive force. But there is a strong case for considering the LOW RISING tone (preceded by mid level), TONE 3, as the cohesive variety of tone 1, since it does function in other respects as a kind of dependent or non-autonomous equivalent of the falling tone.

In the Systemic model of intonation and rhythm there is a clear distinction between potential and actual. Halliday (1970: 44) uses the term *tonic accent* to refer to the potentiality of carrying tonic prominence, and *word accent* for the potentiality of certain syllables, in certain words, to be salient when put into sentences (ibid: 2). Halliday (1985b: 53):

> Words of more than one syllable have an ACCENT on a particular syllable; the accented syllable is strong, others are weak. Long words may have more than one accent. Words of one syllable are strong, if lexical ('content' words), weak, if grammatical ('function' words). Any word, and any syllable of any word, can be strong for special prominence or contrast.

The difference between tonic accent and tonic prominence — potential and actual, respectively — can be illustrated by the words topological and deformation, which both have tonic accent on the third syllable (and word accent on the first and third syllables). However, in answer to the question did you say typological deformation? (on mishearing topological deformation in some discourse context), tonic prominence would typically fall *only* on the *first* syllable of the word topological, as follows: // I / said / topo/logical / defor/mation //.

The difference between word accent and salience — potential and actual, respectively — can be illustrated by the word without, which has word (and tonic) accent on the second syllable. However, in many instances, neither syllable of this word is salient, as exemplified by the instantiation (others are possible) of the wise man is not without fault as / the / wise / man is / not without / fault /.[1]

The unit of rhythm, the foot, is likened to the bar in music (Halliday 1970: 1) and comprises two elements of structure: an obligatory *Ictus* followed by an optional *Remiss* (Halliday 1967: 12).[2] In a *complete* foot, the Ictus consists of a salient syllable, whereas in an *incomplete* foot, potentially occurring after pauses and in initial position in tone groups, the Ictus is silent; the Remiss consists of one or more weak syllables (ibid).

Foot structure is exemplified below for the instantiation (others are possible) of the wise man is not without fault as / the / wise / man is / not without / fault / in which the first foot is incomplete, the silent Ictus marked by the caret symbol ( ).

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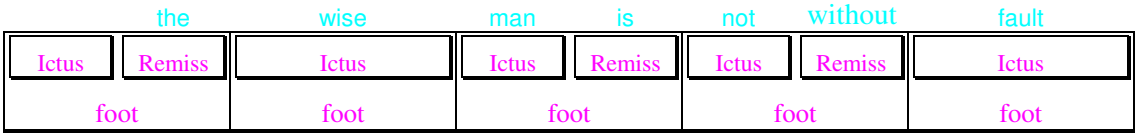
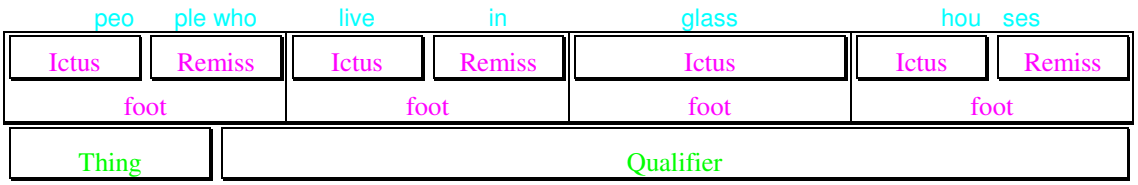
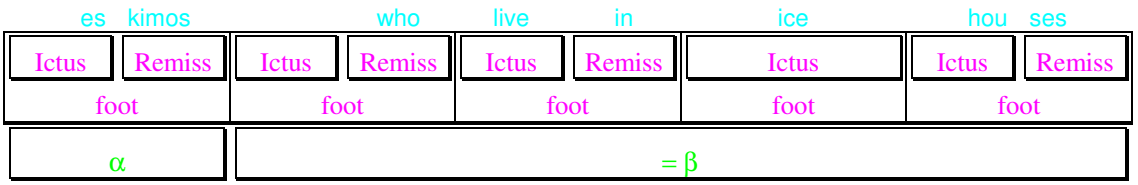
[1] The Irish proverb: ní bhíonn saoi gan locht.

[2] After Abercrombie (1965, 1967).



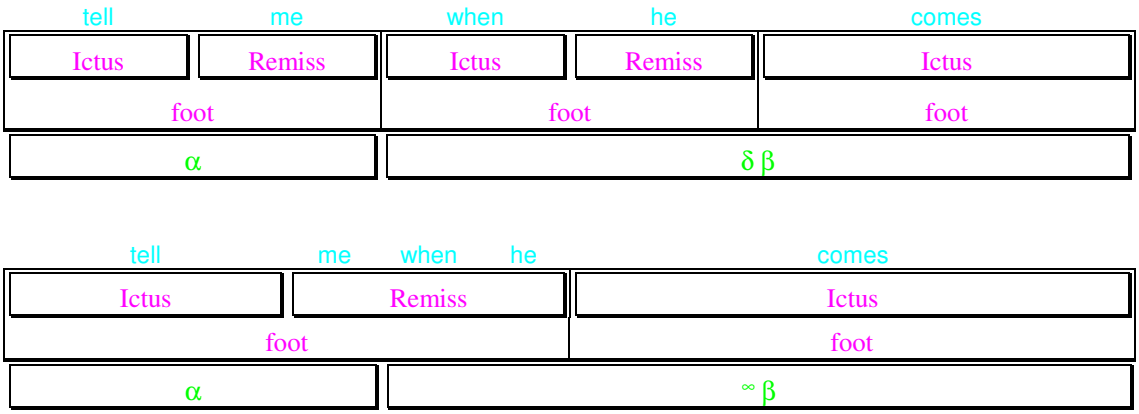
The discourse function of rhythm in English is to highlight content words, lexical rather than grammatical items, and to create the potential for tonicity and tone (Halliday 1985b: 60). Although the foot does not correspond to any content plane unit, rhythm can distinguish between such grammatical structures as defining and non-defining relative clauses.[1] The example given by Halliday (ibid: 52) is alternatively represented below, with the defining relative clause presented first.





Halliday (1994: 295) notes that rhythm can also distinguish lexicogrammatical elements related through projection from those related through expansion, and illustrates this with the clause complex tell me when he comes. When the two clauses are related through projection, the meaning is 'inform me *of* the time of his [habitual] arrival'; when the clauses are related through expansion, the meaning is 'inform me *at* the time of his arrival'. The difference in rhythm is based on the convention that 'interrogatives are accented, and hence embody a salient syllable, whereas relatives and conjunctives are not' (ibid). This contrast is represented below, with projection presented first.

[1] These are also distinguished by tonality, since a defining relative clause typically included in the same tone group as the preceding nominal that it qualifies, while a non-defining relative clause typically begins a new tone group (Halliday 1994: 228).



Systemic work on the rank of syllable and below varies in a number of important respects. One point of divergence concerns the way systems are placed with regard to rank. For example, Halliday (1967: 14)[1] mentions syllable systems for English with reference to the higher rank of foot:

> Within weak syllables there are a number of systems of secondary classes, involving not only "reduced/non-reduced" but also differences in duration correlating with the number of syllables in the foot…'

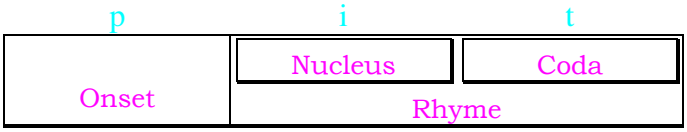
Other work in this domain that looks down the rank scale to phonemes and articulatory features also varies in approach. For example, Halliday (1992: 98-121) proposes syllable systems for Peking Mandarin whose paradigmatic oppositions are phonological features, thereby dispensing of any need for a lower rank in the description. McGregor (1992: 20), on the other hand, takes the phoneme as the entry point to systems of phonological features in a description of Gooniyandi, whereas Matthiessen (1987) proposes syllable and phoneme systems for Akan, employing phonological features and segment classes as paradigmatic oppositions at both ranks.

Another point of divergence is the modelling of syllable structure. In discussing English consonant clusters, Young (1992: 51-2) employs a syllable structure of C^1VC^2T, where V is any vocalic — short or long, monophthong or diphthong — C^1 and C^2 are single consonants or clusters, and following Fudge[2] (1969: 268-9), word-final T(ermination) corresponds to consonants of inflexional suffixes. The syllable structure realising sixths is thus given as:

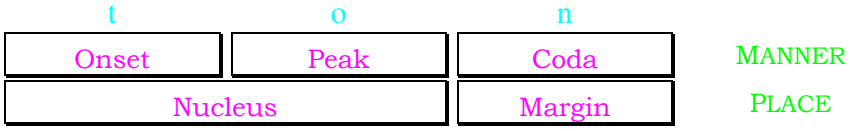
[1] Berry (1977: 91) similarly suggests two systems at syllable rank: strong/weak and long/short (also reported in Butler (1985: 138)).

[2] Fudge (1969) also includes consonants of derivational suffixes as Terminations.

Coleman and Local (1992: 190), in advocating a *monostratal* approach to speech synthesis, include Onset ^ Rhyme (Nucleus ^ Coda)[1] as a formal model of English syllable structure, such that their example pit can be represented here as:



Matthiessen (1987: 3) introduces the notion of structural layering in a description of Akan phonology, modelling the syllable simultaneously both as Onset^Peak^Coda for manner of articulation, and as Nucleus^Margin for place of articulation. The two perspectives are represented below for ton 'buy':



A very different approach is taken by Halliday (1992) where, in an account of the Peking Mandarin, the syllable is modelled in systemic-*prosodic* terms, such that features in systems 'are treated non-segmentally' (ibid: 106). This means (ibid: 116):

> …[I]nstead of taking the minimum articulatory segment as prototypical and reducing everything to that, we can take tone as our prototype and explain the entire system as a network of tone-like features. This is, in essence, what the prosodic analysis does…

The consequence of this is that syllable structure is modelled *dynamically*[2] as a *trajectory* (ibid: 110) from an initial to a final state.[3] Halliday (ibid: 107, 117):

> [T]he syllable is envisaged as a wave, a periodic pattern of movement characterised by a kind of 'flow-and-return'… [T]he syllable is construed as a movement from an initial state to a final state, each of these states is specified as a 'selection expression' (a cluster of features from different prosodic systems)…
>
> [T]he syllable consists of two loci, initial and final…the two are lineally ordered; but they are not segmental. Rather the syllable has an initial state, characterised by a syndrome of features; and a final state, characterised by

---

[1] A variation on the Onset ^ Core (Peak ^ Coda) model of Pike KL & Pike EG (1947: 78-91).

[2] Note, however, that in Martin's (1985) terms, Halliday (1992) views the whole syllable *synoptically* which Martin (1992: 60) *opposes* with dynamically: as meaning 'move by move'.

[3] That is, the syllable is structured as a vector $\overrightarrow{\text{IF}}$.

> another such syndrome — the movement from one state to the other is continuous throughout.

Variation is then seen in terms of spatiotemporal dynamics (ibid: 117; 107):

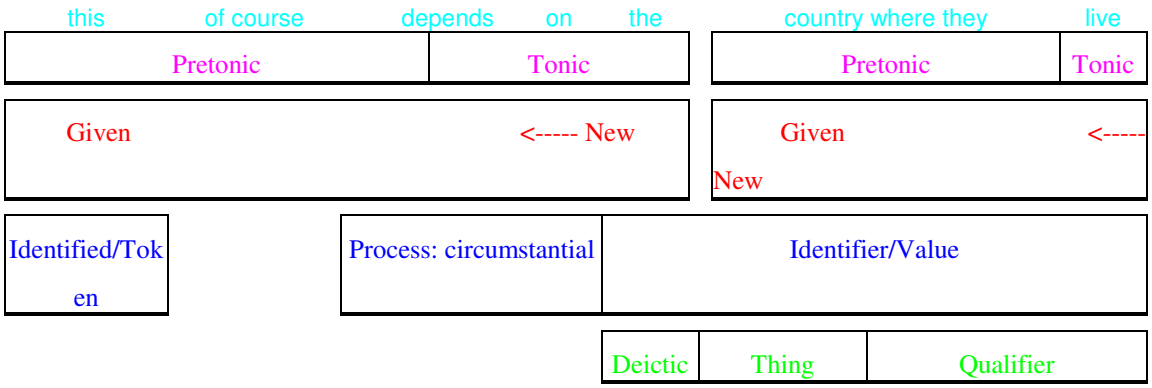
> There is considerable variation in the enactment of the syllable, both among different speakers and within one and the same individual speaker. This variation is explained as a spatiotemporal dynamic: (i) initial, opening features may be more, or less, prolonged; (ii) final, closing features may start earlier, or later; and (iii) there may be more than one route from the one to the other…
>
> [T]here is variation both temporally, in the extent to which a particular feature persists across the syllable, and spatially, in the route that is traversed from the initial to the final state.

1.1.3 Uncertainties

One issue to be addressed (in Chapter 2) concerns the placement of information unit boundaries. Cruttenden (1969: 312-3) raises problems that follow from the requirement (Halliday 1967: 12) that a foot always begin with the Ictus. One problem is that this fails to account for *anacrusis*, wherein weak syllables attach to a following salient syllable in the formation of a foot. A second problem concerns the tone group boundary. Since the tone group is coextensive with an information unit, a boundary between two information units is placed by the Halliday analysis within a clause rank lexicogrammatical unit. For example, in this (constructed) example from Halliday (1967: 19):

//1 this of course de/pends on the //1 country where they / live//

the "Ictus-first" rule results in the placing of a tone group — and thus information unit — boundary between the Deictic and Thing in the nominal group functioning as the Identifier/Value participant at clause rank:



However, the principal theoretical concern here is the general application of Systemic principles, in an illuminating way, to phonological processes operating below the rank of foot. Some of the issues to be addressed include the function(s) of phonology, the

question of a metafunctional organisation of phonological systems and structures, the representation of perspectives on structure, as well as the question of *subpedalian* ranks — those below the foot — and the situation of articulatory features within them.

1.2 Proposals

This section outlines the principal proposals to be pursued in subsequent chapters. Included are a statement of the epistemological assumptions being adopted, a list of the minor theoretical proposals, and a more detailed exposition of the major theoretical proposals.

1.2.1 Epistemological Complexion

The views presented in this section are properly expanded in Chapter 5, but are included here because they inform the linguistic theoretical approach being adopted in this thesis. This discussion is concerned with a consideration of the place of language in the natural world, and its implications for linguistic theorising.

The natural world can be modelled as a hierarchy of organised complexity, with simple physical processes at the base giving rise first to the more complex processes of chemistry and then to the still more complex processes of biology.[1] In this view, higher level phenomena cannot be fully explained in terms of lower level models, but higher level models must be consistent with lower level models, as Gould (1984)[2] elucidates:

> First, nothing in biology contradicts the laws of physics and chemistry; any adequate biology must be consonant with the "basic" sciences. Second, the principles of physics and chemistry are not sufficient to explain complex biological objects because new properties emerge as a result of organisation and interaction...Third, the insufficiency of physics and chemistry to encompass life records no mystical addition, no contradiction to the basic sciences, but only reflects the hierarchy of natural objects and the principle of emergent properties at higher levels of organisation.

This hierarchical model of the natural world[3] can be represented as below.[4]

---

[1] And geology etc.

[2] From *This View Of Life* in Natural History (January 1984) cited in Barlow (1992: 103).

[3] Emergent hierarchies are complementarity hierarchies — contra the "nothing buttery" that characterises reductionism: 'x is nothing but a y' (Depew & Weber 1996: 260).

[4] The complexity hierarchy model reflects a unification of the *semiotic systems* as behavioural adaptations of the human species. The complexity hierarchy is a *recognition* hierarchy created by brain activity. This relates to the model of the brain as a recognition system (Edelman 1989, 1992) whose function includes the ('higher level') recognition of its own categorising behaviour (see Chapter 5). Note then that this hierarchy itself emerges from biological systems.

