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*A declarative account of strong and weak auxiliaries in English**

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1 Introduction

This paper presents a declarative analysis of the phonology of English auxiliaries. The strong and weak forms of auxiliary verbs in English have generally been treated as either related derivationally (Zwicky 1970, Wood 1979, Selkirk 1984) or as lexically suppletive items (Kaisse 1985; this view is also implicit in traditional treatments of English phonetics, e.g. Jones 1960). The derivational treatment involves destructive processes, which Declarative Phonology eschews (Bird 1995, Coleman 1995). The treatment as separate lexical entries fails to address the commonalities observable in related forms such as [hav həv əv v] for *have*. This paper provides a declarative analysis of the relations between the multiple forms of English auxiliaries without derivation, and without suppletion. The analysis is based on a corpus as well as data from informants, and is formalised using a computationally tractable formalism. Many of the examples cited in the paper are taken from MARSEC (Roach *et al.* 1993), a machine-readable English corpus of material taken from BBC radio broadcasts during the 1980s. The dominant variety of English in MARSEC is 'standard', although in reality this merely means that there is a variety of accents represented which tend towards RP. The database provides natural material rather than idealised or specifically elicited material. As Rischel (1992: 381) notes: 'Phonology has been based on very exaggerated idealisations about the power of rule machinery as the format in which to take care of variation'. However, some of the structures needed in the analysis presented in this paper do not occur in MARSEC, so the natural material is complemented by material based on native informants.

The analysis is presented using a formalism commonly used in HPSG and other work in Declarative Phonology, namely ATTRIBUTE-VALUE MATRICES (AVMs). AVMs provide a way to formalise two of the basic

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theoretical constructs of Firthian Prosodic Analysis (Firth 1948, 1957, Robins 1957, Mitchell 1975): system and structure. The analysis presented relies crucially on the notion of polysystemic statement, which has its origins in the work of Firth (1948), Henderson (1948, 1949, 1951) and the Prosodic Analysts working at SOAS from the 1940s to the 1960s. Polysystematicity – the idea that language can be treated as consisting of many separate but interacting systems – is a notion which has recently found new relevance. In this paper I show how polysystematicity can be combined with a set of phonological constraints to generalise in insightful ways about English function words.

The paper has the following structure: after sketching some of the main properties of Declarative Phonology and motivating the analysis, I present a formal notation which explicitly encodes notions of system and structure; in §3, I explore the Firthian notion of polysystematicity, and show how this can be captured using the attribute-value matrices introduced in §2. In §4, I set out an analysis of the weak and strong form of English auxiliaries, and provide both phonological and syntactic arguments to motivate the division of the type V[AUX] into subtypes. In §5, I consider four systems of auxiliaries, and show their various forms and the relations between them.

The analysis I present shows that there are systematic phonological relations between strong and weak forms of auxiliaries. These relations can be stated declaratively, without the need for destructive rules. Instead, I show that it is possible to set up several systems on both syntactic and phonological grounds, and to state constraints on these systems.

2 Declarative Phonology

Declarative Phonology (DP) is a constraint-based phonology (Broe 1991, Bird 1995, Coleman 1995, 1997, Scobbie *et al.* 1996, Scobbie 1997). Constraints in DP are partial descriptions of possible structures. It follows that all structures in a language must conform to the descriptions (constraints) that apply to that language; some constraints are considered to be universal, others language-specific (Scobbie *et al.* 1996). Constraints are not defeasible, i.e. a constraint cannot be overruled. In this way, the constraints of DP are unlike those of Optimality Theory, where they can conflict and the conflict is resolved by ranking them so that some constraints are preferred over others (see Scobbie 1993, Clements 1995 for a discussion of the difference between the constraints of Optimality Theory and DP).

Two of the main characteristics of DP are:

(1) a. *Compositionality*

Operations on signs are constrained by a principle of compositionality (Partee 1984), which is also a principle of Firthian Prosodic Analysis (Ogden 1995).

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COMPOSITIONALITY (Bird & Klein 1994)
The phonology of a complex form can only be produced either by unifying or concatenating the phonologies of its parts.

b. *Monotonicity*
Monotonicity requires that information cannot be removed from representations, nor altered once incorporated into representations. Constraints are not ordered: they all apply simultaneously and are not ranked.

Compositionality and monotonicity make DP a formally constrained, restrictive theory, since they limit severely the kinds of operations that can be performed on structures. The application of constraints can be restricted to a particular domain. By using constraints that are highly specific to particular structures, it is possible to resolve some of the problems that seem to require rule ordering. For instance, Coleman (1995) provides a constraint-based reanalysis of Lexical Phonology which does not use rule ordering, but instead uses constraints which are specific to particular lexical classes. The prohibition against deletion or alteration of information presents another challenge to phonologists: how to handle cases where deletion or alteration of material seems inevitable.

The analysis of the phonology of English auxiliaries presented in this paper demonstrates how apparently destructive processes can be handled declaratively. The basic idea is that various phonological subsystems can be established on phonological and/or syntactic grounds; each subsystem has its own internally coherent structure, and a rather simple set of relations between various forms of auxiliaries within each subsystem stated. The analysis therefore addresses problems of phonological non-productivity in the English auxiliaries (Zwicky 1970, Selkirk 1984, Kaisse 1985) as well as handling phenomena which in process-based, derivational phonologies have to be accounted for by destructive rules such as /w/ → ∅ (as in *will* → *'ll*), or feature-changing rules of the kind that will change 'full' vowels into 'reduced' ones, such as /a/ → /ə/ (as in /kan/ → /kən/).

Bird (1995) proposes two methods for dealing with deletion in a constraint-based approach. These are:

(i) To propose a relationship whereby a segment alternates with zero, so that zero is an allophone of a segment. So a rule that says 'delete x in the context of y' can be declaratively recast as 'the allophone of x in the context of y is ∅'.

(ii) To search for phonetic detail which counters claims of complete neutralisation or deletion. In suggesting this approach, Bird cites Dinnsen (1985), who claims that 'every genuine phonological distinction has some phonetic reflex'. Bird also points out that Articulatory Phonology sometimes shows that gestures are not deleted, but 'hidden' or acoustically masked by other gestures.

These two strategies for dealing with deletions are complementary. The first one is essentially a phonological solution, while the second one is a phonetic solution. The second solution is an attempt to find evidence

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against deletion in the first place, so that it need not be countenanced as an analytic possibility. It seems plausible that in many cases the phonetic approach does work (e.g. Kelly & Local 1989, Manuel *et al.* 1992, Hawkins 1995, Manuel 1995) but to claim that there is *no* phonetic deletion ever is overly strong; hence (i) is a necessary alternative, for those cases where there is no clear evidence in the phonic material for e.g. a remnant gesture.

This paper argues for something akin to (i), and does so in a more elaborated and thoroughly polysystemic framework. Subtypes of auxiliary have particular constraints on their phonological shape; individual word forms conform to the phonological shapes imposed on them according to their subtypes.

2.1 Attribute-value matrices as a means of representation

The basic unit of representation adopted is the sign (Pollard & Sag 1987, 1994), which is composed of [ATTRIBUTE: *value*] structures, where a *value* can itself be an [ATTRIBUTE: *value*] structure, and where a feature structure can consist of more than one [ATTRIBUTE: *value*] pair.

(2) *General structure of attribute-value matrices*

$$_{avm}\begin{bmatrix} \text{ATTRIBUTE}_1\text{: } value_1 \\ \text{ATTRIBUTE}_2\text{: } \begin{bmatrix} \text{ATTRIBUTE}_3\text{: } value_3 \\ \text{ATTRIBUTE}_4\text{: } value_4 \end{bmatrix} \end{bmatrix}$$

Attributes and values are constrained according to the type of object they describe. For example, (3) has the appropriate attributes for a syllable:

(3) *Syllable structure*

$$_{syll}\begin{bmatrix} \text{ONSET: } onset \\ \text{RHYME: } rhyme \end{bmatrix}$$

Subscripts indicate the type of sign. Attributes appear in small capitals, and the values in italics where these refer to types. The notation *onset* in (2) indicates that the value of the attribute ONSET must be an object of type *onset*, and likewise for the rhyme. This ensures that a sign of type *rhyme* cannot be the value for the attributes of the onset, and so on. Attribute-value matrices (AVMs) are enclosed within square brackets [ ]. Angle brackets ⟨ ⟩ indicate an ordered list; curly braces { } indicate a set of choices (that is, a phonological system); parentheses ( ) indicate an optional element. The notation [ATTRIBUTE: (*value*)] is equivalent to two separate statements: [ATTRIBUTE: *value*] and [ATTRIBUTE: [ ]], where [ ] stands for the empty list.

Phonological signs form part of more general signs that contain other kinds of linguistic information. At the very least, I assume that signs contain syntactic and semantic information as well (Pollard & Sag 1994: 20).

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(4) *AVM for words*

$$_{word}\begin{bmatrix}\text{PHON: } & \textit{phonological} \\ \text{SYNSEM: } & \textit{syntactic/semantic}\end{bmatrix}$$

2.2 Operations on AVMs

Before presenting the analysis of English auxiliaries, I will show some examples of what AVMs can be used for, drawing out in particular the features that make them especially suited to the description of English auxiliaries: their ability to encode polysystematicity, and express relatively easily constraints between phonological form and other linguistic but not phonological factors. I will also show the kinds of operations that can be performed on AVMs, looking at two in particular: 'tagging', to show token-identity between values of different AVMs, and unification, a non-destructive combinatory process on signs.

2.3 Stating constraints on structures

Constraints on phonological terms in systems at given places in structure are expressed by stating what a well-formed structure is. For instance in Finnish, onsets may not branch. This can be expressed by a simple statement such as that in (5), which describes the permissible onsets of Finnish:

(5) *Finnish onsets*

$$_{onset}[([\text{CONSONANT: } \textit{consonant}])]$$

Codas in Finnish may branch, but only in the first syllable of a word in a disyllabic foot. Since the first foot of the word is the head of the word, and the first syllable the head of the foot, the constraint can be expressed as in (6), where heads are values of the feature HEAD-DTR (head daughter), and complements (i.e. non-heads) are values of the feature COMP-DTRS (complement daughters).

(6) *Finnish branching codas*

$$\left[\begin{array}{l}\text{HEAD-DTR: } \left[\begin{array}{l}\text{HEAD-DTR: } \left[\begin{array}{l}\text{HEAD-DTR: } \left[\begin{array}{l}\text{HEAD-DTR: } \textit{nucleus} \\ \text{COMP-DTRS: } \left\langle \left(_{coda}\left[\left[\left[\begin{array}{l}CONS: C_i \\ (CONS: C)\end{array}\right]\right]\right]\right)\right\rangle\end{array}\right]_{rhyme} \\ \text{COMP-DTRS: } \langle onset \rangle\end{array}\right]_{syll} \\ \text{COMP-DTRS: } \langle syllables \rangle\end{array}\right]_{foot} \\ \text{COMP-DTRS: } \langle feet \rangle\end{array}\right]_{word}$$

Despite the superficial differences between the two constraints, the two of

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them differ only in the amount of information that they encode, with the statement for onsets more general and the statement for codas quite specific.

