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Optionality, lexicality and sound change[1]

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This paper investigates the relationship between variability and lexicality on the one hand and sound change on the other within the theory of Lexical Phonology. The former leads to the proposal of the Optionality Constraint (OC), which prohibits the application of optional rules in the lexical module. The constraint is found to be violated at the word level. The violation of OC as well as of other lexical modular principles is accounted for by the help of a new licensing principle, called the Polarity Principle. This allows for interacting modules to have different properties of representation and rule application at their opposite ends. The OC leads to a resolution of the Neogrammarian Controversy, that is consonant with the standard assumption concerning sound change, namely, the inherent relation between the latter and variability.

1. Introduction

1.1 This paper addresses itself to the following questions:

(1) Can the lexical rule application be optional?
(2) What is the relationship between the optionality of the lexical versus postlexical rule application and the mechanism of sound change?

These questions, as should be obvious, bear on the problem of variability on the one hand, and lexicality and phonological change on the other.

1.2 It is uncontroversial that the postlexical (roughly, allophonic) rule application can be optional. The more interesting question is whether the lexical (roughly, morphophonemic) rule application can also be optional. Stampe (1979) found a total absence of evidence for the optionality of the

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latter type of rules.[2] Mascaro's (1976) theory of cyclicity predicted that optional rules must be non-cyclic, otherwise their application would be wrongly prevented by Strict Cyclicity.[3] More recently, Kaisse & Shaw (1985: 6), in an introduction to the theory of Lexical Phonology (see, for example, Kiparsky 1982, 1985; K. P. Mohanan 1982, 1986), too, assume that only postlexical rule applications can be optional. Kiparsky (1987), however, finds evidence for the systematic optionality of lexical rules. The finding of the present paper, which leads to the proposal of the Optionality Constraint (19), is that while word-level (that is, Level 2, see Kiparsky 1985) lexical rule applications can be systematically optional, the optionality of cyclic (Level 1) lexical rules must be a subregularity, that may be expressed in terms of a well-defined notion of 'subrules'.

A by-product of the present investigation is the discovery of a property of interfacing modules, namely, polarity, which is the presence of different properties of representation and rule application at its opposite ends. It is shown that this notion provides a simple explanation of the optional violation of the principles of the lexical module at the word level, including the Optionality Constraint proposed here. It thus helps avoid the unnecessary division of the lexical module into submodules (see Booij & Rubach 1987, Christdas 1988).

1.3 The question of whether the lexical rule application can be optional is also relevant to the problem of phonological change (see Kiparsky 1971, Labov 1972, Hooper 1976a, Wang 1979, Keyser & O'Neil 1985, Milroy & Milroy 1985).

Kiparsky (1988) shows that Lexical Phonology predicts the two opposite mechanisms of sound change (see Labov 1981), that is, regular or Neogrammarian change on the one hand, and lexical diffusion on the other. The prediction depends upon the principled distinction between two kinds of rule – lexical and postlexical. Kiparsky's conclusions are based on the assumption that postlexical rules are exceptionless. In the light of evidence against this assumption (Rubach 1984, Dresher 1983, Harris 1989a, b, McMahon 1989, this paper), I propose an alternative and more general explanation of the mechanism of sound change based on the assumption regarding the obvious link between rule optionality and sound change. The

[2] '... there is not a single clear case of an optional acquired rule' (Stampe 1979: 47). Stampe's usage of the term phonological 'rule' is equivalent to 'lexical' rule (see K. P. Mohanan 1982: 95–97).

[3] Mascaro's condition on cyclicity, known as 'Strict Cyclicity', precludes the application of a cyclic rule to a string not derived in its cycle. A string is 'derived' if it is a result of either word-formation or phonological rule application. Strict Cyclicity Condition has its origin in Kiparsky's (1973) Alternation Condition (earlier version from 1968), which prevented a class of phonological rules from applying in non-derived environments. Mascaro's 1976 investigation brought forward this class as cyclic rules. For a detailed discussion of SCC as a modular principle of Lexical Phonology see section 3.3.1.

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Optionality Constraint predicts that only cyclic lexical rules must undergo lexical diffusion. Postlexical rules typically undergo exceptionless change, but are not barred from undergoing lexical diffusion. Word-level lexical rules may follow either path.[4]

1.4 The outline of the paper is as follows. Section 2 presents definitions, based on critical discussions, of two notions – optional rules and subrules. Section 3 presents an overview of Lexical Phonology and its controversial issues. Section 4 introduces the notion of polarity with a view to explaining the word-level violations of the principles of the lexical module. Section 5 focuses on the issue of the constraint on optional rule application with relevant data and argumentation. Section 6 deals with the implication of the Optionality Constraint for a resolution of the Neogrammarian controversy in the light of recent literature. Section 7 presents the conclusion and summary of the findings.

2. Critical notions: optional rules and subrules

The answers I propose to the questions raised above depend on two critical notions, namely, OPTIONAL RULE and SUBRULE. Initially therefore it is necessary to define these terms.

2.1 *Optional rule*

The term 'optional rule' has three different meanings related to three different sources of variable output. First, variability may arise on account of different groups of language users. This may be termed as linguistic variability (or E-variability, after the notion of E-language in Chomsky 1986). Secondly, a single individual may produce variability on account of a number of 'grammars' (as understood in earlier theoretical terminology) in his command. The observed variability in this case is evidence of (sociolinguistic context determined) switching between the various grammars. And thirdly, variability may be found within a single I-language (in the sense of Chomsky 1986). The use of the term 'optional rules' in the literature (both formal linguistics and sociolinguistics) does not often distinguish among these three types of variation. The first type is often reported in descriptions of standard or dialectal varieties, as well as in the sociolinguistic approach to the study of the changing structure within the linguistic system of a group or groups based on the concept of 'orderly heterogeneity' (see Weinreich, Labov & Herzog 1968).

[4] The predictions made above have raised problems for two anonymous reviewers. As these are related to the main hypothesis of the paper, I address them at a later stage when the various aspects of the hypothesis will be defended.

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The latter two types of variability arise out of optionality in grammars. There are two ways of considering them. They may be kept distinct or they may be taken as one and the same phenomenon modelled differently – either in terms of switching between different subgrammars, as in the Bickertonian polylectal grammar approach (Bickerton 1971), or in terms of optional rules operating within the same grammar, as in the Labovian approach (Labov 1969).

We assume that variability in the speech of an individual is best represented in accordance with the Labovian model, as optional rules operating in the grammar. We do not however adopt the notion of the 'variable rule' (Labov 1969, Cedergen & Sankoff 1973), which incorporates the quantitative differences in the alternations within a grammar in relation to linguistic and sociological variables. Our approach is somewhat more abstract: we are merely concerned with the linguistic factors conditioning the observed variability in a grammar.

There is an apparent difficulty in trying to explain the mechanisms of sound change with the help of an organizational constraint on optional rules, as proposed at the outset. While the nature of optionality being investigated here relates to a 'grammar', language change involves the linguistic system of a group or groups. One way out of this difficulty is found within the social network approach (see, for example, Milroy & Milroy 1985) that addresses the actuation problem.[5] According to this approach, there is a need for a distinction between 'innovation', which is the act of a speaker or speakers, and 'change', which is the reflex of a successful innovation in the linguistic system observed post factum. Following this distinction, we might say that the behaviour of a group will reflect the behaviour of a speaker with regard to a constraint on rule optionality or variability. Thus, if the variability of a rule is regular, the change which it implements will also be regular. The converse is also true.

A rule with optional application potentially applies to all words that meet its structural description, but not all the tokens of any such word are subject to its application. This interpretation of the notion 'optionality', however, applies to cases of regular or systematic optionality, that is, where the entire rule has optional application (see section 5.2), and not to cases of subregular or 'partial' optionality, that is, where the rule applies optionally to some irregular forms or to phonological, morphological or lexical subsets of more general sets that meet the structural description of the rule, as discussed below.

[5] The 'actuation problem' is one of the five main areas into which Weinreich, Labov & Herzog (1968) divide the task of explaining linguistic change. The 'actuation' problem has been stated in the form of a question: 'Why do changes in a structural feature take place in a particular language at a given time, but not in other languages with the same feature, or in the same language at other times?' (Weinreich et al. 1968: 102). The problem remains intractable despite many recent attempts to explain it.

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2.2 *Subrule*

2.2.1 Although it is possible to present a grammar in terms of a series of elementary rules of the form $A \rightarrow B/C__D$, it is generally assumed that in order to capture significant generalizations and to achieve economy and elegance of description, a number of elementary rules can be conflated into a non-elementary rule or schema with the help of abbreviatory devices such as parentheses and variables.

It is crucial to the subsequent argument of the paper to assume that phonological rules are both of elementary and non-elementary types. We can define a subrule as follows:

(3) Given an elementary rule X and a non-elementary rule X′, a subrule is
  (a) X which applies to a limited set of items out of those which meet its structural description;
  (b) X whose structural description is a proper subset of X′, and whose structural change is identical with the structural change of X′;
  (c) X which applies to a lexical subset that meets the structural description of X′, and whose structural change is identical with the structural change of X′.

2.2.2 (3a) is the standard characterization of a 'minor' rule (see Kenstowicz & Kisseberth 1977, Zonneveld 1978, and references therein). Grammars may abound in them. As an illustration, consider a palatalization rule in a dialect of Dakota, as described in Shaw (1980: 110–112). The dialect, Santee, has a t-palatalization rule that irregularly changes a /t/ to [č] before a derivational suffix beginning with /j/. Alternatively, /t/ is found to occasionally also assimilate in voicing to the following segment /j/, yielding [d], or to undergo lenition and surface as [n]. Thus,

(4) (a) /khat + ja/ → [khačá] ~ [khadjá] ~ [khanjá] 'to make warm'
  /khat/ → [khatá] 'to be warm'
  (b) /stut + ja/ → [stučá] 'to thaw, cause to be thawed'
  /stut/ → [stutá] 'thawed'

Shaw describes the rule of t-palatalization as a considerably irregular rule. Forms with stem-final [č] (< /t/) are rather infrequent in occurrence.

A (3a) type subrule may be obligatory or optional. The rule of t-palatalization in Santee is of the latter type. We have included (3a) as a type of subrule in our account since it is sometimes found to have optional lexical application. The optionality of such a rule must be treated as subregular.

