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CONTRASTIVITY AND NON-SPECIFICATION IN A DEPENDENCY PHONOLOGY OF ENGLISH*

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1. Introduction

A major motivation in the development of the theory of phonological representation associated with dependency phonology (DP) has been the differentiation of those aspects of structure and substance which are contrastive from those which are redundant (cf. e.g., Anderson and Jones 1974, 1977; Anderson and Ewen 1987). Such a distinction is relevant both to general principles ('universal grammar') and to the lexicons of particular languages.

I want to pursue here, in a systematic way, the consequences of optimising contrast in the initial phonological representations proposed for a specific language. In DP, representations are constructed out of substantive elements, the simplex features, or **components**, related by **linearity**, **dependency** and **association**, including particularly associations between **gestures**, or systematic sub-groupings of features. It seems clear that many individual instances of features and of dependency and association relations are redundant, need not be stipulated lexically – whether the redundancies involved are general or language-particular. And many instances of linearity are similarly non-contrastive (cf. Anderson 1987).

Quite generally in English, suprasegmental dependencies, both at utterance and word level, are typically projective (cf. e.g., Anderson 1986a): the suprasegmental dependencies of lexical structure need not be stipulated independently of the rep-

* The work reported on here grew out of joint research with Colin Ewen (cf. particularly Anderson and Ewen 1981) and Jacques Durand (cf. Anderson and Durand 1988, 1989, forthcoming); the analysis of a part of English vowel phonology embodied in §6 was presented (with some generous help from the other participants) at the San Diego workshop on the structure of the segment, 11 April 1987; and the version on which this presentation was based was scrutinised by Fran Colman, Jacques Durand, and April McMahon: to all concerned my thanks and absolution. Thanks too to Phil Carr for comments on the penultimate version.

esentations for individual segments (plus morphosyntactic information); nor is utterance structure independent of the (sequence of) representations for individual ords and their associated syntactic and pragmatic properties. Representations at both levels of suprasegmental structure are given by rule.

I do not consider in what follows the character of the rules assigning (suprasegmental) utterance structure, or (in any detail) even lexical suprasegmental structure. Rather, I shall focus in §§2 and 3 below on the character of the non-suprasegmental lexical redundancies that seem to be appropriate for English (or, at least, some varieties thereof). Thus, I return (cf. again Anderson 1987) to the issue of redundancy of linearisation within the word, but now together with a concern with some of the many inter-gestural associations and inter-featural dependencies that are also redundant, as well as with redundancies to do with the presence of individual features. The limiting case in this last instance is **non-specification**: contrastively, the total absence of features from a particular gesture. §§2-3 are thus intended to provide an overview of the consequences of optimising contrastivity in the lexicon.

§§4-6 pursue in more detail the consequences of non-specification with respect to the vowel phonology of English. Specifically, they argue that descriptive advantages follow from the assumption that certain vowels may lack articulatory specification, and that the selection of these vowels is in accord with the kind of system-geometric principles proposed by Anderson and Durand (1988, 1989, forthcoming). I shall propose further a polysystemic approach to unspecified gestures: English shows several unspecified vowels, in the sense that the realisation of the empty gesture varies, depending on the (prosodic) sub-system to which it belongs (long vs. short, stressed vs. unstressed, etc.).

The establishment of the descriptive appropriateness of the non-specification assumption is particularly significant for a framework like DP wherein representations are constructed out of simplex features (or components), which may be individually present or absent. The notation, unlike one based on variable-value features, predicts the possibility that all features within a gesture may be absent, i.e., non-specification; non-specification is one possible combination. And this has been exploited within DP since Lass proposed such an analysis for glottal segments (Lass and Anderson 1975: App.2; Lass 1976: ch.6), albeit with respect to non-unary features. In this respect, non-specification within DP differs from underspecification theories based on binary features (as discussed by e.g., Archangeli (1984, 1988) and Kiparsky (1985)), in that, in the latter, underspecification introduces an additional hypothesis, one that does follow from the formal character of the representation itself.

§7 returns to the theme of minimal-, rather than necessarily non-, specification (cf. Anderson and Durand forthcoming), and argues for the elimination of the vowel shift as a rule of English phonology in favour of an analysis involving alternative realisations of under-specified segments: these are segments which though marked as incomplete are not necessarily totally unspecified with respect to a particular gesture; their representations are nevertheless maximally contrastive.

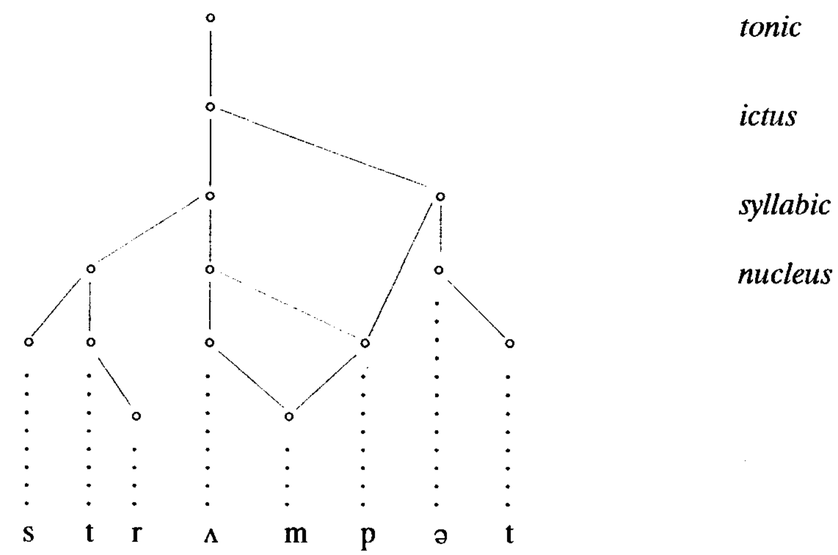
2. Minimal lexical specification exemplified

How minimal a lexical specification can the optimising of contrastivity lead to? Consider as an example an English disyllable like that in (1):

(1) /strʌmpət/

The suprasegmental structure of the word – say (2):

(2)



is non-contrastive. It is given by rules which I shall not specify here, but which are, I think, in role uncontroversial, whatever their precise character (for some suggestions, see again Anderson 1986a; Anderson and Ewen 1987: ch.3), and whatever one may think of the representation proposed in (2) – but this is not at issue here. I take it that the dependencies in (2) – or whatever relationships the reader might prefer – are redundant. So too are the segmentality assignments, the association of infrasegmental material (abbreviated in (2) by the terminal symbols) with the lowest nodes in (2), in corresponding in this case one-to-one with the number of categorial gestures present (Anderson and Ewen 1987: ch.7), each correlating with a feature change. In DP, features (as anticipated above) are grouped into subsegmental bundles called **gestures,** on the basis of closer association between the members of particular gestures, reflected in recurrent interaction between these features (as illustrated below) and participation of gestures as a whole in recurrent phonological processes (Anderson and Ewen 1987: ch.1, part II). The categorial gesture contains (roughly) the 'major class' features; and the assignment of segmentality (the number of terminal nodes in a representation such as (2)) is determined by the configuration of gestures present in the representation for a word – in the unmarked case the number of categorial gestures.

But let's now look at non-suprasegmental structure. (1) contains two potential syllabics, whose sequence must be stipulated lexically; sequence of syllables is contrastive:

(3) /ʌ/ << /ə/

where << indicates (not necessarily immediate) precedence. If we assume that the unmarked position for non-syllabics is prior to a syllabic (crudely, C+V is preferred to V+C), and this is assumed universally unless over-ridden, then only the linearity relations in (4) need be lexically specified in addition to that in (3):

(4) a. /ʌ/ << /m/, /p/ b. /ə/ << /t/

Again the appropriate infrasegmental representations are for the present abbreviated by the symbols in slashes.) Initial position for the /str/ cluster in (1) is given by the convention associated with the aforementioned assumption, which I give provisionally as (5):

(5) {C} << {|V|}

where **C** is the (unary) 'consonantality' component, and **V** is 'vocalic': consonants contain a **C** in their categorial gesture ({} enclose gestures), perhaps in combination with **V**, whereas vowels contain only **V**, indicated by the verticals enclosed within the gestural braces in (5).

This interpretation of the contrastive role of linearity differs from that proposed in Anderson 1987. There intrasyllabic linearity stipulations are removed in their entirety from lexical entries, in favour of groupings of potential segments into at most two unsequenced bundles, one containing one or more {|V|}, the other (possibly empty) one not: the former is sequenced after the latter, giving rhyme vs. onset. However, such a lexical characterisation now seems to me undesirable in anticipating an aspect of suprasegmental structure (rhyme vs. onset), otherwise not lexically stipulated.