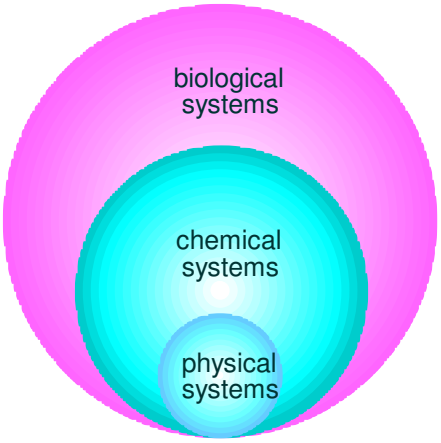
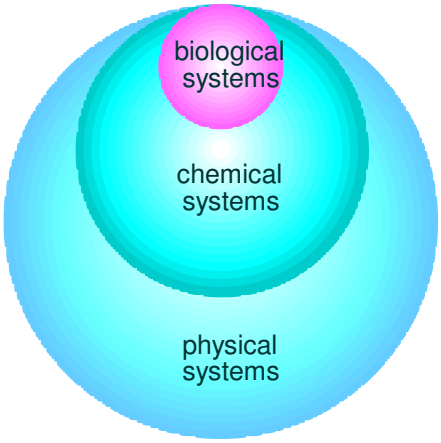


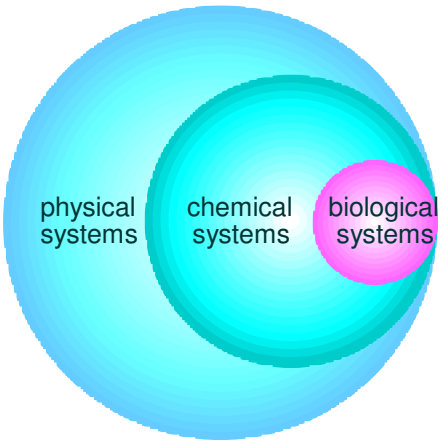
Figure 1.4 The Hierarchy Of Organised Complexity[1]

Given that language emerges from phenomena modelled by biology[1] — language is a human activity that arises from biological processes — the general proposal here is to

[1] Exapting Martin (1992: 20-1): presenting strata as cotangent circles helps to capture the sense in which biology addresses patterns of chemical patterns and chemistry in turn addresses patterns of physical ones; the meanings made by smaller circles are progressively recontextualised by larger ones. The cotangent circles model represents the emergence of new levels (from substrates) in an informationally expanding bootstrapping complex system. It is important to recognise that this is *not* a set theory diagram — which would be along the following lines:

place linguistic systems above biological systems in the hierarchy of organised complexity as represented below.[2]





But note that the metaphor of inclusion is less helpful here (and in the text to follow). While there is some sense in which biology is a subset of chemistry which is a subset of physics, it is not so clear that there can be some sense in which discourse is a subset of lexicogrammar which is a subset of phonology. More useful are the ideas of implication, and of (historical) emergence: wherein simple local processes give rise to complex global processes. On these models, biological systems imply chemical systems which imply physical systems, and biological systems historically emerge from chemical systems which historically emerge from physical systems. Similarly, discourse systems imply lexicogrammatical systems which imply phonological systems, and discourse systems historically (ontogenetically and phylogenetically) emerge from lexicogrammatical systems which historically emerge from phonological systems. Or more precisely, lexicogrammatical systems historically emerge from conceptual repertoires that become *correlated with* sensorimotor repertoires, whereas phonological systems historically emerge from sensorimotor repertoires that become correlated with conceptual repertoires (see Chapter 5). It is this last point that motivates Figure 1.6 in the text, wherein Figure 1.3 is modified so as to distinguish the content plane from the expression plane.

[1] It is also important to recognise that a theory is distinct from the phenomena it models, and that a linguistic model (metalanguage) is distinct from the phenomenon it models (language).

[2] Psychological and cognitive systems would be similarly placed above biological systems in this hierarchy.

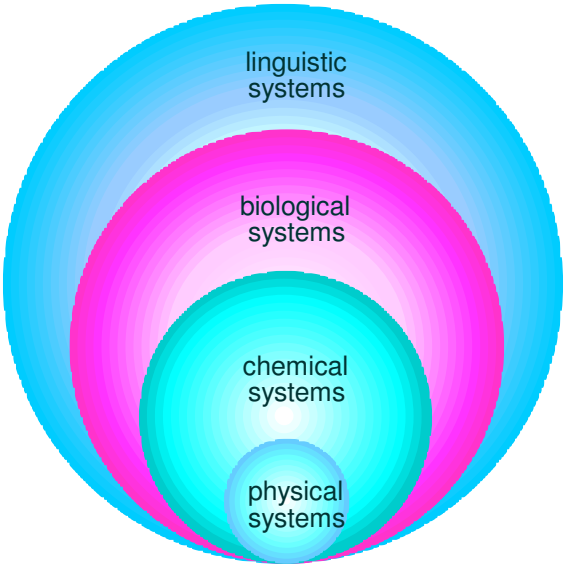


Figure 1.5 Linguistic Phenomena In The Hierarchy Of Organised Complexity

The above quote from Gould (1984) can be thus be paraphrased in the following way to clarify the view being adopted:

> First, nothing in linguistics should contradict the laws of biology, chemistry and physics; any adequate linguistics must be consonant with the more "basic" sciences. Second, the principles of physics, chemistry and biology are not sufficient to explain complex linguistic phenomena because new properties emerge as a result of organisation and interaction. Third, the insufficiency of physics, chemistry and biology to encompass linguistics records no mystical addition, no contradiction to the basic sciences, but only reflects the hierarchy of natural phenomena and the principle of emergent properties at higher levels of organisation.

If the corporeity of language is given priority in the framing of linguistic theories, then two observations immediately follow. Firstly, language emerges as a behaviour of a *neuro*muscular substrate. Models of language therefore are optimally framed in a way that is consistent with the organisation of neuromuscular systems. Secondly, language emerges as an evolutionarily successful *interactive* behaviour for the individual bodies housing the genes that make language possible.[1] Biologically consistent models of language are therefore optimally framed in a way that reflects *the function of language for individuals in communities*.

In Chapter 5, a theory that models brain function on Darwinian principles and another that models cultural evolution on Darwinian principles will be introduced. This will allow language to be modelled more specifically as a lineage of self-replicating processes evolving on the Darwinian principle of selection acting on variation in

[1] This, of course, is not to invoke the bogey of *behaviourism* wherein externally observable behavioural responses are treated as functions of environmental stimuli, and wherein mental states are either ignored or redefined in stimulus/response terms (Macquarie Dictionary 1991: 157).

populations.[1] Two immediate consequences of conceptualising language as an evolving system are that linguistic models describe *populations* of variant categories, and that there are *timelags* in the development of systems and structures. Both of these factors mean that a biologically consistent linguistic model is properly based on statistical probabilities.

On the one hand, if languages are modelled as evolving systems, then general descriptions of a language hold probabilistically, because exceptions may arise historically from localised changes to linguistic systems — systems of phonology, lexicogrammar and discourse (and their sensitivity to contextual systems of register, genre and ideology) within idiolects, sociolects and dialects — and from evolutionary timelags in changes to such systems. On the other hand, if linguistic feature categories represent populations of variants, then a feature *label* ideally[2] symbolises the most probable variant — for a specified linguistic and lectal context — in a functionally specific population of variants.[3] It will also be seen in later discussions that probability can be applied to the syntagmatic axis, in the sense that a syntagmatic abstraction can represent a measure of the *probability* of the location of a structural unit.

1.2.2 Minor Theoretical Proposals

Given the diversity of approaches taken in Systemic phonology, it is necessary to clarify the present position with respect to previous work by outlining three minor proposals. The first of these concerns the notion of axis: paradigm and syntagm.[4] The procedure here is to follow Firth[5] in apportioning *equal* weight to system and

---

[1] Dennett (1996: 394-5):

> Brian Goodwin's denial (1986) that biology is a historical science…is a denial that historical interactions with earlier environments are the sources of the complexities to be found in organisms.

Similarly, any denial that linguistics is an historical discipline is a denial that historical interactions with earlier environments are sources of the complexities to be found in languages, and as Dennett (1996: 197) points out:

> …[A]ny functioning structure carries implicit information about the environment in which its function "works".

[2] Or, less ideally, category labels should be sufficient to distinguish one *functional* population of variants from others in the paradigmatic system for a given context, and sufficient to suggest the semantic or phonetic space in which the population of variants lie.

[3] That is, a gaussian distribution of a population is treated as a measure of probability.

[4] Metaphorically, the palette and the painting, respectively.

[5] See Martin (1992: 4).

structure.[1] Consequently, the entry conditions to paradigmatic systems will be specified syntagmatically rather than paradigmatically, *contra* Halliday (1992: 106-7). One advantage of this is that it facilitates a *dynamic* — in the sense of Martin (1992: 60) — modelling of phonology as a step by step process of changing potential.[2] For example, at syntagmatic position *n* the options {a b c…} are available, then at position *n+1* the options {a c e…} are available, and so on.[3]

Furthermore, considering the corporeity of language, the syntagmatic axis is conceptualised in terms of behavioural cycles. Phonological syntagm is interpreted as a process of *cycling through behavioural states*,[4] the cycles being periodicities in the *neuromuscular behaviour* of the vocal tract. Paradigmatic systems, are treated as models of potential *categorical states produced by neuronal activity*, consistent with the Theory of Neuronal Group Selection (TNGS) of Edelman (1987, 1992), which will be discussed in Chapter 5. This latter is a slightly stronger claim than the following made by Halliday (1994a: 14) in his relating Systemic Theory to the TNGS:

> It is not suggested that the network is modelling the neural processes themselves, it is an abstract representation of the potential, of selecting within the potential, and of the "output".

The second minor proposal is to follow Matthiessen (1987) in treating the opposition between the polysystemic approach of Firthian linguistics and the monosystemic approach adopted elsewhere as a difference of perspective only. Matthiessen (op cit: 4):

> The Firthian [polysystemic] principle…contrasts with the monosystemic principle of classical phonology. I think the two principles are essentially compatible and can be thought of simply as complementary perspectives on the same thing. When we adopt the polysystemic principle, we look at sound patterns from above in the phonological rank scale, typically from the syllable, and we find different systems operating at different places in the structure of the unit from whose rank we view the sound patterns. For example, we find one (consonantal) system at the Onset of a syllable and a different (consonantal) system at the Coda of a syllable. When we adopt the monosystemic principle, we look at sound patterns from below, typically from the phonemic rank. We focus on the systemic organisation of that rank and we

---

[1] This is appropriate for phonology because its paradigmatic categories are constrained by the syntagmatic cycles of the vocal tract, but it is less so for lexicogrammar because the sequencing of Content plane categories is not limited by the transitions of muscle and bone. The theoretical work that is being distributed here across axes is distributed in Systemic grammar as paradigmatic states across ranks. This will be taken up in Chapter 6.

[2] This is to adopt the *process* philosophy of Whitehead 'which replaces a traditional metaphysics of static substances with an ontology in which what we think of as things are actually emerging processes' (Depew & Weber 1996: 416).

[3] Paradigmatic and syntagmatic functions would appear to be associated with different regions of the brain. Edelman (1992: 105) points out that categorisation processes occur in the cerebral cortex whereas timing and succession in movement are orchestrated by the cortical appendages: the cerebellum, the basal ganglia, and the hippocampus.

[4] In terms of dynamical systems, paradigmatic potential thus represents the *state space* of the system: 'the range of all possible behaviours' (Kauffman 1995: 75), and wherein 'each dimension corresponds to a single variable of a system' (Depew & Weber 1996: 504).

> do not focus on the differentiation according to function in the structure of a higher ranking unit.[1]

The procedure here will be to devise a general "decontextualised" system network for a given rank such as syllable, and to indicate how the system is differentially constrained for specific syntagmatic positions within the rank structure.[2]

The third minor proposal is to follow Halliday (1992) in locating articulatory features as paradigmatic oppositions operating at syllable rank. Syntagmatic loci of paradigmatic choice within syllables may or may not correspond to segments, depending on the language and the perspective required by the purpose of the description.[3]

1.2.3 Major Theoretical Proposals

There are two major proposals, the first concerns phonological function, the second phonological structure. These will be each expounded in some detail below.

1.2.3.1 Phonological Function

The first major proposal is to differentiate phonological systems and structures according to two principal functions in the expression of lexicogrammar. On the one hand are those that express lexicogrammatical units as paradigmatic selections. On the other hand are those that *additionally* express the syntagmatic domains of lexicogrammatical units within larger structures.

The exposition of this proposal is organised in the following way. First, the functional relation between lexicogrammar and phonology being adopted here is clarified, then

---

[1] As Tench (1992: 6) points out, Firthian polysystemicity also includes the recognition of different phonological systems for different word classes, and for loanwords not wholly assimilated.

[2] There is a biological parallel that will be developed in Chapter 5 (wherein the sensorimotor repertoires that are categorised as articulatory features are interpreted as self-replicating entities, on the genetic model): just as the general paradigmatic system of articulatory potential is differentially constrained spatiotemporally in the construction of a spoken text, a genome is differentially constrained spatiotemporally in the embryological construction of the phenotype. As Kauffman (1995: 24) points out:

> [T]he single cell type of the zygote differentiates to form the roughly 260 cell types of the adult…the set of genes in all cell types is virtually identical. Cells differ because different subsets of genes are active within them, producing various enzymes and other proteins.

[3] Features are not *syntagmatic* constituents of segments. Features compose phonemes or segments paradigmatically: a segment comprises a number of features that are co-extensive syntagmatically. (Thus, features can be compared to quarks, which come in threes as the constituents of hadrons such as protons and neutrons (Pitt 1977: 305, 175).) Further, each feature is one of a number of potential states that might have been selected at a given phase of articulation. (Compare the view of the *proton* and *neutron* as two potential states of the *nucleon* differentiated by the direction of isospin (Gribbin 1987: 286-7).)

the phenomena performing the two phonological functions are distinguished, and situated within Systemic theory.

1.2.3.1.1 Stratal Relations

The relation of lower to higher strata is one of realisation: discourse is realised by lexicogrammar, which is realised by phonology (Matthiessen 1989: 11). The model of stratal relations presented above (Figure 1.3) was devised to background the Hjelmslevian duality of content and expression (Martin 1992: 21), being formulated in work focusing on content plane strata.

In contrast, this study of relations between lexicogrammar and phonology foregrounds the distinction between the *arbitrary* relation between the planes of content and expression, on the one hand, and the *solidary* (i.e. natural) relation[1] between discourse and lexicogrammar strata within the content plane, on the other. This distinction can be represented as in the figure below.

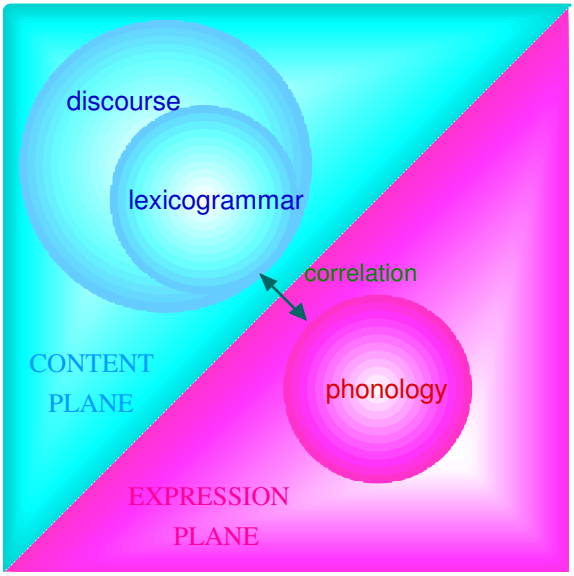


Figure 1.6 Plane And Stratum Relations

This formulation presents the arbitrary *inter*-planal relation as realisation through *correlation*. That is, during logogenesis, the process of creating texts, configurations of content plane features are realised by correlated configurations of expression plane features. In other words, both discourse and lexicogrammatical organisations of content correlate with phonological organisations of expression.

