SOME RULE ORDERING PROBLEMS IN MALAY PHONOLOGY*

FARID M. ONN
Universiti Kebangsaan Malaysia

SINOPSIS

Karangan ini membincangkan masalah atur rumus yang merupakan salah satu daripada isue terpenting dalam teori fonologi kini. Teori standad pengajian fonologi generatif yang menentukan supaya rumus-rumus dilaksanakan mengikut aturan satu rumus harus mendahului rumus yang lain dan yang bersifat ekstrinsik, adalah dianggap terlalu ketat. Bagaimanapun gantian hipotesis-hipotesis lain yang dicadangkan sebagai gantian, seperti "Local Ordering", "Unordered Rule Hypothesis", dan "Direct Mapping Hypothesis" terbukti tidak juga sesuai. Dalam karangan ini dicadangkan supaya penggunaan "global constraints" diterima dalam perlaksanaan rumus-rumus fonologi yang membolehkan sesuatu rumus itu merujuk kepada derivasi bentuk "input string" yang terdahulu. Tanpa rujukan kepada "global constraints" ini, penganalisaan proses penyengauan vokal dalam dialek Melayu Ulu Muar tidak dapat dibuat melainkan digunakan juga kaedah atur rumus yang bersifat ekstrinsik, atau lain-lain kaedah yang arbitrari.

SYNOPSIS

This paper discusses one of the main issues in current phonological theory, namely rule ordering. The standard theory of generative phonology which provides for the ordered application of phonological rules in one fixed linear order, is considered too strong; however, other proposed hypotheses, such as "Local Ordering", "Unordered Rule Hypothesis" and "Direct Mapping Hypothesis" are equally untenable. In this paper evidence is given in favour of incorporating a generalized version of derivational history into phonological theory. Specifically, it is argued that unless we make use of global constraints that can refer to derivationally earlier forms of input strings, then the process of vowel nasalization in Ulu Muar Malay cannot be explained without recourse to extrinsic rule ordering statements or other arbitrary devices.

0.0 Purpose

Recent investigation of rule ordering phenomena[1] has given rise to a num-

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1 For details of the controversy over rule ordering, see, for example, S.R. Anderson,

ber of independent proposals to abandon some, if not all, of language-specific rule ordering constraints from grammars of natural languages.[2] In one such proposal, evidence has been given in favour of incorporating a generalized version of derivational history into phonological theory. More specifically, it has been shown that some phonological rules[3] apply under conditions that cannot be stated solely in terms of the immediate input string. Derivationally earlier or later forms of the string may also have to be taken into consideration. Thus, in their recent papers, Kenstowicz and Kisseberth,[4] Kisseberth,[5] and Miller[6] have argued for the existence of global constraints[7] that refer to derivationally earlier forms of input strings.

In this paper it will be shown that there is a vowel nasalization rule in Malay[8] which can only be adequately stated by having access to derivational or global constraints. Specifically it will be argued that unless we make use of derivational history, the occurrence of non-nasalized vowels in forms like [mãni] 'bathe', [nõmo(r)] 'number', [bono] 'possession' etc., cannot be explained without recourse to extrinsic rule ordering statements or other arbitrary devices.

1.0 Status of the Nasalized Vowels in UMM

The claim has been made about Ulu Muar Malay (hence forth, UMM), a dialect spoken in a settlement called Kubang Rusa in Kuala Pilah, Negeri

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West Scandinavian Vowel Systems and the Ordering of Phonological Rules, MIT Doctoral Dissertation, 1969; W.L. Chafe, "The Ordering of Phonological Rules," *IJAL*, 34, 1968, pp. 115–136; P. Cole, "Mutual Bleeding and the Ordering of Phonological Rules", *Studies in Generative Phonology*, C.W. Kisseberth (ed.) Alberta: Linguistic Research, Inc., 1972; M. Kenstowicz and C.W. Kisseberth, "Rule Ordering and the Asymmetry Hypothesis," *Papers from the Sixth Regional Meeting*, Chicago Linguistic Club, 1970, pp. 504–519; A. Koutsoudas, G. Sanders, and C. Noll, "On the Application of Phonological Rules, "*Mimeo*, Indiana University Linguistic Club, 1971 (to appear in Language).