Sequence within clusters is calculable from a combination of the sonority hierarchy with language-particular constraints. This involves us in looking more closely at the substantive representations involved, including feature redundancies. Consider the medial cluster. The post-syllabic sequence nasal plus oral is the unmarked possibility; so too is the homorganicity, as well as the plosive-hood of the oral portion. So that all that need be stipulated concerning the cluster is (6):

(6) /ʌ/ << {C}
{C}
{n}
{u}

/ʌ/ is followed by two unsequenced consonantal categorial gestures and by a (equally unsequenced) nasal gesture and an articulatory gesture specified as **u** ('grave'). Velars are lingual (as well as redundantly 'grave'), and denti-alveolars are unmarked, unspecified (and redundantly lingual) – cf. Anderson and Ewen (1981):

(7) /p/ = {u} /t/ = { } /k/ = {l}

The articulatory specification for the final /t/ in (1) will thus be empty, as will that of the one in the initial cluster.
(6), indeed, could be simplified further, given the observation that presence of the nasal gesture also brings along redundantly a consonantal one: i.e., one of the Cs could be eliminated. With respect to (6) redundancy rules will fill in association and (strict) linearity relations as in (8), where for simplicity of presentation left-right ordering indicates strict linear precedence:

(8) /ʌ/ {C} {C}
{n}
{u}

as well as more detailed feature representations. (8) assumes that {n} constitutes a distinct sub-gesture (Anderson and Ewen 1987: part II).

The initial cluster is the unmarked initial three-consonant cluster. Since also initial position is unmarked (given by (5)), all that need be stipulated in its case is (9):

(9) {C}
{C}
{C}

The initial sequences in (10):

(10) /spr/, /skr/

would be specified, respectively, as in (11):

(11) {C} {C}
{C} {C}
{C} {C}
{u} {l}

With linearisation as (12.a), (9) might be characterised redundantly, given initial position, as (12.b), and the articulatory specifications completed as (c):

(12) a. {C} {C} {C}
b. {V:C} {C} {V;{V:C}}
: : :
c. {l} {l} {l}
/s t r/

whereas /skr/ would be (13):

(13) {V:C} {C} {V;{V:C}}
: : :
{l} {l,u} {l}
/s k r/

{|V:C|}, mutual dependency between **V** and **C**, is the representation for a voiceless fricative. {V;{V:C}} is that for a liquid, such that a mutually dependent **V** and **C** are represented by placement to the right of the semi-colon as dependent on a **V**. (On categorial (and specifically phonatory) representations see e.g., Anderson and Ewen 1987: ch.4.) The latter representation, then, introduces a second-order dependency, a dependency of a dependency. Association is a second-order combination, a combination of a (potential) combination.

These categorial gestures are amplified by redundancies associated with initial position. The articulatory values in (12) and (13) are filled in by the general, non-positional redundancies in (14):

(14) a. {l} ⇒ {u} (velar)
b. { } ⇒ {l} (denti-alveolar)

(14.b) supplies the default value for consonantal place; (14.a), which with a less general structural description applies before (b), gives that for linguals.

Clusters involving the lateral would involve a more complex initial specification, as either (15.a) or (b):

(15) a. {C} b. {C}
{C} {C}
{C} {V,C} = /spl/
{u} {u}
{λ}

partly depending on the legitimacy of the feature lateral (λ). The final segment will be expanded as in (16):

(16) {V;{{V:C};C}}

the extra **C** reflecting the greater consonantality of [l] (Anderson and Ewen 1987: §4.1.3), as evidenced by its syllable position (in rhotic varieties at least) in monosyllabic realisations of (17) and the like:

(17) curl, twirl, swirl

(Whereas the tendency to syllabify the final lateral reflects the minimalness of the categorial difference between the two homorganic liquids – cf. the related discussion in Ohala and Kawasaki 1984: §5.) Given the marginality of /skl/ and the absence of /stl/, however, the u might be dropped from (15).

Consider finally the vowels in (1): they can be characterised lexically by an empty categorial gesture; all other elements contain at least {C}, they are consonants. As the unspecified major class, vowels are most susceptible to deletion and insertion, and to alternative realisations. Further, schwa is the vowel without an articulatory gesture, and [ʌ] is its stressed equivalent (stressedness of course being derived). I'll justify this later: see particularly §§4-6. So the vowels in this case are characterised by two empty gestures.

What needs to be stipulated in the case of *strumpet*, then, in terms of substance and structure, is (18):

(18) { } << { }

{ } << {C} OR { }^{2} << {C}
{ }

{ } << {C}
{u}
{n}
{C}^{3}

All else, of substance or structure, is redundant, allowed for by redundancies like (5), revised as (5′):

(5′) {C} << { }

in recognition of the unspecified status of vowels.

The lexical representation in (18) is not unlike the kind of specification that one might suggest for a 'template language' like Yawelmani (cf. Archangeli 1984; and, in terms of simplex features, Ewen and van der Hulst 1985; Anderson and Durand forthcoming) – except that the number of categorial gestures for vowels is typically specified by the morphology (with 'non-neutral' suffixes; with 'neutral' suffixes, the number of vowel gestures is idiosyncratic to the stem). Take forms like those in (19):

(19) a. ʔliik + ʔaa + n ⇒ ʔlekʔn "is singing"
b. ʔlk + iin ⇒ ʔlken "will sing"

with the suffixes in (20) (if we ignore the final (future) *n* in (19.a)):

(20) a. -ʔa *durative*
b. -iin *future*

the first of which imposes a three-vowel-gesture **template** on the stem (as in (19.a)), while the latter allows the stem to emerge in its 'neutral', one-gesture shape (as in (19.b)).

The canonical templates are (21):

(21) a. {C} { } {C} { } { } ({C})
b. {C} { } { } {C} ({C})
c. {C} { } {C} ({C})

contrasting in the number of empty, i.e., vowel gestures – i.e., (22):

(22) a. $\{\ \}^3$
b. $\{\ \}^2$
c. $\{\ \}^1$

In the case of (19.a), (22.a) interacts with a lexical specification for the stem of the character of (23):

(23) a. {C} << {C} << {C} = ʔ << l << k
{λ} {l,u}

b. { } = i (subsequently lowered to **e** if long)

(23.a) gives the sequence of consonants in the stem, and (b) the vowel melody, here the unspecified one, giving by redundancy [i], or [ee] via long vowel lowering. The position of the vowels is determined by the number of vowel categorial gestures given in the template: three, as here, select (21.a), giving (24):

(24) {C} { } {C} { } { } {C}
: :
{λ} {l,u}

The vowel melody in (23.b) is associated with the three empty categorial gestures:

(25) {C} { } {C} { } { } {C}
: : : :
{ } {λ} { } {l,u}

continuously where possible. In (25) associations of the vowel melody are interrupted by the specification for the lateral consonant. This is not so in the case of e.g., the stem in (26):

(26) neʔew-al "come late"

where there is no such interruption, on the assumption that /ʔ/ displays not merely an empty articulatory gesture but *absence* of this gesture (a distinction I shall otherwise not pursue here – see Anderson and Durand 1988, forthcoming):

(27) {C} { } {C} { } { } { }
: : : :
{n} { } {u}

This accounts for the differential effects of long vowel lowering, which lowers both the stem vowels in (27) but only the (original) long vowel itself in (25). (In the Gashowu dialect of Yokuts, lowering affects all vowels of the stem no matter what consonants intervene; it is therefore a stem prosody: see again Anderson and Durand forthcoming.)

(28.a) also shows lowering, as well as the effect of roundness harmony, which spreads roundness to suffixes which agree in height with the height of the stem vowel melody (both are in DP terms either **a** or not-**a** (where **a** is the 'sonority', or 'lowness' component); the suffix is, in the absence of harmony, as in (28.b):

(28) a. t'uloo^{ʔ}y "burning" + *nom.*
b. -ʔiy

Roundness harmony I take to involve a word prosody, unsequenced and unattached lexically, but derivatively associated with the tonic or with a governing stem node in the morphological structure (cf. e.g., Anderson, Ewen and Staun 1985; Anderson 1986b; Anderson and Durand forthcoming).

The major differences between (18) and (23) are that the vowel articulation of the stem is limited to one (given in (23.b)) and the number of vowel categorial gestures is determined morphologically (in the unmarked case), which means that the consonants must be initially sequenced with respect to each other rather than the vowels (as in (23.b)). Otherwise, the non-redundant information is analogous: sequencing and association specification is minimal, as well as the stipulation of substantive properties. In this way, I suggest, the notation allows for the expression of what is contrastive, without exaggerating differences between language types; rather, restricting the salient differences to their appropriate domains. What is distinctive about the template language is the morphologically determined template and the consequent non-contrastiveness of stem-internal vowel sequencing. Compare here too the discussion in Anderson (forthcoming *b*) of the 'vowel-less' lan-

guage Kabardian, which again tries to be specific about what is distinctive in the phonology of such a language, in the context of a framework which does not exaggerate typological differences.