---

[1] Martin (1992: 20) describes the relationship between discourse and lexicogrammar as 'solidary (or "natural")', by which he means that discourse and lexicogrammar share the common interest and responsibility of providing meaning potential.

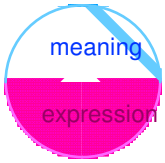
The solidary *intra*-planal relations are presented in terms of levels of organisation. Discourse is conceived of as a higher level organisation of lexicogrammar in the same way that chemistry is a higher level organisation of physics. It can be seen then that, in this sense, lexicogrammar is not a higher level organisation of phonology. While discourse and lexicogrammar are levels of organisation founded on content (conceptual meaning/behaviour), phonology is a level of organisation founded on expression (sensorimotor behaviour).[1] The motivation for this distinction requires the following brief anticipation of the evolutionary model of language developed in Chapter 5.

In the historical (ontogenetic, phylogenetic) emergence of language, some concepts become associated with some bodily gestures and their products. This amounts to a correlation of some sensorimotor routines with some conceptual routines. By being differentially correlated with sensorimotor systems, conceptual systems are more delicately or finely elaborated than they would otherwise be. The elaboration entails the higher level *categorisation* of the correlated conceptual systems as lexicogrammatical systems, and the historical (ontogenetic, phylogenetic) emergence of higher level systems: discourse semantics, register, genre, ideology.[2] And, by the same token, by being differentially correlated with conceptual systems, sensorimotor systems are more delicately or finely elaborated than they would otherwise be. The elaboration entails the higher level *categorisation* of the correlated sensorimotor systems as phonological systems.[3]

---

[1] The expression plane might be stratified with *phonology* as a higher level organisation of phonetics — but to clarify, phonetics has two distinct related meanings: on one hand, phonetics is concerned with language-independent classifications, on the other hand, with functionally-independent classifications in languages. Where phonetics classifies sensorimotor repertoires regardless of linguistic function, phonological descriptions are higher level recategorisations of phonetic patterns according to linguistic function. The procedure here will be to locate "phonetic" categories on the phonological stratum as the categories to be organised into functional systems and structures.

[2] That is, in this model of language, all content plane categories, including those of lexicogrammar, are semantic: that is, categories of meaning. This can be disguised by the fact that the referent of a particular grammatical category alternates with context of usage: there is, for example, the *meaning* of a word-as-*expression* — which is given by its potential in lexicogrammatical systems and higher level (conceptual) contexts — and there is the (phonological/graphological) *expression* of a word-as-*meaning*, but there is no third entity except the correlation itself. This formulation is represented below.



[3] On the model presented in Chapter 5, the brain is a *recognition system* (Edelman 1989, 1992). The brain recognises events by its own activity; the events that it recognises include its own recognition processes. Categorisation systems in the brain are therefore *mutual recognition systems*: conceptual and sensorimotor systems *recognise* (correlate with) each other. During logogenesis, (linguistic) conceptual repertoires *specify* (linguistic) motor repertoires in the speaker/signer/writer, and (linguistic) sensory repertoires *specify* (linguistic) conceptual repertoires in the listener/signee/reader.

1.2.3.1.2 Content-Expression Correlations

If language is modelled as a set of correlations between content plane variables and expression plane variables, then the evolution of language is the co-evolution of content and expression. The co-evolution of content and expression, in turn, includes the evolution of content, the evolution of expression and the evolution of the co-ordination of content and expression.

If the co-evolution of content and expression results in some phonological systems and structures becoming correlated with specific lexicogrammatical domains, then those phonological systems and structures acquire the additional function of chunking, or tracking the syntagmatic extent of, lexicogrammatical units.[1]

Drawing on the notion of *prosody* in Prosodic Analysis (Firth 1948), two fundamental phonological strategies for tracking the syntagmatic extent of lexicogrammatical[2] units can be identified: *extension* and *demarcation*. Firth (op cit):

> Generally speaking two reasons may be seen for the allotment of given features in a language to a prosody:
>
> (1) The phonetic extension of the feature over the whole of, or a part of, a stretch of utterance correlatable with a definable structure, and
>
> (2) The syntagmatic function ascribable to the feature, even though itself of segmental extent, as demarcative of a given structure or a structural division.

These will be discussed below in reverse order.

1.2.3.1.2.1 Demarcation

Demarcation can be illustrated by English, where it involves the correlation of syllables with morphemes[3] and words.[4] Demarcation can be effected by paradigmatic or syntagmatic variation. One instance where a phonological *paradigmatic option*

---

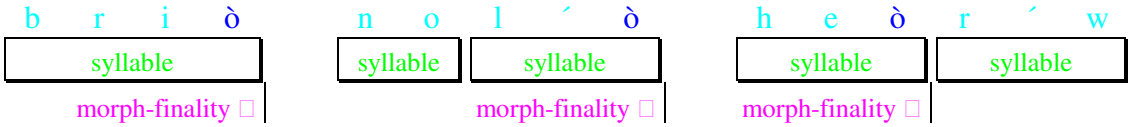
[1] In some sense, such systems and structures have lost their association with loci in the phonological structure and become associated with a lexicogrammatical domain.

[2] In Prosodic Analysis, demarcation and extension prosodies can be recognised for *any* definable structure, including phonological units. However, in this account, phonological demarcation and extension functions will only be recognised for correlated lexicogrammatical structures.

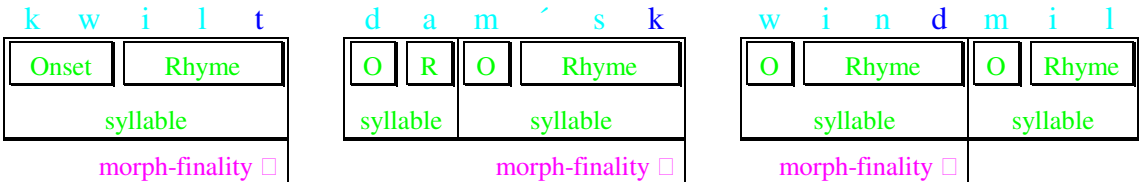
[3] Throughout this thesis, the criteria used for defining a morpheme will be from an etymological perspective rather than from, say, a synchronic cognitive one. This is to view language as an evolutionary lineage (embedded in genetic phenotypes: communities of nervous systems — see Chapter 5). Categories such as morpheme are viewed as evolutionary lineages within languages in the same sense as genes within biological species. While it is true that some morphological analyses are more indispensable for language use than others — for example recognising grammatical inflections is crucial, while recognising the lexical morphemes in main+tain is not — this variation can be understood as a *cline* of necessity rather than as an in/out dichotomy. This permits all positions on the scale to be seen as facets of the language to be modelled.

[4] This account of English demarcation has been simplified here for ease of exposition. See the Appendix for a more detailed description.

signals a lexicogrammatical domain is syllable closure by a consonant such as /ò/, as in the words bridge /briò/ knowledge /nol´ò/ and hedgerow /heòr´w/. With near certain probability — see below — a syllable closed by /ò/ is morpheme-final and, in the majority of instances, also word-final. Thus:



An instance where a phonological *syntagmatic locus* signals a lexicogrammatical domain is where the Rhyme of a syllable contains more than two moras, as in the words quilt /kwilt/ damask /dam´sk/ and windmill /windmil/.[1] Again, with near certain probability, a consonant counting as the third or later mora[2] — here /t/ /k/ and /d/ respectively — is morpheme-final and, in the majority of instances, also word-final. Thus:



Of course, not all morpheme boundaries are demarcated phonologically. For example, neither morpheme of the word truly /truwliy/ is demarcated phonologically in this way. Rather, as will be shown in subsequent chapters, there are some syllable systems and structures that have free lexicogrammatical distribution, and others — like those illustrated above — that are restricted in their distribution to specific lexicogrammatical loci, and which therefore have the function of signalling such loci.

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[1] If windmill is eroded to /winmil/, then the demarcative consonant is lost. However, the transition /nm/ still demarcates a morph boundary (see the Appendix). If windmill is eroded to /wimmil/, then the geminate /mm/ still demarcates a morph boundary. If windmill is eroded to /wimil/, then there is no consonantal demarcation of the morph boundary. However, if /wimil/ retains stress on both syllables, then the morph boundary is still indicated by rhythm (see subsequent discussion in the text).

[2] Counting long vowels and diphthongs as two moras, and each short vowel or consonant in the Rhyme as one mora.

The demarcative function in English is probabilistic in that not every demarcative consonant delimits a *present-day* morpheme boundary.[1] This is generally due to language being an evolutionary lineage[2] and arises from the type of word evolution that involves the fusion of previously independent morphemes.[3] As Hopper[4] (1991: 3) puts it, such a fusion:

> …typically results in a phonological reduction, and is accompanied by a semantic change sometimes seen as a fading or bleaching of the original lexical meaning.

That is, the juxtaposition of morphemes within a single word typically results in a loss of both content and form. The process of losing phonological form, 'the loss by attrition of segments, usually at the margins of words' (Hopper 1991: 1) has been termed *erosion* by Heine & Reh (1984: 21-4). The process of losing content — '[t]he process of loss of function and productivity in morphemes is known in recent literature[5] as *demorphologisation*' (Hopper 1991: 3) — is better described in the present context as the loss of *correlation* between phonological form and morphological content.

The process of demorphologisation introduces uncertainty because, as Hopper (1991: 2, 8) points out:

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[1] The description of Australian English in the Appendix shows that a demarcative consonant more properly indicates a morpheme boundary between two syllable peaks. The uncertainty can arise from the suffixation of vowel-initial morphemes, which "capture" the final demarcative consonant of the preceding morpheme as an Onset, as evinced in English capture, caption, captain and chapter. The uncertainty can also arise from vowel erosion, as in atmosphere (from a+tomos 'in+divisible'), and from more extensive erosion, as in proctor (from pro+curator 'for+carer').

[2] Because language evolution acts *on* populations of linguistic entities and *in* populations of speakers (see Chapter 5), different tokens can represent different evolutionary stages, resulting in variation across words, across space and across time. For example, the nonassimilation of nasals to following stops demarcates morpheme boundaries (see the description of Australian English in the Appendix). Variation across the lexicon can be seen in words containing the prefix in- such as inbreed (Germanic ancestry) and imbibe (Romance ancestry); variation across time by the in+bibo ancestry of imbibe; variation across space by local (dialectal/sociolectal/idiolectal) pronunciations of inbreed as [imbri:d]. Another complicating factor is *convergent evolution* where a syllable with no morphemic correlation, such as the first of English alter or alder evolves the phonological shape of a syllable (once) correlating with a morpheme, as the first in English albeit, also, altogether and always.

[3] Meillet (1912/1948: 131), the English translation cited in Hopper (1991: 3):

> Wherever the history of a grammatical morpheme is known for certain, the morpheme can be shown to have its origin in an autonomous lexical item.

[4] Hopper (1991/4), in treating phonemes as constituents of morphemes, argues that all morphemes eventually become phonemes, through a process he calls *phonogenesis*.

[5] See, for example, Joseph & Janda (1988).

> [T]here is no categorial point at which a morpheme ceases to be a morpheme and becomes a set of functionally empty phonological segments…[1]
>
> Especially in more recent formations…demorphologisation is sometimes not complete, and often the morphological status of a form is more transparent for some forms than for others.

Thus, there are words[2] like cranberry in which two lexical items — crane[3] and berry — have been historically compounded into a single word, with subsequent vowel change obscuring the morphological status of cran-.[4] In this case, the lack of phonological change for berry[5] leaves its morphological status transparent, and *suggests* that cran- still retains a distinct correlation with content (as an allomorph of crane).

However, in cases where phonological change has obscured the morphological status of both lexical items, as in maintain, the probability increases that the word will be analysed as a single morpheme.[6] This probability increases further still for words like dazzle, waddle, and wrestle, which have evolved from the lexical items daze, wade, and wrest, respectively, suffixed with the — erstwhile productive — [frequentative] morpheme /l/.[7]

Because of the uncertainties introduced by language evolution, although it is certain that a demarcative consonant occurs at *one-time* morpheme boundary, it is slightly less certain that a demarcative consonant occurs at *present* morpheme boundary, and slightly less certain again that a demarcative consonant occurs at a word boundary.[8]

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[1] Hopper (1991/4), treats phonemes as constituents of morphemes. This can be reworded in the present framework as: there is no categorial point at which a phonological syntagm ceases to be correlated with a morpheme.

[2] Similarly: Sunday, Monday, Tuesday, Wednesday, Thursday, Friday, Saturday etc.

[3] Mediæval Europeans knew that the seasonal arrival of cranes coincided with the ripening of cranberries.

[4] …and potentially denied in strictly synchronic cognitive models of language.

[5] Reduction of {bEri:} to {bri:} does not obscure the relation the berry of cranberry to the same phonologically reduced morpheme in strawberry, mulberry etc.

[6] Despite (historical) allomorphs of main- being found in words like manuscript, manicure, manual, manage and manacle, and the same phonological form of -tain being found in prefixed cognates such as abstain, contain, detain, obtain, pertain, retain and sustain (Macquarie Dictionary 1991: 7, 386, 482, 1229, 1323, 1499, 1762), though not attain which is an instance of recent convergent evolution (op cit: 105).

[7] Macquarie Dictionary (1991: 698; 456, 1959, 2021).

[8] That is, demarcative consonants are historical *word boundary* phenomena, but because of time lags in language evolution, some of these remain as morpheme markers after word fusion. Time lags are greater for some consonant sequences than others (see following footnote).

Demarcative consonants can be seen to be the *debris* of syllables left over from the gradual erosion of phonological form.[1] For example, the six aforementioned instances of English demarcative consonants are all former Onsets — and all that remains — of (unstressed) syllables. The recent ancestral forms of these words are set out below.[2]

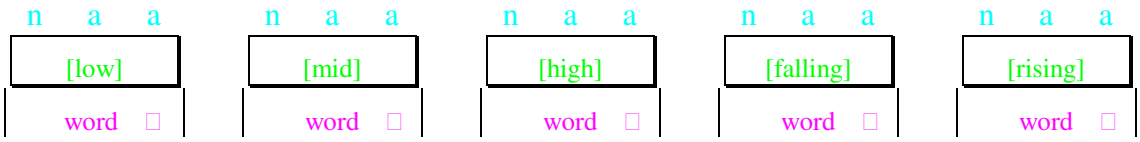
MODERN ENGLISH	**MIDDLE ENGLISH**	**COGNATES**
bridge	brigge	Brücke (German)
damask	damaske	damascós (Greek)
hedge(row)	hegge	Hecke (German)
knowledge	knowleche	
quilt	quilte	cucilta (Latin)
wind(mill)	wind	vindr (Icelandic) ventus (Latin)

1.2.3.1.2.2 Extension

The other major phonological strategy for tracking a lexicogrammatical domain, the extension of a (suprasegmental) feature for the duration of a lexicogrammatical unit, has two subtypes: *integration* and *concatenation*.[3]

1.2.3.1.2.2.1 Integration

In integration, a phonological feature (or features) extends for the duration of a lexicogrammatical domain. This can be exemplified by the use of tone in 'tone' languages. In Thai, one tonal feature from the system {[low] [mid] [high] [falling] [rising]} extends for the duration of the word. This is shown below for nàa 'nickname', naa 'rice paddy', náa 'younger maternal uncle or aunt', nâa 'face' and na&a 'thick'.