2.4 Information sharing

It is possible for values in signs to be shared by more than one sign. Such information sharing is shown by tags, in this paper presented as numbers in circles, written in front of the relevant attribute-value structure. Tagging indicates a forced (i.e. not accidental) identity of two or more items, and can thus be used to model effects more conventionally described as spreading. For example, in English, morpheme-internal nasal + plosive clusters are homorganic. This can be represented as in (7), where the PLACE attributes of the two coda slots have the same value.

(7) *Agreement of* PLACE *features in English codas*

$$\textit{coda}\left[\left\langle\left[\text{CONSONANT}:\left[\begin{matrix}\text{MANNER}:\textit{nasal}\\ \textcircled{1}\text{PLACE}:\alpha\end{matrix}\right]\right],\left[\text{CONSONANT}:\left[\begin{matrix}\text{MANNER}:\textit{plosive}\\ \textcircled{1}\end{matrix}\right]\right]\right\rangle\right]$$

This describes /ŋk nt mp/ and rules out */ŋp ŋt .../, etc., because in these latter cases the values of 'place' would not be identical. (In fact, such clusters just could not be described if (7) were the only description of permissible codas in English.) Whether [PLACE: α] appears in the first or second slot of the coda makes no formal difference to the tagging. Tagging indicates structure sharing, or token identity, so as long as both attribute-value pairs are tagged to the same object, they will always be identical, regardless of where the full information is stated in the AVM. In the AVMs for the English auxiliaries presented in §5, tagging is used extensively to indicate token identity between places in structure for varying forms of the same auxiliaries in different systems.

2.5 Unification of signs

Two signs UNIFY if (a) they describe the same entity and (b) they do not contain mutually incompatible information. The result of unifying two signs is a new sign which contains information from the signs it is composed of. For example in (8), (a) describes a rhyme, but contains information only about the nucleus. (b) describes a rhyme also, but only contains information about the coda. (a) and (b) do not contain mutually

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incompatible information, and can therefore be unified to produce (c), which is a more complete description of a rhyme:

(8) *Unification of AVMs*

a. *Partially specified rhyme*

$$\textit{rhyme}\begin{bmatrix}\text{HEAD-DTR: } \textit{nucleus}[\text{VOWEL: } \text{ɑ}] \\ \text{COMP-DTRS: } \langle[\ ]\rangle\end{bmatrix}$$

b. *Partially specified rhyme*

$$\textit{rhyme}\begin{bmatrix}\text{HEAD-DTR: } [\ ] \\ \text{COMP-DTRS: } \langle \textit{coda}[\text{CONSONANT: d}]\rangle\end{bmatrix}$$

c. *The unification of (8a) and (8b)*

$$\textit{rhyme}\begin{bmatrix}\text{HEAD-DTR: } \textit{nucleus}[\text{VOWEL: } \text{ɑ}] \\ \text{COMP-DTRS: } \langle \textit{coda}[\text{CONSONANT: d}]\rangle\end{bmatrix}$$

d. *AVM with information incompatible with either (8a) or (8b)*

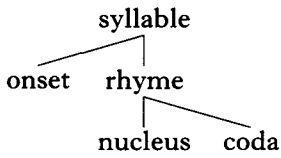
$$\textit{rhyme}\begin{bmatrix}\text{HEAD-DTR: } \textit{nucleus}[\text{VOWEL: i}] \\ \text{COMP-DTRS: } \langle \textit{coda}[\text{CONSONANT: z}]\rangle\end{bmatrix}$$

However, (d) will not unify with (a), since it contains mutually incompatible information in the nucleus: the vowel /i/ is not compatible with /ɑ/, although the coda of (d) is compatible with the coda of (a), which contains the empty list [ ], which unifies with anything.

2.6 Syllable structure

The model of syllable structure adopted here (9) is based on Fudge (1969, 1987), augmented by the principle of headedness (Anderson & Ewen 1987, Coleman 1992, Piggott & van der Hulst 1997). Further illustrations of how this model is applied to the phonology and phonetics of English can be found in Coleman (1995), Local (1992) and Local & Ogden (1997).

(9)



In the graph, vertical lines express headedness, so that the rhyme is the head of the syllable, and the nucleus is the head of the rhyme. Slanting lines represent complements. The head–complement distinction is handled in a way similar to that used in HPSG. One attribute of the syllable is the HEAD-DTR, which must contain a sign of the type *rhyme*; another attribute is COMP-DTRS, which contains a list of signs which

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constitute the complement of the syllable; this list may be empty. *Mutatis mutandis*, rhymes, feet, words, etc., are represented in the same fashion.

The syllable also has an attribute HEAD-FEAT(URE)S, which contains information about the syllable as whole. (This means that phonological contrasts can be expressed as non-terminal nodes, in common with Firthian Prosodic Analysis, as I have argued elsewhere, Local & Ogden 1998, Ogden 1999.) The value of this attribute must be the same as the value of the HEAD-FEATS of the HEAD-DTR (the Head Feature Principle, Pollard & Sag 1987: 58ff, 1994: 31ff, Broe 1991, Ogden 1999). The syllable, then, is described by the AVM in (10a). AVMs for child nodes of the syllable are given in (10b–d):

(10) *Syllables and syllable constituents*

a. *AVM for the syllable*

$$_{syll}\begin{bmatrix}\text{HEAD-FEATS: } \textit{features}\\ \text{HEAD-DTR: } \textit{rhyme}\\ \text{COMP-DTRS: } \langle \textit{onset} \rangle\end{bmatrix}$$

b. *AVM for the rhyme*

$$_{rhyme}\begin{bmatrix}\text{HEAD-FEATS: } \textit{features}\\ \text{HEAD-DTR: } \textit{nucleus}\\ \text{COMP-DTRS: } \langle \textit{coda} \rangle\end{bmatrix}$$

c. *AVM for the onset*

$$_{onset}[\langle[\text{CONSONANT: } \textit{consonant}]^{0-3}\rangle]$$

d. *AVM for the coda*

$$_{coda}[\langle[\text{CONSONANT: } \textit{consonant}]^{0-2}\rangle]$$

3 Polysystematicity

One of the most striking properties of the analyses proposed in this paper is the fact that they are polysystemic. The idea stems from Firth (1948) and Henderson (1948, 1949, 1951), as well as the work of other Firthian phonologists, who show that language is best treated as a set of interacting systems, rather than one monolithic system or inventory ('un système où tout se tient', as Firth 1948 – and elsewhere – quotes Meillet). The work in this paper draws on Firthian work, which like DP is a theory of representations rather than a theory of processes.[1]

[1] It is striking, for example, that Firth (1957) has a polysystemic account of variant forms of the same morpheme. Rather than derive one allomorph from another, he proposes instead different systems with a different form possible in each one. This makes Firth's analysis essentially declarative. He establishes the auxiliaries of English as a separate system on this basis.

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In Firthian linguistics, it is an expectation that several systems will have to be set up for the most cogent analysis. Systems are of many kinds and at many levels. Some examples are: syllable-initial *vs.* syllable-final systems (Henderson 1948); systems based on word-internal morphological structure (Palmer 1955); systems of syllable junctions (Carnochan 1957, Sprigg 1961) or systems of loanwords *vs.* native vocabulary (Henderson 1951). A consequence of the Firthian approach is that analyses in this tradition – unlike contemporaneous phonemic analyses – see 'grammar' (essentially other levels of linguistic description) as central to conducting phonological analysis (Firth 1957), since establishing phonological systems is commonly done with reference to non-phonological systems. What in contemporaneous approaches was treated as allomorphy was in Prosodic Analysis treated by means of phonetic exponency with regard to the system and structure within which a phonological term was situated.

While there are some problems arising from polysystematicity (not least of which is the number of systems allowed), it leads to some insights that are nowadays widely accepted, and many of the phonological subsystems that modern phonologists posit are virtually identical to those proposed by the Firthian phonologists a generation before them.

Inkelas (1996) shows that by adopting 'cophonologies', it is possible to do away with cyclical application of rules. (This finding is almost the same as that of Coleman 1996, working in a different framework.) Itô & Mester (1995) show that in Japanese, a number of subsystems can be established, and membership of each class determines what phonological constraints apply to them, a finding prefigured by Henderson (1951). McCarthy & Prince (1995) show that stems and affixes have different phonological properties, which is a possible prediction of the Firthian approach.

The analysis in this paper draws heavily on the Firthian tradition, and formalises the Firthian notions of 'systems of contrast' at 'places in structure' using the sign-based notation introduced in §2.[2] Like DP, Prosodic Analysis is a theory largely concerned with representation, rather than with rules (Anderson 1985, Broe 1991).

Auxiliaries in English form a system with its own phonological characteristics, as well as its obvious syntactic properties. By adopting a polysystemic analysis, I will show that a declarative non-destructive analysis of relations between word-forms such as /hav həv əv v/ for *have* is possible. Why should this be desirable?

One of the enduring problems of phonology is to account for items which have varying phonetic shapes but which at some other level of linguistic analysis count as the same thing. A good example of this is the morphophonology of English, where it is generally assumed that forms such as *electric*, *electricity* and *electrician* have at some level the same affix

[2] While not wishing to deprecate other traditions, Firthian Prosodic Analysis has had direct influence on Declarative Phonology (Broe 1991, Coleman 1992, 1996, Local 1992, Ogden 1993, 1995, 1999, Scobbie *et al.* 1996, Local & Ogden 1998).

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ic which happens to have the phonetic shapes [ɪk ɪs ɪʃ]. Much of modern phonology and morphology has dealt with precisely this issue.

DP shares the same concern to have a parsimonious phonological description despite several phonetic forms. In fact, the data in this paper and the resulting analysis depends on the assumption that such an analysis is possible and desirable.

Using the mechanism of tagging, it is possible to indicate that certain properties of a description of a linguistic object must be identical to other properties in another sign. Thus in a sign-based approach, the overall linguistic architecture is not just hierarchical, but also a network. Part of the task of linguistics becomes to situate a particular linguistic item within the wider network. I will show that the strong and weak forms of English auxiliaries are not suppletive allomorphs, as Kaisse (1985) claims, but are phonologically related. In a polysystemic framework, the question of productivity of processes (or relations between signs) has to be reframed as a question of the domain of constraints (or, equivalently, descriptions of structural well-formedness), i.e. a statement of which systems and subsystems a particular constraint applies to.