3. Minimal substantive specifications for English non-syllabics

In (29) I've tentatively tabulated the contrastive specifications that seem to be maximally necessary for the various English consonants:

(29) a.	{C} {u}	{C} {l}		{C;V} {u}	{C;V}	{V} {l}	{n} {u}	{n}	{V;C} {λ}	{V;C}	{V:C} {u}	
	p	t	k	b	d	g	m	n	l	r	f	
	{V:C}	{d}		{C} {i}	{V,C,V} {u}	{V,C,V}	{V} {d}		{C,V} {i}	{C,C}	{C,V,C}	
	s	θ		ʃ	v	z	ð		ʒ	tʃ	dʒ	

d is dental (Anderson and Ewen 1987: §6.7.2); a dental is redundantly **l**, and fricative in English. The alveolars lack an articulatory gesture (apart from in the case of the laterality feature λ (if appropriate); they are unmarked both universally and descriptively in English: there is no contrast in place in the case of the liquids anyway; and it is the alveolar obstruents that can be extra-metrical. I return below to the descriptive advantages of such non-specification.

The semi-vowels and the glottal fricative, like vowels, have no categorial gesture, and the glottal has no articulatory gesture:

(29) b.	{u}	{i}	{ }	
	w	j	h	

but unlike vowels they conform to the generalisation governing **C** elements embodied in (5′), favouring indeed foot- or word- initial position, and thus in lexical representations they are typically unsequenced, and in this way distinguished from vowels: their linear position need only ever be stipulated (if at all) as following a vowel, and no vowel need or may be sequenced after them; they are limited to onsets, as illustrated in the lexical representation for *wombat* given in (30):

(30)
{u,a} << {a}
{u,a} << {C}
{n} = *wombat*
{u}
{a} << {C}
{u}

such that {u} is a word, or morpheme prosody, which will be assigned initial position by default, filling an otherwise empty onset slot. Occurrence in foot-initial (rather than (also) word-initial) position, as in *Kuwait*, again need not be stipulated, as non-contrastive. Anderson (1986b) illustrates in more detail these distributional properties in relation to English [h], and argues for its status as a word (or morpheme) prosody which is derivatively assigned to appropriate empty syllable onsets. Sequence need be stipulated lexically only if there are competing empty onsets in the same word, or morpheme, and these are not discriminated by general principle.

The vowels in (30) are sequenced with respect to their following consonants: the second is characterised by simple presence of the sonority component **a**; the first involves a combination of the gravity component **u** with **a**. Here and subsequently in this paper the vowel space is characterised in terms of combinations (possibly involving dependency relations) of these two components and the palatality feature **i**. I ignore for present purposes the possibility that the articulatory gesture may involve a partition into sub-gestures, such that e.g., **i** and **u** form a grouping excluding the sonority component, with vowel height thus being represented by relations between two sub-gestures rather than directly by relations between the individual components (cf. e.g., Anderson forthcoming *a*, and references therein).

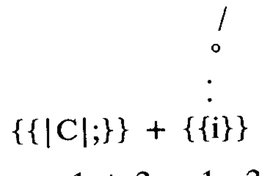
[h], lexically completely unspecified, will be provided redundantly with the articulatory properties of the following vowel, by joint association, and (categorially) with a fricative specification – or perhaps {V,O}, the characterisation of a voiceless vowel, **O** being the component of glottal opening (Anderson and Ewen 1987: §§5.1-4).

(29) are intended as the maximal lexical specifications that will be necessary, i.e., those appropriate to positions of maximal contrast. But clearly, and as we have seen in relation to (1), often the specifications can be even more meagre. The lexical representations are thus polysystemic, so that the 'same' element will receive a different (lexical) characterisation in different circumstances. As values, structural and substantive, are filled in by redundancy rules, such differences will be minimised (but other (phonetic) differences introduced). The significance of the minimal initial representations is enhanced to the extent that redundancies apply late, after at least some phonological rules proper. Some of the categorial specifications, in particular, must apparently be filled in prior to the erection of syllable structure, if the sonority hierarchy is to play the crucial role in this that is attributed to it by e.g., Anderson 1986a; Anderson and Ewen 1987: ch.3. For instance, although the specifications in (29) will provide with reference to sonority (i.e., in terms of relative preponderance of **V**) for the sequencing and dependency relations in the initial cluster in e.g., *shred*, the lateral in (17) and the like will have to specified as less vowel-like than /r/ if the sequencing illustrated therein is to fall out from relative sonority. (Alternatively, the specifications in (29) are not the most appropriate ones, at least in certain contexts.) But most lexical phonological processes in English require no more detail than is given in (29).

One of the virtues of the theory of underspecification (Archangeli 1984, 1988) has been to demonstrate the descriptive advantages that flow from the postulation

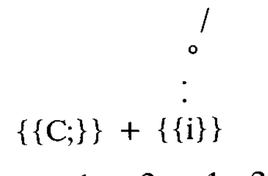
of minimal initial representations. Let me note one further descriptive advantage of some of the representations proposed in (29). Consider the familiar spiranto-palatalisations characterised in (31.a):

(31) a. (resolution, division; cf. resolute, divide)



b. {{C}{i}} ⇒ :V

c. (sensual, visual, perpetual, gradual)



d. {{|C|;}{i}} ⇔ {{C,C}}

e. {C<,V>,C} ⇒ {C<;V>} + {V:C}

If (31.a), which removes the precedence relation between two segments, the second of which is (part of) a syllable onset, applies before the relevant redundancies, then it can stand as formulated there, as applying to a sequence of a segment with empty articulatory gesture in which a **C** governs on its own, which selects /t/ and /d/, followed by a onset segment with empty categorial gesture, but specified articulatorily as **i** i.e., [j]. So, by (31.a), the sequence {{C}{ }} + {{ }{i}} in forms like *resolution* becomes {{C}{i}}. Conversion to a fricative will be accomplished by the consonantal redundancy (31.b), which also applies in the derivation of original /ʃ, ʒ, tʃ, dʒ/, and therefore need not be included as part of (31.a). The palatalisations captured by (31.c), on the other hand, follow application of (31.b); so that the output fricatives and stops remain as such, with the stops being affricated by the bilateral redundancy (31.d), which equates palatal plosives with affricates. The categorial specification for the affricates is subsequently filled out by the redundancy in (31.e), which introduces a linearity relation between the two **C**s and adds an equipollent **V** to the second one. The **V** in angles allows for the voicedness of /dʒ/.

The relative order of of application of (31.a) and (c) (before and after application of (b)) is congruent with further observations, not pursued here, but such as to induce Rubach (1984), within the framework of 'cyclic phonology', to argue that whereas 'spirantisation' is cyclic, 'palatalisation' is post-cyclic (though he offers

a more traditional two-stage interpretation of spiranto-palatalisation). Note too that for many varieties the palatalisations of (31.c) are optional. We can regard (31.c) as the post-cyclic analogue of (31.a), the different results of application being associated with whether or not the segmental redundancy (31.b) has applied or not. Indeed, (31.a) and (31.c) are arguably the same rule. If we remove the |C| stipulation from the former, giving {{C;}} for the first segment, so that the two rules are identical, then (31.a) will also allow for the fricative palatalisations in *confusion* (cf. *confuse*) and the like. The cyclic application of (31.a/c) takes as input redundancy-free representations; the post-cyclic follows application of (31.b).

The small fragment of English consonant phonology presented in (31) is illustrative only: it can only be properly evaluated when embedded within a matrix which includes other relevant processes and stipulates an architecture for the phonology; and it also ignores some dialectal variation in the application of (31.c), such that only in some varieties does it apply initially in the tonic syllable in forms like *fortuitous*. However, I want now to turn to English vowels to try to establish in some more detail that the optimisation of contrast coincides with the facilitation of the expression of independent phonological generalisations - further phonological rules proper. In particular we find support for the notion that particular segments may be characterised by an empty gesture.

4. Non-specification and the phonology of the vowels: introduction

I take as my starting point the vowel system of Present-day English, as manifested in terms of surface contrasts in Received Pronunciation (RP) and Scottish Standard English (SSE), presented in their maximal forms in (32) and (33) respectively, in a notation which recognises, redundantly, both quality and quantity differences. These ignore (as well as RP's centering diphthongs) some problematical nuclei which don't affect the immediate conclusions I want to draw, but to which we shall return.