2 For some arguments against extrinsic ordering or language-specific rule ordering constraints, see, especially, Koutsoudas, Sanders, and Noll, *Ibid.*; C. Ringen, "On Arguments for Rule Ordering", *Foundation of Language*, 8, 1972, pp. 266–273.

3 For a discussion of the concept 'rules' from the standpoint of generative phonology, see N. Chomsky and M. Halle, The *Sound Pattern of English*, N.Y., 1968, especially Chp. 8 (henceforth, *SPE*)

4 Cf. M. Kenstowicz and C.W. Kisseberth, *op. cit.*

5 Cf. C.W. Kisseberth, "A Global Rule in Klamath," 1970, *mimeo*; "An Argument against the Principle of Simultaneous Application in Phonology," *Linguistic Inquiry*, 3, 1972, pp. 393–396; "Is Rule Ordering Necessary in Phonology?", *Papers in Linguistics in Honour of Henry and Renee Kahane*, B. Kachru et.al. (eds.), 1973.

6 Cf. G.D. Miller, "A Case for Derivational History in Greek," *Papers in Linguistic*, 5, 1972, pp. 46–72.

7 Cf. G. Lakoff, "Global Rules," *Language*, 46, 1970, pp. 627–639.

8 The Malay dialect discussed here is that of Ulu Muar, as described and analysed by Hendon in *The Phonology and Morphology of Ulu Muar Malay*, Yale Publication in Anthropology, 70, 1966. The phonological system of this particular dialect differs slightly from that of the literary Malay. For some discussion on this, see Farid M. Onn, *Aspects of Malay Phonology and Morphology*, University of Illinois Doctoral Dissertation, 1976.

Sembilan, that it has underlying nasalized vowels.[9] In what follows I will examine the basis for this claim, and it will be shown that such a claim is incorrect. A different analysis which employs the principle of ordered rule application based on the framework of generative phonology is suggested.

The claim that nasalized vowels are phonemic (i.e., non-predictable) in UMM is based specifically on Hendon's observations of the following set of examples:[10]

(1) a.

eñse	'bolt (of a door)'	sẽñsẽ	'Chinese doctor'
waras	'healty'	wãrã ?[11]	'pious'
takat	'until, up to'	tã ?ãt	'obedient'

b.

panẽh	'hot'	paney	'clever'
mãnĩ	'semen'	mãni	'bathe'
bonõ	'commoner'	bono	'possession'
anũ	'such and such'	rinu	'longing'
rimãw	'tiger'	ramaw	'Rembau (place-name)'

c.

lamõ	'long time'	lampu	'lamp'
amẽh	'gold'	ampe ?	'four'
baŋĩh	'enraged'	baŋka ?	'swollen'

A cursory examination of the examples in (1a-b) shows that surface forms like [takat] 'until, up to' [mãnĩ] 'semen' and [bonõ] 'commoner' on the one hand, and [tã ?ãt] 'obedient', [mãni] 'bathe', and [bono] 'possession' on the other, form perfect constrastive pairs, and this fact would easily lead a strictly taxonomic phonemic analyst to consider vowel nasality phonemic, as Hendon observes. Such an analysis, however, cannot be maintained for it is based on incorrect observations, and hence it does not correctly describe the generalizations involved in the process of nasalization in UMM. The examples in (1) will be discussed shortly. Meanwhile, a claim could be made that there is no underlying contrast between oral and nasalized vowels in UMM. Specifically, all nasalized vowels in the language are rule-derived. Thus, given a statement of progressive nasalization, like (2), it could be predicted that one or more oral vowels immediately following a nasal segment will be nasalized, and, in fact, this is what happened, as evidenced by forms as in (3).

(2)   [+ syllabic]→[+ nasal] / [+ nasal] [+ syllabic]$_0$────────

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9 Cf. Hendon, *op.cit.*, p. 4
10 Most of these examples and others used in the present paper are taken from Hendon, *Ibid.*, some of these examples appear in Table 2 in Hendon, *Ibid.*, p. 5.
11 In Hendon, *ibid*, the nonconsonantal *?* is represented by *q*

(3) kumĭnãm   'I drink'
     dimãkañŏ   'was eaten by him/her'
     mãkan   'eat'
     mãũ   'want'
     taŋãh   'middle'
     kuimũĭ   'various kinds of cakes'
     buñĭbuñĭãn   'musical instruments'
     kokunĭŋkunĭŋãn   'yellowish'

If (3) includes all of the facts about nasalization, then Rule (2) should be sufficient to correctly predict the occurrence of nasalized vowels in UMM. However, there are other data which indicate that a rule like (2) cannot be the entire statement of nasalization in the language. Consider the examples in (4).