As noted above, polysystematicity can be understood as a general principle that different systems of contrast are available at different places in structure. In other words, different constraints apply to different linguistic structures. This view can easily be captured using AVMs, as I have shown in §2. (11) describes a well-formed rhyme containing a short vowel in a stressed syllable in English.

(11) *AVM for strong syllables with short vowels in English*

$$\left[\begin{array}{l}\text{HEAD-FEATS: [STRONG: +]} \\ \text{HEAD-DTR: } \left[\begin{array}{l}\text{HEAD-DTR: } {}_{nucleus}\left[\begin{array}{l}\text{HEAD-FEATS: [LONG: }-\text{]} \\ \text{VOWEL: \{ɪ ɛ a ʌ ɒ ʊ\}}\end{array}\right] \\ {}_{rhyme}\left[\text{COMP-DTRS: } \left\langle {}_{coda}\left[\left\langle [\text{CONSONANT: } \textit{consonant}] \right\rangle\right] \right\rangle\right]\end{array}\right] \\ {}_{syll}\left[\text{COMP-DTRS: } \langle \textit{onset} \rangle\right]\end{array}\right]$$

(11) can be read as a constraint that says 'a well-formed strong syllable can consist of a nucleus containing a short vowel (one of /ɪ ɛ a ʌ ɒ ʊ/) and a consonant in the coda'. (11) is a statement of the vowel system in a strong syllable with a short nucleus. If the value of STRONG is '−' instead, the set of choices (i.e. the available system of contrast) for the values of the nucleus is different. AVMs, in defining well-formed structures, make reference to both system and structure (including where needed syntactic structure) and thus encode polysystematicity inherently.

In general, a derivational rule that makes reference to structure can be cast declaratively as a disjunction of permissible structures. A derivational

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rule such as $/a/_{\text{stressed}} \rightarrow /ə/_{\text{unstressed}}$ can be recast declaratively as two separate statements, one describing the possible vowels of stressed syllables, and another describing the vowels of unstressed syllables. The declarative analysis does not treat one vowel as primary and the other as derived from it: it treats the two vowels as forming parts of different contrastive systems at different places in structure. The declarative analysis, then, makes the explicit claim that different places in structure license different systems of contrast (see also Goldsmith 1990, Harris 1997, Scobbie 1997 for similar views).

Constraints on phonological structure need not, of course, be purely phonological. In many cases, constraints on phonological structure – or, more particularly, constraints on phonological systems at specific places in structure – make reference to 'grammatical' (i.e. linguistic, but not phonological) categories. A good example of this is word-initial consonant mutation in Welsh and Irish, which is sensitive to noun gender. It is well known that in many languages the constraints on well-formed minimal words are different for (open) lexical systems than for (closed) functional systems, and different processes apply to function words, including auxiliaries (McCarthy & Prince 1995: 324, Iivonen 1996: 110, Casali 1997: 495f, 503).

Finnish provides a good example of functional items meeting different structural constraints from lexical items. If monosyllabic, all noun, adjective and verb stems are minimally of the form CVV (12a). Other monosyllabic stems do exist, but not as nouns, adjectives or main verbs (12b).

(12) a. saa 'get (V)'
suo 'bog (N)'
sää 'weather (N)'
syö 'eat (V)'

b. en NEG + 1SG (V[AUX])
ja CONJ
se PR + 3SG
me PR + 1PL
jos 'if'
kun 'when'

The functional items in Finnish form phonological words, since they do not (unlike clitics) undergo alternations conditioned by vowel harmony, whose domain is the phonological word. This indicates that the function words form independent phonological words and different constraints on their minimal forms apply to them than to open-class items.

There is evidence, then, that some phonological constraints make reference to linguistic structure which is not phonological. This is also true of the English auxiliaries. I will argue that while they are types of weak syllable, their various forms are related in ways which are peculiar to the auxiliaries as a system. In particular, they form their past tense forms in untypical ways, and they distinguish two types of onset.

The analysis I present holds only for the auxiliaries of English, although it may be that some elements of it could be useful in the analysis of other

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words of English with weak forms, or that other languages contain similar systems and subsystems established along the same lines as those set up for English. The AVMs I present are intended to be contained within the signs of the form at (13). I will concentrate on the contents of PHON, and take SYNSEM pretty much for granted.

(13) *AVM for words*

$$_{word}\begin{bmatrix}\text{PHON:} & \textit{phonological} \\ \text{SYNSEM:} & V[AUX]\end{bmatrix}$$

V[AUX] is an abbreviation for a more complex sign (Pollard & Sag 1987: 202ff), the details of which are not relevant in this paper. The PHON attribute contains phonological information. Two kinds of information are represented in such signs (14) (see also Bird & Klein 1994):

(14) *Structure of phonological information*

$$_{phon}\begin{bmatrix}\text{SEGS:} & \langle \textit{list-of-terminal-elements} \rangle \\ \text{PROS:} & \textit{prosodic-structure}\end{bmatrix}$$

SEGS makes the content of the AVM easier to read; but more importantly it is a list of feature bundles (abbreviated for the most part as familiar phoneme-style atoms, for convenience) which makes it easier to capture adjacency effects. PROS contains hierarchically organised information, using a prosodic hierarchy. This will not be discussed in much detail, as it is not central to the aims of this paper. (However, as will be seen, there are some complex issues concerning the place in the prosodic hierarchy of some forms of the auxiliaries.) The syllable is a unit in the hierarchy, and an important one in the analysis of the auxiliaries.

A sign of the type *phon* is well-formed if all the material in SEGS is incorporated into PROS, and *vice versa* (Bird & Klein 1994).

4 Strong and weak forms of English auxiliaries

4.1 Analysis of strong and weak forms of English auxiliaries

It is well known that many English words have what are traditionally called 'strong' and 'weak' forms. The set of items generally accepted as having two forms goes back at least as far as Sweet (1890), and is given in many textbooks on English pronunciation (e.g. Ward 1948, Jones 1960, Roach 1983, Gimson 1989).

There are in general two treatments of the relationship between strong and weak forms in English. One is to treat the weak forms as derived from the strong forms by processes of consonant deletion and/or vowel reduction (e.g. Zwicky 1970, Wood 1979, Selkirk 1984). The other is to treat the various forms as suppletive allomorphs. Kaisse (1985) does this

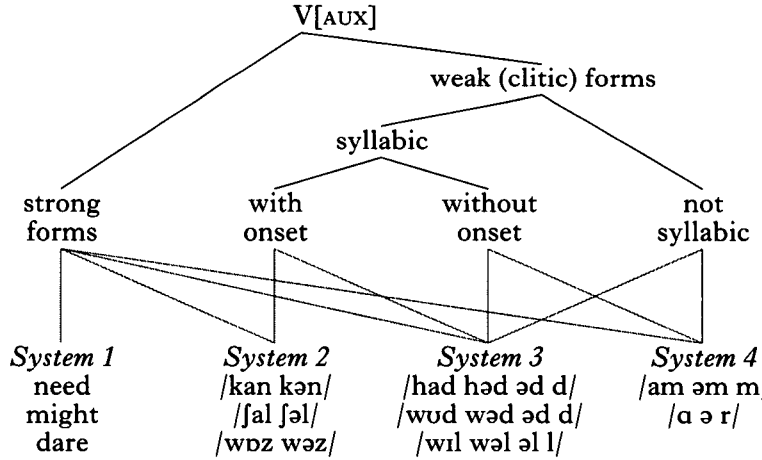
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on the basis that the syntactic distribution of the weak and the strong forms (primarily of *is*) is different.

The analysis where strong and weak forms are related by rule has the weakness that the rules of *h*-deletion (to relate /haz həz/ and /əz/) and *w*-deletion (to relate /wɪl wʊd/ and /əd/) apply to a restricted set of words unproductively. The more significant problem for DP is that *h*-deletion and *w*-deletion are destructive processes and therefore are not possible operations. The other approach – that of suppletion – on the other hand, loses sight of the relations which do exist between the strong and weak forms: if /wɪl/ ~ /əl/ are suppletive allomorphs, they do not exhibit the kind of total suppletion of /gəʊ/ ~ /wɛnt/.

The polysystemic analysis developed here captures consistent phonological relations between related forms. At the same time, these relations hold only within a given system, and a statement about auxiliaries need not be a statement with implications for the whole of English phonology. The hierarchy of types proposed in the analysis is as given in (15). The topmost level is the most general one; subtypes appear at lower levels. All subtypes inherit properties of their type, so all the types in (15) have properties of auxiliaries, and all the subtypes of weak (clitic) forms have properties of this type. At the bottom of the diagram are instances of actually occurring words, connected to specific nodes in the hierarchy. Subsequent sections of this paper argue for the analysis summarised in (15) and present it in a more formal notation using attribute-value matrices. An important advantage of the analysis I propose is that makes it possible to make statements to relate forms like /wɪl/ and /əl/ which have generality within the system, but not beyond it.

(15) *Hierarchy of types of V[AUX]*



Some of the general problems for an analysis of the weak forms of English auxiliaries are:

(i) which auxiliaries have strong/weak forms;

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(ii) how much of the strong/weak relation is structure-bound and how much is due to more general connected speech processes, or lexical exceptionality;

(iii) the distribution of the syllabic and non-syllabic clitic forms;

(iv) the incorporation of clitic forms within higher-level prosodic structure.

The next sections explain the analysis of (15) in more detail, and present phonological and/or syntactic arguments for it.

4.2 Strong forms

The first division to make in providing a phonological analysis of V[AUX] is between strong forms and weak forms. This division is robust and easy to make on both phonological and syntactic grounds.

The strong forms are prosodically independent, i.e. they form possible independent prosodic words and can be pronounced separately, for example as citation forms. Consequently they have properties of strong (stressed) syllables, including 'full' vowels (long vowels, diphthongs, or one of /ɪ ɛ a ʌ ɒ ʊ/, but not /ə/). The strong forms occur utterance-finally, while the weak ones cannot (16).

(16) You said you hadn't bought any, but I thought you [had/ *həd/*əd/*d].
Bill didn't come, but Peter said he [wʊd/*wəd/*əd/*d].

Strong forms can form a negative with *n't*, but weak ones cannot (17a); and strong and weak forms are not always syntactically equivalent ((17b), from Kaisse 1985):

(17) a. wʊdnt *((w)ə)dnt
ɑ:nt *ənt
wɒznt *wəznt
kɑnt *kənt

b. There's a book just been published.
*There is a book just been published.
Where's the lions?
*Where is the lions?