(32) a. /i:/ /u:/ b. /ɪ/ /ʊ/

/eɪ/ /əʊ/ /ɛ/ /ʌ/ /ɒ/

/ɔ:/ /æ/

/ɑ:/

/aɪ/ /aʊ/

RP

(33) a. /i:/ /u:/ b. /ʊ/

/e:/ /o:/ /ɛ/ /ʌ/

/ɔ:/ /a/

/aɪ/ /aʊ/

SSE

These are exemplified in (34) and (35) respectively:

(34) a. bead food b. bid good

jade road bed bud pod

bawd bad

balm

side loud

RP

(35) a. bead food, good b. bid

jade road bed bud

bawd, pod bad, balm

side loud

SSE

The (a) vowels are those which can appear finally in a stressed syllable; they also show greater inherent length – or, perhaps better, tenseness – than vowels at roughly the same height. I've accordingly distinguished the monophthongs with a colon, as involving a $\{V\}^2$ specification – or rather $\{\ \}^2$ (if vowels are unspecified categorially) – and inducing two nodes in suprasegmental structure.

There is perhaps a wee bit of doubt about the status of the Scottish low vowel in (33.b), in that some marginal examples show it finally in a stressed monosyllable:

(36) baa, lah, Da, Ma

(the latter pair being dialectal), and there is no vowel at the same height to compare it with. It has its historical sources in both a long and a short vowel, as can be seen in comparison with the RP forms in (34); but the longs are not numerous. (Examples with stressed final /ɛ/, such as *meh* (imitation of sheepspeak), are clearly even more marginal.) At any rate, there is no lexical low long/short contrast (but see §5 below).

Two of the Scottish (a) vowels also show both long and short sources: the high back rounded one and the low mid back rounded. But despite the absence of short congeners they plainly belong with the long set, as does /o:/, also lacking a short congener: the neutralisation has a long realisation, where possible (see below). As is familiar, 'hard-line' SSE, unlike RP, thus rhymes the members of the pairs in (37):

(37) psalm/Sam, food/good, bawd/pod

Despite these differences, the two systems display analogous geometric idiosyncrasies: in both, the status of /ɔ:/ among the long vowels and /ʌ/ among the short is anomalous. I am assuming that the RP high mid vowel diphthongisations are superficial, and that the vowels need be characterised contrastively only as in (38); and I am ignoring the effects of non-rhoticness.

In both Scots and RP the presence of /ɔ:/ requires that, contrastively, a dependency relation be invoked among the vowels containing **u** but not among those containing **i**; if /ɔ:/ is contrastively unspecified as to articulation, then this asymmetry is eliminated:

(38) {i} {u}

{i,a} {u,a}

{ }

{a}

RP

(39) {i} {u}

{i,a} {u,a}

{ }

SSE

Anderson and Durand (1988, 1989, forthcoming) have argued that such geometrical asymmetries are stigmatic with respect to the character of the unspecified vowel;

and that this is confirmed by the descriptive advantages that flow from the selection based on system geometry. I pursue these in this case in a moment.

Similarly, among the short vowels, /ʌ/ is clearly anomalous. In RP, to specify /ʌ/ would disturb the simple triangular system of (40):

(40) {i} {u}

{i,a} { } {u,a}

{a}

RP

characterised by **i**, **u** and **a** and simple combinations of the first two with the last. Again, in Scottish English /ʌ/ is eccentric in a system otherwise involving only **i** and **a** and combination thereof:

(41) {i}

{i,a} { }

{a}

SSE

[ə] is the unstressed variant of /ʌ/; it too will be articulatorily empty, though in many cases, at least, only derivatively (as a consequence of phonological reductions – see below).

The representations in (38) through (41) optimise contrast: by eliminating various quality distinctions between members of the short and long systems; and by eliminating an idiosyncratic vowel from each. What is even more significant is that the optimal expression of further phonological generalisations depends on such analyses.

Before pursuing this, let us observe that we have now invoked two rather different general (as opposed to language-particular) criteria in designating unspecified segments (or more precisely gestures). Anderson and Ewen (1981) appeal to markedness in arguing for particular non-specifications, e.g., of the alveolars in English. But clearly this is not always appropriate. And, as I have observed, Anderson and Durand base their selection for non-specification on asymmetries in the system; and they propose general 'geometrical principles' in terms of which selection is made. It is unclear how these different sets of principles interact: are they hierarchised, or, where both are potentially applicable, is the decision language-particular (in accord with descriptive considerations)? Moreover, are there further sets of principles involved? And to what extent must we admit language-particular selection of non-specification (exceptions to any principle)? I do not attempt to answer any of these questions here. I am concerned simply to show that in the case of the English vowel system selection based on asymmetry coincides with descriptive demands.

5. Scottish Standard English and the Vowel Length Rule

Consider firstly the SSE system in relation to the so-called Scottish Vowel Length Rule (SVLR, or 'Aitken's Law' - Aitken 1962, 1975, 1980; Lass 1974; Ewen 1977; Wells 1982: §§5.2.3-.4). SSE, like other varieties of English, shows the (possibly universal) superficial vowel length gradations associated with the positions in (42):

(42) final before voiced consonants before voiceless

with length decreasing to the right. Amongst the consonants, continuants favour length more than non-continuants. (Cf. e.g., Wiik 1965.) But there is (allegedly) to be found in addition in SSE (and Scots dialects) a lexical length adjustment, such that the vowels of (33.a/35.a/39) above are realised relatively long in the stressed contexts crudely specified in (43.a):

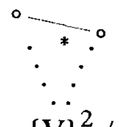
(43) a. _____r, v, z, ð, ʒ, §, #

b.

Long	*Short*
more	mole
save	safe
lose	loose
mouth (vb)	mouth (nn)
rouge	ruche
pylon	pile
rowed	road

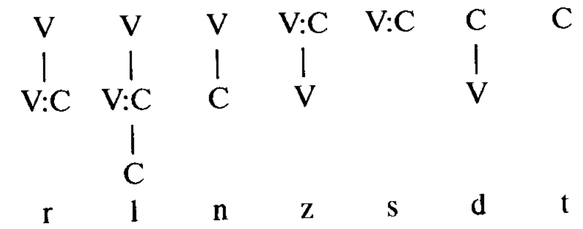
and relatively short elsewhere. '§' is syllable boundary, not included in all formulations (cf. e.g., Lass 1974). But it seems to me rather crucial in allowing not just for the penultimate pair in (43.b) but also for the long variant in e.g., bias, [bɑ:eəs] (cf. (45) below). Indeed, the formulation in (44.a), which embodies a well-formedness condition on the erection of complex nuclei above $\{V\}^2$, and which thus formulates the circumstances in which the 'short' variants occur, requires that a following 'shortening' consonant belong to the same rhyme:

(44) a. *Scottish Vowel Length Rule*



$\{V\}^2$ / →,+ {C} ≠ {|V,{V:C}|}

b.



(44.a), whose formulation presupposes that categorial redundancies have applied, 'prosodically shortens' vowels which have to the right ('+') a dependent consonant (where '→' expresses dependency) which is not uniquely characterised by **V** and a co-dependent **V** and **C**. Shortening thus occurs before any of the consonant types in (44.b) except for /r/ and the voiced fricatives. (44.a) predicts that there will be no shortening syllable-finally, even before a 'shortening' consonant in the following syllable, as in *pylon* or *spider* (both with [ɑːe]): the following consonant is not dependent on the relevant vowel. Contrast here too *phial*, dissyllabic and with a long stressed vowel, with *file*, monosyllabic and with a short vowel. (Presumably, the /l/ in e.g., *idle*, with short vowel, is not syllabic when (44.a) applies, and the preceding /d/ is consequently part of the rhyme associated with the preceding vowel.) Similarly, the inflexional /d/ in *rowed* is 'extrametrical', or (44.a) applies 'pre-cyclically', and the /d/ is not attached to the preceding rhyme (cf. e.g., Anderson 1986c), and thus does not cause shortening. We can therefore eliminate the '#' environment as such. Other morphological conditions favour syllabification of a consonant with a shortenable vowel: thus the first vowel in *wider* or *glider* is short in contrast with that in *spider*; in the former the /d/ is forced into the preceding syllable by the following morphological boundary. This can be allowed for by ordering SVLR before the addition of the relevant affixes. (I do not pursue this here; see, however, Anderson 1988b.)

It is also often claimed that the short vowels of (41) containing a (viz. /ɛ/ and /a/) likewise show a lengthened variant before /r/ and voiced fricatives, though (impressionistically) this variation seems to be much less marked than in the case of the long vowels of (39). This is particularly striking in the case of /ɛ/: the length difference between e.g., *bed* and *Perth* is no greater than one would expect from the hierarchy of (42). In the case of /a/ we could allow for the variation, if necessary, by making it redundantly long (since there is no short/long contrast at this height). Thus, in a sense, /a/ belongs underlyingly to both the long and the short set. (A similar analysis might be suggested for /u:/ and /o:/, there again being no long/short opposition at these places; but cf. the data of (47) below.) Anderson (1988b) suggests instead that some instances of /a/ (such as those in (36)) be marked lexically as long, thus overriding the redundancy {a} ⇒ {|V|}. This seems to be required independently to allow for the stress placement in e.g., *candelabra*.