(4) mõyãt   'corpse'
     mẽwãh   'prosperity'
     mã ʔãlum   'informed'
     smãyãnãn   'seedbed'
     mnãwãn   'to capture'
     pnãŋãhãn   'central focus'

The set of examples in (4) shows that nasalization in UMM penetrates not only vowels but other nonconsonantal segments as well, namely, *y*, *w*, *h*, and *ʔ*, and proceeds to nasalize the vowel/vowels following these nonconsonantal segments. In fact, nasalization continues to spread through the word, to be stopped only when it encounters a consonantal segment that blocks it. Thus, in order to account for facts, as in (4), Rule (2)will have to be reformulated as (5).

(5) $[+ \text{syllabic}] \rightarrow [+ \text{nasal}]$ / $[+ \text{nasal}]$ $[-\text{cons}]_0$————

Rule (5) which makes use of the convention for expending the schema $(X)_0^{12}$ represents a potentially infinite schema, whose various subrules are each to be applied simultaneously.[13] Thus the application of (5) will result in the nasalization of as many vowels as are separated from preceding nasals only by nonconsonantal segments. It is interesting to note that in another Western Malayo-Polynesian language, namely, Sundanese,[14] the nasalization rule is somewhat more restricted in that it is allowed to pro-

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12 Cf. Chomsky and Halle, *op.cit.*, pp. 343–344.
13 The word 'simultaneous' here implies that the rule is to apply iteratively going from left to right. For detailed explanation of the mechanism of iterative rules, see Anderson, *op.cit.*
14 A language spoken in the island of Java.

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pagate only across *h* and *?*, and not across *w* and *y*.[15] Another interesting fact about Sundanese nasality is that if a pluralizing infix — ar/l — appears after the initial nasal consonant of the stem, the following effects take place: the vowel of the infix is nasalized, as to be expected. What is strange, however, is that if the vowel immediately following the infix is itself followed by another vowel, or a sequence of *h* or *?* and a vowel, then this following vowel is also nasalized. Examples follow.[16]

(6) nãŭr   'to say'   pl. nãlaŭr
     nĭ ?ĭs   'to cool oneself'   pl. nãri ?ĭs
     nãhŏ   'to know'   pl. nãrahŏ
     dahar   'to eat'   pl. dalahar

The case, as in (6), does not exist in UMM, since the language strictly forbids nasality to propagate across consonantal segments, as the examples in (7) show:

(7) mrawat   'to nurse'   cf. mãwã(r)   'a kind of flower'
     pnãlahan   'prediction'   cf. pnãŋãhãn   'central focus
     mlayaŋ   'to float'   cf. mãyãŋ   'coconut flower'
     mlawat   'to visit'   cf. plawanãn   'competition'

2.0 Unassimilated Loan Words

So far, we have been dealing with fairly straightforward facts about UMM nasalization. Thus, given forms like those in (3) and (4), Rule (5) should be able to account for all of them without any exception. The problem will arise when one begins to consider forms like those in (la-b) repeated here for convenience as (8a-b):

(8) a. eñse   'bolt (of a door)'   sẽñsẽ   'Chinese doctor'
        waras   'healthy'   wãrã ?   'pious'
        takat   'until, up to'   tã ?ãt   'obedience'

    b. panẽh   'hot'   paney   'clever'
        mãnĭ   'semen'   mãni   'bathe'
        bonŏ   'commoner'   bono   'possession'
        anŭ   'such and such'   rinu   'longing'
        rimãw   'tiger'   ramaw   'Rembau (place-name)'

The pairs of words in (8a) clearly show contrastive use of the vowels. All the vowels of the words in the left-hand column are oral or non-nasali-