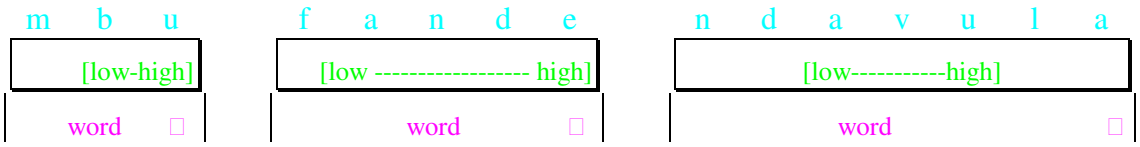
Similarly, in Mende[1], a language of Sierra Leone, one tonal feature from the system {[high] [low] [high-low] [low-high] [low-high-low]} also extends for the duration of the

[1] Because the twin processes of de-morphologisation and phonological erosion can proceed evolutionarily at different rates, word-internal demarcators can persist long after de-morphologisation has been completed. In English, the demarcative consonants {/p/ /k/} are particularly robust before /t/ in (mostly) Latin-derived words such as opt+ic and act+ive.

[2] Macquarie Dictionary (1991: 222, 449, 817, 979, 1445, 2002).

[3] After Andersen (1986: 6), see further below.

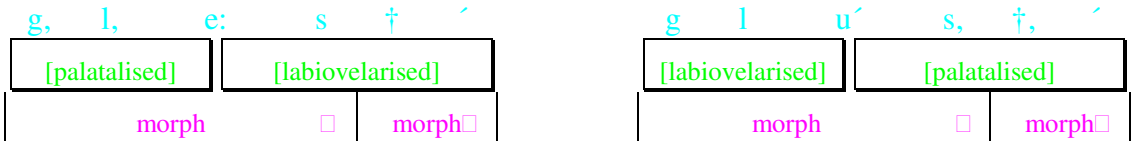
word. This is shown below for monosyllabic mbu 'rice', disyllabic fande 'cotton' and trisyllabic ndavula 'sling'.



1.2.3.1.2.2.2 Concatenation

In concatenation, the second strategy for tracking lexicogrammar by the suprasegmental extension of a phonological feature, a phonological feature or features extends, not for the duration of a lexicogrammatical domain, but across a lexicogrammatical boundary within a larger domain. In the description of Irish in Chapter 3, both the mutation and secondary articulation of consonants are interpreted as concatenative in function. Here concatenation will be illustrated by the latter.

Irish phonology employs a kind of "consonant harmony" wherein consonants in a cluster are either palatalised or labiovelarised (Úneutral).[2] This consonant harmony binds morphemes together within a word. This binding can be illustrated by the words gléasta /g,l,e:s†´/ 'dressed' and gluaiste /glu´s,†,´/ 'moved', which consist of the verb roots gléas 'dress' and gluais 'move' and an [adjectival] suffix -taÚ-te.[3]



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[1] Data from Leben (1978: 186).

[2] There are exceptions that are described in Chapter 3.

[3] The vowel symbols used here are for ease of exposition only, and the Irish vowel system will be re-interpreted in Chapter 3.

1.2.3.1.2.2.3 Vowel Harmony

An extension strategy that combines characteristics of both integration and concatenation is vowel harmony. In Turkish[1], for example, one phonological feature from the TONGUE POSTURE system {[front] [nonfront]} extends for the duration of the word, but only affects vowel[2] positions.[3] This is demonstrated below for the lexical items ev 'house', kIz 'daughter', gün 'day' and kol 'arm', in combination with the [plural] suffix lar/ler, which harmonises for TONGUE POSTURE, and the [genitive] suffix in/In/ün/un, which additionally harmonises for a LIP POSTURE system feature {[round] [nonround]}.

---

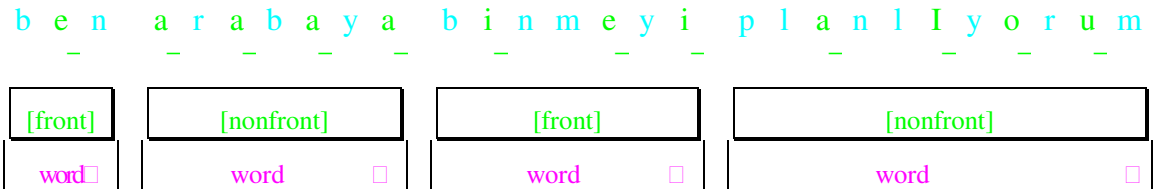
[1] Data from Clark & Yallop (1990: 138-9).

[2] Clements & Sezer (1982) note that the consonants /k/ and /l/ also harmonise for frontness.

[3] Cf Martin's (1992: 11) characterisation of negative attitude as *prosodic* structure in the clause 'That stupid bloody cretin is really giving me the bloody shits':

> Note that the prosody is realised continuously, amplifying attitude wherever the potential for expressing attitudinal meaning is made available…

This can be further illustrated by the sentence ben arabaya binmeyi planIIyorum[1] (1sg taxi ride plan) 'I am planning to take a taxi' where the duration of each word is tracked by the extension of the alternating features [front] and [nonfront]:



1.2.3.1.2.3 Other Phonological Ranks

All the examples of content-expression correlations presented so far have been between the *minimal independent* units on each plane: words composed of morphemes on the lexicogrammatical stratum, and syllables composed of segments on the phonological stratum. Because of this, lexical correlations are relatively constant. However, the tracking, through demarcation and extension, of lexicogrammar by rhythm[1] (feet composed of syllables) and intonation (tone groups composed of feet) correlate with syntagmatic *combinations* of words. Because of this, such correlations are highly variable, depending on text and context, but it will be argued that some correlations are more *cohesive* than others.

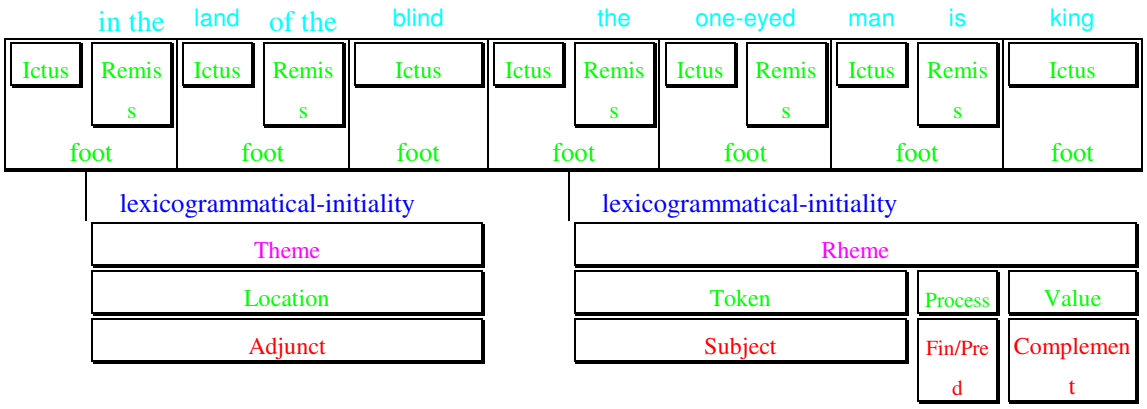
1.2.3.1.2.3.1 Rhythm: Demarcation

One way in which lexicogrammatical domains can be demarcated by rhythm is through the Remiss of an incomplete foot — a foot with a silent Ictus[2] — which probabilistically demarcates lexicogrammatical initiality. This can be illustrated by one possible instantiation of in the land of the blind, the one-eyed man is king[3] as / in the / land of the / blind / the / one-eyed / man is / king / where the initiality of the Theme/circumstantial Adjunct (and clause) and of the Rheme/Token/Subject is signalled:

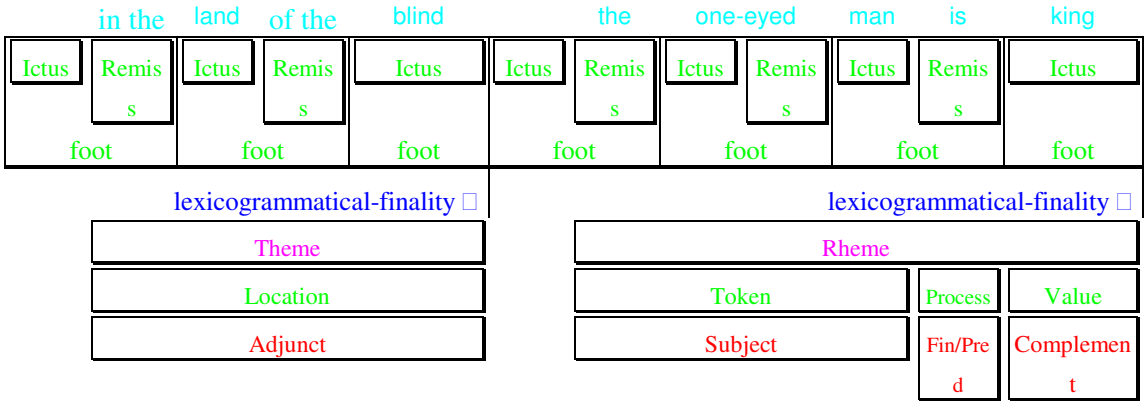
[1] Data courtesy of Fikret Gürgen (personal communication).

[2] In Chapter 2, it will be shown that in some cases the Remiss of an incomplete foot can be re-interpreted as proclitic to the following Ictus.

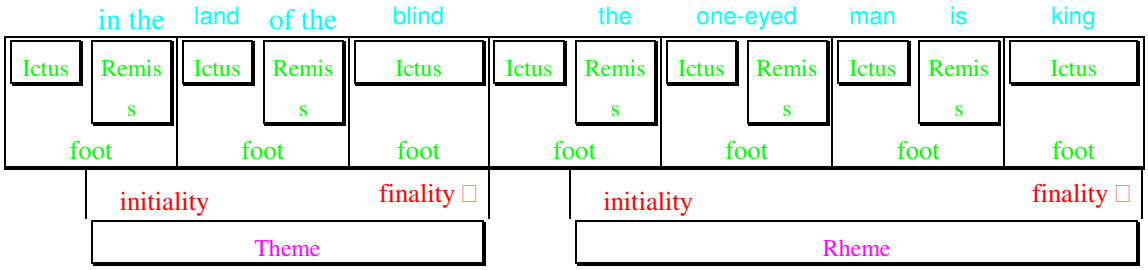
[3] The Irish proverb: i dtír na ndall is rí fear na leathshúile (Dorris P 1983 *Pocket Irish Phrasebook* South Belfast: Appletree, p33).



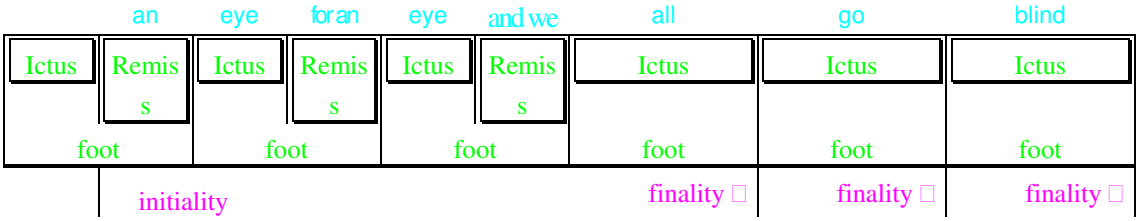
Another way in which lexicogrammatical domains can be demarcated by rhythm is through an absent Remiss, which probabilistically demarcates lexicogrammatical finality. This is illustrated by the same instantiation / in the / land of the / blind / the / one-eyed / man is / king / where the finality of the Theme/circumstantial Adjunct and of the Rheme/Value/Complement (and clause) is signalled:



It can be seen, then, that this rhythmic rendering of this clause marks both the beginning and end of each element — Theme and Rheme — of its Textual structure, and nothing else:



Several "Ictus-only" feet in succession can produce a staccato effect, which not only 'highlights' lexical content (Halliday 1985b: 60) but also demarcates each word boundary. This is illustrated below for the instantiation (others are possible) of an eye for an eye and we all go blind as / an / eye for an / eye and we / all / go / blind /:

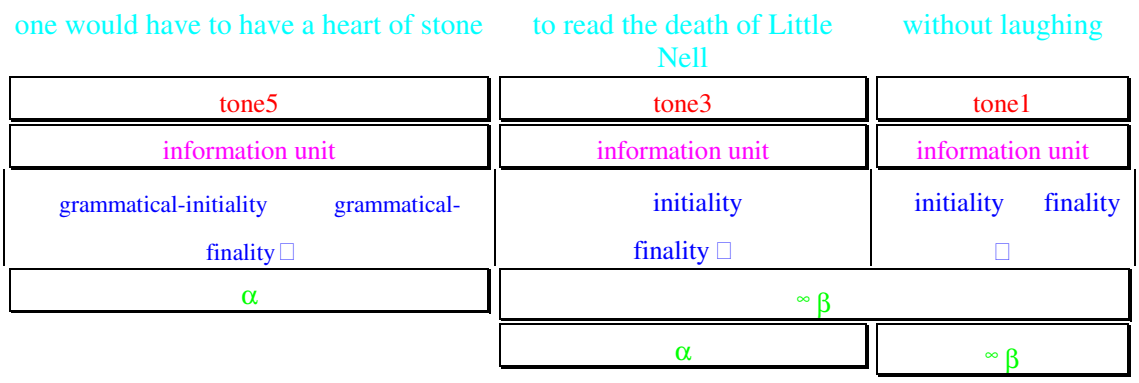


1.2.3.1.2.3.2 Intonation: Integration

The tracking of lexicogrammar by intonation differs from those above by organising lexicogrammatical elements into units of information.[1] Information units can be demarcated by junctural prosodies such as pauses and sustensions at tone group boundaries. Information units are also tracked phonologically by the integrative extension prosody of tone. This is illustrated below for[2] //5 one would / have to / have a / heart of / stone //3 to / read the / death of / Little / Nell //1 with/out / laughing // where the extent of each information unit — one for each clause — is marked by the duration of tone selection:

[1] The unmarked or *default* (≠ most common) *lexicogrammatical* unit corresponding to the tone group/information unit is taken by Halliday (1967: 20-2) to be the clause. Where a tone group extends for less than a clause, the boundary mainly falls between Theme and Rheme or before a clause-final Adjunct. The most likely occurrences of a tone group extending beyond a clause are hypotactic clause complexes comprising 'reporting clause followed by reported clause and conditioned clause followed by conditioning clause' (ibid) — ie projections and expansions of the type α'β and $\alpha^{\infty}\beta$.

[2] Oscar Wilde's comment on Charles Dickens' *The Old Curiosity Shop*, as spoken by Miriam Margolyse in her stage show *Dickens' Women*, broadcast on ABC Radio.



To conceive of the information unit as arising from the systematic *interaction*[1] of phonology and lexicogrammar — rather than as a unit operating on a specific stratum — is consistent[2] with the view that 'the tone group serves to organise discourse into Information Units…' (Halliday 1994: 292) and offers an explicit resolution to potential theoretical uncertainties concerning its domain of operation.[3]

1.2.3.1.3 Theoretical Interpretation

Two functions of phonological systems and structures have so far been distinguished. On one hand is the general function of expressing lexicogrammatical selections, while on the other is the more specific function of tracking the syntagmatic extent of lexicogrammatical units. The question arises as how to situate these functions within the wider framework of Systemic theory. The following three proposals are proposed in this regard:

(1) the function performed by demarcation, integration and concatenation can be termed *phonological cohesion*;

---

[1] A mathematical analogy: a *parabola* as an interaction (equidistant relation) between a point (*focus*) and a straight line (*directrix*).

[2] To view Informational function of tone groups (and the function of tone sequence and tone concord) as an interaction pattern rather than a (phonological) stratal system is also consistent with Martin's (1992: 491) characterisation of interaction patterns as dynamic processes and stratal systems as synoptic — though not consistent with his treatment of Given/New Information, which he locates in phonology (ibid: 384, 393, 401).