I am not concerned here specifically with the formulation of the SVLR (cf. e.g., Ewen 1977, for an alternative formulation in a DP framework); rather, with that subclass of the long/tense vowels in (33.a) susceptible to it. But it should be noted that there is some controversy as to whether the pre-voiced fricative exam-

ples, in particular, are indeed longer in SSE than one would expect on the basis of (42) and its extensions, and whether the phenomenon is limited to Scots-based varieties (cf. Agutter 1988a,b; McMahon 1989). Similarly, with the pre-syllable-boundary penultimate example. The last example, however, is particularly striking - though it may be characteristic of other varieties as well. Why the distribution illustrated in (43.b) has been remarked on particularly in SSE and Scots is partly, perhaps, because in some instances at least the quantity difference is accompanied by a marked quality one, as in the notorious (45):

(45) sighed [sɑːed] vs. side [sʌɪd]

which is sufficiently salient to have led to a suggested marginal phonemicisation of the distinction for many speakers (Wells 1982: §5.2.4). However, more generally, speakers of Scots/SSE and related Irish varieties of English can be much more readily made aware of the SVLR differences than speakers confronted by (42): the SVLR differences are perceptually accessible to such speakers to an extent that makes it difficult to lightly dismiss the 'reality' of the phenomenon, or its dialectal restrictedness.

Whatever the context of the rule (and its dialectal status), it is striking that among the long monophthongs in (33.a) only /ɔː/ fails to participate uncontroversially in SVLR:

(46) *Long*: gnawed Maud

This suggests, in terms of the analysis presented in (39) on the basis of systemic asymmetry, that SVLR applies only to vowels with articulatory specification.

We might associate other distributional asymmetries in SSE with such a synchronic status for /ɔː/. Thus, only short vowels normally take [ŋ] as a coda (47.a); other long monophthongs reject such a coda (47.b), except /ɔː/, historically attributable to the collapse of /ɔː/ and /ɒ/:

(47) a. sing, length, hang, hung

b. *[iːŋ], [eːŋ], [uːŋ], [oːŋ]

c. long, song

And we find a similar distribution before [mp]. Only the articulatorily unspecified long monophthong is permitted in such short vowel environments.

SVLR also apparently fails in SSE with /ʉ/ and /ɔʊ/, omitted from (33.a/35.a):

(48) a. *Long*: feued feud
annoyed avoid

b. {i} { }

{ } {i}

Are these diphthongs also to be characterised as combinations with the unspecified vowel as the more prominent partner, i.e., lexically as in (48.b), thus extending the polysystemic character of the realisation of the unspecified vowel articulation? We do indeed find some support for this from a consideration of some further phenomena. These are also relevant to the status of /aʊ/, whose availability to SVLR is also at best controversial.

6. Received Pronunciation and the Vowel Shift

Let's now focus on the perhaps slightly more familiar RP system in (32/38). Suppose for the moment that (in accord with their historical development) all of the specified non-low vowels in the long vowel set are outputs to the Vowel Shift (VS), illustrated by the stressed syllables in (49):

(49)
ɛ:/	⇒ /e:/	profane
/e:/	⇒ /i:/	serene
/i:/	⇒ /aɪ/	divine
/ɔ:/	⇒ /o:/	verbose
/o:/	⇒ /u:/	school
/u:/	⇒ /aʊ/	profound

Alternations motivating some of these derivations (particularly among the back set) are scarce; and the alternation involving /u:/ is asymmetric – /aʊ/ vs. /ʌ/: I shall return to this below. What I am not concerned with at this point, however, is arguing for the precise status of the VS in the phonology of English, in particular whether it is a general phonological rule or one limited to some stipulated sub-part of the lexicon (i.e., just those items participating in the particular morphological relationships). In what immediately follows I shall assume the latter interpretation; but I take up this issue again in §7.

Given an underlying long vowel system of the character of (50), appropriate for at least this sub-part of the lexicon:

(50)
{i}		{u}
{i;a}		{u;a}
{a;i}	{ }	{a;u}
	{a}	

instantiated as in (51):

(51)

divine		profound
serene		school
profane		verbose
	bawd	
	balm	

we can exclude the vowel in balm from the vowel shift by requiring that the input vowel contain a feature other than **a**, as in the rough formulation in (52) (cf. Anderson 1980, forthcoming a, for more details):

(52) *Vowel Shift*:

$$\{\neg a\} \Rightarrow \neg a$$
$$\vdots$$
$$\{\ \}^2$$

where once more $\{\ \}^2$ is the characterisation for a long/tense vowel (in the absence of specification), and I leave unrepresented the suprasegmental environment (its character not being at issue). (52) increases the strength of the non-**a** feature in a long vowel which already contains a feature other than **a**; the output values are given by universal convention (cf. again Anderson 1980).

This formulation will also, without modification, exclude the vowel in *bawd* provided it is unspecified at the point at which vowel shift applies, i.e., before it is filled in by (53):

(53)
$$\{\ \} \Rightarrow a;u$$
$$\vdots$$
$$\{\ \}^2$$

Non-specification enables us to maintain the VS in its maximally general form without having to exclude /ɔ:/ by diacritic use of a feature specification distinct from its realisation (cf. e.g., Chomsky and Halle 1968: ch.4, §4.3.7), thus introducing an undesirable degree of abstractness.

The synchronic status of the /ɔ:/ vowel reflects an asymmetry in the historical development of the vowel shift: whereas the Middle English diphthong /aɪ/ develops all the way to /e:/ (as does Middle English /a:/), and Middle English /ɛ:/ goes (in most cases) to /i:/, leaving the low mid position vacant, Middle English /aʊ/ develops to /ɔ:/, now without a front congener (See e.g., Anderson forthcoming a.).

I suggest that the vowels in (48) also do not participate in the vowel shift. They do alternate, though somewhat marginally, with a short vowel, as shown in (54):

(54)
a. seduce ~ seduction
b. destroy ~ destruction

But notice that the short vowel concerned is in both instances the unspecified vowel, given content by (55):

(55) $\{\ \} \Rightarrow [ə]$

If the underlying vowels in (54) are respectively as in (48.b), then (categorial) shortening (laxing), here as elsewhere, simply removes the less prominent vowel, as in (56):

(56) *Shortening*:

$\{\ \} \Rightarrow \varnothing\ /\ \{\ \} \rightarrow \underline{\quad}\ /\ \ldots$

where again irrelevant environment is excluded, and the single arrow indicates dependency: i.e., (56) removes a dependent vowel. In the case of the underlying representations in (48.b), application of (56) leaves the unspecified vowel. Once more, the derivation of the long vowels does not involve the abstractness associated with application of the vowel shift WW(cf. e.g., Chomsky and Halle 1968: ch.4, §§5 and 4.3.3), but rather simply amplification by redundancy.

Shortening, unlike the SVLR, modifies segmental structure: a gesture associated with a dependent node, part of the nucleus, is removed; thus rendering such forms ineligible for e.g., VS. So too, lengthening (see (68) below) changes segmental structure, and feeds VS. Both are subject to the strict cycle condition (SCC), whereby:

Strict cycle condition:

a. Cyclic rules apply only to derived representations
b. A representation ϕ is derived with respect to rule R in cycle j iff ϕ meets the structural analysis of R by virtue of a combination of morphemes introduced in cycle j or the application of a phonological rule in cycle j (Kiparsky 1982:154)

SVLR does not affect segmental structure, but rather bans the erection of the expected nuclear configuration (as expressed in (44.a)); nor is it therefore subject to the SCC. VS, however, changes segmental structure; it is therefore unfortunate that it does not appear to be subject to SCC, given what would be the most restrictive view of lexical rules, whereby each structure-changing rule (rather than only those within 'cyclic strata' – Halle and Mohanan 1985) must be so subject. On such an interpretation, as they observe, VS (which they assign to stratum 2 in their variant of 'lexical phonology') "applies ... to forms not derived at stratum 2 (*divine*, *serene*, etc.), thereby violating the SCC" (1985:95). However, the most restrictive view would insist on what one might call a 'strong derivationality condition', such that all lexical structure-changing rules apply only to derived representations. We return to this problem in §7 below.