2.2.3 (3b) characterizes a class of subrules which have an intrinsic relation with a more general rule. Note that in the case of X being optional and not applying, the outputs of X and X′ would be different.

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There are certain proposals in the literature, including the Proper Inclusion Precedence Principle (PIPP; see Anderson 1972, Kotsoudas et al. 1974) and the Elsewhere Condition (EC; Kiparsky 1973, 1982) which attempt to get at the notion that two rules can have an intrinsic relation. These principles are stated either in terms of comparing the features used to formalize the rules (PIPP), or by comparing the sets of strings which undergo the other rule (EC). The definition of subrules of the type (3b) is stated in the latter terms.

According to EC, if two rules having common structural descriptions yield different changes, then the one which is more specific takes effect prior to the less specific one. The EC in its latest version (Kiparsky 1982: 136) is stated as follows:

(5) *Elsewhere Condition*:
Rules A, B in the same component apply disjunctively to a form $\emptyset$, if and only if:
(i) the structural description of A (the special rule) properly includes the structural description of B (the general rule), and
(ii) the result of applying A to $\emptyset$ is distinct from applying B to $\emptyset$.
In that case, A is applied first, and if it takes effect, then B is not applied.

As is clear, the rules in question in (5) must necessarily yield incompatible outputs; only then are they subject to EC. A (3b) type subrule is similar to rule A of (5) in that both are intrinsically connected to a more general rule. But the (3b) type subrule differs from A in that its application does not yield a different output from that of a more general rule. Its non-application, however, does. I assume that a (3b) type optional subrule, as also a (3c) type, discussed below, should be subject to the EC.

2.2.4 In a discussion of subrules, Kenstowicz & Kisseberth (1977: 352–353) try to show the need to reserve the concept of 'elementary rule' for a rule having some independent status. However, in the present investigation, there are many cases of optionality among lexical phonological rules that must be stated as a subregularity of (3c) type, even though they may not have independent status as elementary rules in the sense of Kenstowicz & Kisseberth (1977). Consider, for example, the Retraction rule in Polish discussed in section 5.3.3 (see example (31)). The rule changes a high, front vowel /i/ to a central vowel [ɨ] in the context following 'hard' (that is, non-palatal and non-palatalised) coronals. For example, /strax + i + ć/ → [straš + ɨ + ć] 'frighten'. However, in borrowed words, the rule applies optionally, as reflected by the orthographic representations in *miting* ~ *mityng* 'meeting', *bridż* ~ *brydż* 'bridge'. The orthographic *y* stands for the central high vowel, and *i* stands for the front, high vowel. The optional subregularity here is of type (3c), as it is restricted to a lexical subset which

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meets the structural description of the general rule, namely /i/ after non-palatal and non-palatalised coronals. It should be noted that subregular optionality of the type (3c) has found expression in both 'variable rules' (Labov 1972), as conditioning factors with statistical information, as well as in 'implicational hierarchies' or 'squishes' (Bailey & Shuy 1973, Ross 1973 [1967]), as hierarchically ranked conditioning environments. Panini includes them as independent subrules with the modalities 'may' or 'should' (see Kiparsky 1980).

Notice that although both subrules (3a) and (3c) show lexical selectivity, they are different in that whereas an elementary minor rule, (3a), does not bear an intrinsic relation to a more general rule, (3c) does.

3. Lexical phonology

3.1 *The framework*

The main objective of Lexical Phonology (Kiparsky 1982, 1985, K. P. Mohanan 1982, 1986, Halle & Mohanan 1985, Kaisse & Shaw 1985) is to search for modular principles governing phonological representations and rule applications.

Its basic claim is that the grammar organizes the application of phonological rules not into one but into two modules – namely, lexical and postlexical. The modules are assumed to have the following differences with regard to the properties of phonological rules and representations.

A. *Phonological rules*

(i) Lexical rules apply within words. Postlexical rules apply both within and across words.
(ii) Lexical rules interact with morphology. Consequently, cyclicity is now seen to be a natural property of lexical rules, which apply to forms each time their structural description is met as a result of word-formation rules. Postlexical rules apply after morphological rules and rules in the syntactic component. As a result, they are non-cyclic.
(iii) Lexical rules may have exceptions. Postlexical rules are exceptionless.

B. *Representations*

(i) Only categorial segments are represented in the lexical module.
(ii) Predictable values of features are not specified in the underlying representation in accordance with the theory of underspecification (see Kiparsky 1982, 1985, Archangeli 1984).
(iii) Unspecified feature values are filled in by language particular and universal Readjustment rules.

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C. *Convention and constraints*

The derivation of forms in the two modules is assumed to be subject to the following convention and constraints:
(i) Morphological brackets are erased at the end of each stratum, following the Bracket Erasure Convention (Pesetsky 1979, Halle & Mohanan 1985).
(ii) Cyclic rules are subject to the Strict Cycle Condition, which prevents the former from applying in non-derived environments.
(iii) Lexical rules are subject to the principle of Structure Preservation (see Kiparsky (1984: 141; 1985: 92), Ito 1986), stated as follows, after Myers (1991: 380):

(6) *Structure Preservation*:
A restriction on the underlying representation holds throughout the lexical phonology.

That is, lexical rules may not add to the inventory of segments present at the underlying level. Coupled with the constraint (Bi) on representations in the lexicon, (6) also implies that gradient sounds (that is, sounds with feature specifications along a continuum) can only be introduced in the postlexical module.
(iv) Phonological rules, which are specified with their ordering 'en bloc' in one component,[6] apply in both modules in accordance with the principle known as the Strong Domain Hypothesis (Kiparsky 1984, 1986) stated in (7), after (Myers 1991).

(7) *Strong Domain Hypothesis*
(a) All rules are available at the earliest level of the phonology.
(b) Rules may cease to apply, but may not begin to apply, at a later level by stipulation.

The hypothesis says that the only permissible language-specific constraints on rule domains are those which turn off a rule at a given level. No rule can be stipulated to begin to apply after a given level.

3.2 *Controversies*

Despite a consensus among lexical phonologists regarding the properties of the two modules, there exist notable differences among them.

3.2.1 *The lexical module*

The differences regarding the properties of the lexical module relate to three main issues, among others – the number of strata, the admissibility of non-

[6] In the model proposed in Figure 1, the rules are shown to belong to a component in the sense defined here.

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cyclic rules, and the validity of Structure Preservation as a universal principle of Lexical Phonology. I shall take up the last of these in section 3.2.2.

Differences with regard to the first two issues are found in Kiparsky (1982, 1985) and Booij & Rubach (1987) on the one hand, and K. P. Mohanan (1982, 1986) and Halle & Mohanan (1985) on the other.

A well-established principle of the lexical module is the Strict Cycle Condition (Kiparsky 1982: 152) stated as follows, after Halle & Mohanan (1985: 94):

(8) *Strict Cycle Condition* (*SCC*)
Lexical rule applications cannot change structure in environments not derived in their cycle. (Derived environment = environment created by the concatenation of two morphemes, or by the application of an earlier rule in the same cycle.)

Kiparsky (1985) modified the SCC to exclude the word-level from its jurisdiction on the ground that it is noncyclic. Kiparsky assumes a two-level organization of the lexical module:

(9) Stratum 1 (cyclic): Class I derivation, irregular inflection.
Stratum 2 (non-cyclic): Class II derivation, regular inflection, compounding.

Since level 2 is assumed to be non-cyclic in (9), it follows that rules at this level, but not at level 1, apply to non-derived environments. In Kiparsky (1982), both levels 1 and 2 were assumed to be cyclic and thus subject to the derived environment condition. Halle & Mohanan (1985) propose a four-stratal organization of the lexical module:

(10) Stratum 1 (cyclic): Class I derivation, irregular inflection.
Stratum 2 (non-cyclic): Class II derivation.
Stratum 3 (cyclic): compounding (a loop to stratum 2).[7]
Stratum 4 (cyclic): regular inflection.

According to Halle & Mohanan (1985), the SCC may be switched off at any level, not just the word-level.

The basic difference between (9) and (10) is with regard to the existence of strata 3 and 4. Strata 1 and 2 of (10) are the same as those of (9). If Strata 3 and 4 in (10) could be unified with Stratum 2, then the two models would be alike. Booij & Rubach (1987) successfully demonstrate the need for such a unification. The authors propose a universal bi-stratal organization of the lexical module, based on the need for Dutch and Polish to distinguish

[7] The loop device in (10) is to allow compounds to undergo a rule, namely, l-Resyllabification, at stratum 2, a device that considerably weakens the theory in that the relative ordering of the strata is no longer strict (see Kaisse & Shaw 1985, Giegerich 1988). As Kaisse & Shaw observe, the evidence for more than two levels in the lexicon is somewhat strained.

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between non-cyclic lexical rules applying within words, and postlexical rules applying across words:

(11) Lexical: Cyclic: Stratum 1: cyclic phonological rules.
Postcyclic: Stratum 2: non-cyclic phonological rules.
Postlexical: Stratum 3.

Within this model, only rules of stratum 1 are subject to SCC. Postcyclic rules are those word-level non-cyclic rules that do not take effect in phrasal phonology.

The attempt to delimit the number of lexical strata and to confine non-cyclic lexical rules to the postcyclic stratum is in the interest of the theory of Lexical Phonology, which is relatively diminished in (10) because of the laxities permitted in it. But (11) is not necessarily universal (see Giegerich 1988). Besides, there isn't, to our mind, any clear evidence for proposing the postcyclic stratum as an independent submodule in the sense that it cannot exclusively be shown to have properties which go with non-cyclic rules. The theory assumes that non-cyclic rules have two main properties, namely, absence of interaction with word-formation rules, and their application in non-derived environments. With regard to the former, although Dutch and Polish may require phonological rules to follow morphological rules at the word-level, English intersperses them, as clearly shown by Halle & Mohanan (1985) for rules for compounding and inflection.

With regard to the latter property of non-cyclic rules, Hualde (1990) convincingly shows that certain postcyclic rules in the Basque dialect of Ondarroa must apply in derived environments. The evidence is discussed below.