[3] Martin (1992: 384, 393, 401), for example, distributes meaning over all strata — including phonology — and identifies information as a text-forming resource of phonology/graphology. For Halliday (1985b: 55), on the other hand, '[i]nformation is a property of connected discourse…'; 'one tone group [and therefore: information unit] is as it were one move in a speech act' (Halliday 1967: 30). Halliday (1994: 295):

> There is an important difference between the tone group and the foot as regards their function in the expression of meaning in English. The foot itself is not the expression of any semantic unit…The tone group…functions as the realisation of…a quantum or unit of information in the discourse. Spoken discourse takes the form of a sequence of information units…

(2) phonological cohesion along with phonological structure create *phonological texture*; and

(3) phonological cohesion is a pattern of systematic interaction between the linguistic strata of phonology and lexicogrammar.

On the first point, the interpretation of the function of demarcation, integration and concatenation as one of *phonological cohesion* draws on the observations of Andersen (1986: 6) who, in the context of a rule-based approach to describing sandhi phenomena, identifies:

> …three aspects of cohesion that seem to be signalled by phonological sandhi. Rules that apply within a domain irrespective of boundaries within this domain serve an integrative function. They produce signs of the internal cohesion of the given domain. Rules that apply at boundaries may serve a concatenative function, if they produce signs that link elements together across the given boundaries. Or they may have a delimitative function if they produce signs that do not.

On the second point, Halliday (1994: 334), in his *unstratified* model of linguistic *content* opposes cohesion[1] with structure[2] as resources that give *texture* to a piece of discourse. Adapting his model to this *unstratified* model of *expression* (phonology), demarcation, integration and concatenation can be interpreted as resources of *phonological cohesion*[3] which contribute, with *phonological structure*, to *phonological texture*.[4]

On the third point, Martin (1992: 392, 491), in his *stratified* model of linguistic content (lexicogrammar and discourse), opposes interstratal interaction patterns[5] with discourse strata systems[6] as resources that give *texture* to a piece of discourse.[7] Adapting this model to stratal relations between phonology and lexicogrammar, the cohesive resources of demarcation, integration and concatenation are to be interpreted here as *systematic interaction patterns* between phonology and lexicogrammar, which

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[1] That is, reference, ellipsis and substitution, conjunction and lexical cohesion.

[2] That is, thematic structure: Theme and Rheme, and information structure and focus: Given and New.

[3] It will be seen that phonological cohesion is a process effected by phonological peripheries: demarcation by consonants at the syllable periphery and by weak syllables at the periphery of feet. (Extension can also be modelled as peripheral: eg as like an electron cloud around a nucleus [see below].) This is consistent with the Halliday (1994: 308-34) metaphor for (content plane) cohesion as functioning "around" the rank structure (clause).

[4] The model implies that phonological structures are organised by the textual metafunction, and this will be introduced in the next section and expounded in Chapter 2.

[5] That is, what he terms the 'dynamic processes' of modal responsibility, method of development, point and cohesive harmony.

[6] That is, what he terms the 'synoptic systems' of negotiation, identification, conjunction and ideation.

[7] Orchestrated by the metaprocess of grammatical metaphor (ibid: 491).

give rise to *phonological texture.*[1] The theoretical model can therefore be summarised as the figure below.

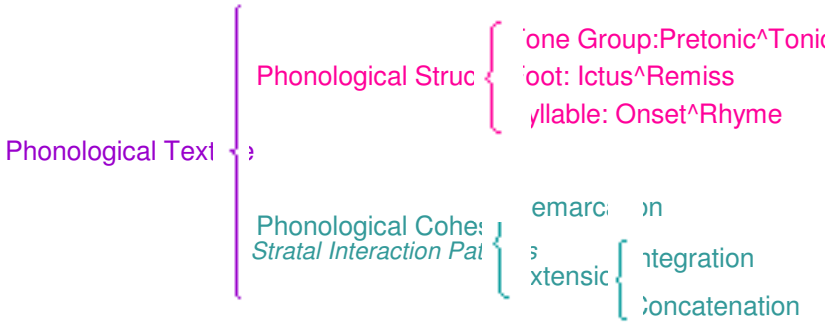

Figure 1.7 Phonological Texture As Arising From Both Phonological Structure And Phonological Cohesion (Phonology–Lexicogrammar Interaction Patterns)

Three components of phonological texture[2] can be identified from the perspective of the phonological rank scale: *articulatory* cohesion and structure (syllables), *rhythmic* cohesion and structure (feet), and *intonational* cohesion and structure (tone groups). These will each be explored further in Chapter 2.

1.2.3.2 A Quantum Field Model of Syntagm

The second major proposal is to expand, in an illuminating way, the conceptualisation of phonological syntagm beyond the particulate model of segmental theories to include particles, waves and fields as types of structure. The initial suggestion by Pike (1967, 1982) of using these complementary perspectives in linguistics has been adopted in Systemic theory, notably by Halliday (1985/1994), Martin (1992) and Matthiessen (1991). Martin (1993: 22) argues contra the particulate-only perspective for linguistics generally:

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[1] It might be added that just as 'texture is a function of text in context' (Martin op cit: 493), *phonological* texture is a function of phonology in its context: the content plane (lexicogrammar and discourse). That is, the deployment of phonological texture varies with context (lexicogrammar, discourse, register, genre, ideology — using Martin's (1992) stratification), echoing Halliday's (1994: 334) position that the deployment of *content plane* texture varies with *its* context (Halliday's stratification): register.

[2] Phonological texture can also be said to include *prosodic cohesion* (Davies 1992; 1997), whereby Given and *contrastive* New information, as expressed by intonation patterns, function cohesively in discourse in parallel with those cohesive strategies identified by Halliday & Hasan (1976) and Halliday (1985, 1994). Further, as Davies suggests (personal communication), it can also be taken to include the use of phonæsthemes and all the resources usually studied in literary discussion, such as rhyme, metre, alliteration, assonance etc.

> grammatics for the 21st century needs to metastabilise beyond merocentrism (ie the theoretical obsession with segmentation), treating constituency not as a primitive, but as a fudging and reductive form of representation, the privileged status of which has to do with the evolution of writing systems, not the structure of language.

Similar concerns have been raised outside Systemic theory, but within phonology, by Clark and Yallop (1990: 321):

> [Prosodic Analysis, Autosegmental Phonology and CV Phonology] question the traditional status of the segment — and revive a constant worry in phonology: that our interest in segmental transcription and representation is driven more by tacit emulation of alphabetic writing systems than by genuine insight into the nature of phonological organisation.

In physics, models of structure have been forced beyond those of particulate constituency, and to remain within this perspective in phonology in particular and in linguistics in general is to risk maintaining procrustean theoretical decisions that may seriously constrain the *types* of theories likely to emerge.

In order to expand models of structure to include particles, waves and fields, this discussion is organised in the following way. First, phonological syntagm is related to the periodic behaviour of the vocal tract and these periodicities are modelled as waves. Second, phonological waves are interpreted as measurements of probability of the location of phonological particles, on the quantum model, such that a phonological event can be thought of as a quantum with wave–particle duality. Third, the notion of "charged" fields is introduced. Fourth, phonological quanta are interpreted, on the quantum field model, as fluctuations — energetic excitations — in phonological fields. Fifth, quantum phonological fields are related to morphogenetic fields in biology. Sixth, phonological fields are interpreted as vectorfields, and direction within them in terms of *phoricity*. Finally, the proposal is situated within Systemic models of metafunction and structure.

1.2.3.2.1 Syntagm As Waves Of Periodic Behaviour

To foreground the corporeity of language is to foreground modelling phonology as vocal tract behaviour emerging from *processes* of a neuromuscular substrate.[1] One way to model gesturing of any kind — sounding, signing or writing — is in terms of periodicity. That is, gestures can be modelled as cyclical processes, with one trajectory through the cycle varying (paradigmatically) at specific phases in the cycle

[1] Phonological events are conceived here in terms of sensorimotor correlations, to which contribute *proprioception*, sensory excitation originating in muscles, tendons and joints, and *kinæsthesia*, the sensation of movement or strain in muscles, tendons and joints (Macquarie Dictionary 1991: 1414, 972). In this regard, Goldwin-Meadow and Mylander in Science, 25 April 97 (pp 593-4) report that*visual* linguistic cues — such as watching a speaker's lips during face to face conversation — activate the *auditory* cortex. Phonological paradigmatic features are thus conceived as categorisations of states in sensorimotor repertoires. Sensorimotor behaviour is a fundamental means of categorising all phenomena, including sensorimotor behaviour itself.

from another. Three vocal tract cycles that give rise to phonological prominence[1] will be described.

The first vocal tract cycle to be identified here[2] is the process of opening and closing the vocal tract by articulators to dampen phonation in the production of syllables. This process can be termed *articulation* to distinguish it from other behavioural cycles of the vocal tract. The simplest way to model a cycle is as a binary oscillation between two states.[3] Since, within the syllable, it is the constituents of the Rhyme that are potentially *moraic* — that is, can count as a timing unit, or *mora* — while those of the Onset are *nonmoraic*, the articulatory cycle can be thought of as a continual process of switching *moraicity* (syllable weight) on and off. This alternation is illustrated below for the instantiation (others are possible) of since he lost his hearing, people seldom see him as {sins hi: lost hiz hi´riN pi:p´l seld´m si: him}:

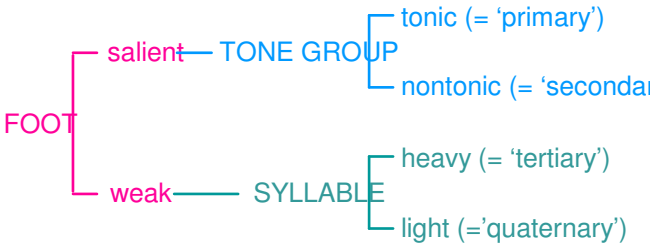
s	i n s	h	i :	l	o s t
moraicity off	moraicity on	moraicity off	moraicity on	moraicity off	moraicity on

h	i z	h	i ´	r	i N
moraicity off	moraicity on	moraicity off	moraicity on	moraicity off	moraicity on

p	i :	p	´ l	s	e l
moraicity off	moraicity on	moraicity off	moraicity on	moraicity off	moraicity on

d	´ m	s	i :	h	i m
moraicity off	moraicity on	moraicity off	moraicity on	moraicity off	moraicity on

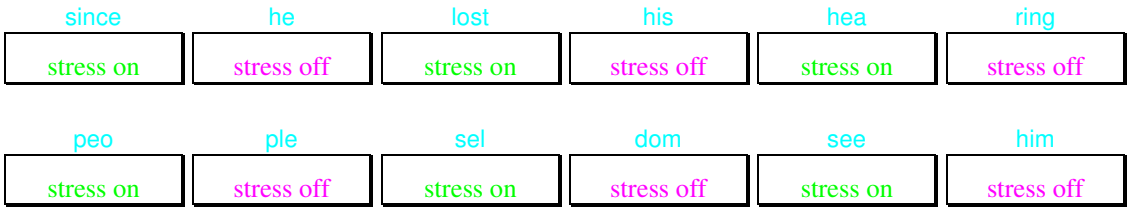
[1] Systemic theory distributes phonological prominence across the ranks of tone group, foot and syllable. The following diagram shows how the Systemic organisation of phonological prominence relates to primary, secondary, tertiary and quaternary "stress":



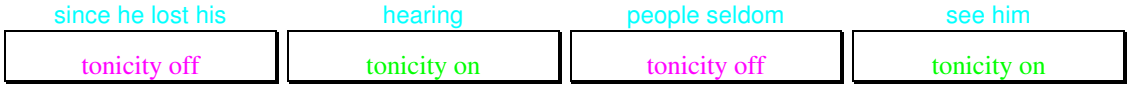
[2] Segments will be interpreted as *phases* in this cycle.

[3] These cycles of switching on and off (electrochemical) neuromuscular systems correspond to different energy states in motor systems perceived by sensory systems — *proprioceptive* as well as auditory.

The second vocal tract cycle to be identified here is the process of varying such quantities as loudness and duration to add *stress*. This process can be termed *rhythm* to distinguish it from other behavioural cycles of the vocal tract, and the rhythmic cycle can be thought of as a continual process of switching *stress* on and off. This alternation is illustrated below for the instantiation (others are possible) of since he lost his hearing, people seldom see him as / since he / lost his / hearing / people / seldom / see him /:



The third vocal tract cycle to be identified here is the process of applying major pitch shifts to create tonic prominence or *tonicity*.[1] This process can be included under the term *intonation*[2] to distinguish it from other behavioural cycles of the vocal tract. The *intonation* cycle can be thought of as a continual process of switching *tonicity* on and off. This alternation is illustrated below for the instantiation (others are possible) of since he lost his hearing, people seldom see him as //3 since he / lost his / hearing //1 people / seldom / see him //:

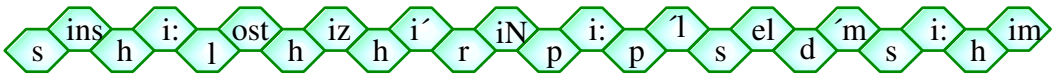


To conceive of phonology dynamically as periodic neuromuscular behaviour allows syntagms like those above to be modelled as waves. A wave is defined in physics as 'a curve of an alternating quantity plotted against time' (Pitt 1977: 408). On this basis, the oscillation of moraicity can be represented as a wave by plotting moraicity on the vertical axis against time on the horizontal axis, while labelling each phase of the wave

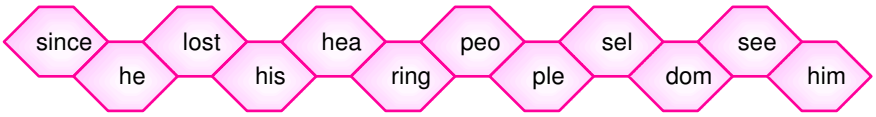
[1] Halliday (1967: 18) uses the term *tonicity* to refer to 'the placing of the tonic syllable … the location, in each tone group, of the pretonic and tonic sections'. Here *tonicity* will be used as synonymous with tonic prominence.

[2] The term *intonation* is being used here to include both (waves of) tonicity and (fields of) tone. See further in the discussion.

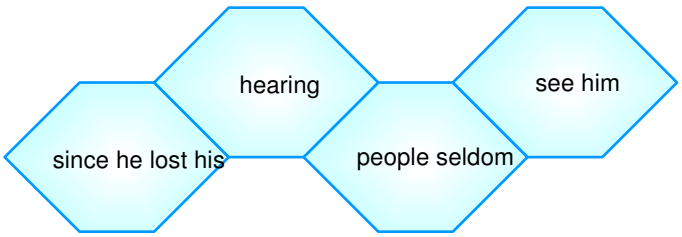
according to its "charged" (paradigmatic) state.[1] This is illustrated below for the previous example:



Similarly, the ebb and flow of stress can be represented as a wave by plotting stress on the vertical axis against time on the horizontal axis, as illustrated below:



And again, the fluctuation of tonicity can be represented as a wave by plotting tonicity on the vertical axis against time on the horizontal axis, as illustrated below:



This view of phonology presents structure as process: as the synergetic co-ordination of three waves[2] — tonicity, stress and moraicity — each with its own dynamic periodicities. The organisational principle from the wave perspective is *culmination* through *synchronicity*: some moraic peaks are enhanced by being *in phase* with stress peaks, and some stress peaks are enhanced by being in phase with tonic peaks. That is, whereas moraicity involves a *single* wave, stress involves *two*: both stress and moraicity, and tonicity involves *three*: tonicity, stress and moraicity.