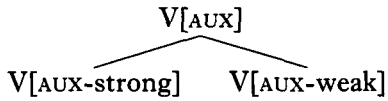
The general shape of strong auxiliaries is as in (18). Because of the distinct syntactic distribution of auxiliaries, I analyse them as having (at least) two syntactic subtypes (19):

(18) *AVM for strong forms*

$$\begin{bmatrix} \text{PHON } |\ldots|: \begin{bmatrix} \text{HEAD-FEATS: [STRONG: +]} \\ \text{HEAD-DTR: } \textit{rhyme} \\ \text{COMP-DTRS: } \langle \textit{onset} \rangle \end{bmatrix}_{syll} \\ \text{SYNSEM: } V[\textit{AUX-strong}] \end{bmatrix}_{word}$$

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(19)



4.3 Weak forms

Weak forms are prosodically deficient (Booij 1995, 1996): that is, they are clitics, syllables which cannot stand alone as prosodic words but which need a host to attach to. As can be seen from (15), the present analysis proposes subtypes of clitic for English auxiliaries.

All the syllabic clitics in English are part of a metrically weak syllable. Metrically weak syllables, being in non-head structural positions, contain a reduced vowel system, which in the case of the auxiliaries is {/ə ɪ/}, though /ɪ/ only occurs in *did* and *is*, if these are assumed to have a weak form identical to the strong form.[3] The AVM in (20) describes the clitic forms of English auxiliaries in general. Because the clitic forms may be syllabic or non-syllabic, they are best defined as not being strong syllables. They cannot be defined as weak syllables, because the non-syllabic clitics can attach to strong syllables.

(20) *AVM for weak forms*

$$\begin{bmatrix} \text{PHON} \mid \text{PROS} \mid \text{WORD} \mid \text{FOOT} \mid \neg \begin{bmatrix} \text{HEAD-FEATS: [STRONG: +]} \\ \text{HEAD-DTR: } \textit{rhyme} \\ \text{COMP-DTRS: } \langle \textit{onset} \rangle \end{bmatrix}_{syll} \\ \text{SYNSEM: } V[\textit{AUX-weak}] \end{bmatrix}_{word}$$

4.4 Syllabic forms

The major division in clitic types is between syllabic and non-syllabic clitics (Palmer 1988: 240f, Spencer 1991: 383). The syllabic clitics can be subdivided into clitics with onsets and clitics without onsets. The onsetless syllabic clitics all have non-syllabic congeners. All the onsetless clitics have a corresponding non-syllabic clitic form.

The onsetless clitics have the form /əC/, where C can also be (r), i.e. a linking *r* which has the phonetic exponents [rhoticity] and [approximation] only before a vowel.[4] The syllabic clitics /əd əl əv əz ə(r)/ occur with non-

[3] Some researchers consider these verbs to have weak forms (e.g. Kreidler 1989), but in British English there are no criteria by which to differentiate between the strong form and the weak syllabic form, since the vowel of *is* and *did*, /ɪ/, occurs in strong and weak syllables. In the analysis presented, I make provision for a weak form of *is* and *did* in which the vowel is [ɪ], identical to the strong form; but there is an argument for treating these verbs as having only two forms: strong and non-syllabic.

[4] The treatment of linking and intrusive *r* is not developed in any detail. For the sake of simplicity, I have treated (r) as being one of the terms of the coda system, so that the non-rhotic variety described here looks more like a rhotic variety. Having (r) in

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pronoun hosts, while the non-syllabic clitics, except /s ~ z/, must have pronoun hosts. This can be shown with reference to linking-*r* behaviour in non-rhotic varieties of British English (based primarily on middle-class speakers with 'modified northern' accents from the North West and Yorkshire).[5] The examples in (21) demonstrate this:

(21) a. /pitəd laɪk ðat/ Pete'd... *Peter'd...
b. /pitəɹəd laɪk ðat/ Peter'd...

(21a) has to be parsed as pit] əd], while (b) has to be analysed as pitə(ɹ)] əd], with linking *r*. Intrusive *r* can also be found in these structures:

(22) /ʃiləɹəd laɪk ðat/ Sheila'd....

If the non-syllabic forms were possible, then (21a) would be ambiguous between *Pete'd* and *Peter'd*, which is not possible for standard British English. The same comments also apply to the other syllabic clitics.

Some (rhotic) speakers claim that forms such as *Sheila'd* – i.e. a vowel-final host without linking *r* – can be disyllabic (/ʃiləd/). Speakers of non-rhotic varieties are less comfortable with such forms. They may be explained by the simple coalescence of [-ə.ə-] to [-ə(ˑ)-].

A second piece of evidence for the syllabicity of these clitics comes from comparison with past-tense forms with possible linking *r*:

(23) Colour /kʌlə/ the picture in!
Colour it /kʌləɹɪt/ in!
I've coloured /kʌləd/ it in.

The suffix *-ed* is not syllabic and so does not induce linking *r*. The clitic form *'d* does induce linking *r*, implying that the clitic has to be syllabic and does not get incorporated into the word in the way that *-ed* does (24):

(24) This colour'd /kʌləɹəd *kʌləd/ look nice in the kitchen.

A third piece of evidence for the syllabicity of these clitics is their behaviour when they follow a consonant with which they would form an acceptable coda cluster (25):

(25) Jill'd /ʤɪləd *ʤɪld/ be happy to see you.
John'd /ʤɒnəd *ʤɒnd/....

Both /ld/ and /nd/ are of course good coda clusters, but in these cases are

---

the coda highlights the fact that linking *r* is a property of the word of which the syllable containing coda *r* is a part. This analysis also implies that linking *r* and intrusive *r* before vowels must be ambisyllabic (i.e. an onset and a coda simultaneously). See Bird (1995) for a more detailed declarative treatment of /ɹ/ in a non-rhotic variety.

[5] One non-rhotic informant (from Tyneside) can produce *Peter'd* without linking *r*, but the vowel in the unstressed syllable is noticeably backer than in his production of *Pete'd*; more research is needed on this.

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not possible: this is because the clitic has to be syllabic when the host is not a pronoun.

4.5 Syllabic forms with and without onsets

Syllabic clitic forms of auxiliaries fall into two subsystems. One system has the structure Cə(C(C)) – i.e. a non-null onset – and the other system has the structure əC – i.e. a null onset. The two systems are straightforwardly relatable to the strong forms they correspond to: the clitics with null onsets are related to strong forms with non-obstruent onsets (or no onset, in the case of *am*, *is* and *are*), and the clitics with non-null onsets are related to strong forms with obstruents:

(26)	kan	kən	had	(h)əd
	du	də	has	(h)əz
	ʃal	ʃəl	wɪl	(w)əl
	ʃʊd	ʃəd	wʊd	(w)əd
	mʌst	məs(t)	am	əm
	hav	(h)əv	a(r)	ə(r)

Five items – the three forms of HAVE along with *will* and *would* – have auxiliaries in both systems, and can appear with or without onsets. No present tense forms of BE occur with onsets. The past tense forms *was* and *were* always occur with lip-rounding. This makes *was* and *were* exceptional, compared to *will* and *would*.

Pierrehumbert & Talkin (1992) found that the magnitude of the laryngeal gesture for [h] in English varies according to prosodic context. On this basis, it might be argued that there is no clear dichotomy between forms of HAVE with and without an onset. However, Pierrehumbert & Talkin's data are lexical items, not function words for which two distinct forms are generally conventionalised. In connected (non-rhotic) British English, /h/ and /r/ are in complementary distribution in linking together function words (Nolan 1996):

(27) I did it for him [fə{ɹ h}ɪm].

The presence or absence of linking *r* in such structures is not gradient. This fact implies that whatever the strength of the phonetic exponents of /h/, its phonological presence or absence is categorical, not gradient; so establishing two forms of HAVE, one with an onset and one without, is well-founded.

Why should *was* and *were* always retain rounding? The answer lies in the way in which present and past tense are marked in the English auxiliary system (Simpson 1992). The transparently present/past tense pairs are (28):

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(28)

present	*past*
do	did
can	could
have, has	had
will	would
is	was
are	were

Will and *would* have been included on the basis of their behaviour in reported speech:

(29) I will do the cleaning.
I said I would do the cleaning.

There are two main observations to make about the present *vs.* past tense forms in (28):

(i) The past tense forms of DO, CAN, HAVE and WILL end in /d/. BE is unique in that the present and past tense forms end in /z/ (*is*, *was*) or /(r)/ (*are*, *were*) in both the present and the past tenses.

(ii) DO, CAN and WILL exhibit a polarity of [±round], so that if the vowel of the present tense is [αround], then the vowel of the past tense is [−αround]. BE is similar, but the details are different: in the present tense, its forms have an empty onset, but in the past tense the onset contains the labiovelar approximant /w/.

BE is the only auxiliary verb in the system to use neither the resources of syllable-final /d/ nor [±round] polarity in the nucleus.[6] By analogy with the rest of the paradigm, we would expect the following:

(30)

wʊd	hav	wɒz	C_1VC_2
wəd	həv	wəz	$C_1əC_2$
əd	əv	əz	$əC_2$
d	v	z	C_2

Losing /w/, in the case of *was*, means losing the only thing which marks tense for the finite forms of BE, so that the hypothetical non-syllabic clitic

[6] The British English strong form of *was* is /wɒz/, with a rounded vowel. This vowel is however predictably [+round]: open vowels after /w/ are always [+round] unless followed by a velar: *what* /wɒt/, *wash* /wɒʃ/, *want* /wɒnt/, but *wax* /waks/, *wag* /wag/, *wangle* /waŋgəl/. The [±round] contrast is neutralised after /w/, so the /ɒ/ vowel in *was* need not be lexically specified with a value for [round]. In Firthian terms, this presents an argument for treating labiovelarity as a prosody of the syllable, because /w/ has implications over the whole domain.

A more radical solution to the problem (similar to that proposed by Simpson 1992), is to treat /w/ in *was/were* as phonologically different from *would/will* by allotting /w/ in *would* and *will* to an 'onset prosody' (cf. Henderson 1949), and doing likewise for initial /h/ that is variably present or absent. In this way, *would*, *will*, *have*, *has* and *had* would have the structure $^{w/h}$VC, and *was* and *were* CVC, making them like *can* and *shall*, i.e. without a weak form with no onset, and making *would*, etc., like *am*, *are*, etc. The prosodic term would be obligatorily present in strong syllables and potentially absent in weak syllables, and this presence/absence would form the basis for treating /w/ and /h/ as prosodic as opposed to phonematic.

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forms of *was* and *were* /z (r)/ would be identical to the non-syllabic clitic forms of the present tense, *'s* and *'re*.

Non-syllabic forms of *was* can frequently be observed in normal speech.[7] When such forms occur, they contain front rounded vowels:

(31) ø̃z 'it was'
ʃyz 'she was'
aʉz 'I was'

One explanation of these and other similar forms is that labiality marks the past tense, and although these words have lost much else in normal speech (including syllabicity), they retain labiality (which marks tense) and friction (which marks number). Forms like these provide evidence that speech is informationally rich (Hawkins 1995) and provide evidence against the idea that connected speech processes necessarily destroy information (cf. Nolan 1996).