One of the rules in the dialect, simplified in (12), raises /a/ to [e] when preceded by a high front vowel word-finally:

(12) $/a/ \rightarrow [e] \; / \; \begin{matrix} V \\ [+\text{high}] \end{matrix} \; C____]$

The Vowel Assimilation rule applies only to derived *a*'s (13), and not to underived ones (14):

(13) /lagun-a/ [laɣune] 'the friend'
/gišon-a/ [gišona] 'the man
/aɾ̄i-ka/ [aɾ̄ike] 'throwing stones'

(14) /ikas-i/ [ikasi] 'to learn'
/muga/ [muɣa] 'limit'
/eliša/ [eliša] 'church'

The condition on the word-final environment shows that the rule has non-cyclic application. If the condition is not met, (12) does not apply:

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(15) (a)	/mutil-a/	[mutiʎe]	'the boy'
	/mutil-a-k/	[mutiʎak]	'the boy (erg.)'
(b)	/ondaɾ̄u-ra/	[ondaɾ̄ure]	'to Ondarroa'
	/ondaɾ̄u-ra-ko/	[ondaɾ̄urako]	'bound for Ondarroa'
(c)	/bi-na/	[biɲe]	'two for each'
	/bi-na-ka/	[biɲaka]	'two by two'
(d)	/aɾ̄i-ka/	[aɾ̄ike]	'throwing stones'
	/aɾ̄i-ka-da/	[aɾ̄ikara]	'throwing of a stone'

Being a postcyclic rule, (12) refutes the assumption that derived environment effects are a consequence of cyclic rule application, as assumed in Booij & Rubach (1987).

While the evidence from Basque supports Booij & Rubach's contention that the lexicon consists of two levels, it militates against their proposal to split it into two submodules. Following Kiparsky (1982, 1985), we assume that the two levels are parts of one module, the lexical module. The original insight regarding the bi-stratal organization of the lexical module can (and should, in view of its restricted claim) be retained under one condition: the proposed theory must allow word-level rule applications to optionally violate the lexical modular constraints. As the possible violation of modular constraints at the word-level is not licensed by any principle, phonological theory is in need of such a principle. In section 4 I propose such a principle. Strong support for it comes from an investigation of optional rule application discussed in section 5. In order to present the principle in a clear light, I turn to a discussion of the postlexical module below.

3.2.2 *The postlexical module*

The controversy regarding the properties of this module is centred around two topics – the number of strata in the module, and the place of phonetic implementation rules vis-à-vis phonological rules in the grammar. We shall begin with the second topic first.

The prevalent view among generative phonologists is that phonetic implementation rules are not entirely universal, as proposed by Chomsky & Halle (1968), but that at least some of them are a part of the grammar (see, for example, Chen 1970, Fromkin 1976, Keating 1985). It has led phonologists and phoneticians to look for explicit characterizations of phonetic implementation rules and phonological rules. An example of the former type would be the gradient rule (Kiparsky 1985) that devoices sonorants in English: c[r̥]y, p[l̥]ay, sp[l̥]it. The devoicing of sonorants may not be complete; moreover, the degree of devoicing may vary depending on the stress, the rate of speech, etc.

Lexical Phonology differentiates between the two types of rules in terms of their location in the grammar. There are two different points of view here. One is to be found in Kiparsky (1985), who assigns their application at a single level in the postlexical module (see section 3.2.1 above).

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The other approach assigns the application of phonetic implementation rules either to a separate stratum (Kaisse 1985) or to a separate submodule (K. P. Mohanan 1986, Keating 1988). The idea that postlexical rule applications take place at more than one level originally comes from Selkirk (1972, 1984), who distinguishes between sentence-level rules which are syntactically conditioned, such as the French rule of liason in colloquial style (Selkirk 1972: 46), from sentence level rules which are conditioned entirely by the prosodic structure, such as Flapping and Aspiration in English. Kaisse (1985) presents a formalized account of such a postlexical module. Her syntactically conditioned rules or P-1 level rules precede Fast Speech or P-2 level rules, which are equivalent to Selkirk's prosodic structure dependent rules. Kaisse (1990) defends her position with regard to the bi-stratal organization of rules in the postlexical module, which has been questioned in Hayes (1990). The latter proposes that all syntactically conditioned allomorphs are derived by 'pre-compiled rules', a subset of lexical rules, in the lexicon, with the specification of the syntactic contexts in which they can be inserted. The basic allomorphs are inserted elsewhere as default allomorphs. Consequences of this move are that direct-syntax phonological rules do not exist, and all postlexical rule applications take place in prosodically defined domains.

Whether phonological rules in the postlexical module apply at two levels or at one, rules of phonetic implementation must be kept distinct from postlexical phonological rules (Mohanan 1986, Keating 1988) on two main grounds.

First, Structure Preservation cannot be accepted as an operative principle of Lexical Phonology. The principle is indeed found to be untrue in a variety of cases (see Myers 1991). These include not only a large number of word-level rules (see Borowsky's 1986 analysis of English) but also higher level rules, much cited examples of the latter being rules for nasals and well-formedness constraints on syllable structure in Malayalam (see Mohanan & Mohanan 1984, T. Mohanan 1990), vowel harmony rules affecting mid-vowels in Southeastern Bantu languages (Harris 1987), rules for dentalization and /æ/-tensing in English dialects (Harris 1989a), and the rule for dorsal fricative assimilation in German (Hall 1989). The last accounts for a lexical phonological alternation between the palatal fricative [ç] and the velar fricative [x]. It led to a proposal by Macfarland & Pierrehumbert (1991) to exclude the application of Structure Preservation to certain assimilatory processes. The proposal, however, has been shown, by Iverson & Salmons (1992), to be irrelevant to the German rule in question, since it applies at the word-level, where Structure Preservation no longer holds.

The second reason for allocating phonetic implementation rules to a separate module is based on the recognition of a clear distinction between phonological (both lexical and postlexical) rules and phonetic implementation rules in phonetic studies (see Huffman 1988, Keating 1988,

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Pierrehumbert & Beckman 1988, Cohn 1990). Thus Keating (1988), on the basis of Pierrehumbert (1980), shows the following, among other, differences between the two types of assimilation rules: phonological rules are categorial (with binary feature specifications), whereas phonetic rules are gradient (with feature specifications along a continuum); phonological rules manipulate discrete, timeless entities, whereas phonetic rules manipulate entities changing in space and time; phonological rules affect full segments, whereas phonetic rules may affect part of a segment, and so on.

Distilling from the works discussed above, the model of the organization of rule components of a sound system may be represented as in Figure 1.

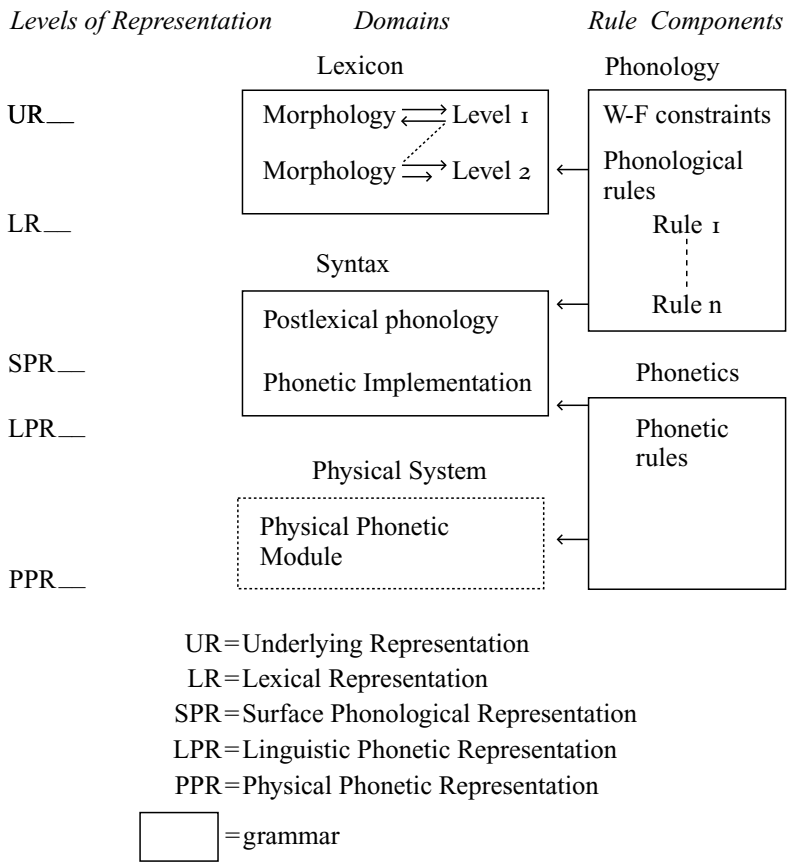


Figure 1
Components of the sound system of a grammar

Figure 1 shows the existence of four sequentially ordered modules – lexical phonology, postlexical phonology, phonetic implementation and physical phonetics – of which the first three belong to the grammar. Further, there are two sequentially ordered rule components – phonology and phonetics. In

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addition to the claim that the application of one type of rule (phonological) in different modules has different properties, the model in Figure 1 also implies that there is no interaction between rules of the phonological and the phonetic components (as they operate on different types of sound units). Besides, phonetic rules must follow phonological rules.

4. POLARITY

4.1 There are two ways in which the possible violation of the principles of lexical phonology at the word-level can be explained. One is to propose a separate submodule of postcyclic rules, as is argued for by Booij & Rubach (1987) (see (11) above). Alternatively, one can propose a general licensing principle that permits such violations at that level. I take the latter approach, since it provides a better explanation of the violations, which have been found to be optional, not obligatory. Besides, the violations are observed to have a general pattern, found at other levels in the phonology, as I shall try to show below. The licensing principle is called the Polarity Principle (see (18) below), which is crucially based on the notion of POLARITY.[8]

By 'polarity' I mean that a module may have different properties as to representations or rule applications at its opposite ends. Perhaps it is natural for a linguistic module which shares a set of rules with an interfacing module to have this property: the properties of the interfacing module may percolate into it (cf. Kaisse & Shaw 1985: 23). The empirical facts regarding the violation of constraints in the lexical module can be conceptually explained with the help of the notion of polarity. As Figure 1 shows, the lexical module is polar. While no module precedes it, it is followed by the postlexical module, and both share the phonological rule component. The notion of polarity predicts that its modular constraints may be violated in the last stratum. In section 5, I shall try to show that the Optionality Constraint proposed here has the same pattern of violation as the other lexical phonological constraints discussed in section 3.3.1.