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[1] Note that the waves here are of vocal tract behaviour, not of the (longitudinal compressions and rarefactions of) sound waves that are its acoustic products. Cf Pike (1967, 1982) who interprets the syllable as a wave of opening and closing the articulatory channel. The wave is taken to be an *organising principle* of articulation, and not the *result* of segmental organisation; Catford (1988: 345-6) makes an analogous point in taking the stress contour to be the organising principle of rhythm, and not the *result* of syllable organisation:

> In systemic phonology, however, we look at the foot from the opposite point of view. The foot is a stress-contour in its own right, and the causation operates in the opposite direction. It is the stress-contour of the foot that imposes different degrees of stress upon the successive syllables it dominates, according to their location within the foot.

[2] On the physical model, the moraic wave can be thought of as a carrier wave, and the stress and tonic waves as modulating waves using amplitude and frequency modulation. Speech is an amplitude- and frequency-modulated carrier (moraic) wave.

1.2.3.2.2 Quanta: Waves As Measures Of Particle Probability

One way to analyse the continuous flux of speech gestures into discrete bundles for categorisation by observers — speakers as well as hearers — is to identify positions in the stream where systems of paradigmatic choice become available. This was the technique used to develop the range of writing systems, charactery, syllabary and alphabet, from which the study of phonology has evolved.

This method will be complemented here with one suggested by quantum physics. As Gribbin (1985:118-22) points out, the Copenhagen interpretation of quantum mechanics[1] explains the wave/particle complementarity of any quantum[2] in terms of *probability*.[3] That is, the wave of an electron or photon, for example, is interpreted as a measure of the probability[4] of the observer finding the respective electron or photon particle at that particular point.[5]

Applying this to phonology means interpreting waves of moraicity, stress and tonicity as measures of the probability of the observer — speaker or hearer — finding the respective syllable, foot or tone group particle at that particular point.[6] In this way, each of the three wave-trains can become quantised as a string of localised particles.[1]

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[1] Specifically: Max Born (ibid). The Copenhagen Interpretation, through Niels Bohr, attributes the uncertainty inherent in complementarity to observable "reality" rather than to the limits of perception systems.

[2] Planck's Quantum Hypothesis states that waves — eg electromagnetic — behave as if composed of particles: being emitted or absorbed in packets or quanta (Hawking 1988: 56). Heisenberg's Uncertainty Principle, on the other hand, (ibid):

> implies that particles behave in some respects like waves: they do not have a definite position, but are "smeared out" with a certain probability distribution.

[3] The quantisation of the earth's cycle around the sun as a particulate year reflects interpreting the (northern hemisphere) seasonal temperature fluctuation as a probability wave. Each peak in the wave represents the most probable location of each particle (year). Each trough in the wave represents the least probable location of each year, and thus where the boundary is placed.

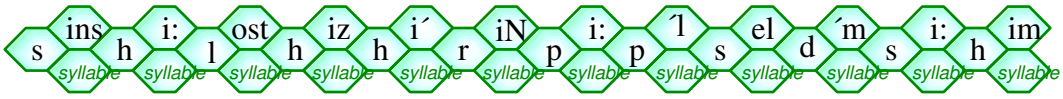
[4] The position adopted here is that the world is seen as probabilistic, as in quantum physics, because *probability is the way the brain works in categorising the universe*, which includes *its own categorising behaviour* (see Edelman 1989, 1992). That is, *probability is inherent in the categorising process rather than in phenomena being categorised*.

[5] Gribbin (ibid: 119):

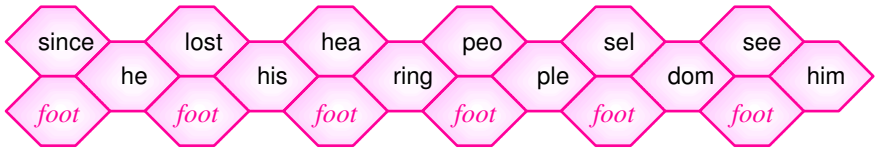
> …[I]n some sense [particles are] guided by the wave, and the strength of the wave…at any point in space [is] a measure of the probability of finding the particle at that particular point.

[6] That is, a syntagmatic abstraction represents the *probability* of a particle's syntagmatic location, whereas a paradigmatic abstraction represents a statistical probability in a population of paradigmatic variants. A phonological feature like [front] tongue posture, for example, symbolises the most probable variant in a population, each variant being a specific tongue position in continuous articulatory state space. Less probable variant states spreading through a lexicon and through a population of speakers become more probable, thereby bringing about language change. See Chapter 5.

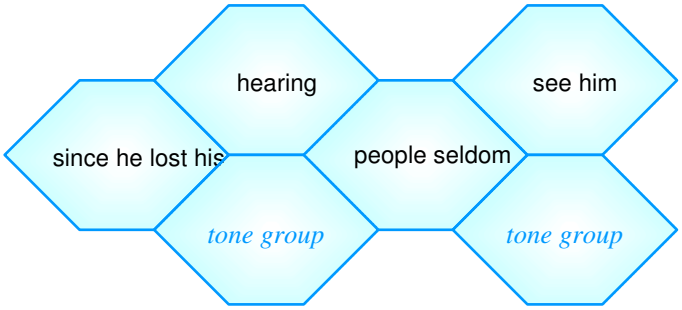
More specifically, the peak phase of the moraic wave ("moraicity ON") represents the most probable syntagmatic location of the syllable, and this degree of certainty can be indicated by similarly labelling the moraic wave, such that the varying probability of locating the (syntagmatic) position of the syllable is represented by the varying amplitude of the wave[2]:

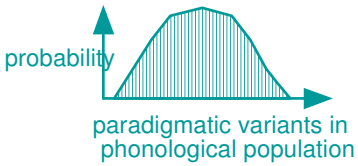


Similarly, the peak phase of the stress wave ("stress ON") represents the most probable syntagmatic location of the foot, and this degree of certainty can be indicated by labelling the stress wave in like fashion:



Likewise, the peak phase of the tonic wave ("tonicity ON") represents the most probable syntagmatic location of the tone group. This degree of certainty can be indicated by labelling the tonic wave in the following way:





[1] Or as the sequence of locations of one particle in motion (see Chapter 2). Interpreting the flux of a dynamic process as a particle in motion has prompted the view that watching the flux of the focus of neuronal activity in the brain using MRI is watching the mind wander around the brain.

[2] The analogy is with *phase* waves — a.k.a. *matter* or *de Broglie* waves — in physics (Pitt 1977: 95-6):

> A set of waves that represent the behaviour under appropriate conditions of a particle…They are sometimes regarded as waves of probability, since the square of their amplitude at a given point represents the probability of finding the particle at that particular point.

It will be seen that hexagonal phases in the articulatory wave represent, through their 'amplitude' (vertical dimension), the probable syntagmatic locations of segments (particles). That is, each hexagon within a syllable corresponds to the vocal tract behaviour that produces the acoustic 'wave packets' that are labelled as segments in Speech Technology Research.

Away from the peaks, the syntagmatic location of the particle — syllable, foot or tone group — becomes less probable and so uncertainty[1] increases. Because of this uncertainty, (suprasegmental) boundaries are typically determined either by arbitrary phonological criteria alone, such as 'a foot always begins with the beat or Ictus', or by correlating a phonological pattern such as 'syllables always begin at the point of minimum sonority' with a lexicogrammatical pattern such as 'maximise syllable Onsets consistent with word-initial sequencing patterns'. This wave model of syntagm builds the indeterminacy of such structural boundaries into the theoretical representations.

The segmentation of these wavetrains into particles is the focus of Chapter 2, wherein phonological boundaries will be determined by reference to the two functions outlined in the first proposal. It is apposite here, though, to compare the (more familiar) particle perspective on structure with the wave perspective already outlined.

The particle perspective on phonology differs from the wave perspective in that it focuses on stasis rather than process, on position rather than motion, or as Prigogine and Stengers (1985) would put it: on being rather than becoming. Positions are envisioned as point particles rather than phases of a movement. The motion is segmented as a series of stills, as frames in a reel of film. The organisational principle from the particle perspective is *hierarchical constituency*[2] with particles consisting of smaller particles: tone groups consist of feet which consist of syllables which consist of segments.

At this point it is possible to envisage three types of discrete phonological quanta in a way that encompasses both wave and particle perspectives. On the quantum physics model, the complementarity of particle and wave is reconciled in terms of a wave-packet or "wavicle" which represents the uncertainty in the location of the particle, as described by Gribbin (1985a:104-5):

> The appropriate image is…of a short wave train which only extends over a small distance, a distance roughly corresponding to the size of the equivalent particle.

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[1] This uncertainty feeds language change (see Chapter 5). For example, a shift of stress placement in Old Irish brought about widespread syllable loss, so that carnos /karnos/ 'cairn' became Modern Irish carn /karn/. In this instance, syllabic indeterminacy of the least sonorant intervocalic segment /n/ allowed it to be retained as part of the first syllable, so that the word-final syllable closure /rn/ made a rare appearance in the language (Foclóir Póca (1986) lists only six other (monosyllabic) tokens: cearn, spairn, corn, dorn, scorn and sorn). If, on the other hand, the Old Irish word had been /kanros/, and the syllable loss yielded /kan/, the deletion would have had no effect on Irish syllable structure potential.

[2] Every entity in a hierarchy is a "janus-faced" *holon*: defined by Kœstler (in Barlow 1992: 90-100) as an entity that is simultaneously a self-contained *whole* and a dependent *part*. To put it another way, a unit in a hierarchy does not exist in isolation, but in a set of *relations*, both to units below, and to units above. Accordingly, the tone group, foot or syllable can be viewed according to its relations above and to those below. A syllable, for example, is a unit to be examined in terms of its relation to segments (below), and in terms of its relation to feet (above). The relativity of 'part' and 'whole' requires that a phonological particle be considered both as a subordinate within a higher level of organisation and as a whole emerging from the organisation of subordinates.

Applying this principle to phonology, three types of phonological quanta, such that the wave/particle duality of the wave-packet[1] is reflected, can be *provisionally*[2] represented below:

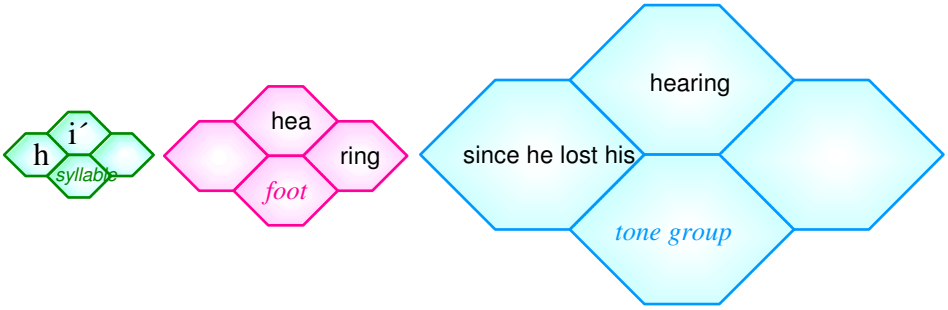

Figure 1.8 Syllable, Foot And Tone Group As Three Phonological Quanta

To summarise the development of this proposal so far: first, phonological structure was viewed dynamically, in process terms, as periodic behaviour of the vocal tract that can be modelled as waves; second, the waves were interpreted as measures of probability of particle location, giving rise to the idea of phonological quanta incorporating both wave and particle aspects. In the following sections, these

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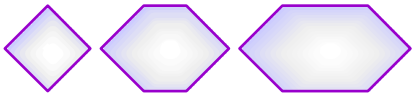
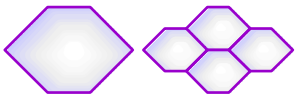
[1] The hexagonal shape of each position is intended to represent a wave-packet that has the duality of being both particle and wave; each hexagon as wave represents a vocal tract behavioural cycle that corresponds to a measure of probability of locating the counterpart particle — segment, syllable, foot, tone group — in syntagmatic spacetime (see further in the discussion). Note that duration can be represented by proportionately shortening or lengthening the horizontal dimension, as, for example, from the syntagmatic limen (minimally discernible) to double duration:



There is also an analogy here with the *fractal* concept — a geometrical structure that is of a similar character at all magnifications — to the extent that a syllable resembles each of its component segments, a foot resembles each of its component syllables and a tone group resembles each of its component feet.



[2] This view of structure will be further elaborated in Chapter 2.

complementary wave and particle formulations of structure will be supplemented with several interrelated notions of phonological field.[1]

1.2.3.2.3 Phonological Fields Of Charged States

In physics, a field is most generally defined as 'a region under the influence of some physical agency' (Pitt 1977: 149). An example is an *electric* field, which is 'the space surrounding an electric charge within which it is capable of exerting a perceptible force on another electric charge' (ibid: 121).[2] This type of physical structure can be introduced to models of phonological structure in the following way.

The act of speaking can be understood as a process of continually assigning specific paradigmatic states (*qualia*) to ongoing syntagmatic structures (*quanta*). For example, the syllables /NöH/ and /Â¨ʃ/ have the same syntagmatic structure, but differ in the paradigmatic state at each of the three phases of the process. That is, the production of each syllable takes the speaker through the same syntagmatic cycle, but along different trajectories through the state space of paradigmatic features.

These paradigmatic states can be thought of as *charges* like those of electric fields, and the syntagmatic extension of a specific paradigmatic state can be modelled as an electric field. A phonological field of this type, then, is the syntagmatic domain within which a paradigmatic feature is capable of exerting a perceptible influence on another paradigmatic feature. The field of the feature [nasal] for instance typically extends further than a particular segment, since its sphere of influence frequently extends to adjacent syntagmatic positions, nasalising vowels or prenasalising stops.

In this way of thinking, any phonological event can, in principle, be modelled as a field. Generally, however, it is descriptively useful to adopt a complementary approach, modelling periodicities as quanta — employing particles when the indication of boundaries is necessary, and waves when it is not — and modelling phonological

---

[1] There are several different types of physical field, as Sheldrake (1987: 64) explains:

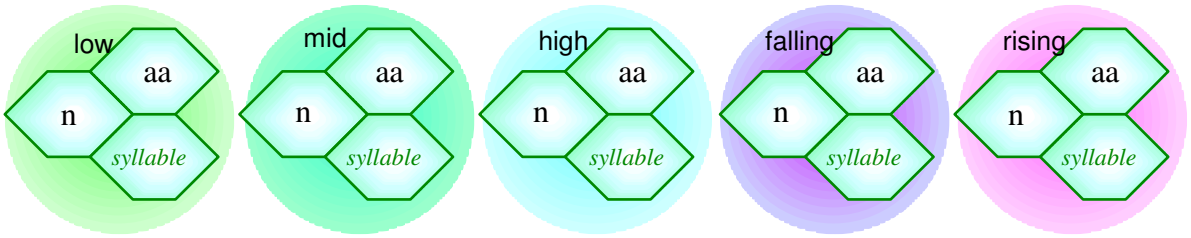
> First, the gravitational field, which in Einstein's General Theory of Relativity is equated with space-time and considered to be curved in the presence of matter. Secondly, the electromagnetic field, within which electrical charges are localised and through which electromagnetic radiations propagate as vibrational disturbances. According to the quantum theory, these disturbances are regarded as particle-like photons associated with discrete quanta of energy. Thirdly, the quantum field theory of matter, sub-atomic particles are thought of as quanta of excitation of matter fields. Each kind of particle has its own special type of field: a proton is a quantum of the proton-antiproton field, an electron is a quantum of the electron-positron field, and so on.

[2] Similarly, a magnetic field is 'the field of force surrounding a pole or a current flowing through a conductor, and in which there is a magnetic flux' (op cit: 229); a gravitational field is 'the space surrounding a massive body in which another massive body experiences a force of attraction' (op cit: 171).

events exceptional to specific periodicities as fields.[1] (This will be further elaborated below.)

As will be elaborated in subsequent chapters, the types of events best modelled as fields are principally those that were identified above — in the exposition of the first major proposal — as *extension* prosodies and whose function is to either *integrate* or *concatenate* lexicogrammatical domains.