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15 Cf. S.R. Anderson, "On Nasalization in Sundanese", *Linguistic Inquiry*, 3, 1972, pp. 253–268. For an interesting discussion on some universal characteristics of processes involving vowel nasalization, see L. Schourup, "Characteristics of Vowel Nasalization," Presented at the summer LSA meeting, July 28, 1972.
16 These examples are taken from Anderson, *op cit.*, p. 255

zed, while those in the right-hand column are nasalized, even when no nasal segment immediately precedes them. However, upon closer examination, the set of examples in (8a) reveals the following facts: all the words in the left-hand column are considered to be native words, or at least not known to be of recent borrowings, whereas those in the right-hand column are all loan items.[17] The words *wãrã?* and *tã?ãt* are derived from the Arabic words ورع and طاعة respectively, and the speakers of UMM tend to imitate the original pronunciation of these borrowings by substituting the closest native phonetic devices. There is a definite established pattern by which ? and nasalization of preceeding vowel is substituted for the Arabic ع 'ain'. One must assume that the motivation for this substitution is either acoustic or articulatory similarity, but without serious investigation we cannot speculate further. There exists a similar pattern in borrowings from Chinese, especially when final syllable has a high tone.[18]

The point to note is that these loan items do not seem to get assimilated into the sound pattern of UMM. Thus, in attempting to describe the process of nasalization in UMM, one must exclude these so-called 'unassimilated loan words'[19] from the corpus. As Robins says, "to deal with the vowel nasality of these excluded classes of words, separate frameworks of statement would be required, and any attempt to make an overall statement would lead to the phonological misrepresentation of the phonetic data."[20]

Now if such unassimilated loan words can be treated as exceptions[21] to the speech pattern of UMM speakers, and hence could be excluded from the phonological analysis of the language, what about the forms in (8b) which do not constitute foreign or loan words?. Notice that each of the pairs of words in (8b) forms a minimal or near-minimal pair, thus appa-

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17 Cf. *Kamus Dewan*, Dewan Bahasa dan Pustaka, 1970 esp. pp. 1069, 1151, and 1343.
18 Thus in the case of the form sĕnsĕ, it could be that since the original pronunciation of this word ends somewhat with a high tone (as indicated to me by Yeoh Chiang Kee — personal communication), the speakers of UMM tend to substitute this with final ? (which does not appear phonetically) and nasalization of preceding vowels as it was the case with Arabic loans.
19 By this term is meant those loan words that in a purely synchronic analysis of the language reveal their foreign origin "by the fact that their phonological structure stands apart in some way from what appears to be the regular system or pattern of the language in which they occur." (E.J.A. Henderson, "The Phonology of Loan-words in some South-East Asian languages", *TPS*, 1951, p. 131). Cf. C.C. Fries and K.L. Pike. "Coexistent Phonemic System," *Lg.* 25, 1949, pp. 29–50, where the term, 'unassimilated loan word' was first used (p. 30). Cf. also footnote 5 in R.H. Robins "Vowel Nasality in Sundanese," *Diversions of Bloomsbury*, North-Holland, 1970, p. 275.
20 Ibid., p. 286.
21 For some suggestions on the treatment of foreign or loan words, see, for example, P. Kiparsky, "Linguistic Universals and Linguistic Change, *"Universals in Linguistic Theory"*, E. Bach and R. Harms (eds.). New Yorks Holt, 1968, pp. 171–204. For a more general discussion on the treatment of exceptions in generative phonology, see C.W. Kisseberth, The Treatment of Exceptions," *Papers in Linguistics*, 2, 1970, pp. 44–58.

rently providing sufficient evidence for the distinctive status of nasalization in UMM.

However, the apparently contrastive status of nasalization does not really indicate that vowel nasality should be treated as a non-predictable phenomenon in the language. In fact, an explanation comes immediately to mind as to why the vowels in the second syllables of those words appearing in the right-hand column in (8b) are not nasalized. In the first place, each of these words, when pronounced without the nasalized final vowel, constitutes an alternate pronunciation of the same word which (originally) contains a voiced noncontinuant segment between the nasal consonant and the final vowel. Thus the form [mãni] 'bathe' is derived from *mandi*, [bono] 'possession' from *bondo*; [rinu] 'longing' from *rindu*; [ramaw] 'Rembau; from *rambaw* [paney] 'clever' from *pandey*; and [nõmo] 'number' from *nombor*. The crucial fact to note is that deletion of the voiced stop does not trigger a nasalization of the following vowel, thus the forms like [bonõ] 'commoner' and [bono] 'possession' remain separated — the former has a nasalized vowel after the nasal, *n*, the latter does not. What we have in UMM then, is a phenomenon somewhat identical to that in Sea Dayak,[22] where simplification of nasal-voiced stop clusters does not feed the vowel nasalization rule.