4.2 I now turn to certain questions pertaining to 'polarity' that must be answered for a fuller understanding of the notion.

A. *Is polarity a unique property of the lexical module? If not, how does it manifest itself in the postlexical module?*

The rational justification for lexical polarity offered above has a principled basis in the nature of the organization of a grammar. The modules of the sound system of a grammar are sequentially ordered as shown earlier in Figure 1. Besides, there are two rule components, each relating to a different module. Phonological rules apply in the sequentially ordered lexical and postlexical modules. It was seen above that most properties of the lexical module can be violated at the postcyclic stratum. These are also the

[8] It has an analogue in developmental biology (see, for example, Herman & Rozenberg (1975) and relevant references therein).

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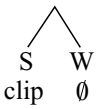
properties that do not hold in the postlexical module. It is thus reasonable to assume that the loss of lexical properties as an end-of-module phenomenon is on account of its interfacing the postlexical module. In short, we hypothesize that polarity is a property of interfacing modules. It therefore follows that polarity is not a unique property of the lexical module.

In order to substantiate this view, it is necessary to show how polarity is manifested in the postlexical module, notwithstanding the poorly understood nature of the module (see, for example, Bromberger & Halle (1986: 515), McCarthy (1988: 106)).

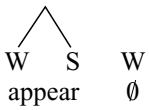
Examples of postlexical rule applications that have properties normally considered as predicative of lexical rule applications are found in Kaisse (1990) and Carr (1991). I cite just one illustrative case discussed at length by Carr – Weakening in Tyneside English.

Tyneside English in fact has two related processes: one is Weakening and the other is Glottalization. Weakening takes place when an intervocalic /t/ is realized variably as the post-alveolar continuant [ɹ] or as the coronal tap [ɾ] in certain grammatical words such as *not*, *but*, *what* and *that* and in verbs, but not in nouns, adjectives or prepositions, and in a specific metrical environment, namely, as the coda of the head (s) syllable. The rule in forms such as *not a chance*, *what a night*, *put in front*, *met him*, *fit her*, *excite her* as a general process of cliticization gathering weak rhymes into the weak right branch of a foot containing a zero syllable (see Giegerich 1985), as shown in (16).

(16) (a)



(b)



Weakening does not apply word-internally, in either morphologically simple words like *putty* or morphologically complex words like *fitter*, which have an identical surface metrical structure as *fit her* in (16). The word-internal /t/ in these words undergoes another process, namely, Glottalization, which has the same metrical constraint as Weakening, but is more general in many respects: one, it applies to all voiceless plosives and affricates and not merely to /t/, yielding segments such as [ʔ͡p], [ʔ͡t], [ʔ͡k] and [ʔ͡t]; two, it allows sonorants to occur before the stops, as in *temper* and *thinker*; and three, it applies across-the-board to all words irrespective of their syntactic constituency and morphological structure, as in (17).

(17)

Morpheme internal	Across morpheme boundary	Across word boundary
stupid	clamper	clip her wings
temper	fitter	wreck her
alter	milker	milk her
		*fit her

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The structural description of Glottalization properly includes the structural description of Weakening. The Elsewhere Condition thus requires that the latter precede the former. Carr follows Mohanan (see also Kaisse 1985, 1990) in assigning the rules to different sequentially ordered strata in the postlexical module – Weakening to the syntactic submodule and Glottalization to the postsyntactic submodule – on the grounds of the presence or absence of syntactic constraints. According to Carr (1991: 44), 'Weakening applies in a kind of postlexical, metrically derived, environment.'. Weakening is thus a postlexical neutralization rule (both /t/ and /r/ are realized as [ɹ]), which possesses properties of a lexical rule application[9].

Modular constraints on representation of forms may also show polar patterns, as illustrated in Pandey (1992), with the help of a case of ordering paradox in American English (discussed at length in Vennemann (1972) and Anderson (1975)) relating to a phonological rule of t/d Flapping (see Kahn 1976, Kiparsky 1979) and a phonetic rule of Vowel Lengthening (House & Fairbanks 1953, Lehiste 1970, Fromkin 1976, Keating 1985, de Jong 1991). It is shown that the phonetic rule of Vowel Lengthening (that lengthens both short and long vowels by a variable amount before certain consonants) must be ordered before the postlexical phonological rule of Flapping in the midwest variety of American English in order to avoid the conclusion that the length of vowels before flaps is contrastive in the language (in forms such as *writer* /rajt + ər/ [rajDər] and *rider* /rajd + ər/ [ra:jDər], and *latter* /lætər/ [læDər] and *ladder* /lædər/ [læ:Dər]).

In the fact that the phonetic implementation rule of Vowel Lengthening must precede the postlexical rule of Flapping, we have evidence for allowing both gradient representations and phonetic rules in the postlexical module. The status of Structure Preservation as a lexical modular principle being questionable (see section 3.3.2), neither gradient representations nor the intermixing of phonetic and phonological rules in the postlexical module are licensed by any previously known modular principle. The notion of polarity, which is independently motivated for explaining end-of-module violations of lexical phonological principles, can very well account for the presence of gradient representations and phonetic rules in the postlexical module.

B. *Is it the case that any property can be polar, that is, no properties holding at one end of the module also hold at the other end? If no, then which properties are polar, and what is the principled basis for their polarity*?

Polar properties are subject to two main conditions. One, the properties are absent in the other module (and are the main reason for the difference between the two modules). This means that a principle such as SCC can be

[9] The evidence for the lexical property of a postlexical rule will later (sections 6.4, 6.5) be shown to agree with the evidence for the lexical diffusion of some postlexical rules. Both will be shown to be crucially connected with the idea 'optional rule'.

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polar in the lexical module, as it does not hold in the postlexical module, but the constraint on binary feature specifications for segments in the lexical module cannot be polar to give way to scalar representations, as postlexical rules, too, operate on categorial segments.

The second condition on polar properties is that only modular principles can be polar. These include the nature of representation of linguistic units as well as principles governing the application of rules within a module. Inductive evidence shows that constraints on the well-formedness of representations are not subject to polarity. WFCs are amodular and can either hold throughout the phonology, for example, the universal constraint on crossing lines, and the language-specific constraint ruling out word-initial *[ps], *[tn], *[ŋk] clusters in English, or cease to hold at any level in the grammar, for instance, the constraint ruling out alveolar nasals in Malayalam (Mohanan & Mohanan 1984), which does not hold at Stratum 1, or the constraint disallowing aspirated plosives in English, which is void in the postlexical phonology.

It seems plausible to believe that the Obligatory Contour Principle (see, for example, McCarthy 1986), too, being a WF principle requiring language-specific implementation, may have global violations (Odden 1988, Goldsmith 1990). This controversial issue needs further investigation along the lines proposed here.

It is relevant to explain here the relation between polarity and the Strong Domain Hypothesis (7). At the end of the lexical module, polarity allows phonological rules which respect modular constraints to be intermixed with those that violate them. This implies that the modular constraints may be on or off. This seems to be in apparent violation of SDH, as pointed out by a referee. Notice, however, that the SDH is concerning the application of phonological rules, and not the application of other modular constraints. SDH permits a given rule to be switched off after a certain level in the grammar. Polarity permits a modular constraint such as Strict Cyclicity to be optionally switched off at the end of a module, so that both cyclic and non-cyclic rules apply at the word level in the lexical module. For example, l-Resyllabification and Velar Softening are level 2 rules in English. Whereas the former is cyclic, the latter is non-cyclic. Trisyllabic Shortening is a level 1 rule in English, but it does not apply at level 2, even though its structural description is met, since its domain of application is restricted to level 1, in accordance with SDH.

C. *What is meant by* '*end*' *of a module? Does similarity of properties across modules* (*and dissimilarities within a module*) *get stronger when one gets closer to the ends of a module?*

The term 'end' of a module refers to the beginning or end of the derivation of forms in the module. The interpretation of the term depends on the nature of the module. Thus, for the lexical module, which has more than one

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stratum, it means the first and the last strata. But for the postlexical module, we are on controversial ground, as discussed in section 3.3.2. Kaisse (1985) and K. P. Mohanan (1986) posit two strata in the postlexical module for rule applications which are syntactically conditioned and rule applications which are entirely prosodically conditioned and automatic.

We however hold (see also Odden 1990) that the possible (not systematic) sharing of properties of lexical rule applications by early postlexical rule applications cannot be the sole basis for positing more than one level in the postlexical module. That is easily explained with the help of the notion of polarity.

The notion 'end' of module with respect to the postlexical module, therefore, can at best be interpreted in terms of 'beginning' and 'end' rule applications. The theory of polarity predicts that rule applications at the beginning of the postlexical module may share properties with lexical rule applications, whereas rule applications which take place towards the end of the postlexical module, that is, which are automatic, may share properties with rules of phonetic implementation.

4.3 We can now put forward a principle that accounts for the polar properties of linguistic modules:

(18) *Polarity Principle*
Interfacing modules that have a common rule component or domain of rule application can be polar.

The Polarity Principle predicts that the lexical module can be polar, since it shares the phonological rule component with the interfacing postlexical module. It also ensures the polarity of the postlexical module vis-à-vis the phonetic implementation module (see Fig. 1 above), as they have a common domain of rule application, namely, syntax.

5. Optional rule application

5.1 Optionality in lexical rule applications has been found to be restricted to subrules (see Pandey 1991), on the basis of a preliminary examination of optional rules in English, Sanskrit and Dakota, selected at random for representing different degrees of variability, from high, as in Sanskrit (Kiparsky 1980), to low, as in Dakota (Shaw 1980). A detailed investigation of these and other languages reported here confirms the finding. The only exceptions are found at the word-level, where optional rule application can be systematic in certain grammars. As these exceptions can be taken to be owing to the polarity of the lexical module, the generalization stands, and can be stated as a universal constraint:

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(19) *Optionality Constraint*
(a) Rule optionality is systematic only in the postlexical module.
(b) Rule optionality in the lexical module is restricted to subrules.