The interpretation of the realisational domain of the unspecified vowel that we have arrived at requires the redundancies in (57), replacing (53) and (55):

(57) a. $\{\ \} \Rightarrow$ u / {i} ____

b. $\{\ \} \Rightarrow$ a;u / $\{\ \}^2$

c. $\{\ \} \Rightarrow$ [ə]

which apply only to gestures attached to vowel categorial gestures, with (b) providing for the low mid vowel in both /ɔː/ and /ɔʊ/.
The final vowel in forms such as those in (58.a):

(58) a. argue, value, curfew
b. seduce, new, muse, cue

differs from that in *seduce* etc., i.e., those in (58.b), in being short rather than long. That is, we have lexically (59):

(59) a. $\{\ \}^2$ vs. b. $\{\ \}$

{i} $\{\ \}$ cue

{i} $\{\ \}$ argue

though the final vowel in argue will be superficially 'tense' ($\{V\}^2$). I shall henceforth distinguish (a) from (b) as /ɪu/ vs. /ʊ/ (long vs. short). After a coronal plosive, {i} before a stressed unspecified vowel produces palatalisations like those illustrated in (31), as in the medial [dʒ] of *seduce* found with many British speakers – or it disappears without a trace, as for many Americans.

The most obvious remaining anomaly among long-short alternations is that illustrated in (60):

(60) profound ~ profundity

Historically, this belongs with the other vowel shift pairings, and I assumed a vowel shift derivation for it in (51); but the original relationship has been obscured by the subsequent split of /ʊ/ and /ʌ/:

(61) /ʊ/ $\Rightarrow$ { /ʊ/ (put, pull, full); /ʌ/ (putt, but, profundity) }

We can allow for the short form if with respect to its articulatory gesture the second vowel in *profundity* and *profound* is underlyingly as in (62):

(62) $\{\ \}$ {u}

with again the less prominent element being erased under shortening, and the remaining unspecified vowel being filled in by (56.c). However, if the vowel in *profound* is to undergo vowel shift, then the redundancy in (63) will have to apply before vowel shift does, if the vowel shift is to be applicable:

(63) $\{\ \} \Rightarrow$ u / ____ {u}

Alternatively, and preferably, profound does not undergo vowel shift, but rather the first element is filled in by a redundancy of the form of (64):

(64) { } ⇒ a / _____ {u}

which applies at the same time as (56), after vowel shift has failed to apply to *profound* etc. This would accord with evidence that speakers fail to equate the *profound/profundity* alternation with the other vowel shift pairings (Cena 1978; Jaeger 1984, 1986; Wang and Derwing 1986), as well as, perhaps, with its doubtful status with respect to the SVLR.

This presupposes the underlying vowel inventory in (65):

(65) a. {i} {u}
{i;a} {u;a}
{a;i} {u;a}
{a}
{ }, { }{i}, {i}{ }, { }{u}

b. {i} {u}
{i,a} {u,a}
{a}
{ }, {i}{ }

which departs from some familiar analyses (of the tradition of Chomsky and Halle 1968: ch.4; Halle 1977; Halle and Mohanan 1985) in introducing not only an unspecified vowel, long and short, but a series of diphthongs, all involving one unspecified articulation.

The /ɹu/ and /ɹʊ/ diphthongs are, appropriately, the most marked, in that they will have to be specified lexically as involving the sequence relation (66):

(66) {i} < { }

sequence otherwise being given by a redundancy which places the unspecified gesture first. And the short one differs from the other diphthongs in RP in this respect (i.e., in being short). It will therefore fall under the universal redundancy whereby short diphthongs are rising (as argued by Schane at the San Diego workshop – see note*), as well as conforming to the redundancy which accords syllabicity to the unspecified vowel.

However, a consideration of the role of lengthening suggests a modification to the analysis of /ɹu/ just suggested. Under lengthening, the unspecified short vowel emerges as /ɹu/, as illustrated in (67.a):

(67) a. sulphuric vs. sulphur
Lilliputian vs. Lilliput

b. variety vs. various
managerial vs. manager
Canadian vs. Canada

This suggests that both articulatory gestures are unspecified in the case of /ɹu/, if (categorial) lengthenings (or tensings) take the form of (68):

(68) *Lengthening*:
∅ ⇒ { } / { } → ____ /....

(where again I ignore the further, diverse contexts involved – that in the case of *sulphuric* perhaps being unique to the unspecified vowel). That is, [ɹu] is either a derived or original unspecified diphthong. (68) results in simple lengthening (addition of an empty categorial gesture in the case of the examples in (67.b)). But with the examples in (a) both the categorial and the articulatory gestures are empty; application of (68) gives a long diphthong: two empty articulatory and two (or a geminate) empty categorial gesture(s). With [ɹu], original or derived, both governor and dependent in the nucleus are articulatorily empty, both being filled in by the redundancy in (69):

(69) { } { } ⇒ {i} {u}

which replaces (57.a); with the short vowels in this case again being completed by (57.c). Insertion of **i** varies according to context and dialect.

Underlying non-specification would also provide an alternative explanation (to the structural difference posited in §3 above) of why we find not spiranto-palatalisation (31.a) but palatalisation (31.c) in *perpetuate* etc.: **i** is simply not present at the point at which (31.a) applies.

[ɹu] would then involve perhaps the ultimate non-specification: two unspecified articulatory gestures combined with a geminate unspecified categorial one. This seems to be appropriate in view of its eccentric structure (with pre-nuclear [ɹ]) and distribution (such as its occurrence as a lengthened form in *sulphuric*).

The proposed analysis of this area of vowel phonology has moreover the desirable effect that the only feature-changing rule involved in these various alternations is the VS; even the adjustments required by lengthenings and shortenings (see e.g., (71) below) involve suppression or addition of features and or structural relations rather than feature-change, and are, moreover, subject to the SCC. Besides the VS and these lengthenings and shortenings, it is redundancies that supply all the other non-underlying specifications, thus avoiding a large part of the abstractness associated with the aforementioned tradition.

If we assume that the VS is lexically restricted (no 'free rides'), then the long system of (65.a) will also be asymmetrically distributed across the lexicon, with {a;i} appearing only in VS items and {u} only in non-VS. (See further, however, §7 below.) Omitted from (65) is a source for those instances of [aɹ] which do not derive from /i:/ via VS. We can maintain the position that all underlying diphthongs include at least one unspecified articulatory gesture if such [aɹ]'s realise the diphthong {a} { }. What this requires is the introduction of a further redundancy, as presented in (70), which replaces or incorporates (57), (64) and (69):

(70) a. { } ⇒ a / _____ {u}

b. { } ⇒ i / {a} _____

c. { } { } ⇒ {i} {u}

d. { } ⇒ a;u / { }[2]

e. { } ⇒ [ə]

thus extending the polysystemic character of the system, as well as providing a uniform characterisation of underlying diphthongs (as always partially specified). This [aɪ] differs from the other diphthongs and /ɔ:/, which are resistant to SVLR, in that only the dependent element in the nucleus is unspecified.

The analysis also posits, however, an asymmetry between the (monophthongal) long and short vowel systems both at the underlying and the surface level, as revealed by comparison of, say, tables (40) and (50), or (65.a) and (b), on the one hand, and by comparing (38) and (40), on the other, but with the values for the unspecified vowels filled in. The asymmetry between the underlying long and short mid vowel systems is what underlies the asymmetry in the qualitative effects of shortening:

(71)

{i;a}	⇒ {i,a}	serenity
{a;i}	⇒ {a}	profanity
{u;a}	⇒ {u,a}	scholar
{a;u}		verbosity

and lengthening. There are not enough short vowels to go round, as it were, and the mid back vowels collapse under shortening, while the deficiency at the front is solved by the availability of /a/. Further consideration of these asymmetries prompts a modification to the analysis just proposed, one with rather far-reaching consequences, involving a still greater decrease in abstractness. This will also lead us to a resolution of the problem posed by the fact that the structure-changing VS violates any 'strong derivationality' requirement, as observed earlier in this section. Let us approach this via a further elaboration of the notion of minimal specification, and a further enhancement of contrastivity.

7. Underspecification and the death of the Vowel Shift Rule

Anderson and Durand (forthcoming) offer an extension of the notion of minimal specification within DP which envisages **underspecified** as well as unspecified gestures. Notice, in this spirit, that the representations for the (monophthongal) mid vowels in (65) are over-specified; we might substitute for them those in (72):

(72)

a.			b.		
{i}		{u}	{i}		{u}
{i,}		{u,}	{i,}		{u,}
	{a,}			{a}	
	{a}				

illustrated once more by the forms in (73) (cf. (51)):

(73) a. divine school
serene verbose
profane
balm

b. various, bid good
manager, bed pod
Canada, bad

Representations like {i,} are underspecified rather than unspecified; they are, like { }, overtly incomplete, but in their case by virtue of incorporating an unsatisfied combination: they involve combinations lacking one element therein.

I return to the asymmetry between (a) and (b) in a moment. Let us observe, in the first place, however, that such representations eliminate the need for a vowel shift rule as such in favour of non-mutative rules of realisation (redundancies), as well as the necessity of allowing separately for the qualitative effects of shortening and lengthening illustrated (in the case of shortening) in (71).