The Thai tone system can be used to illustrate charged phonological fields. Recalling from above that one tonal feature from the system {[low] [mid] [high] [falling] [rising]} extends for the duration of the word, these features are shown in the diagrams below as states of fields surrounding the syllables that express the words nàa 'nickname', naa 'rice paddy', náa 'younger maternal uncle or aunt', nâa 'face' and na&a 'thick', respectively:



The secondary articulation of Irish consonants can also be used to illustrate charged phonological fields. Recalling from above that Irish consonant clusters are either palatalised or labiovelarised (Úneutral), these features are shown below as states of fields[2] surrounding the syllables that express the words gléasta /g,l,e:s†´/ 'dressed' and gluaiste /glu´s,†,´/ 'moved', which consist of the verb roots gléas 'dress' and gluais 'move' and an [adjectival] suffix -taÚ-te. Palatalisation is represented as /y/, and labiovelarisationÚneutrality as /w/:

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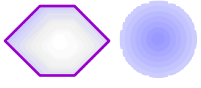
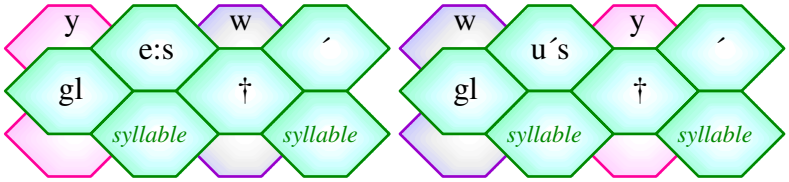
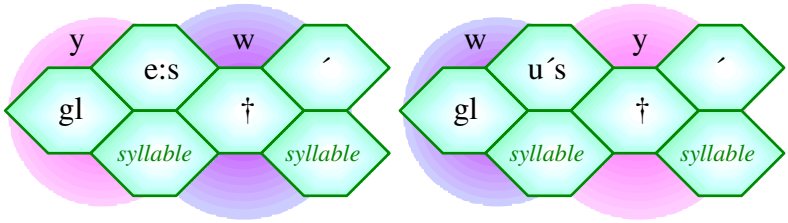
[1] Every paradigmatic selection can be instantiated in syntagms either as a probability quantum wavicle/wave-particle/wave-packet — ie continuous waves can be quantised for descriptive utility — or as a (probability) field of scatter, as shown below.

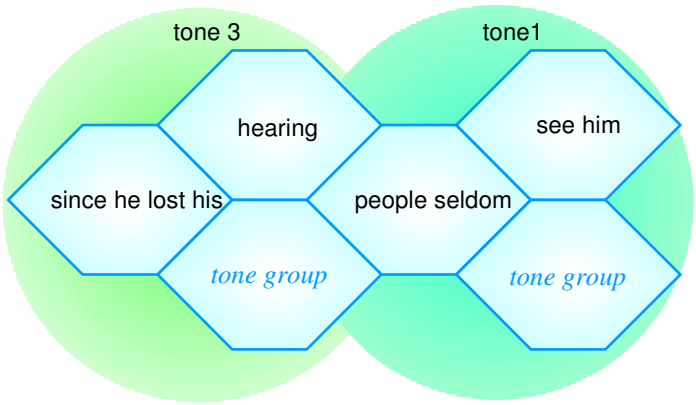


[2] These secondary articulations can be alternatively depicted as phase-shifted waves, as below:

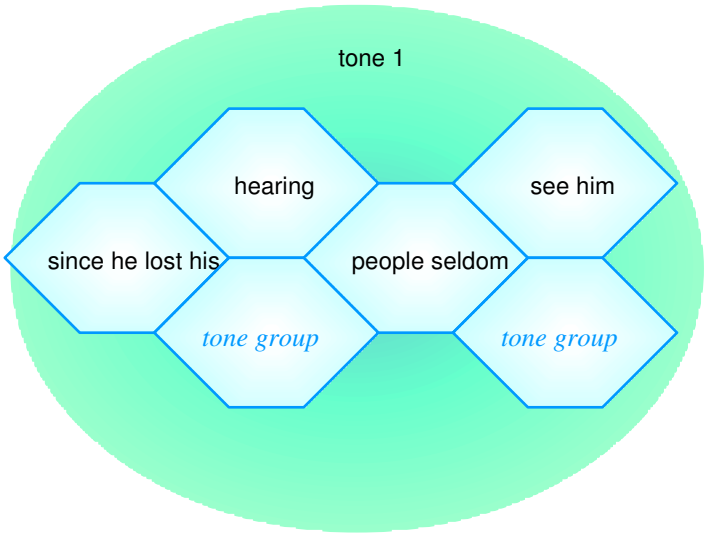




The tones of English intonation can also be represented syntagmatically as charged fields. This is illustrated below for //3 since he / lost his / hearing //1 people / seldom / see him //, where tones 3 and 5 are shown as states of fields surrounding the tone groups that express each clause in the clause complex:



Alternatively, in the case of //1 since he / lost his / hearing //1 people / seldom / see him //, a single tonal field extends for the duration of the whole clause complex, as represented below:



1.2.3.2.4 Phonological Quantum Fields

The second type of phonological field to be proposed draws on the idea of a *quantum* field. In quantum physics, wave-packets or quanta are seen as manifestations (energetic excitations) of quantum fields.[1] As Gribbin (1987: 257) explains:

> ...[T]he field is now the ultimate, fundamental concept in physics, because quantum physics tells us that particles (material objects) are themselves manifestations of fields. One of the first great surprises of quantum physics was the realisation that a particle, such as an electron, had to be treated as a wave. In this first application of quantum principles, we learn to treat these matter waves as fields, with one field corresponding to each type of particle...Quantum physics says that energy in the field cannot be smoothly changing from place to place, continuously, as in the classical picture. Energy comes in definite lumps called quanta, and every matter field must have its own quanta...The particles are energetic bits of the field, confined to a certain region by the uncertainty principle.

If this principle is applied to phonology, then each phonological quantum is a field quantum: a manifestation of a quantum field.[2] A tone group is an energetic bit of an intonation field, confined to a certain region by the probability expressed by a tonic wave and enveloped by a charged tonal field. A foot is an energetic bit of a rhythm field, confined to a certain region by the probability expressed by a stress wave. A syllable is an energetic bit of an articulation field, confined to a certain region by the probability expressed by a moraic wave. These three types of phonological field quanta can thus be represented as follows:

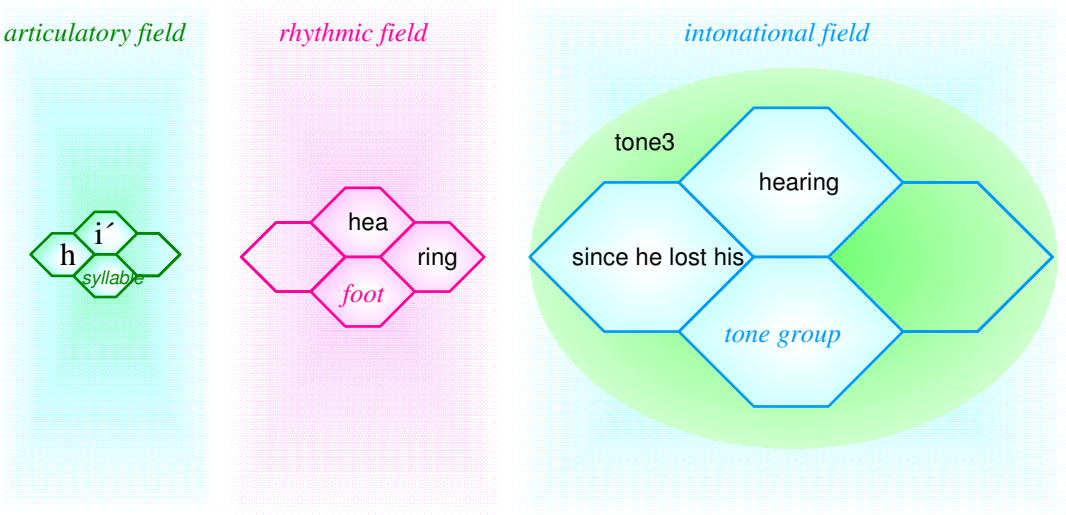


Figure 1.9 Articulation, Rhythm And Intonation As Three Quantum Fields

[1] The relation of quantum to quantum field is analogous to a wrinkle in a fabric: the quantum and the field are one and the same material.

[2] The phonological field as quantum field might also be thought of as a field of potential.

The organisational principle from this field perspective is *complementarity*. Phonological syntagm is viewed in terms of three types of interacting complementary fields — intonation, rhythm, and articulation — differentiated by the functional division of labour embodied. Each of these quantum fields will be further interpreted below as a *phonogenetic* field.

1.2.3.2.5 Phonogenetic Fields

The two preceding models of phonological fields can now be integrated in a way that allows the phonological component of logogenesis — henceforth *phonogenesis*[1] — to be modelled in a manner consistent with some general principles of biological ontogeny or development.[2] This entails introducing the biological notion of a *morphogenetic* field — also known as an *embryonic* or *developmental* field — and the two fundamental processes of ontogeny: cell *differentiation* and *morphogenesis*.[3]

In developmental biology, a morphogenetic field geometrically represents the space-time in which form is created from position during embryonic development.[4] This will be used as a means of modelling each of the three quantum phonological fields discussed in the preceding section. The fields of intonation, rhythm, and articulation are each to be interpreted as a type of *phonogenetic* field. A phonogenetic field represents the space-time in which phonological form is created from position during phonogenesis.

Specifically, the intonational field represents the space-time in which intonational form is created from position during phonogenesis; the rhythmic field represents the space-time in which rhythmic form is created from position during phonogenesis; and the articulatory field represents the space-time in which articulatory form is created from position during phonogenesis.

---

[1] Not to be confused with Hopper's (1991/4) abovementioned definition of *phonogenesis* as the historical process whereby morphemes become phonemes.

[2] This foreshadows the discussion in Chapter 5 wherein the logogenesis of texts is interpreted as a process of creating phenotypes of culturally shared categorisations of the observable world, just as in biology, ontogeny is a process of creating phenotypes of genomes.

[3] According to Sheldrake (1987: 54), the idea of morphogenetic (or embryonic, or developmental) fields originated independently with Gurwitsch (1922) and Weiss (1926), and has been developed by embryologists such as Waddington (and elaborated mathematically by theoreticians such as Thom). According to Thain & Hickman (1994: 212-3), Waddington introduced the term *epigenetics* in 1947:

> for the branch of biology which studies those causal interactions between genes and their products which bring the phenotype into being. It has two main aspects: (i) changes in cellular composition (cell differentiation, or histogenesis) and (ii) changes in geometrical form (morphogenesis).

[4] For a discussion of morphogenesis, see Edelman (1989, 1989a) or Kauffman (1993). The phrase 'epigenetic events that create form from place' is from Edelman (1992: 23).

In developmental biology, the two fundamental processes in the ontogeny of multicellular organisms are cell differentiation and morphogenesis (Kauffman 1996: 93-112). Cell differentiation creates the *diversity* of cells from a single type, the zygote, and morphogenesis is the process of *co-ordinating* cells into organised tissues and organs. These two aspects of ontogeny, cell differentiation and morphogenesis, as events occurring in morphogenetic fields, can be applied to phonogenesis[1] in the following way.

The process of differentiation in phonogenetic fields was prefigured in the above discussion of *charged* phonological fields. There it was said that the act of speaking can be understood as a process of continually assigning specific states ("electric charges") from system networks of paradigmatic options to ongoing syntagmatic structures ("electric fields"). In the present context, this can be restated as: the selection of paradigmatic options, by attributing specific states to a phonogenetic field, is the differentiation process that creates *topological diversity* in phonogenetic fields.

On the other hand, the counterpart phonological process of biological morphogenesis is that whereby feature categories are co-ordinated into the organised functional structures. This is the process that has been described above in terms of probability[2] waves that correspond to periodic vocal tract behaviour.[3] One way this syntagmatic process of "morphogenesis" can be related to the paradigmatic process of "differentiation" is through *positional information*, the notion that paradigmatic states can carry implicit information about their position in syntagmatic cycles.

Some paradigmatic states are more likely than others to occur at a specific phase of a vocal tract cycle, and these features can be easily mapped onto positions in the respective phonogenetic wave. For example, the consonantal feature [stop] is highly likely to occur at a syllable boundary, and the vocalic feature [open] is highly likely to occur at the syllable peak. Other paradigmatic states, however, are less probably associated with a specific phase, and these are usefully modelled as (charged) fields, centred on the region of most intense influence. Examples of this type of feature

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[1] These two aspects of biological ontogeny, cell differentiation and morphogenesis, can similarly be applied to linguistic ontogenesis — ontogenesis being achieved through multiple logogenetic events, just as phylogenesis is achieved through multiple ontogenetic events (logogenesis is a subroutine of ontogenesis which is a subroutine of phylogenesis). First, the counterpart process of differentiation is the ongoing subcategorisation of more generalised features of child language into the more delicate functional components of adult language systems. Second, the counterpart process of morphogenesis is the co-ordination of these feature categories into the organised functional systems of adult language ("systemogenesis").

[2] In a more general application not restricted to ontogeny or even biology, Sheldrake (1987: 85-7) identifies morphogenetic fields as probability structures, being 'given by probability distributions' (ibid: 86).

[3] Pattern formation in morphogenesis has been found to depend on two components: short-range activation and long-range inhibition (Coveney & Highfield 1995: 217). In contrast, pattern formation in phonogenesis would seem to depend on short-range inhibition: the *filtering* of phonation by articulation, and long-range activation: the *amplifying* of phonation by both rhythm and intonation.

include those in TONE systems, whether functioning in articulatory fields (as in "tone" languages) or in intonational fields.

Positional information in the articulatory field can be understood here in terms of *sonority*. Ladefoged (1982: 284) defines sonority as 'the loudness of a sound relative to that of other sounds with the same length, stress and pitch'. Because sonority is a relation between sounds, it permits sounds to be ranked relative to each other, as Clark and Yallop (1990: 97) explain:

> [Sonority] refers to energy relative to effort, or more informally to the 'carrying power' of a sound. A sonorous sound is one with high output relative to the articulatory effort required to produce it, and sounds can therefore be ranked according to their degree of sonority.

Hogg and McCully (1987: 33), for example, present a sonority scale of sound classes in which vowels are more sonorous than glides, which are more sonorous than liquids, which are more sonorous than nasals, which are more sonorous than fricatives, which are more sonorous than stops; with voiced segments being more sonorous than voiceless. Such a scale appears in the following table.

Sound Class	**Token**	**Sonority Value**
low vowels	/a/	10
mid vowels	/e o/	9
high vowels	/i u/	8
flaps	/V/	7
laterals	/l/	6
nasals	/m n N/	5
voiced fricatives	/v D z/	4
voiceless fricatives	/f Q s/	3
voiced stops	/b d g/	2
voiceless stops	/p t k/	1

Table 1.2 A Sonority Scale Of Sound Classes

It is important to recognise that sonority is a scalar relation between *decontextualised* sounds and, as such, is a grading of paradigmatic potential not of sounds in instantiated syntagmatic structures. (The 'carrying power' of a sound in structures will vary according to syntagmatic position relative to peaks and troughs of moraicity, stress and tonicity.) Nevertheless, there is a *probability* relation between sonority and the *sequencing* of sounds in syllable structures, as Anderson and Ewen (1980:37) note:

> It is widely accepted that the internal structure of the syllable correlates with a 'sonority hierarchy', whereby more sonorant elements are nearer to the syllabic than less sonorant. The most sonorant segment in any syllable, then, is the syllabic.

Considering the scale now in terms of *features* rather than the sound classes they define, it can be said that the inherent sonority of a paradigmatic feature carries

syntagmatic information to the extent that it is suggestive of the position of the feature in syllable structure. The relationship between features, sonority and syllable position can be encapsulated by representing the sonority scale of features as a cline of syllabic nuclearity, such that centrality indicates both the high sonority and syllable nuclearity of a feature, as in the following diagram.