In this section, I shall adduce evidence in support of (19). (19a) is the least interesting of the predictions. Optional postlexical rules are unproblematic for all theories, so I shall only present an illustrative case (section 5.2) showing that postlexical rules can be optional. The predictions in (19b) are more interesting: they relate to lexical rule application. I shall present more data and argumentation in support of these cases (section 5.3, section 5.4), since it is with regard to these that the theory has something new to say. I must state here, however, that only a few of the languages investigated for this study,[10] contain detailed discussions of phonological variation, even less of morphophonemic variation. The general paucity of optional lexical rules in phonological descriptions provides an empirical corroboration of the universal constraint in (19).

5.2 *Postlexical optionality*

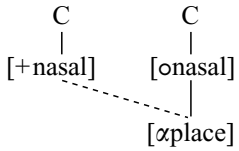
I discuss here the rule of Nasal Assimilation in English as a postlexical rule with optional application.

The rule of Nasal Assimilation in English (see Borowsky (1986) for a recent discussion) assimilates nasals to the place of articulation of the following stops, as is seen in the following examples:

(20) rent, sound, bump, simple, bomb, sing, sink, hunger, monkey

Two relevant facts may be noted here. One is that *b* and *g* following nasals may get deleted on account of not being syllabifiable in given contexts, as, in, for example, *bomb* and *sing*. Secondly, the velar nasal [ŋ] is not a phoneme in English, but is always followed by a velar obstruent that may not always be apparent on the surface. The rule of assimilation for nasals may be stated as follows:

(21) *Nasal Assimilation* (*NA*) *in English*



The rule has both lexical and postlexical application with different effects. In its lexical application, (21) is a blank-filling rule that fills in the place features

[10] The languages examined include Menomini (Bloomfield 1962), Yawelmani (Kuroda 1967), Greek (Sommerstein 1973), Russian (Lightner 1972), Turkish (Lees 1961), Bangla (Dasgupta 1982, 1985), Tamil (Christdas 1988), and Swahili (Bakari 1985).

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of nasals before obstruents. This is evident from forms such as *Canberra*, *Camden*, *Vancouver* in which the application of NA is blocked on account of an underlying specification of place features.

NA cannot assimilate the nasals lexically since they are already specified for place: /kænbərə/, /kæmdən/, and /vænkuvər/.

Another feature of the lexical application of NA is that it cannot assimilate velar obstruents to preceding nasals at Stratum 1 on account of a well-formedness constraint (22) against velar nasals applicable at that level:

(22) * X
|
[+nasal]
|
[+velar]

Consequently, we get forms like [impres] ← [[iN][pres]], but [ingres] ← [[iN][gres]]. The alveolar place is assigned as a Default rule in (23).

(23) [ ] → [+coronal]

The constraint against velar nasals does not hold at level 2, so that NA applies at word level giving velar nasals in, for example, *king*, *hunger*, etc.

In its postlexical application, NA is feature changing, as well as optional. Consequently, we get alternating forms such as [kæmbrə] ~ [kænbərə] 'Canberra', [væŋkuvər] ~ [vænkuvər], 'Vancouver', [iŋgres] ~ [ingres] 'ingress', [iŋgrætitju:d] ~ [ingrætitju:d] 'ingratitude', etc.

NA applies optionally in compounds and phrases as well, thus attesting to its postlexical status. The examples in (24) are from Selkirk (1975).

(24) i**n** bad condition [im] te**n** pence [tem]
i**n** principle [im] paw**n** broker [m]
fro**m** New Guinea [fron]

The postlexical optionality of NA is regular and systematic, and not subject to any lexical condition.

5.3 *Lexical optionality*

Optionality in rule application throughout the lexical module involves subrules. Of the four rules discussed below, the first two apply at stratum 1 and the last two at stratum 2 or the word level. The relevant stratum is specified for each rule.

5.3.1. '*Anunasikatiprasaram*' *in Malayalam* (Stratum 1)

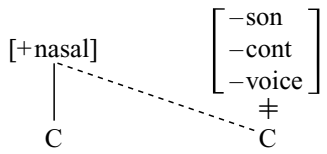
Malayalam has a rule of voiced stop assimilation, traditionally known as 'anunaasikaatiprasaram', that changes voiced stops to nasals after nasals, as, for example, in (25):

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(25) /pandi/ [panni] 'pig'
/wandu/ [wannu] 'came'
/andə/ [annə] 'that day'
/maNja/ [manna] 'yellow'

The rule is stated as follows:

(26) *A̲unaasikaatiprasar̄am* (Mohanan & Mohanan 1984: 584)



Mohanan & Mohanan (1984) show that the rule applies obligatorily in words of Dravidian origin, exemplified in (25), but optionally in words of Sanskrit origin. Alternations in the latter are exemplified below:[11]

(27) Formal Colloqial
bhaŋgᵊi b(h)aŋŋi 'beauty'
anjᵊan̲am annan̲am 'a stone'
candᵊan̲am cannan̲am 'sandalwood'

(26) is a lexical rule since it must contain morphological information in terms of the feature [±Drav]. Moreover, as it does not apply either in phrases ([[awan] [balawaan]] 'he is strong'→[awambalawaan] /* [awammalawaan]) or in compounds ([[miin] [gootram]]) 'the clan of fish'← [miiŋgootram /* [miiŋŋotram]), it is assumed to apply at stratum 1 (Mohanan & Mohanan 1984: 589). However, as (26) changes a nonsonorant to a nasal in non-derived environments, it goes against the principle of Strict Cyclicity. The authors' explanation of the violation is that it takes place in a non-cyclic stratum and should therefore be licensed like all such violations noted in the literature (Mohanan & Mohanan 1984: 593).

The problem with this analysis is that it is too short on evidence. The authors offer just one example cited above in support of the claim that (26) does not apply across stems in compounds. The stems are of Sanskrit origin, which, on the authors' own admission, do not undergo the rule regularly. In the light of arguments (Hargus 1989) against the four-stratal analysis of Malayalam, and lack of substantial evidence against positing (26) at stratum 2, we assume that it does indeed apply at stratum 2. What is crucial to note at this stage is that the optionality of (26) is a subregularity, confined to a section of the vocabulary specified for the feature [−Drav]. The subregularity is of (3c) type.

[11] I follow Christdas (1988) in using a subscript __ for alveolars rather than for dentals, as in Mohanan & Mohanan (1984).

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5.3.2 *Labio-Velarar Palatalization in Polish* (stratum 1)

Contemporary Polish has a cyclic rule of Palatalization whereby /j/ is inserted after labial and velar consonants before the mid front vowel [e]. Rubach (1984) shows that the cyclicity of the rule is evident from its application both at cyclic boundaries and before a derived [e] morpheme-internally. In the latter case, the trigger [e] is derived by a general rule of Lower from an underlying /i/. I reproduce below some of the examples from Rubach illustrating the j-insertion effect of the rule. I shall follow here the standard convention of enclosing underlying phonological representations in '//' brackets and intermediate and surface phonological representations in '[ ]' brackets. The '[ ]' brackets within '//' show the morphological constituency of words.

(28) (a) *mopheme internally*

(i)	/[pis]i/	[p'jes]	'dog'
	/[bis]i]/	[b'jes]	'devil'
(ii)	/[giz]i]/	[g'jez]	'gadfly (pl.)'
	/[cukir]i]/	[cuk'jer]	'sugar (pl.)'

(b) *at cyclic boundaries*

(i)	/[slup]ie]/	[−p'+je]	'pole (loc.)'
	/[gɔlf]ie]/	[−f'+je]	'golf (loc.)'
	/[tɔrb]ie]/	[−b'+je]	'bag (fem.) (loc.)'
	/[[[[s]cham]ie]c]/	[−m'+je]	'to be caddish'
(ii)	/[[krɔk]em]/	[−k'+jem]	'step (instr.)'
	/[[wrɔg]em]/	[−g'+jem]	'enemy (instr.)'
	/[[bɔg]em]/	[−g'+jem]	'God (instr.)'

The general rule of Labial-Velar Palatalization is quoted from Rubach (1984: 177) as follows:

(29) *Lab./Vel. j-Insertion* (Rubach, rule (252))

$$\emptyset \rightarrow j / [-\text{coron}] __ \begin{bmatrix} +\text{syll} \\ -\text{high} \\ -\text{back} \end{bmatrix}$$

[−coronal] in (29) covers labials, velars as well as vowels. There is some evidence to show that a vowel preceding [e], too, induces j-Insertion. For example, /ide+a/ 'idea' tends to be pronounced as [idej+e]. In further support of the cyclicity of the rule, it should be pointed out that (29) does not apply in non-derived environments, ie, morpheme-internally before a non-derived /e/. This explains why there is no /j/-insertion in, for example, *perz* 'couch grass', *wesel+e* 'wedding', *pedał* 'pedal', *Felix* 'Felix', *generał* 'general', *kelner* 'waiter', etc., in all of which the [e] following the labial and velar consonants is the underlying /e/. There are also examples which have more than one instance of non-coronals before [e], but in which (29) applies

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only to those occurring in derived environments, for example, *pedagog + iem* 'pedogogue (instr.)', *Belg + iem* 'Belgian (Instr.)', *Norweg + iem* 'Norwegian (instr.)', etc.

The analysis of labial-velar j-Insertion in Rubach shows that (29) is a contemporary extension of an earlier rule that applied after labials only. The latter is stated as follows:

(30) *j-Labial Insertion* (Rubach 1984 rule (238)):

$$\emptyset \rightarrow \text{j} / [+\text{labial}] __ \begin{bmatrix} +\text{syll} \\ -\text{high} \\ -\text{back} \end{bmatrix}$$

In its extended version, (29) is found to have obligatory application after labials, but optional application in certain dialects, after velars. The variation in the case of velars (i.e. [k'je, g'je] or [k'e, g'e]) may be conditioned. For example, velars may get a [j] more often in stressed than in unstressed syllables. However, in all instances, *Słownik wymowy polskiej* (Polish Pronouncing Dictionary) records [k'je, g'je] to be in free variation with [k'e, g'e].

(29) is thus an excellent example of a cyclic lexical rule with subregular optionality. Its optionality is of the (3b) type. If (29) is a rule schema with three subrules applying to labials, velars and vowels before /e/, then its optionality is restricted to the subrule containing velars.