Thus, we can offer the second vowel in both *profane* and *profanity* the underlying quality {a,} (**a** in potential combination); however, the latter shortens and undergoes a different realisation rule:

(74) {{V,V}{a,}} ⇒ i

{{V}{a,}} ⇒ | |

emerging as low {|a|} rather than mid {i,a}. The long vowel has **i** added to its articulatory specification to complete the combination; in the case of the short vowel **a** is combined with the identity element, indicated by the verticals which exclude the presence in the gesture of any other feature. (74) also apply to forms which are not morphologically related, such as *jade* and *bad* (cf. (32-4) above).

Similarly, *obscene* and *obscenity* will both have a second vowel of {i,} quality, but after shortening the latter will again be given a different realisation:

(75) {{V,V}{i,}} ⇒ | |

{{V}}{i,}} ⇒ a

The long vowel emerges as high, along with 'non-vowel-shift' bead etc.; the latter, along with bed etc., as mid {i,a} (cf. again (32-4) above). Again, 'vowel-shift' and 'non-vowel-shift' items are not distinguished phonologically (or diacritically): the 'vowel-shift' relation (as opposed to lengthenings and shortenings) is expressed purely morphologically.

The basic observation is this: the non-high vowel in *profane/profanity* emerges as mid if long, as low if short; whereas the non-low vowel in *obscene/obscenity* emerges as high if long, as mid if short. We have alternative length-dependent realisations rather than a structure-changing rule. And 'non-vowel-shift' items are susceptible to the same realisational regularities. 'Vowel-shift' items do not need to be distinguished lexically in these instances. The one apparent exception to this involves the second vowel in *divine/divinity* pairs – to whose analysis we now turn.

The diphthong in *divine* is underlyingly {{V,V}{i}}; only 'vowel-shift' items are lexically so. There is a corresponding short vowel, that in *various* and *bid*; but the 'non-vowel-shift' long vowel in *bead* has underlying {i,} (giving {|i|} by (75)), whereas *side* we have so far assigned underlying {a}{ } (giving {a}{i} by (70.b)). Nevertheless, we can once again allow for the divergent developments in the second syllables of *divine/divinity*, given shortening, in terms of differential realisation. Whereas the long vowel in *divine* has an **a**-gesture epenthesised in front of the {i} by (76):

(76) {{V,V}{i}} ⇒ {a} +

giving the dipthong {a}{i}, short {i}'s remain unaffected. (76) adds an extra (articulatory) gesture to the segmental structure without altering it otherwise.

Notice now, however, that if 'non-vowel-shift' items with /aɪ/, such as *rice*, are given the same source – i.e., as specified on the left of (76) – then (70.b) can be eliminated from the set of redundancies for the unspecified vowel. And this would also mean that none of the 'vowel-shift' vowels bears a specification that is different from that for some 'non-vowel-shift' item; no lexical marking is necessary.

(72.b) gives the minimum specification for the second vowel in *Canada* or the vowel in *bad* as {a}. This is just, contrastively. However, if the second vowel in *Canadian* is to be eligible, after lengthening, for the long realisational possibility in (74), giving appropriately {i,a}, then the specification for such short vowels must be amplified to {a,}:

(77) {a} ⇒ , /{V}

before (74) applies, the latter being fed by the amplification in (77).

Similarly, the statement of the long/short realisational alternatives affecting the vowels containing **u** requires that the specifications in (72.a), which again are the minimum demanded by contrast, be extended as in (78):

(78) {u} ⇒ {u,} (school, food)
{u,} ⇒ {u,a} (verbose, road) } {V,V}

The realisational possibilities are then given by (79):

(79) {{V,V}{u,} ⇒ | |

for *school* and *food*, while the amplified specification for *verbose* and *road* remains unchanged. Both the short(ened) vowels in *verbosity* and *pod* and that in *scholar* (the latter originally {{V,V}{u}} but {u,} by (78), and then shortened) are given their realisations by (80) (vacuously in the case of *verbosity*):

(80) {{V}}{u,} ⇒ a

with the vowel in *good* (lexically {{V}{u}}) being unaffected. I am assuming here, as with the non-**u** vowels, that the further differentiation between the long and short mid vowels (as high vs. low mid – so [e:] vs. [ɛ]) involves a later redundancy; so too the diphthongisation in RP etc. of the long mids and the centralisation of the short high vowels ([ɪ] and [ʊ]).

(81) provides some sample derivations (wherein for clarity of presentation I have given fully specified categorial gestures):

(81) {{V,V}{i,}} ⇒ {V} (56) ⇒ {i,a} (75) (obscenity)
{{V}{i}} ⇒ {V,V} (68) ⇒ {a}{i} (76) (variety)
{{V,V}{i,}} ⇒ {i,a} (75) (bed)
{{V}{a}} ⇒ {a,} (77) ⇒ {V,V} (68) ⇒ {i,a} (74) (Canadian)
{{V,V}{u}} ⇒ {u,} (78) ⇒ {V} (56) ⇒ {u,a} (80) (verbosity}
{{V,V}{u}} ⇒ {u,} (78) ⇒ {|u|} (79) (food)
{{V,V}{{ }{u}}} ⇒ {{a}{u}} (70.a) (profound)

The final example is included to illustrate the failure of the second vowel in *profound* to participate in these realisational alternations; as argued for in §6, the *profound/profundity* differentiation is allowed for by the interaction of shortening with the redundancies spelling out fully unspecified articulations.

The underlying vowel specifications still provide appropriate contexts for determining the (non-)applicability of 'velar softening' (whatever its character and status – cf. e.g., Halle (1977:614-15) on its role as evidence for a synchronic vowel shift rule): thus, prior to the redundancies the final syllable in *criticise* contains {{V,V}{i}} and that in *authenticate* {{V,V}{a,}}. 'Velar softening' occurs only before {i}, which includes the final vowel in *criticise*, in which **i** appears uncombined, as well as e.g., the second one in *longevity*, which is {i,}, but excludes the final vowel in *authenticate* as well as, of course, that in logical, again {a,}.

The above realisation rules allow for the 'vowel shift' alternations (those not

accounted for by the proposals of §6 above) without recourse to a structure-changing, SCC-violating rule like (52), without the attributing of quality shifts (such as are illustrated in (71)) to the operation of shortening and lengthening, and without lexical marking of forms eligible for vowel shift 'effects'. As is appropriate to processes not subject to the SCC, the rules involved are structure-building rather than -changing, and the derivations thus maximally 'concrete'. The most 'abstract' of the rules are the amplifications to the contrastive specifications (77-8), which, as the derivations in (81) reveal, must be ordered before shortening and lengthening. The realisation rules which follow these are, on the basis of the minimal specification assumption, largely required anyway, independently of the capturing of the 'vowel shift' alternations.

This final section has explored one rather striking consequence of optimising contrastivity in the lexical expression of the English vowel system, viz. the elimination of the troublesome 'vowel-shift rule'. Crucial to this has been that aspect of contrastivity which has been dubbed minimal specification. Many questions concerning the behaviour of, in particular, unspecified segments remain unresolved; and many of these, as anticipated, I have indeed not pursued. Let me conclude by spelling out one question which the phenomena we have surveyed have highlighted. In the case of a rule of the character of the vowel-shift formulation of (52), its exclusion from applying to the unspecified segment would be a natural one: the unspecified vowel lacks the qualitative property ({¬a}) demanded by the rule. But it is unclear why unspecified vowels should be invisible to quantitative adjustments like SVLR. This particular instance is not an isolated one (see Anderson 1988b): what then is the basis for this correlation?

Codetta on non-specification and vowel-reduction

§4 suggested that various asymmetries in the English vowel system are eliminated if certain (in this case, articulatory) gestures are contrastively empty, which possibility is predicted by the unary feature notation of DP. In §§5-6 I investigated phenomena whose description is facilitated or at least illuminated on the basis of this assumption and indeed provided that the unspecified articulations are as selected in accordance with the asymmetries of §4. Clearly, the adequacy of the analyses presented here in outline requires to be explored further; and the suggested non-specifications need to be shown to be compatible with independent phenomena. Finally here I sketch out one further area which warrants such investigation, and where preliminary observations are at least promising with respect to the proposals of §4.