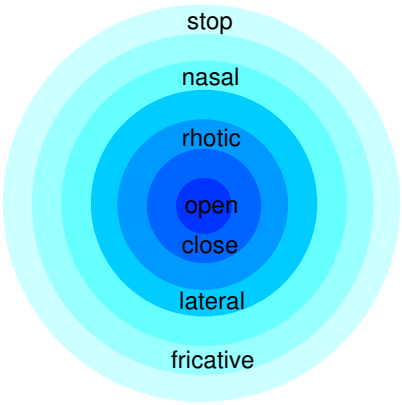
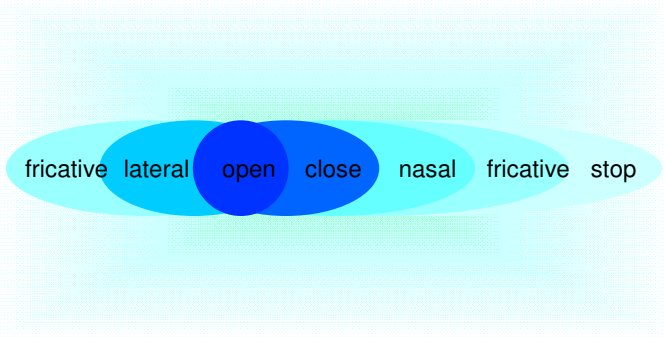


Figure 1.10 Sonority Scale Of Feature States As Cline Of Syllable Nuclearity[1]

When features are instantiated in structures, the sonority scale can be thought of as a *concentration gradient* in an articulatory field.[2] This can be illustrated by the syllable expressing the English word flounced /flaunst/, which can be represented as the following localised concentration gradient of sonority in the articulatory field:



[1] Cf the *nuclearity* model of experiential functions for lexicogrammar (Matthiessen 1992/6), and see Chapter 6 on the implications for lexicogrammar.

[2] The analogy here is a *chemical concentration gradient* in a (biological) morphogenetic field. As Sheldrake (1987: 44) explains what he (sceptically) refers to as a mechanistic model of morphogenesis:

> Then there is the problem of how this 'positional information' brings about its effects. The simplest possibility would be that the 'positional information' is specified by a concentration gradient of a specific chemical, and that cells exposed to more than a certain concentration synthesise one set of proteins, while cells exposed to concentrations below this threshold synthesise another set of proteins.

1.2.3.2.6 Phonogenetic Fields As Vectorfields

Phonogenetic fields can be more delicately described as *vectorfields*. A vectorfield is a region in which each point is characterised by a vector quantity: that is, a quantity that possesses both *magnitude* and *direction*.[1] The magnitude of phonogenetic fields is measured by waves of moraicity in the articulatory field, stress in the rhythmic field and tonicity in the intonational field. The concept of direction will be elaborated here for articulation, the most explored field of phonology.[2]

The articulatory phonogenetic field is polarised[3] in one direction, along the time axis, and is therefore asymmetric in time.[4] The biological basis of this is that the vocal tract functions asymmetrically in time: speech is a process that primarily exploits *egressive*[5] airstreams. Initiating and terminating a syllable are therefore not equal articulatory events, and this can have consequences for the instantiation of features in structures, as will be explained below.

All syllable boundary positions can be said to have implicit direction in that they may be either inclined forward to the next syllabic peak or backward to the previous syllabic peak.[6] This sense of direction in phonogenetic fields can be modelled in terms of *endophoricity*, and all boundary positions can be said to be potentially *phoric*.[7] That is, boundary positions that incline forward to the next syllabic peak will be termed *cataphoric* in their reference (to be indicated by the vector symbol □), those that incline backward to the previous syllabic peak will be termed *anaphoric* ( ), and those that are indeterminate or point in both directions will be called *ambiphoric* ( ).[8]

The phoricity of a boundary position can cause (and be revealed by) variation in the instantiation of paradigmatic options. This can be demonstrated by the pronunciation

---

[1] Macquarie Dictionary (1991: 1931). In contrast, *scalar* fields have magnitude alone (Gribbin 1987: 257-8).

[2] The asymmetry of phonogenesis is evident when recorded speech is played back in reverse. Direction in the articulatory field will be further elaborated in the descriptions of Irish in Chapter 4 (and of English in the Appendix); direction in rhythmic and intonational fields will be described in Chapter 2.

[3] See Sheldrake (1987: 113-4) on the polarity of morphogenetic fields.

[4] That is, the directionality of phonogenetic fields is given by the arrow of time.

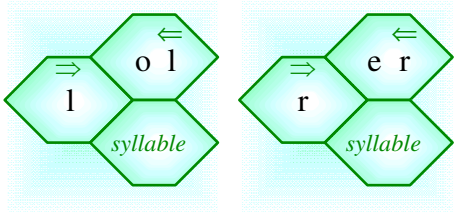
[5] Ingressive consonants are only momentary interruptions to the general flow.

[6] In dynamic terms, there is a sense in which syllabic nuclei are attractors in articulatory fields. Prevocalic positions in a syllable are in suspense, cataphorically waiting for a vowel, while postvocalic positions are (anaphoric) resolutions. The inclination of a consonant position, either forward or backward to a vowel, can also be thought of as its *direction of momentum* as a particle, which relates to its "starting" or "stopping" function in the syllable.

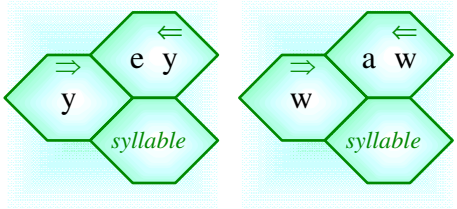
[7] Martin (1992: 98) coins the term *phoricity* from endo*phoric*, exo*phoric*, homo*phoric*, ana*phoric* and cata*phoric* reference as a semantic resource for discourse.

[8] This syntagmatic differentiation of consonants in terms of phoricity can be compared with Firth's (1948) differentiation of a consonant in syllable-initial and syllable-final position in terms of differing paradigmatic relations.

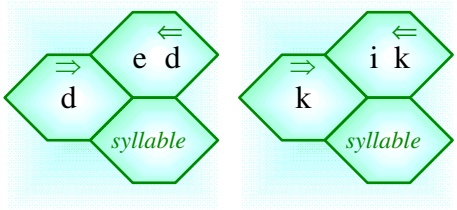
of Australian English liquid consonants. Anaphoric laterals differ from those pointing cataphorically in being (labio)velarised {l›}, sometimes to the point of losing all trace of laterality and becoming vocalic {ø}, while anaphoric rhotics differ from those functioning cataphorically in losing all trace of rhoticity and becoming vocalic {´}. This is illustrated below by the words loll {lÅl›}Ú{lÅø} and rare {®E´}.



Likewise, anaphoric palatal and labiovelar approximants — in Catford's (1977) meaning of the term to include both glides and close vowels — differ from those cataphorically oriented in being vocalic {È} and {ø}, respectively, rather than the glides {y} and {w}, respectively. This is illustrated below by the interjections yea! {yeÈ} and wow! {waø}.



Similarly, Australian English stops tend to be more plosive when cataphoric than when anaphoric. This is illustrated below for the words dead {dEdñ} and kick {kõÈkñ}.[1]

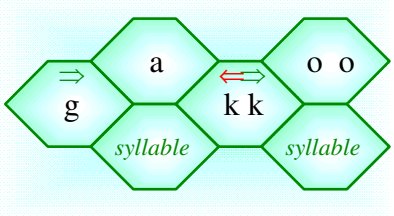


The phoricity of a boundary position, as expressed by the feature variation described above, assists in determining the location of syllable boundaries, since cataphoric states are properties of syllable Onsets and anaphoric states are properties of syllable Rhymes (Offsets and Codas), in contrast to ambiphoric states which are properties of both. Furthermore, where a sound is limited in its phoric potential, its presence always marks a syllable boundary. For example, the English glottal continuant {h}

[1] Note that such *anaphoric* consonants can become *ambiphoric* (lone intervocalic consonants can be usefully analysed as ambiphoric) if followed by a vowel-initial morpheme or word — eg stops can become more plosive — which indicates that such sounds are contributing to the Onset of the following syllable.

only occurs in cataphoric positions and its presence therefore always marks syllable initiality.

It can be added that the notion of phoricity can be employed in the representation of geminate consonants. An advantage of this is that the otherwise CV syllable structure of a language can be preserved in the representation, while the moraic status of a consonant can be indicated by rendering it anaphoric ( ) to the preceding (moraic) vowel. This is illustrated by Japanese gakkoo 'school', where each of the four units (g)a, k, (k)o and o count as a single mora.



1.2.3.2.7 Theoretical Interpretation

As discussed briefly above, Halliday (1979) proposed that different metafunctions favour different modes of structural realisation: experiential meanings predispose particulate forms of realisation, interpersonal meanings prosodic ones and textual meanings periodic ones. More specifically (Halliday 1994: 190):

> [I]t is a general principle of linguistic structure that it is the experiential meaning that most clearly defines constituents. Interpersonal meanings tend to be scattered prosodically throughout the unit; while textual meanings tend to be realised by the order in which things occur, and especially by the placing of boundaries…
>
> The textual meaning of the clause is expressed by what is put first (the Theme); by what is phonologically prominent (and tends to be put last — the New, signalled by information focus); and by conjunctions and relatives which if present must occur in initial position. Thus it forms a wave-like pattern of periodicity that is set up by peaks of prominence and boundary markers.[1]
>
> The interpersonal meanings are expressed by the intonation contour; by the 'Mood' block, which may be repeated as a tag at the end; and by expressions of modality which may recur throughout the clause. The pattern here is prosodic, 'field'-like rather than wave-like.
>
> To complete the triad, first proposed by Pike, of 'language as particle, wave and field', the kind of meaning that is expressed in a particle-like manner is the

[1] Halliday in Thibault (1987: 612), in explaining the textual metafunction in discourse structure, transforms the horizontal dimension of dynamic periodicity into the vertical dimension of synoptic hierarchy:

> Textual meanings typically give you the periodic movement that is so characteristic of discourse at all levels; everything from the smallest waves to the very large ones. In other words, there is a hierarchy of periodicity, and that comes from the textual metafunction.

> experiential; it is this that gives us our sense of the building blocks of language.[1]

This quote makes clear that meaning of the textual metafunction is expressed by the order in which elements occur, and that this ordering forms a wave-like pattern of periodicity that is set up by peaks of prominence and the placing of boundary markers. On this basis, it can be said that the preceding discussion of phonological structure, in terms of three periodicities in vocal tract behaviour which create peaks of articulatory, rhythmic and intonational prominence during their respective cycles, has framed phonological structure as being organised by the textual metafunction. On this basis, phases in these cycles will be regarded as elements of textual structures, as represented below.

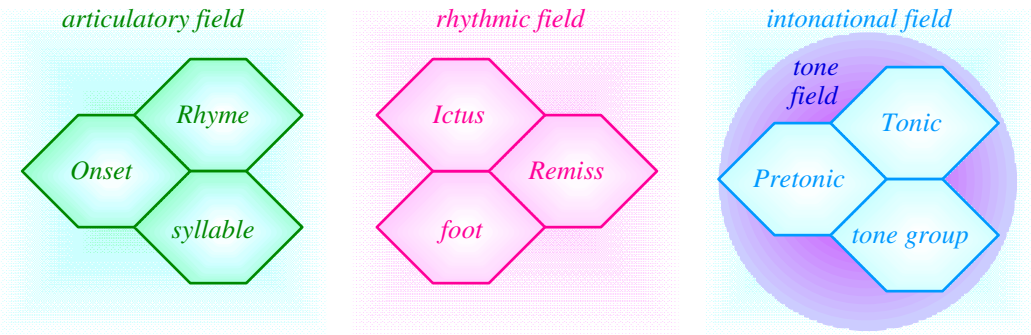


Figure 1.11 Phonological Quanta As Textual Structures

A significant departure from other work in Systemic theory here is that, with equal weight being given to syntagm and paradigm, it is proposed that fields, as *syntagmatic structures*, are also resources of the textual metafunction, but that the *paradigmatic states* of waves, particles and fields can potentially express any metafunction. That is, it is the paradigmatic state of a tonal field in the intonational field that functions interpersonally; the syntagmatic extent of the tonal field functions cohesively: it tracks the extent of a lexicogrammatical syntagm integrated as an information unit.

In addition, it can be noted that *phoric reference* — here: of phonological *boundary* positions to nuclear positions — is a resource that is identified in Systemic studies of content plane systems with the textual metafunction, whether it is interpreted as *cohesion* (Halliday and Hasan 1976; Halliday 1994) or as *structure* (Martin 1992).

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[1] Halliday omits the logical metafunction here. Martin (1992) associates particulate structures with the ideational metafunction, distinguishing the experiential and logical metafunctions by associating the former with orbital structures (adopting a synoptic perspective), and the latter with serial structures (adopting a dynamic perspective).

1.3 Summary

This chapter presented a brief overview of Systemic theory, focusing on Systemic phonology, and outlined the two major (and several minor) proposals to be expounded in the rest of the thesis. The two major proposals pertain to phonological function and structure and can be summarised as follows.

The first proposal, which concerns phonological function vis-a-vis lexicogrammar, is that phonological texture arises from systems of phonological structure and of phonological cohesion, both being manifestations of the textual metafunction. Systems of phonological structure are those of the Pretonic and Tonic in the tone group, the Ictus and Remiss in the foot, and the Onset and Rhyme in the syllable. Systems of phonological cohesion, which were ascertained by correlating evolved interaction patterns of phonology with lexicogrammar, are those that signal the syntagmatic extent of lexicogrammatical units.[1]

Three strategies for effecting phonological cohesion were identified: demarcation, integration and concatenation, the latter two grouped as extension. Demarcation is the phonological delimiting of a lexicogrammatical boundary: initiality or finality. Integration is the phonological consolidation of a lexicogrammatical domain as a single unit. Concatenation is the phonological annexation of two or more lexicogrammatical units within a larger (lexicogrammatical) structure.

The second proposal concerns phonological structure as dynamic process. Phonogenesis, the phonological component of the text-making process, logogenesis, is conceptualised as a composite of phonogenetic fields: timescapes in which phonological form is created from position. The creation of form from position is accomplished by charging syntagmatic positions (quanta) with selected paradigmatic states (qualia).

Phonogenetic fields are vectorfields in as much as positions in them possess direction as well as magnitude. Direction is interpreted in terms of (endo)phoricity: the orientation of one position toward another local one, and magnitude was said to be given by the waves of prominence resulting from vocal tract periodicities: moraicity, stress and tonicity. These waves are measurements of the probability of syntagmatically locating the particle that is complementary to each wave: syllables, feet and tone groups, respectively. Such wave/particles are quantum disturbances in phonogenetic fields as quantum fields. Not all paradigmatic states can be mapped onto wave/particle structures; some less localisable states are better mapped instead onto charged field structures.

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[1] Articulatory cohesion can gather lexicogrammatical syntagms into words (or morphemes where there are evolutionary timelags in phonological erosion). Rhythmic cohesion also gathers lexicogrammatical syntagms, but not into meaningful units beyond those already identified by varying lexicogrammatical categories. Intonational cohesion, on the other hand, gathers lexicogrammatical syntagms into meaningful units that transcend the varying lexicogrammatical categories: into cycles of Given and New information.

The structures identified thus far are manifestations of the textual metafunction, though the paradigmatic state of any position can serve other metafunctions, as when, in English, the choice of tone in *intonation* structures expresses interpersonal meaning. In the next chapter, structure will be elaborated more delicately in terms of modification, manifesting the logical metafunction. This will occur as part of the larger purpose of Chapter 2 of integrating both major proposals for use in the description of Irish that follow in Chapters 3 and 4 (and of Australian English in the Appendix).