5.3.3 *Retraction in Polish* (stratum 2)

Polish has a productive rule of Vowel Retraction that changes /i/ into a high, central vowel [ɨ] after coronal consonants excluding the palatal and palatalized ones: /s z t d r c ʒ š ž č ǯ/. The group is also called 'hard' coronals. The rule is reproduced from Rubach (1984: 203) below:

(31) *Polish Retraction*

$$\begin{bmatrix} +\text{syll} \\ +\text{high} \end{bmatrix} \rightarrow [+\text{back}] / \begin{bmatrix} +\text{cor} \\ -\text{back} \\ -\text{lat} \end{bmatrix} ___$$

In order to see the effect of the rule, consider the complex verbs *strasz + y + ć*[straš + i + ć] 'frighten' and *woz + i + ć*[voz + i + ć] 'carry', derived from the nouns *strach* /strax/ 'fright', and wóz /voz/ 'cart' respectively. The derivations of 3 sg. pres. forms *strasz + y* 'he frightens' and *woz + i* 'he carries' (see Booij & Rubach 1987: 16) are given in (32) below. Note that the differences in the surface pronunciations of [i] and [ɨ] are reflected in Polish orthography: *i* for [i], and *y* for [ɨ].

(32)

strax + i	voz + i	
straš + i	____	Velar Palatalization

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$$x \rightarrow \check{s} / ____ \begin{Bmatrix} i \\ e \end{Bmatrix}$$

____ voź + i Coronal Palatalization

$$z \rightarrow \acute{z} / ____ \begin{Bmatrix} i \\ e \end{Bmatrix}$$

Postcyclic straš + i ____ Retraction

Booij & Rubach (1987) show that (31) is a postcyclic or word-level rule on two counts. One, it is ordered after postcyclic rules, namely, Yer Deletion and r-Spell-Out. Two, (31) is not postlexical; it applies morpheme-internally in non-derived environments, for example, in *optym + al + n + y* 'optimal', *limuzyn + a* 'limousine', *uniwersytet* 'university', all foreign borrowings assimilated into the Polish vocabulary. Further, it does not apply across words. Phrases such as *kosz Iren + y* 'Irene's basket', *brat i siostra* 'brother and sister' have [i], not [ɨ] in them. It is therefore a word-level rule.

The relevant point regarding the application of the rule is that it must be assumed to be optional for the borrowed section of the vocabulary which shows variation, sometimes reflected in the spelling (see Rubach 1984: 65, 205): *miting* ~ *mityng* 'meeting', *bridż* ~ *brydż* 'bridge', *faksimile* ~ *faksymile* 'fascimile', *singiel* [si-] ~ [sɨ-] 'single play', *ring* [ri-] ~ [rɨ-] 'boxing ring', *reżim* ~ *reżym* 'regime', *plastik* ~ *plastyk* 'plastic', etc.

The optionality of this word-level rule is of (3c) type, as it is restricted to a lexical subset of the forms that meet its structural description.

5.3.4 *Sonorant Resyllabification in English* (stratum 2)

(33) *Sonorant Resyllabification* (Mohanan 1985: 145).

$$V \rightarrow C \; / \; ____ \; V \quad [+\text{cons}]$$

(33) accounts for syllabic versus nonsyllabic alternation of sonorants in *simple* / *simplicity*, *prism* / *prismatic*, *cylinder* (AmE) / *cylindrical*. When followed by the inflectional suffix *-ing*, however, the loss of syllabicity is optional in the case of [l]:

(34) doubling [dʌbl̩iŋ] ~ [dʌbliŋ]
bugling [bju:gl̩iŋ] ~ [byu:gliŋ]
bubbling [bʌbl̩iŋ] ~ [bʌbliŋ]

The stem-final [l] remains syllabic in compounds:

(35) double-edged [dʌbl̩ɛʤd]
bugle office [bju:gl̩ɒfis]
bubble eye [bʌbl̩ai]

Halle & Mohanan (1985) and Mohanan (1985) regard the fact about the optional resyllabification of [l̩] before *-ing* as the basis for positing stratum-

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4 at which Compounding, restricted to stratum-3, does not apply. Within the revised bistratal organization of lexical phonology, (33) would apply at stratum 2.

Notice that the optionality of (33) is restricted to [l]-, and occasionally, to [n]-ending stems, but not to [m]- or [r]-ending stems. Thus you can get [bɒtl̩iŋ] or [bɒtliŋ], [bʌtn̩iŋ] or [bʌtniŋ], but only [blɒs(ə)miŋ], not [blɒsm̩iŋ] 'blossoming', and [bætriŋ], not [bætr̩iŋ] 'battering'.[12] The optionality of (40) is on account of a subrule of (3b) type, as only a class of sonorant consonants (namely, /l/ and /n/, but not /m/ and /r/) has syllabic / non-syllbic alternations due to it.

5.4 *Word-level rules*

In the above discussion of lexical rule applications, I hope to have shown that the rules and the data provide sufficiently strong motivation for the proposal of the Optionality Constraint (19). It now remains for me to show that the possible violations of the constraint are in accordance with the theory of polarity proposed in section 4. While I am not aware of any evidence in the existing literature for the systematic optionality of a level 1 rule, I have found some evidence for the systematic optionality of word-level rules, despite the dearth of discussion of optional rules in the literature. I discuss below two representative cases from Kashmiri. The discussion of these rules and the data are drawn from Grierson (1906), Kelkar & Trisal (1964), Bhat (1983), and my own records.[13]

5.4.1 *j-Insertion in Kashmiri*

In colloquial Kashmiri, a front semivowel /j/ may optionally be inserted in the word-initial position before a high, front vowel [i] or [i:], as exemplified in (36):

[12] In the case of the sonorants [m] and [r], their syllabicity would depend on the deletion of the preceding underlying schwa which is optionally retained on the surface. According to Hooper (1976b, 1978), as pointed out by an anonymous referee, the alternant forms with or without a schwa are, in a majority of cases, lexically selective, depending on word-frequency. However, Hooper also shows that phonological constraints relating to syllable structure and segmental environment, too, play a crucial role in blocking the application of the schwa deletion rule, such that only one of the alternant forms appears. Thus in a form such as *battery* (see Hooper 1976b: 97), the schwa before /r/ fails to delete because of the preceding flap [ɾ] derived from /t/. The same explanation could be given for the non-syllabic [r] in *battering*. However, as the schwa-less variant [bætriŋ] is also found to exist, an alternative explanation of the non-syllabic [r] in such instances would be that the rule of Schwa Deletion in them applies after Sonorant Resyllabification.

[13] I am grateful to Vijay Koul, Manoj Bhat and Dileep Pandit for the data on Kashmiri.

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(36) [ina:m] ~ [jina:m] 'reward'
[i:ma:n] ~ [ji:man] 'honour'
[ira:da] ~ [jira:da] 'intention'
[iba:dat] ~ [jiba:dat] 'prayer'
[izzət] ~ [jizzət] 'respect'

The rule of j-Insertion in Kashmiri may be stated as follows:

(37) *Kashmiri j-Insertion*

$$\emptyset \rightarrow y / [__ \begin{bmatrix} +\text{syll} \\ -\text{high} \\ -\text{back} \end{bmatrix}$$

/j/ is not inserted if a consonant precedes it. This is so even in the case of reduplicated forms such as those below:

(38) [ina:m vina:m] ~ [jina:m vina:m] *[jina:m vjina:m]
'reward etc.'
[i:ma:n vi:ma:n] ~ [ji:ma:n vi:ma:n] *[ji:ma:n vji:ma:n]
etc. 'honour etc.'

It is possible to assume that (37) is a postlexical rule, in which case its optionality would be regular. There is, however, one piece of evidence to prove that (37) must be lexical. Grierson (1906) records instances of complex forms with Prefix Stem structure in which /j/ is inserted after prefixes:

(39) [be:jizti:] /[[[be:]izzət]i:]/ 'dishonour'
[be:ji:ma:n] /[[be:]i:ma:n]/ 'dishonest'
[la:jila:z] /[[la:]ila:z]/ 'without cure'

The forms in (39) show that (37) precedes Prefixation, and therefore must be a lexical rule. Note that the prefixed forms in (39) are a part of the Perso-Arabic vocabulary, which Kashmiri shares with other modern Indo-Aryan languages. We assume that the rule of Prefixation in these instances is a word-level lexical rule as in Hindi (see Pandey 1990: 294–95).

5.4.2 *Deaspiration in Kashmiri*

Another productive optional rule in Kashmiri leading to systematic variation in the language is the rule of Deaspiration, informally discussed in Bhat (1983), and attested in Grierson (1906). The rule is stated as follows:

(40) *Kashmiri Deaspiration*:
$$\begin{matrix} -\text{son} \\ [-\text{cont}] \end{matrix} \rightarrow [-\text{spr. gl.}] \; / \; ____]$$

(40) causes word-final stops to lose their aspiration optionally, leading to free variant forms, such as those in (41).

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(41)

/poṭh/	[poṭh]	~	[poṭ]	'fat'
/vjoṭh/	[vjoṭh]	~	[vjoṭ]	'stout'
/dozakh/	[dozakh]	~	[dozak]	'hell'
/gɒph/	[gɒph]	~	[gɒp]	'cave'

When followed by a suffix, the obstruents remain aspirated, as in (42).

(42)

[vjeṭh'is]	'fat (masc., sg., Acc.)'
[vjeṭhun]	'to grow fat'
[doz(ɨ)khas]	'hell (Acc.)'
[gɒphi]	'cave (Acc.)'

It is interesting to observe that Kashmiri also has the opposite process of aspiration whereby word-final unaspirated obstruents are optionally aspirated, as illustrated in (43).

(43)

/lu:ṭ/	[lu:ṭ]	~	[lu:ṭh]	'robberry'
				/pra:t/
	[pra:t]	~	[pra:th]	'every'
/drɒk/	[drɒk]	~	[drɒkh]	'vomit$_N$'
/phɒk/	[phɒk]	~	[phɒkh]	'sting$_N$'

The underlying forms of these stops, too, can be determined on the basis of the alternant forms in complex words, as is shown in (44).