The exceptionality of *was* and *were* is an indication that the clitics with and without onset are phonologically motivated, and not the result of a casual speech process which drops /w/: connected (postlexical) speech processes would be expected to apply across the board, including to *was* and *were*. While the possibility of *h*-dropping in Standard British English can be connected to the absence of stress (e.g. /haz, *az/), the same is not true for /w/. Since a more general statement about (C_1)əC_2 can be made where C_1 = a non-obstruent, and the exceptionality of *was/were* can be explained paradigmatically (i.e. with reference to systemic contrast), this analysis is preferable. *Was* and *were* may be exceptional, but the poly-systemic account of auxiliaries provides a plausible explanation for their unexpected behaviour: if they were regular, the {PRESENT/PAST} distinction would be lost.

The AVM for syllabic clitic forms is given in (32). The onsetless forms have the empty list [ ] in the onset.

(32) *AVM for syllabic clitic forms*

$$\left[\begin{array}{l}\text{HEAD-FEATS: [STRONG: } -\text{]} \\ \text{HEAD-DTR: } \left[\begin{array}{l}\text{HEAD-DTR: } {}_{nucleus}\left[\begin{array}{l}\text{HEAD-FEATS: [LONG: } -\text{]} \\ \text{VOWEL: } \{\text{ə ɪ}\}\end{array}\right] \\ {}_{rhyme}\left[\text{COMP-DTRS: } \left\langle {}_{coda}\left[\langle[\text{CONSONANT: } \textit{consonant}]\rangle\right]\right\rangle\right]\end{array}\right] \\ {}_{syll}\left[\text{COMP-DTRS: } \left\langle {}_{onset}\left[\langle[\text{CONSONANT: } \textit{consonant}] \vee [\ ]\rangle\right]\right\rangle\right]\end{array}\right]$$

[7] In material collected in Buckie (North Eastern Scotland) as part of a variationist study, forms of *was* and *were* are very commonly, if not normally, non-syllabic (Atkins 1998), the phonetic exponents of rounding having extent over the whole syllable, including the fricative portion of *was*.

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4.6 Non-syllabic clitic forms

The non-syllabic clitics have the form C, where C has to be one of {/m v l d s ~ z (r)/}. If a verb has a syllabic onsetless clitic form, it also has a non-syllabic clitic form, where C of the non-syllabic clitic is token-identical to the coda consonant of the syllabic clitic. With the exception of /s~z/, the non-syllabic clitics attach only to pronouns. The non-syllabic clitics have a more restricted syntactic distribution than the syllabic clitics; /s~z/ also has a different syntactic distribution from its full form, although in the opposite direction. (33a–c) contains examples of pronoun + clitic forms for *we're*, *you're* and *they're*. (d) contains examples of *I'm*. (e) illustrates that the non-syllabic clitics cannot have a noun as host.

(33) a. [we̲] told [wəɹ] all
[wɵ] virtually... [wɵɹ] OK
[we̲] not [wəɹ] assured
b. [jɵ] right [jɔ] late
[jə] fiddling if [jɔ] black
[jʏ̈] clearly
c. [ðə] not [ðəɹ] all
[d̲ə] hoping and [n̪əɹ] often
d. I'm {[aɪm aɪŋ am aŋ]} going home.
I'm {[aɪm aɪn am an]} not sure.
e. The children had /had (h)əd *d/ eaten all their sweets.

Note the assimilation of /m/ in the 1st person singular. Word-final /m/ does not normally assimilate in English, whereas word-final /n/ frequently does (Jones 1960, Gimson 1989).

(34) lime green [-m g-, *-ŋ g-]
ten green bottles [-{n, ŋ} g-] [-{n, m} b-]
I'm going home. [-{m, ŋ} g-]
I'm not coming. [-{m, n} n-]

The assimilation in *am* is parallelled by assimilation of /m/ in *from*, where /-m/ can assimilate to at least a following dental:

(35) set apart [fn̪ʸ·ə] world

At first sight, it seems appealing to explain the assimilation of /m/ as a connected speech process. However, the assimilation of /m/ in lexical items does not regularly occur, even in quite common compounds: *ha*[m/*n] *sandwich*. This implies that assimilation processes may be sensitive to the coda systems, which may be different in functional items from in lexical items.

This behaviour of /m/ word-finally at least in the auxiliary system might be explained by the fact that within the system of non-syllabic clitics, /m/ is the only nasal, and so nasality might be its most salient property with labiality less important. In the lexical system, on the other

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hand, the place of articulation for /m/ *is* contrastive, since it distinguishes lexical items such as *lime/line*, *dime/dine*, etc. (Kelly & Local 1989).

The polysystemic analysis makes it possible to account for peculiar or idiosyncratic phonetic behaviour, because it is possible to refer to the system a phonological item belongs to. In the case of the non-syllabic clitics, the system contains only one nasal. Another implication is that phonetic interpretation is sensitive to systemic contrasts.

A remarkable aspect of the non-syllabic forms is the phonological fusion with pronouns that they exhibit ((33a–c), (36)), particularly with weak forms of pronouns. This is especially true of the items with /-(r)/, which exhibit very complex behaviour. Some of the variability (notably /ʊə ~ ɔ/) mirrors variability in lexical items such as *poor* /pʊə pɔ/.

(36)

	strong	*weak*		*strong*	*weak*
BE	aɪm	am, əm	HAVE	aɪv	av
	jʊə(r), jɔ(r)	jə(r)		juv	jəv
	hiːz	(h)iz, (h)ɪz		hiːz	(h)iz, (h)ɪz
	ʃiːz	ʃiz, ʃɪz		ʃiːz	ʃiz, ʃɪz
	ɪts	ɪts, ts, ʔs		ɪts	ɪts, ts, ʔs
	wiə(r), wɪː(r)	wɪ(r)		wiːv	wiv, wɪv
	ðeɪ ə(r), ðɛː(r)	ðə(r)		ðeɪv	ðɪv

This pattern of fusion indicates that the phonological exponents of V[AUX] and of the pronoun occur in the same syllable (cf. Palmer 1988: 243): the patterns of centring diphthongs or long 'lax' vowels (/iə ~ ɪː, ɛə ~ ɛː, ʊə ~ ɔː/) and the patterning of linking *r* are consistent with this analysis:

(37) I'm [aɪm am] only joking.
You're [jər] only joking.
They're [ðɛ ðə] never in.
They're [ðɛr ðər] always out.

Booij (1995, 1996) notes similar fusional patterns for Dutch, and observes that the clitics in this case are similar to inflectional suffixes. Because the Dutch examples only occur in specific syntactic conditions (pronoun + auxiliary), Booij argues that they are lexicalised. This is similar to Kaisse's (1985) position, that full and weak forms are suppletive allomorphs, i.e. separate lexical entries. Sadler *et al.* (1997) take this idea even further, and suggests that forms like *I've* form not only a phonological unit, but also a syntactic unit: in effect, an inflected pronoun, an idea suggested also by Palmer (1988: 243). Special dispensation has to be made under this analysis for the behaviour of conjoined structures, where the syllabic form of the auxiliary has to be used (38).

(38) You and I [əl, *l] see the film together.
He and you are [ju ə, *jɔ/jə] hungry.

The non-syllabic clitic /s ~ z/ is unlike the other non-syllabic clitics in that it is syntactically more promiscuous and can attach to non-pronoun

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hosts. It is also unlike its full form in that it may occur in syntactic positions where the full form *is* may not (Kaisse 1985):

(39) Where's the lions?
*Where is the lions?

There are therefore at least two good syntactic reasons to treat the non-syllabic form of *is* (and perhaps of *has*) as not part of the same system syntactically as the other non-syllabic clitics.

The analysis I propose here for English accounts for the possible fusion of the pronoun and auxiliary by treating the phonological sign that describes these forms as the unification of the phonological description of the pronoun with the description of the auxiliary. I argue that the non-syllabic clitics are represented phonologically in the same way as inflections. My analysis therefore treats the English non-syllabic clitics as phonologically dependent, but not syntactically dependent (cf. Booij & Lieber 1993).

Phonologically the clitic *'s* behaves just like the inflectional suffix *-s* (plural in nouns, 3rd singular in verbs). It exhibits two particular properties:

(i) It forms complex clusters which can only be clusters formed by inflection (such as /-sts, -nθs/).

(ii) It shares its value for voicing with the last specification for voicing in the syllable: /-iz, -nz, -lts; *-is, *-ns, *-ltz/.

The phonological behaviour of /s ~ z/ may seem to argue for treating *'s* separately from the other non-syllabic clitics. There are two reasons to treat it as part of the same phonological system as the other non-syllabic clitics, although with different syntactic properties from them:

(i) /d l/ also behave like inflections with respect to epenthetic vowels;

(ii) data from varieties of English which distinguish between vowels in open *vs.* closed syllables.

The non-syllabic clitics /d l/ can both attach to the only pronouns in English which are not V-final, *it*, *that* and *this*. (The other non-syllabic clitics, excluding /s ~ z/, can only attach to V-final pronouns, because of their syntax.) /d/, when it attaches to *it*, behaves like the past tense marked *-ed* does when it attaches to a syllable with {-t/d}: an epenthetic vowel appears.

(40) pitted pɪt] ɪd]
it'd ɪt] əd]

The same analysis can be given for *it'll*: whatever analysis is given for *-ed* applies also to the non-syllabic clitics /d l/. What is more, /s ~ z/, as we have seen, attaches to hosts in the same way as inflectional *-s* in English. Therefore it looks like a unified account of clitics /s ~ z, l, d/ and inflections is possible.

In some varieties of English, such as Belfast, Tyneside and varieties of Scottish English, it is possible to distinguish morphologically simple

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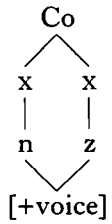
words from morphologically complex ones. In Tyneside English, for example, the diphthong /ɑɪ/ in open syllables has a different quality from the one in closed syllables (41a–b), while the diphthong in morphologically complex words has a quality that matches that of the vowel in the open syllable (a) and (c). Similar patterns are of course well known for Scots English (Wells 1982) and Belfast English (Harris 1985), although the details are somewhat different. In Tyneside, if the strong form of a pronoun has a weak non-syllabic clitic attached, then the vowel has the quality of the open syllable, not of the closed syllable: i.e. it rhymes with *tied*, not with *tide* (41d). Jim Scobbie (personal communication) comments that in Scottish English, *I'd*, *I'm*, *I'll*, etc. have the length of an open syllable, i.e. like in Tyneside, *I'd* rhymes with *tied*, not with *tide*.