Many mysteries still surround the area of vowel reduction in English (cf. e.g., Fidelholtz 1975), not the least on account of the amount of variability between speakers that may be observed. In particular, we lack a theory of factors favouring vowel reduction. What I offer here are simply some gross observations concerning the availability of various vowels for reduction under low stress. What they seem to suggest is that reduction is resisted among long vowels that are contrastively

unspecified. The specified long vowels in (82.a) show the reduced variants, typically realised as [ə], in (b):

(82)	a.	f<u>ae</u>ces	b.	defecate
		expl<u>ai</u>n		explanation
		prov<u>o</u>ke		provocation
		sch<u>oo</u>l		scholastic

Examples with some long vowels are difficult to come by (as with the last vowel illustrated in (82)), in that they fail to occur in the appropriate environments. Now, many such reductions of the (82) type may involve prior shortening (56), and we are thus seeing reduction of the 'corresponding' short vowel. But what is striking is that the lexically unspecified long vowels generally fail to reduce, as shown in (83):

(83)	a.	c<u>au</u>se	b.	c<u>au</u>sation
		expl<u>oi</u>t		expl<u>oi</u>tation
		dep<u>u</u>te		dep<u>u</u>tation
		f<u>ou</u>nd		f<u>ou</u>ndation

The status of /aʊ/ is unclear, as typically involving pairs related by VS and shortening, and in its emerging as [ʊ] (*recite – recitation*). Whatever the context for reduction (and whatever the role of shortening in such derivations), there appears to be here another area to whose description the notion of (non-)specification is appropriate.

REFERENCES

Agutter, A.J.L. 1988a. "The not so Scottish vowel length rule." In Anderson, J.M. and Macleod, N., eds. 1988. 120-32.

Agutter, A.J.L. 1988b. "The dangers of dialect parochialiasm: The Scottish vowel length rule." In Fisiak, J., ed. 1988. 1-21.

Aitken, A.J. 1962. "Vowel length in Modern Scots." Unpublished, University of Edinburgh.

Aitken, A.J. 1975. "The Scottish vowel-length system." Unpublished, University of Edinburgh.

Aitken, A.J. 1980. "The Scottish vowel-length rule." In Benskin, M. and Samuels, M.L., eds. 1980. 131-57.

Anderson, J.M. 1980. "On the internal structure of phonological segments: Evidence from English and its history." *FLH* 1. 165-91.

Anderson, J.M. 1986a "Suprasegmental dependencies." In Durand, J., ed. 1986. 55-133.

Anderson, J.M. 1986b. "The English prosody /h/." In Kastovsky, D. and Szwedek, A., eds. 1986. 799-809.

Anderson, J.M. 1986c. "Structural analogy and case grammar." *Lingua* 70. 79-129.

Anderson, J.M. 1987. "The limits of linearity." In Anderson, J.M. and Durand, J., eds. 1987. 199-220

Anderson, J.M. 1988a. "More on slips and syllable structure." *Phonology* 5. 157-9.

Anderson, J.M. 1988b. "System geometry and segment structure: a question of Scots economy." *NELS* 18. 22-37.

Anderson, J.M. forthcoming a. "Exceptionality and non-specification in the history of English phonology." In Rissanen, M. et al., eds. forthcoming.

Anderson, J.M. forthcoming b. "Kabardian disemvowelled, again." *Studia Linguistica* 45. 18-48.

Anderson, J.M. and Durand, J. 1988. "Underspecification and dependency phonology." In Bertinetto, P.M. and Loporcaro, M., eds. 1988. 3-39.

Anderson, J.M. and Durand, J. 1989. "Vowel harmony and non-specification in Nez Percé." In van der Hulst, H. and Smith, N.S.H., eds. 1989. 1-17.
Anderson, J.M. and Durand, J. forthcoming. "Segments non-spécifiés et sous-spécifiés en phonologie de dépendance: le yawelmani et les autres dialectes du yokuts." In Laks, B. and Rialland, A., eds. forthcoming.
Anderson, J.M. and Durand, J., eds. 1987. *Explorations in dependency phonology*. Dordrecht: Foris.
Anderson, J.M. and Ewen, C.J. 1981. "The representation of neutralisation in universal phonology." In Dressler, W. et al., eds. 1981. 15-22.
Anderson, J.M. and Ewen, C.J. 1987. *Principles of dependency phonology*. Cambridge: Cambridge University Press.
Anderson, J.M., Ewen, C.J. and Straum, J. 1985. "Phonological structure: segmental, suprasegmental and extrasegmental". *Phonology Yearbook* 2. 203-24.
Anderson, J.M. and Jones, C., eds. 1974. *Historical linguistics, II: Theory and description in phonology*. Amsterdam: North-Holland.
Anderson, J.M. and Macleod, N., eds. 1988. *Edinburgh studies in the English language*. Edinburgh: John Donald.
Archangeli, D. 1984. *Underspecification in Yawelmani phonology and morphology*. Unpublished Ph.D. dissertation, M.I.T.
Archangeli, D. 1988. "Aspects of underspecification theory." *Phonology* 5. 183-207.
Bennis, H. and Beukema, F., eds. 1985. *Linguistics in the Netherlands 1985*. Dordrecht: Foris.
Benskin, M. and Samuels, M.L., eds. 1980 *So meny people longages and tonges*. Edinburgh: Benskin and Samuels.
Bertinetto, P.M. and Loporcaro, M., eds. 1988. *Certamen phonologicum* (= Proceedings of the Cortona conference on non-linear phonology, April 1987). Turin: Rosenberg and Sellier.
Cena, R.M. 1978. "When is a phonological generalization psychologically real?" Indiana University Linguistics Club.
Chomsky, N. and Halle, M. 1968. *The sound pattern of English*. New York: Harper and Row.
Dressler, W. et al., eds. 1981. *Phonologica 1980*. Innsbruck: Institut für Sprachwissenschaft.
Durand, J., ed. 1986. *Dependency and non-linear phonology*. London: Croom Helm.
Ewen, C.J. 1977. "Aitken's Law and the phonatory gesture in dependency phonology." *Lingua* 41. 307-29.
Ewen, C.J. and van der Hulst, H. 1985. "Single-valued features and the non-linear analysis of vowel harmony." In Bennis, H. and Beukema, F., eds. 1985. 39-48.
Fidelholtz, J.L. 1975. "Word frequency and vowel reduction in English." *CLS* 11. 200-13.
Fisiak, J., ed. 1988. *Historical dialectology*. Berlin: Mouton de Gruyter.
Halle, M. 1977. "Tenseness, vowel shift, and the phonology of the back vowels in Modern English." *LI* 8. 611-25.
Halle, M. and Mohanan, K.P. 1985. "Segmental phonology of Modern English." *LI* 16. 57-116.
Hulst, H. van der and Smith, N.S.H., eds. 1982. *The structure of phonological representations*. Vol. 1. Dordrecht: Foris.
Hulst, H. van der and Smith, N.S.H., eds. 1989. *Features, segmental structure and harmony processes*. Dordrecht: Foris.
Jaeger, J.J. 1984. "Assessing the psychological status of the Vowel Shift Rule." *Journal of Psycholinguistic Research* 13. 13-36.
Jaeger, J.J. 1986. "On the acquisition of abstract representations." *Phonology Yearboook 3*: 71-97.
Kastovsky, D. and Szwedek, A., eds. 1988. *Linguistics across historical and geographical boundaries,* Vol 2: *Descriptive, contrastive and applied studies*. Berlin: Mouton de Gruyter.
Kiparsky, P. 1982. "From cyclic phonology to lexical phonology." In van der Hulst, H. and Smith, N.S.H., eds. 1982. 131-74.
Kiparsky, P. 1985. "Some consequences of lexical phonology." *Phonology Yearbook* 2. 85-138.
Laks, B. and Rialland, A., eds. forthcoming. *Architecture et géometrie des représentations phonologiques*. Paris: Editions du CNRS.
Lass, R. 1974. "Linguistic orthogenesis? Scots vowel quantity and the English length conspiracy." In Anderson, J.M. and Jones, C., eds. 1974. 311-52.
Lass, R. 1976. *Phonological theory and English phonology*. Cambridge: Cambridge University Press.
Lass, R. and Anderson, J.M. 1975. *Old English phonology*. Cambridge: Cambridge University Press.

Ohala, J.J. and Kawasaki, H. 1984. "Prosodic phonology and phonetics." *Phonology Yearbook* 1. 113-27.
McMahon, A.M.S. 1989. *Constraining lexical phonology: Evidence from English vowels*. Unpub. Ph.D. diss., University of Edinburgh.
Rissanen, M. et al., eds. 1992. *History of Englishes*. Berlin: Mouton de Gruyter.
Rubach, J. 1984. "Segmental rules of English and Cyclic Phonology." *Lg.* 60. 21-54.
Wang, H.S. and Derwing, B.L. 1986. "More on English vowel shift: The back vowel question." *Phonology Yearbook* 3. 99-116.
Wells, J.C. 1982. *Accents of English, Vol 2: The British Isles*. Cambridge: Cambridge University Press.
Wiik, K. 1965. *Finnish and English vowels*. Turku: University.