(44)

[lu:ṭir']	'robber'	*[lu:ṭhir']
[phɒkas]	'swelling (acc.)'	*[phɒkhas]
[drɒki]	'vomit (pl.)'	*[drɒkhi]
[bu:ṭas]	'shoes (Acc.)'	*[bu:ṭhas]

Aspiration is a minor optional rule with numerous exceptions. Deaspiration (40), however, is a productive optional rule. A piece of evidence for its lexical application comes from the stray cases of exception such as the following, which do not have unaspirated alternant forms:

(45)

[əkh]	'one'	*	[ək]
[əch]	'eye'	*	[əc]
[kath]	'story'	*	[kat]
[bja:kh]	'another'	*	[bja:k]

Moreover, the rule does not apply to affixes which have final aspirated stops, for example, the Perfective affix *-ath* as in [ma:rath] 'beat, kill (Perf.)'.

As the environment of the rule is limited to the word-final position, it must have word-level application.

The regular optionality of j-Insertion and Deaspiration in Kashmiri would be a problem for OC in a theory without the notion of polarity, just as the cases of violation of SCC have been found to be. All these apparently recalcitrant cases are licensed by the Polarity Principle. Note that unlike level 1 rule applications which cannot have systematic optionality, level 2 rule

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applications can be systematically optional like postlexical rule applications, on account of polarity.

Kiparsky (1987) presents an analysis of Chamorro that seems to refute (19). It contains optional lexical rules to account for variational data resulting from an interaction of Umlaut and Vowel Lowering rules with Stress rules. Kiparsky's analysis has the following organization of rules:

(46)

Lexical:	Main Stress and Prefix Stress (obligatory)
	Gemination (Obligatory)
	Initial Stress (optional)
	Destressing (optional)
	Umlaut (optional)
Postlexical:	Vowel Lowering (obligatory)
	Initial Stress (obligatory)
	Destressing (obligatory)
	Umlaut (obligatory)
	Degemination (optional)

Underlying Kiparsky's organization of Chamorro rules are two theoretical assumptions. One, rules apply subject to the Strong Domain Hypothesis, see (7) above, and, second, systematic optionality is common to both lexical and postlexical rule application. However, if we discard the latter assumption in favour of the Optionality Constraint (19), we have a simpler organization of Chamorro rules:

(47)

Lexical:	
Stratum 1:	Main Stress and Prefix Stress
Stratum 2:	Umlaut (optional for secondary stress only)
	Destressing (optional)
	Vowel Lowering
Postlexical:	Initial Stress
	Vowel Lowering (optional)
	Destress by Default

(47) is found to yield the same results as (46), but without violating (19). There is only one cyclic rule here, the Main and Prefix Stress rule. All the other lexical rules are assumed to be postcyclic. One of them, Destressing, is fully optional, and in accordance with (19). The optionality of Vowel Lowering is not a problem for any approach.

6. Explaining the spread of sound change

An enquiry into the nature of the relationship between lexicality and optionality, in the previous section, was seen to provide ample justification for the Optionality Constraint (19). The independently motivated Polarity Principle (18) licences the violation of (19) at the word-level. I shall try to

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show below that (19) leads to the most satisfactory explanation of the mechanisms of sound change.

6.1 *The Neogrammarian controversy*

The controversy regarding the spread of sound change has its source in the Neogrammarian claim that sound change is regular:

> '… every sound change, inasmuch as it occurs mechanically, takes place according to laws that admit no exception. That is, the direction of the sound shift is always the same for all the members of a linguistic community except where a split into dialects occurs, and all the words in which the sound subjected to the change appears in the same relationship are affected by the change without exception.'
>
> (Ostoff & Brugmann 1878)

The Neogrammarian or the 'regularity' hypothesis has had continued support until modern times (see Bloomfield 1933, Hoenigswald 1964, Chomsky & Halle 1968, Postal 1968, King 1969, Kiparsky 1971,[14] Labov et. al. 1972).

The opponents of the regularity hypothesis, from the time of Schuchardt (see Schuchardt 1980), hold instead that sound change proceeds word by word. The alternative , 'gradualness' hypothesis has now a mass of evidence from historical studies of Chinese and other languages leading to a well-formulated conception of the mechanism of sound change, namely, Lexical Diffusion:

> '… we hold that words change their pronunciation by discrete perceptible increments (i.e., phonetically abrupt) but several at a time (i.e., lexically gradual) rather than always in a homogeneous block. This latter conception of phonological change may be called Lexical Diffusion.'
>
> (Wang & Cheng 1977: 156)

The support for the lexical diffusion hypothesis comes from a large number of languages, most notably 'diatone' formation in English (Sherman 1973), tonal change in Chao-Zhou Chinese (Wang & Cheng 1977), a number of phenomena in Swiss German, Classical Tibetan, Old Welsh and Swedish (Wang 1977), vowel shift in the Belfast vernacular (Milroy 1978), 'apical displacement' in Central Dravidian (Krishnamurthy 1978), alveorization of the final velar nasal in Cantonese (Bauer 1979), spirantization of dental stops in colloquial Mombasa Swahili (Russell 1981).

I summarize below the differences in the claims of the hypotheses.

[14] As Labov (1981: 268) points out, generative historical phonologists' dispute with the Neogrammarians 'has been over the question of grammatical conditioning, not over the regularity of sound change'.

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(48)

The Regularity Hypothesis	*The Gradualness Hypothesis*
(a) exceptionless sound change across time and space;	(a) lexical diffusion of sound change across time and space;
(b) phonetically gradual, imperceptible sound change;	(b) phonetically abrupt, discrete sound change;
(c) assumes homogeneity of inherited[15] lexical items in undergoing change;	(c) assumes heterogeneity of lexical items in undergoing change;
(d) exceptions due to borrowing or analogy.	(d) exceptions due to lexical diffusion, as well as borrowing and analogy.

It is to the credit of Labov (1981) that he dispassionately examined the evidence in support of both the claims and saw a substantive issue in the controversy, amounting to a paradox: '... if Wang and his associates are right about lexical diffusion, and the Neogrammarians were righter than they knew about sound change, how can both be right?' (Labov 1981: 303).

6.2 *Labov's resolution*

Labov proposed a resolution in the form of a question as a vindication of the strategy of historical phonological research: 'What is the full range of properties that will allow us to solve the transition problem – i.e., to predict with a high degree of certainty the way the phonological system will behave as the system changes?' (Labov 1981: 304).

Labov represents the two polar types of change in terms of different clusters of properties of two rules in American speech: (a) vowel shift in Philadelphia speech, undergoing regular change, and (b) the tensing of short /æ/ undergoing lexical diffusion. The differences are reproduced in Table 1.

Labov proposes a resolution of the paradox in terms of a hierarchy of features involved in a rule undergoing change. Abstract features, for example, [±tense] for vowels, normally involve more than one class or subset of sounds such as short vowels or diphthongs, while the low-level ones, for example, [±back], [±high], operate within a subset such as front or low vowels. Logically, a change in an abstract feature would involve a change between subsets, for example, short vowels may become lengthened, and a change in a low-level feature would involve a change within a subset, for example, back vowels may be raised. According to Labov, when a change takes place within a subset it is regular, and when it involves a redistribution between subsets it undergoes lexical diffusion. Thus vowel lengthening or

[15] That is, inherited from an earlier stage of the development of the language.

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	(ohr), (oy), (ay^{o}) (uw), (ow), (æh)	/æ/ ~ /æh/
Discrete	No	Yes
Phonetic conditiong	Fine	Rough
Lexical exceptions	No	Yes
Grammatical conditioning	No	Yes
Social affect	Yes	No
Predictable	Yes	No
Learnable	Yes	No
Categorized	No	Yes
Dictionary entries	1	2
Lexical diffusion		
past	No	Yes
present	No	Yes

Table 1
Features characterizing two polar types of sound change in progress (after Labov 1981: 296)

shortening, and place of articulation shifts would typically follow the path of lexical diffusion, while vowel raising and fronting, and consonant lenition would follow the path of Neogrammarian change.

Hock (1986) focusses on the inverse correlation in Table 1 between the clines of abstractness and noticeability on the one hand, and social affect on the other, and suggests a resolution of the contradiction in terms of the eligibility of the change for sociolinguistic marking. Changes involving major class features, being noticeable, are already marked as violations of established norms, and thus ineligible for another sociolinguistic marking. Rule types involving such features, for example, metathesis and dissimilation, must undergo lexical diffusion. Changes involving relatively concrete, unnoticeable features readily receive sociolinguistic marking as they are not easily seen as speech errors or grammatical mistakes. Rule types involving such changes, for example, assimilation, weakening etc., normally undergo exceptionless change.

The Labovian resolution has been demonstrated (see Phillips 1984, Kiparsky 1988, Harris 1989a) to be inadequate in the face of evidence for the same rule undergoing different mechanisms in languages. As Harris (1989a) shows, æ-tensing in the northern U.S. cities and in western Scottish has undergone exceptionless change, but in New York City, Philadelphia and Belfast it is subject to lexical selectivity. Hock (1979) shows that the Sanskrit rule of s-Retroflection (or RUKI) was subject to different mechanisms in

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different environments: it came to be variable and lexically selective within words, but exceptionlessly lost across words. The Labovian resolution is, in general, underpredictive and oversimplified. The basic difficulty with it seems to lie in the attempt to explain the fate of phonological processes, which are subject to organizational principles of grammar, merely in terms of their representational properties, that is, features (as being more or less abstract or noticeable), and without regard to how they relate to the principles of organization in the grammar.

6.3 *Kiparsky's resolution, and further problems*

Kiparsky shows that the clusters of properties characterizing the two rule types in Table 1 are identical with the modular distinction between postlexical and lexical rules, and comes to the conclusion that 'the existence of two types of sound change, lexical diffusion and "Neogrammarian" sound change, is a consequence of the existence of two types of phonological rules, lexical rules and postlexical rules' (Kiparsky 1988: 404). While the lexical phonological resolution proposed by Kiparsky provides a principled and empirically verifiable explanation of the contradictory mechanisms of sound change, elaborately discussed in Labov (1981), it has been shown to be based on a rather rigid view of phonological change, namely that diffusion and exceptionless change always originate with lexical and postlexical rules. It has been maintained by some (Vennemann & Wilbur 1972, Rubach 1978, van der Hulst 1980) that many lexical rules may, (according to Hooper 1976a, must) begin as low-level, phonetically conditioned processes, and eventually penetrate deeper into the lexical component of the grammar. Harris (1989a) and McMahon (1989) discuss the existencee of such rules in the history of English.