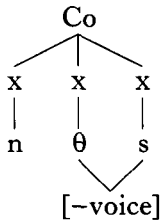
(41) a. tie tɑe]
b. tide tɛɪd]
c. tied tɑe] d]
d. I'd ɑe] d]

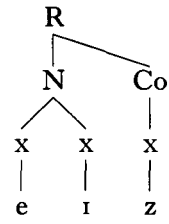
These observations suggest that the analysis of *I'd* should match that of *tied* and not of *tide*.

Inflections generally form part of the coda, according to Kreidler (1989) and Blevins (1995), a termination, according to Fudge (1969), or a separate domain, according to Harris (1994). No account is without its problems; however, I will argue that the least troublesome analysis is to treat them as a sort of appendix which is attached to the lowest node possible in the prosodic hierarchy.

The coda analysis handles the voicing assimilation well, since [voice] is shared between adjacent nodes within the same constituent (42a–b). But this analysis complicates the inventory of possible codas and cannot easily account for pairs like *tied–tide* or *days–daze*, which in some varieties of English are distinguished by different vowel qualities or durations, because there is no obvious way to distinguish codas which contain inflections from other codas (42c):

(42) a.


b.


c.


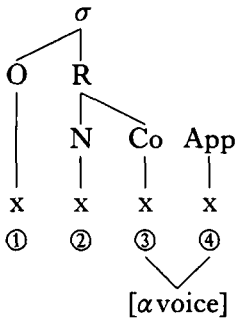
The appendix account explains the vowel alternations which the coda account does not, since it assigns morphologically simple and complex words different structures (43). It also has the advantage that the inventory of codas need not be enlarged to include many codas which only occur in morphologically complex words.

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(43) deɪ] z]$_{app}$
deɪz]$_{syll}$

The voicing assimilation facts, however, are difficult to capture using representations which contain only hierarchical structure. A simpler analysis is possible if the phonological description also contains a flat list structure whose elements are the terminal nodes (cf. Bird & Klein 1994):

(44) *Voicing agreement between adjacent elements of structure*



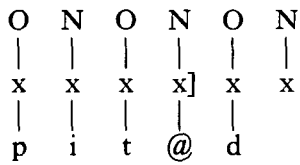
[SEGS: <①∧②∧③[...⑤[α voice]...]∧④[...⑤...]>]

A second problem with the appendix analysis is whether to include an epenthetic vowel as part of the appendix, or whether to treat it as forming a new syllable.

The third issue is where the clitic is attached, or what its parent node is (e.g. Zec & Inkelas 1991, Booij 1996, Peperkamp 1996). The attachment depends on whether the clitic is treated as a part of the coda like any other consonant, whether it is an appendix along with all (coronal) consonants outside some 'core' rhyme – in both cases, the clitic would attach to the syllable; or whether clitics and inflections are the only things which can form an appendix, in which case the clitic might attach to some higher node.

The Government Phonology account of inflectional allomorphy (Harris 1994) is to treat the epenthetic vowel of inflections (in e.g. *churches* or *pitted*) as a manifestation of a normally silent nucleus which forms part of the stem (45). The reasons for this are coherently set out in Kaye (1990) and Harris (1994). This analysis has the advantage that the inflectional markers /s ~ z, t ~ d/ in English only have one allomorph. However, it is hard to see how this account predicts the different vowel qualities in *pitt-*[ɪ]*d* and *it*[ə]'*d* if the vowel is part of the stem rather than the affix or clitic.

(45)



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It is not my intention in this paper to resolve these issues: my aim here is to point out the parallel between inflections and non-syllabic clitics. The non-syllabic clitics can be handled by stating constraints in the SEGS part of the PHON attribute for V[AUX]; the non-syllabic clitics are treated as forming a type of appendix. Following Zec & Inkelas (1991) and Booij & Lieber (1993), I will treat the clitic appendix as attaching to the lowest node in the prosodic hierarchy that it can, using recursive structures of the type in (46). (An alternative analysis is that of Selkirk 1995, who attaches weak syllables to the phonological phrase, noting (1995: 452) that this behaviour is inconsistent with her analysis of English clitics in general.) Appendix (clitics) are of two subtypes: one (*cons-appendix*) consists of consonants only and is the COMP-DTR to a syllable; the other (*syll-appendix*) consists of a vowel + consonant and, as it is syllabic, is COMP-DTR to a foot.

(46) *AVMs showing attachment of clitic appendices*

a. $_{syll}\left[\begin{array}{l}\text{HEAD-DTR: } syllable \\ \text{COMP-DTRS: } \langle cons\text{-}appendix \rangle\end{array}\right]$

b. $_{foot}\left[\begin{array}{l}\text{HEAD-DTR: } foot \\ \text{COMP-DTRS: } \langle syll\text{-}appendix \rangle\end{array}\right]$

4.7 Summary

This section has presented evidence for the hierarchy of types of auxiliary presented in (15). The main divisions are: strong *vs.* weak (clitic) forms; syllabic *vs.* non-syllabic clitic forms; syllabic forms with and without an onset. Non-syllabic clitics attach only to pronoun hosts, with the well-known exception of *'s*. There is phonological evidence for this, based on the behaviour of intrusive and linking *r*, and on the inadmissibility of certain coda clusters that otherwise are well formed. I have also argued that non-syllabic clitic forms resemble inflections. I have provided AVMs that express constraints which hold for each of these subtypes of auxiliary; in the next section, these will be instantiated to deal with actual examples.

5 Four systems of auxiliaries

Having set out the subtypes of V[AUX], I will now state constraints on the systems of auxiliary verbs which are established according to the forms their members may have. I will show that within the systems, there is predictability (with the exception of only *was* and *were*, discussed in §4).

Based on the subtypes presented in (15), there are four paradigms for V[AUX]:

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(47) a. *System 1*
Verbs with strong forms only (*need*, *might*, *dare*).

b. *System 2*
Verbs with a strong form and one clitic form with an onset (*can*, *shall*, *must*).

c. *System 3*
Verbs with a strong form and three clitic forms: syllabic with an onset, syllabic without an onset, non-syllabic (*had*, *would*, *will*).

d. *System 4*
Verbs with a strong form and two clitic forms: syllabic without an onset, and non-syllabic (*am*, *are*).

In this section, I use the AVMs presented in §4 to flesh out the analysis and to state relationships between the four main systems of auxiliaries. The complete set of English auxiliaries is given in (48) (Palmer 1988, Simpson 1992).[8]

(48) a. *Strong forms only*
need, dare, may, might, ought

b. *Strong and weak forms*
am, is, are, have, has, had, will, would, was, were, can, do, did, could, shall, should, must

5.1 System 1: strong forms only

Verbs in System 1 conform to the AVM in (18); but (18) can be more fully specified to describe verbs which only have strong forms. They are distinguished from verbs with strong and weak forms in that they contain vowels which do not occur in Systems 2, 3 and 4. Of the verbs with weak forms, only *do*, *were* and *are* contain long vowels (Simpson 1992). The intersection of the sets of vowels in System 1 and those in the other systems is nil: none of the vowels in the verbs in the strong ~ weak systems occurs in System 1, and *vice versa*.

The strong-only verbs are peculiar in some non-phonological ways. Palmer (1988) shows that *need*, *dare* and *ought* exhibit syntactic behaviour unlike that of other auxiliaries. While *need*, *might*, *ought* and *dare* can form negatives with *-n't*, *mayn't* is unusual, if not obsolete. *Dare* and *need* can form negatives like main verbs: *daren't* and *needn't* are parallel with *don't dare* and *don't need*. *Ought* can also form a negative with *didn't* in some varieties of English. Selkirk (1984: 359) argues that less frequent words

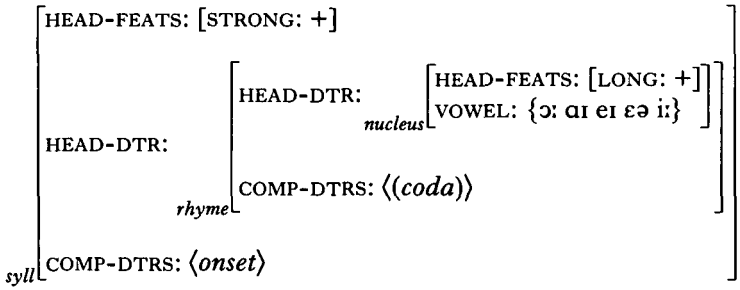
[8] Palmer (1988: 240ff) presents *shall*, *should*, *can*, *could*, *must*, *do*, *did* and *does* in a table with non-syllabic forms; but in discussing the phonetics of /ʃl kd/, etc., provides arguments for treating such forms as being syllabic. In other words, the non-syllabic forms are an illusion caused by transcription. This does not negate the argument for distinguishing syllabic *vs.* non-syllabic forms, since the differences can be maintained on the basis of their syntactic distribution and their patterns of phonological assimilation.

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are less likely to have weak forms: perhaps the somewhat idiosyncratic behaviour of the verbs in System 1 is reflected in their frequency.

The AVM for System 1 items is given as (49):

(49) *AVM for auxiliary verbs with strong forms only*

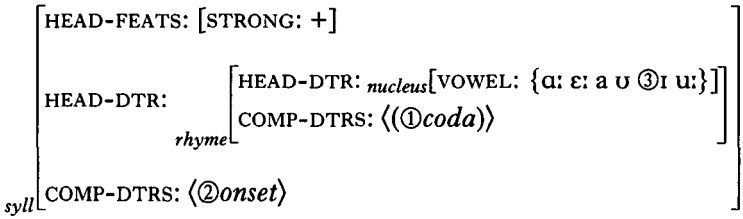


5.2 System 2: strong forms + clitic form with onset

System 2 comprises verbs which have a strong form and one clitic form, which contains a non-null onset. *Was* and *were* are the only members of this system with a non-obstruent onset; they have to be regarded as exceptions for the reasons given in §4.

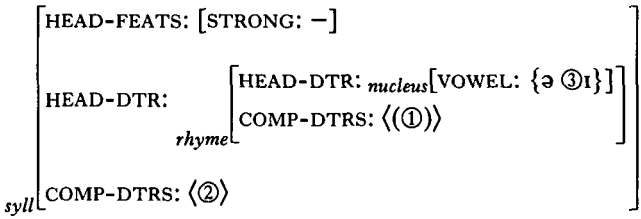
The AVM in (50) describes the strong form of verbs in System 2.

(50) *AVM for strong forms in System 2*



The corresponding clitic forms are described in (51):

(51) *AVM for weak syllabic forms of verbs in System 2*



The clitic forms contain the same onset and coda (② and ①, respectively) as the strong forms. The nucleus of the syllabic clitic form is /ə/, or /ɪ/ if the strong form has /ɪ/.

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5.3 Systems 3 and 4: strong form + syllabic form(s) + non-syllabic form

System 3 contains verbs with a strong form and three clitic forms. System 4 contains verbs which never have an onset and thus it forms a subsystem of System 3.