The case of lexicalization discussed by Harris is illustrated with the help of a panlectal rule in English, namely, the tensing of historically short stressed /æ/, which has undergone unconditional change in the varieties spoken in western Scotland and northern U.S. cities such as Detroit, Chicago, Buffalo, Syracuse and Rochester, but conditioned change in Philadelphia, New York City and Belfast. The phonological condition is imposed by the following consonant (Labov 1981: 285). Harris argues that /æ/-Tensing is lexical in these varieties on many counts. Most importantly, it is sensitive to word-internal morphology. The lexical status of the rule is accounted for as an evolutionary outcome of an originally postlexical rule.

McMahon (1991) discusses the case of the development of a lexical rule in Standard Scottish English and the Scottish dialects, namely, Scottish Vowel Length Rule (SVLR) (see also Lass 1975), from a panlectal rule of Low-Level Lengthening (LLL) (see also Harris 1985), which lengthens all vowels before voiced consonants and word finally. The SVLR lengthens a tense vowel such as /ai/ into /a:i/. McMahon shows that the rule is lexical as it operates

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before a class II derived or regularly inflected form, or in the first stem of a compound, but not in morphologically underived forms.

According to McMahon, the SVLR is being gradually generalized to non-derived lexical items such as [pa:ilɒn] *pylon* (cf. [pʌil],[16] *pile*) [spa:idər] *spider* (cf.[wʌidər] *wider*), [va:ipər] *viper* (cf. [wʌipər] *wiper*), and [fa:il] *phial* (cf. [fʌil] *file*). This development has led to a split between /ʌi/ – /a:i/: an ongoing process of change (see Aitken (1981), Wells (1982: 399 ff.)).

As compared to the complete lexicalization of /æ/-Tensing, SVLR represents a partial lexicalization of the postlexical LLL, which is productive in the varieties having the innovated SVLR.

Another case of partial lexicalization is discussed in Rubach (1978) with regard to Polish. Polish has an obligatory lexical rule, namely, a dental stop deletion rule, which deletes /t, d/ in the environment, nasal, fricative ____/n/, /ń/. The rule has many exceptions. It is derived from a more general optional postlexical rule stated as follows (Rubach 1978: 333):

(49) *Dental Stop Deletion* (*phonostylistic*)

$$\begin{bmatrix} -\text{contin.} \\ -\text{del. rel.} \\ +\text{coron} \\ +\text{ant} \end{bmatrix} \rightarrow \emptyset / <\text{C}> \begin{bmatrix} +\text{obstr} \\ +\text{coron} \end{bmatrix} ___ \begin{bmatrix} +\text{cons} \\ <+\text{contin}> \end{bmatrix}$$

(49) applies before a non-continuant consonant (that is, not before /r/ or /l/), and is exceptionless. The lexical rule of /t, d/ deletion before /n/ or /ɲ/ is argued to be a partial lexicalization of (49), by separating out a portion of its environment. The partially lexicalized rule is, as already stated, lexically selective.

6.4 *An alternative lexical phonological resolution*

6.4.1 The above cases of lexical diffusion through the lexicalization of postlexical rules pose some problems for Kiparsky's resolution. Although postlexical rules are normally lexicalized before leading to diffusion, the modular assumption regarding exceptionality, on which Kiparsky's proposal is based, does not quite explain how lexicalization takes place. Moreover, exceptionality is sufficient but not necessary evidence of lexical status (see Dresher 1983, Rubach 1984). Thus exceptionlessness cannot be considered probative of postlexical status.

I wish to argue below that the Neogrammarian problem has a better explanation within the present approach, which assumes that sound change is crucially related to variability and lexicality.

[16] [ʌi] is derived from an underlying /ai/.

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6.4.2 What is the explanation for the cases of lexicalization discussed above? It lies in the notion 'subrule'.

I propose that lexicalization takes place, in the first instance, in the form of a subrule which optionally applies to specific lexical or morphological subsets. The optional subrule may become obligatory leading to the partial lexicalization of a postlexical rule, as in the case of SVLR in Standard Scottish, and Dental Stop Deletion in Polish. It may, alternatively, be generalized (and come to be obligatory), leading to the lexicalization of a postlexical rule, as in the case of /æ/-Tensing in Philadelphia, New York and Belfast varieties.

Analogy may play a crucial role in starting or extending a change to specific lexical or morphological subsets along with other linguistically arbitrary but socially significant factors. But it is the notion of 'subrule' as a formal device in the grammar, which creates the necessary condition for the generalization to take place

A reviewer points out that the prediction that postlexical rules may undergo lexical diffusion seems to subvert the standard position of Lexical Phonology, and thus to be a problem for the theory, since this mechanism allows access to lexical information which is denied to postlexical rules. However, the prediction is consistent with the explanation of lexicalization of postlexical rules attested in the literature and discussed at length above. It is claimed here that both the processes, lexicalization and lexical diffusion, are crucially connected with the idea 'optional subrule'. Whereas a postlexical optional subrule may simply apply to phonological subsets, as discussed in section 2.2, with regard to specific lexical items, it is the forms themselves that are marked for optionally undergoing the rule, and not the rule. When the application of an optional postlexical subrule to phonological or lexical subsets comes to be established it may 'split off' from the more general postlexical rule and be lexicalized. There is some evidence in favour of the claim that postlexical rules may lead to lexical diffusion. Carr (1991; see section 4.2) discusses two rules of English as such rules – 'r-Insertion' in non-rhotic accents, and Weakening (of verb-final, metrically intervocalic /t/ as the postalveolar continuant [ɹ] or the coronal tap [ɾ]) in Tyneside English.

6.4.3 The condition of polarity implies a somewhat startling conclusion: phonological rules at the lower end of the lexical module may lead to exceptionless change,[17] as these rules can have systematic optionality. If this conclusion is true, the present explanation is preferable to the one based on the exceptionality criterion on grounds of generality and theoretical consistency.

Some languages having postcyclic rules have been encountered with

[17] Notice that end-of-the-module lexical rules are typically subject to diffusion, as shown for initial clusters in Dravidian by Krishnamurthy (1978).

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systematic optionality, for example, Kashmiri and Chamorro. Are there instances of lexical rules undergoing exceptionless change?

I shall cite one instance from the history of English in support of an affirmative answer to the above question. This is the English Plural rule, as elaborately discussed in Keyser & O'Neil (1985). The latter reconstruct three stages in the evolution of the English plural rule, as found in John Hart (ca. 1550–1570), Richard Hodges (ca. 1630–1650), and Mather Flint (1706). The evolution of the phonology of the plural rule involves mainly two rules, a Voicing Rule, and an Epenthesis Rule, which also apply to 3rd Sing. and Past tense morphemes. The authors show that the rule of voicing, which is optional for the plural and for the third person singular morpheme in Hart, becomes obligatory for the third person singular in Hodges. The voicing rule is found to lose its optionality altogether by the time of Flint. And there again the evidence shows regular change. The voicing rule is a last stratum rule, since it applies at the edge of words (and is morphologically conditioned).

6.4.4 A last point concerning the prediction made by the Optionality Constraint. As level 1 lexical rules allow only subrules to have optional application, they must undergo lexical diffusion. The same prediction is also made by Kiparsky's exceptionality hypothesis. A reviewer finds the claim to be odd, at least for English, on the ground that level 1 rules are not truly productive, that is, they are 'on the way out', and the 'lexical diffusion' notion concerns rules which are 'on the way in', that is, they are increasing in productivity. Lexical diffusionists, however, conceptualize the phenomenon as characterizing not the result but the implementation of sound change (see Labov 1981). It is because level 1 rules have exceptions, are non-productive and not optional that a change in them proceeds in slow increments. More specifically, if variation is crucial to language change then the fact that level 1 rules don't have fully optional application has a clear bearing on the prediction that the spread of a sound change due to a level 1 rule must be in small increments.

6.4.5 The Optionality Constraint thus predicts a more complex and indeterminate picture of the spread of sound change than that envisaged by Kiparsky, but one that is closer to reality. In short, it leads to a more restricted claim: cyclic or level 1 lexical rules must undergo lexical diffusion; word-level lexical rules may undergo exceptionless change; and although it is typical for postlexical rules to undergo exceptionless change, they may also lead to diffusion.

7. Conclusion and summary

The present inquiry into the causality of the mechanisms of sound change is informed by the assumption that sound change involves variation. This is an

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assumption that is held widely by historical phonologists, for example, Labov (1966), Weinreich et al. (1968), Kiparsky (1971: 603), Bailey & Shuy (1973), Hooper (1974b: 104), Hsieh (1977), Wang (1977: 361–362), Milroy (1978) and Milroy & Milroy (1985). The assumption is especially pronounced in the work of variationists (see, for example, Weinreich et al. 1968, Labov 1972). According to them, linguistic change takes place when variables in optional rules become simplified and stabilized. Thus, the optional rule, with linguistic and social variables, is seen as the causal mechanism behind sound change. The present investigation has been carried out with a somewhat different view. It is assumed here that variability and language change are not related as cause and effect. Rather they are symptomatic of a common, deeper property of grammars to allow free, non-parametric options of indeterminacy. Thus, current phonological and phonetic research show many manifestations of indeterminacy in grammars. For example, the hierarchical organization of features may have different possibilities (see Clements 1985, Gvozdanovic 1985), rules may be ordered differently in related dialects, phonetic representations may be gradient, language-specific constraints on rules and representations may have indeterminate resolutions (see Kisseberth 1970), and so on. Optional rule applications are one of the best known examples of indeterminacy in grammars. Their investigation in this study has been carried out with a two-fold purpose – to find out formal constraints on them in relation to other formal constraints in grammars, and to seek an explanation for the mechanism of sound change.

The findings of the investigation are summarized as follows:

1. Only subrules in the lexical module may have optional application.
2. The application of lexical phonological constraints at the word level is indeterminate on account of polarity.
3. Phonological theory must distinguish between Modular Constraints and Well-Formedness Constraints. Only the former may be violated at the word level in the lexicon. The latter may be violated at any level in the phonological organization of grammars.
4. Rule applications at Level 1 in the lexical phonology must undergo lexical diffusion. All other rule applications are indeterminate with regard to the mechanism of sound change.

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