The strong form of these verbs satisfies the constraint in (52). The onset here is defined disjunctively so as to accommodate both Systems 3 and 4.

(52) *AVM for strong forms of verbs in Systems 3 and 4*

$$\left[\begin{array}{l}\text{SEGS: } \langle ③ \wedge ① \wedge ② \rangle \\ \text{PROS} \mid \ldots \mid : \left[\begin{array}{l}\text{HEAD-FEATS: [STRONG: +]} \\ \text{HEAD-DTR: } \underset{rhyme}{\left[\begin{array}{l}\text{HEAD-DTR: } \underset{nucleus}{[\text{VOWEL: } ① \{\text{a } \upsilon\ ④ \text{ɪ } \text{ɑ:}\}]} \\ \text{COMP-DTRS: } ⑤ \langle [\text{CONSONANT: } ② \{\text{m z v d l (r)}\}] \rangle\end{array}\right]} \\ \underset{syll}{\text{COMP-DTRS: } \left\langle ⑥ [\text{CONSONANT: } ③ [\ldots [\text{SON: +}] \ldots] \vee [\ ]] \right\rangle}\end{array}\right]\end{array}\right]$$

The syllabic clitic forms with an onset (System 3) are as in (53): note that the tags in (53) correspond to items in (52) above, so that the onsets and codas again are token-identical in the strong and weak forms.

(53) *AVM for syllabic clitic forms of verbs in Systems 3 and 4*

$$\left[\begin{array}{l}\text{HEAD-FEATS: [STRONG: } -] \\ \text{HEAD-DTR: } \underset{rhyme}{\left[\begin{array}{l}\text{HEAD-DTR: } \underset{nucleus}{[\text{VOWEL: } ① \{\text{ə } ④ \text{ɪ}\}]} \\ \text{COMP-DTRS: } ⑤\end{array}\right]} \\ \underset{syll}{\text{COMP-DTRS: } \langle ⑥ \rangle}\end{array}\right]$$

The onsetless clitics are as in (54).

(54) *AVM for syllabic onsetless clitic forms of verbs in Systems 3 and 4*

$$\left[\begin{array}{l}\text{HEAD-FEATS: [STRONG: } -] \\ \text{HEAD-DTR: } \underset{rhyme}{\left[\begin{array}{l}\text{HEAD-DTR: } \underset{nucleus}{[\text{VOWEL: } ① \{\text{ə } ④ \text{ɪ}\}]} \\ \text{COMP-DTRS: } ⑤\end{array}\right]} \\ \underset{syll}{\text{COMP-DTRS: } \langle [\ ] \rangle}\end{array}\right]$$

More informally, this means that the onsetless clitic forms are $əC_2$, where with an onset they have to have the shape $C_1 əC_2$. Since the empty list [ ] will unify with anything, the syllabic onsetless clitics are effectively just

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rhymes which can unify with an onset to form a complete syllable. This explains how linking *r* can work in non-rhotic varieties, where /r/ is licensed only in an onset.

5.4 Non-syllabic clitic forms

The non-syllabic clitics contain even less prosodic material than the syllabic onsetless clitics. They consist of a consonant which is identical to the coda consonant of the syllabic clitic forms. Assuming that these consonants are best treated as an appendix, as argued in §4.6 above, the AVMs in (55) represents appendices. Two types of appendix are required: *cons-appendix*, which is a COMP-DTR of the syllable, and *syll-appendix*, which is a COMP-DTR of the foot.

Since appendices must contain a consonant, the consonant (token-identical with the consonant of the strong forms of the verbs) is the HEAD-DTR of the appendix; since the vowel is variably present, it is treated as a COMP-DTR.

(55) *AVMs for clitic appendices*

a. *non-syllabic clitic with epenthetic vowel*

$$_{syll\text{-}app}\left[\begin{array}{l}\text{HEAD-DTR: ⑤}\\ \text{COMP-DTRS: }\langle[\text{VOWEL: }\{ə\}]\rangle\end{array}\right]$$

b. *non-syllabic clitic*

$$_{cons\text{-}app}\,[\text{HEAD-DTR: ⑤}]$$

The appendix is unified with a syllable, giving as the result the AVM for the syllable + clitic in (56):

(56) *AVM for cliticised syllable*

$$_{syll}\left[\begin{array}{l}\text{SEGS: }\langle ⑦\wedge ①\rangle\\ \text{HEAD-DTR: }_{syll}[\text{SEGS: }\langle ⑦\rangle]\\ \text{COMP-DTRS:}\left\langle {}_{cons\text{-}app}[\text{HEAD-DTR: ⑤[CONSONANT: }①\{\text{m v l d s}\sim\text{z (r)}\}]]\right\rangle\end{array}\right]$$

If the appendix is attached to a foot, the AVM for the foot + clitic is similar to the one in (56), but with structures of type *foot* rather than *syllable*. These AVMs in turn form part of a larger AVM of type *word*, whose SYNSEM attribute has the value Pr + V[AUX].

Two questions remain: how to handle the voicing assimilation of /s ~ z/, and how to predict the insertion of an epenthetic vowel in cases like *it'd*.

(57) shows the constraint that enforces identity of values for VOICE in a cliticised syllable, ensuring /dɒgz kats/, not */dɒgs katz/, for *dog's* and *cat's*. Adjacency effects are not easily handled in AVMs incorporating

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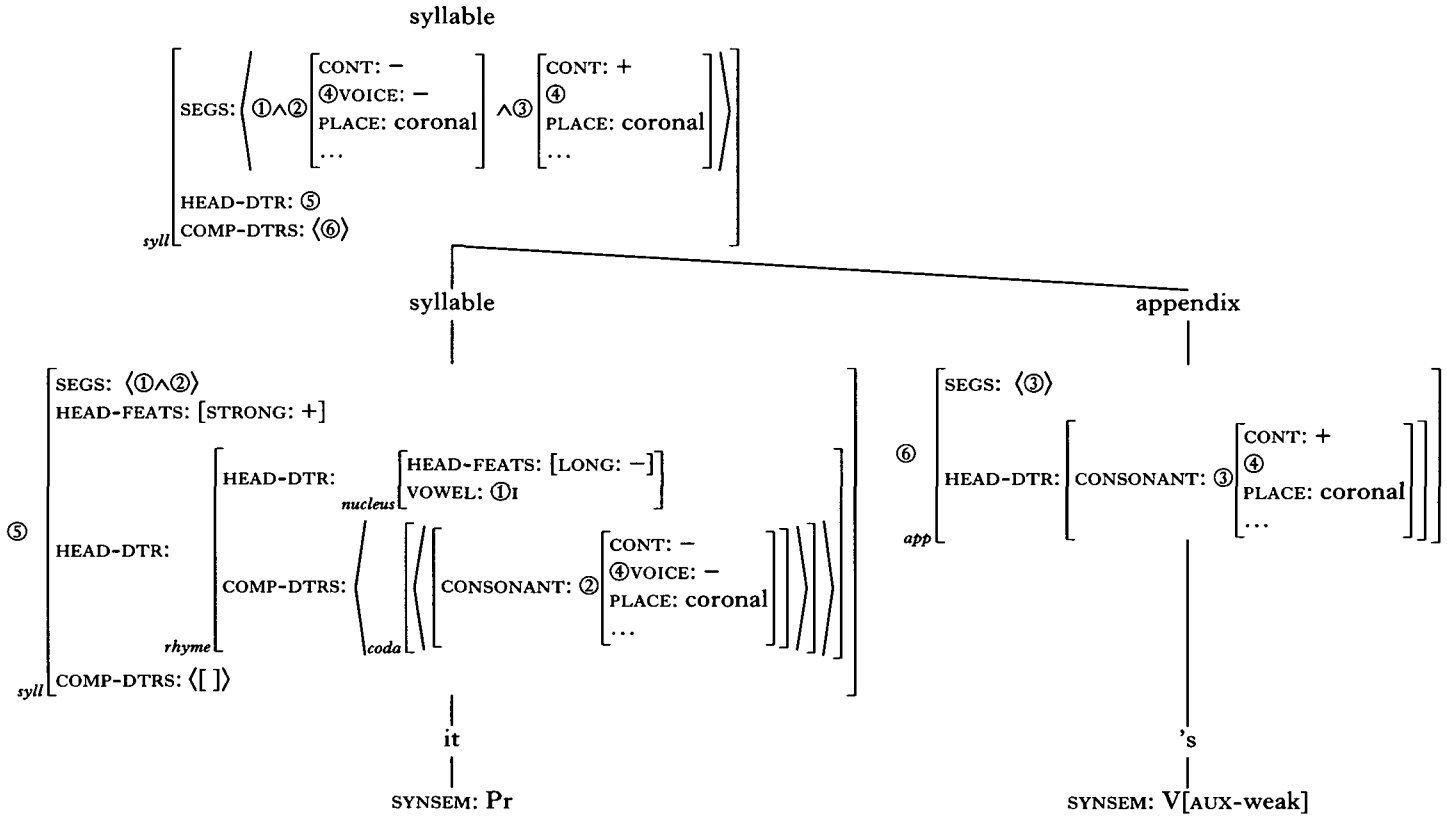


Figure 1
Combined graph/AVM structure for *it's*

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exclusively hierarchical structure, and are better handled by having a flat list structure (the SEGS attribute of the AVM).

(57) *Voicing agreement between appendix and previous segment*

$$\textit{syll}\left[\begin{array}{l}\text{SEGS: }\langle\ldots[\ldots②[\text{VOICE: }\textit{boolean}]\ldots]\wedge①[\ldots②\ldots]\rangle\\ \text{HEAD-DTR: }\textit{syllable}\\ \text{COMP-DTRS: }\langle_{\textit{cons-app}}[\text{HEAD-DTR: [CONSONANT: ①\{s\sim z\}]}]\rangle\end{array}\right]$$

Figure 1 combines graph representations with AVMs. It represents *it's* according to the analysis presented. The middle part of the figure contains two AVMs, one for the syllable *it*, and another for the clitic *'s*. The AVM for *it* has the vowel /ɪ/ in the nucleus, and the consonant /t/ (here shown as a partial feature matrix) in the coda. Note the tags in this AVM: ① is indexed to the nucleus, ② to the coda, and ④ to the [VOICE] attribute of the coda. The SEGS attribute of the sign consists of a list comprising the vowel of the nucleus and the consonant of the coda. The appendix contains /s/ as its head, represented as a partial feature matrix. There is no value for [VOICE], though there is a tag, indicating that the attribute-value pair for voicing of /s/ must be token-identical with some other specification elsewhere.

The top of Fig. 1 contains a partial AVM for the syllable *it's*. This contains in SEGS a list of the terminal elements in the structure, in this case matching with /ɪt/ from *it* and /s/ from the clitic *'s*. The constraint on voicing agreement is given in (57).

The analysis of clitics with ə-epenthesis is given in the AVM in (58), which informally says that when a non-syllabic clitic form of an auxiliary is bound to a host which ends with a coronal, and when the clitic form is itself a non-fricative coronal (i.e. one of {/d l/}), a vowel /ə/ is inserted between the host and the clitic; and this vowel must match the contents of COMP-DTR in the appendix.

(58) *AVM for epenthetic vowels for* 'd *and* 'll

$$\textit{syll}\left[\begin{array}{l}\text{SEGS: }\langle\ldots[\ldots[\text{PLACE: coronal}]\ldots]\wedge②ə\wedge①\{\text{d l}\}\rangle\\ \text{HEAD-DTR: }\textit{foot}\\ \text{COMP-DTRS: }\left\langle_{\textit{syll-app}}\left[\begin{array}{l}\text{HEAD-DTR: [CONSONANT: ①]}\\ \text{COMP-DTRS: }\langle②ə\rangle\end{array}\right]\right\rangle\end{array}\right]$$

A combined AVM and graph for *it'd* is given in Fig. 2.

5.5 AVMs for various forms of the same verb

Finally, to show how various forms of the same auxiliary verb are related, I present AVMs for four forms of *have* in (59). (a) gives the strong form; (b) the clitic form with an onset; (c) the clitic form without an onset; (d) the non-syllabic clitic form.

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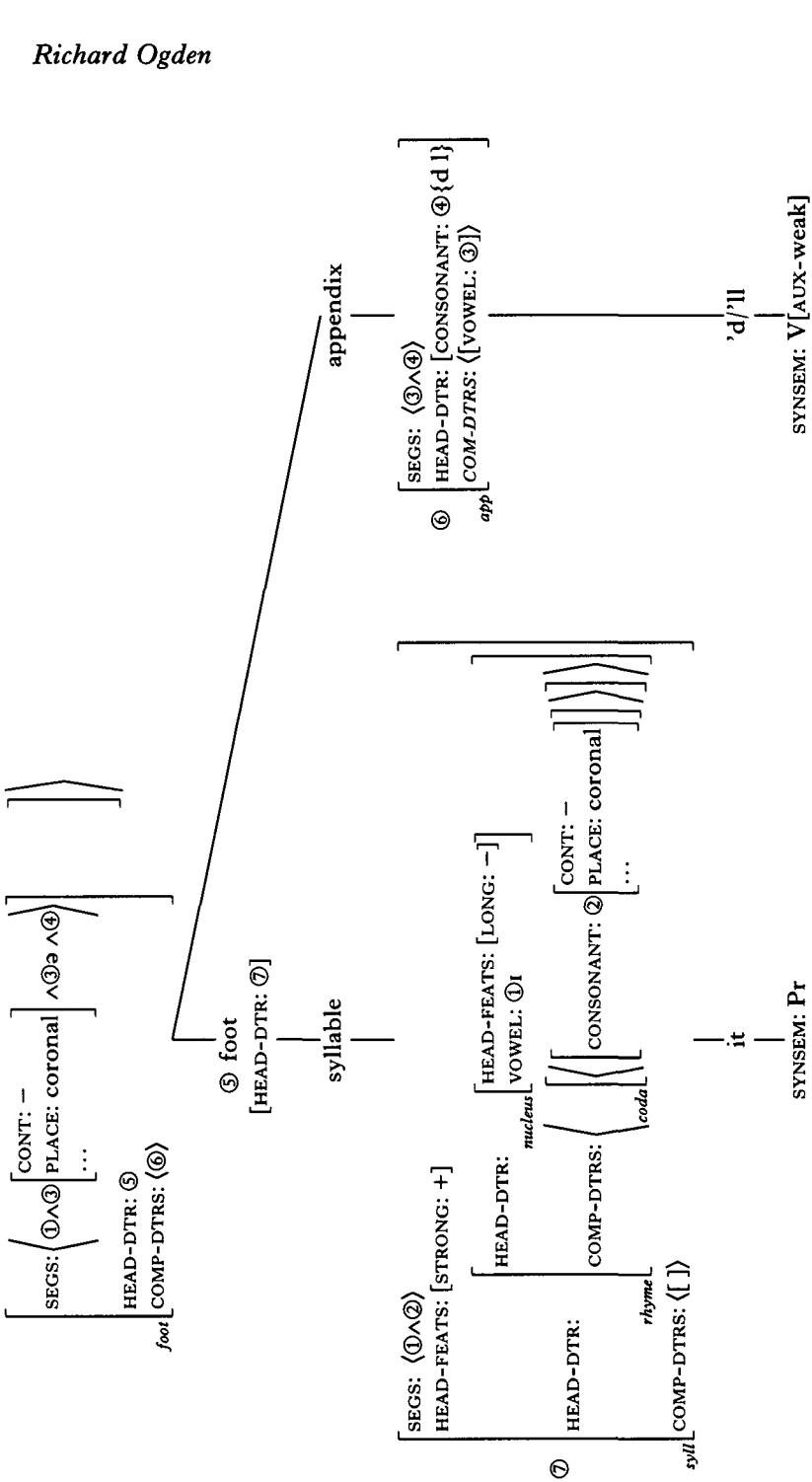


Figure 2
Combined graph/AVM structure for *it'd/it'll*

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(59) *AVM for four forms of* have

a. *Strong form of* have

$$\begin{bmatrix} \text{HEAD-FEATS: [STRONG: +]} \\ \text{HEAD-DTR:} \begin{bmatrix} \text{HEAD-DTR:} \begin{bmatrix} \text{HEAD-FEATS: [LONG: −]} \\ \text{VOWEL: a} \end{bmatrix}_{nucleus} \\ \text{COMP-DTRS: } \langle \textcircled{2}[\text{CONSONANT: v}] \rangle_{coda} \end{bmatrix}_{rhyme} \\ \text{COMP-DTRS: } \langle \textcircled{1}[\text{CONSONANT: h}] \rangle \end{bmatrix}_{syll}$$

b. *Syllabic clitic form of* have *with onset*

$$\begin{bmatrix} \text{HEAD-FEATS: [STRONG: −]} \\ \text{HEAD-DTR:} \begin{bmatrix} \text{HEAD-DTR:} \begin{bmatrix} \text{HEAD-FEATS: [LONG: −]} \\ \text{VOWEL: ə} \end{bmatrix}_{nucleus} \\ \text{COMP-DTRS: } \langle \textcircled{2} \rangle_{coda} \end{bmatrix}_{rhyme} \\ \text{COMP-DTRS: } \langle \textcircled{1} \rangle_{onset} \end{bmatrix}_{syll}$$

c. *Syllabic clitic form of* have *without onset*

$$\begin{bmatrix} \text{HEAD-FEATS: [STRONG: −]} \\ \text{HEAD-DTR:} \begin{bmatrix} \text{HEAD-DTR:} \begin{bmatrix} \text{HEAD-FEATS: [LONG: −]} \\ \text{VOWEL: ə} \end{bmatrix}_{nucleus} \\ \text{COMP-DTRS: } \langle \textcircled{2} \rangle_{coda} \end{bmatrix}_{rhyme} \\ \text{COMP-DTRS: } \langle [\ ] \rangle_{onset} \end{bmatrix}_{syll}$$

d. *Non-syllabic clitic form of* have

$$_{cons\text{-}app}[\text{HEAD-DTR: } \textcircled{2}]$$

6 Conclusion

Declarative Phonology limits the set of operations available in phonology to combination by either concatenation or unification. This restrictive framework forces phonologists to find alternative analyses of cases where deletion seems inevitable. In general, there are two methods of handling deletion in a declarative framework: alternation with zero, and phonetic evidence of gestural reorganisation.

In this paper, I have pursued the first approach, taking the Firthian

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notion of polysystemic analysis as the basis for an analysis of English auxiliaries. The analysis establishes subtypes of auxiliary and allows for constraints on phonological form to be stated for each subtype of auxiliary. The various forms of auxiliaries (such as HAVE, /hav həv əv v/) are treated as the varying phonological exponents of HAVE in different systems.

Words of English with strong and weak forms are commonly treated as a set of items to which a single set of processes applies. While it is true that there is a relation between the constraints on terms in vowel systems and syllable strength, it is nonetheless valuable to treat auxiliaries as forming a separate system. This way, the alternation of /w/ in *would* and *will* with zero ('deletion') need not be seen as having any necessary implications for the non-deletion of /w/ in words like *what* or *with*.

There are several aspects of auxiliaries with strong and weak forms which are problematic, and which a polysystemic analysis can explain. Firstly, which auxiliaries have weak forms alongside strong ones? As Simpson (1992) shows, the set of vowels which occurs in auxiliary verbs with strong forms only is different from the set of vowels in auxiliaries with both strong and weak forms; and the syllable shape of auxiliary verbs with strong forms only must be CVV(C), while verbs with strong and weak forms have a wider range of syllable shapes (including CVV). Verbs with strong forms only may form negatives in ways unlike the rest of the system. A polysystemic analysis, which states constraints applicable only to systems and subsystems, allows such differences to be captured formally.

Secondly, a polysystemic analysis makes it possible to capture /w/ $\sim \emptyset$ and /h/ $\sim \emptyset$ alternations without generalising unproductive and destructive rules to the rest of the language. Evidence from British English, which is non-rhotic, suggests that even if '*h*-deletion' is phonetically gradient, the presence or absence of linking *r* suggests that the distinction between /həv/ and /əv/ is phonological. While *was* and *were* remain irregular, a consideration of the phonological exponents of the present–past tense distinction within the V[AUX] system provides a plausible explanation for this irregularity.

A polysystemic analysis also makes predictions about the behaviour of terms within systems. At one place in the analysis, there is apparent ambiguity. The forms *it'll* and *it'd* apparently contain syllabic clitic forms, but in terms of the rest of the pronoun + auxiliary paradigm, we would expect *'ll* and *'d* to be non-syllabic clitics. The analysis proposed here indeed treats them as non-syllabic, with epenthetic vowels. This decision is based in part on a principle to minimise the number of systems posited and in part on the principle that there is a relatively simple relation between systems of contrast and the structures they occur in. Since epenthetic vowels are required in inflections in exactly the same phonological context, the most parsimonious analysis is to treat the non-syllabic clitics as a type of inflection. Further evidence for this comes from the behaviour of vowels in morphologically simple *vs.* complex words in dialects where vowel qualities are sensitive to this.

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A final consequence of the polysystemic analysis is that phonetic interpretation can make reference to the structure and system of a given phonological term. In the case of the auxiliaries, *'m* has a variety of phonetic interpretations which /m/ in general does not have. A polysystemic analysis provides an explanation for why such variability may occur: the contrastive system at that particular place in structure is smaller than in lexical items. Thus, as well as talking of a language's overall *inventory* of phonological terms, there is value in conducting analyses with regard to its systems.

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