3.0 Rule Ordering Problem

From the above observation, it is clear that in addition to the vowel nasalization rule, UMM requires a nasal cluster simplification rule, which can be postulated as (9).

(9) Nasal Cluster Simplification (optional):[23]

$$\begin{bmatrix} -\text{cont} \\ +\text{voice} \end{bmatrix} \rightarrow \quad \phi/ \quad \begin{bmatrix} \text{C} \\ +\text{nasal} \end{bmatrix} \quad \underline{\hspace{2cm}}$$

The problem that I would like to raise here involves ordering of the two rules: Vowel Nasalization and Nasal Cluster Simplification. It appears that these two rules require an extrinsic ordering statement whereby Vowel Nasalization must apply before Nasal Cluster Simplification in order to derive the correct phonetic forms, as the following derivation shows:

(10)	/#mandi#/	Underlying Form
	mãndi	Vowel Nasalization
	mãni	Nasal Cluster Simpl.
	mãni	Surface Form

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22 Cf. N.C. Scott, "Notes on the pronunciation of Sea Dayak," *BSOAS*, 20, 1957, pp. 509–512; also "Nasal Consonants in Land Dayak", *In honor of Daniel Jones*, D. Abercrombie et, al (eds.) London: Logmans, 1964, pp. 432–436.
23 The rule states that a voiced noncontinuant is deleted when it is preceded by a nasal consonant.

The opposite order would yield an incorrect output:

(11)   /#mandi#/
                 mani   Nasal Cluster Simpl.
                 mãnĩ   Vowel Nasalization
                 *mãnĩ

However, in the literature of generative-transformational grammar, it has often been argued that extrinsic ordering statements, which are language-specific constraints,[24] cannot be too highly valued. Generally, the claim of most phonologists has been that extrinsic rule ordering provides greater descriptive power than can be shown to be necessary. Thus the standard theory of generative phonology (as articulated in *SPE*) which provides for the ordered application of phonological rules in one fixed linear order is considered too strong and must be weakened so that rules could also apply in opposite orders under certain circumstances. Granted these language-specific constraints which assign one linear order of rules are not to be too highly valued, and hence the need to abandon them,[25] as in the above case, what support can be found for alternative proposals?

Anderson[26] has proposed a set of supposedly universal principles in terms of which certain pairwise orders of rules may be considered as more highly valued than others. Somewhat oversimplifying Anderson's proposed theory of 'local ordering', the more highly valued order — the 'unmarked' orders — are those which allow maximal application of a pair of rules in a given derivation. Less highly valued — the 'marked' orders — are those that do not allow maximal application. To illustrate, UMM has, in addition to the vowel nasalization rule, a prefix assimilation rule which assimilates a nasal to the point of articulation of the following noncontinuant (initial) con-

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24 One of the main issues in current phonological theory is whether the order of application of phonological rules is based on language-specific (or idiosyncratic) conditions, or whether the sequence of rule application can be predicted on universal grounds. In the standard theory of generative phonology, rules apply sequentially (i.e., the output of rule A may constitute the input of rule B) and are extrinsically ordered. That is, in the grammar of each language, there is a statement that rule B can apply only after the application (possibly vacuous) of rule A. For some arguments favouring extrinsic rule ordering conditions, see L. Campbell, "Extrinsic Ordering Lives, " *mimeo*, Indiana University Linguistics Club, 1973.

25 Although most generative phonologists agree on the abandonment of extrinsic ordering restrictions from phonological theory, some have argued that such rule or ordering cannot be abandoned completely from grammars of natural languages. For example, Kisseberth, in his paper "Is Rule Ordering Necessary in Phonology" (Cf. footnote 5 in this paper), notes the existence of a type of rule interaction which appears to require extrinsic ordering, namely, mutually bleeding rules. Specifically, two rules A and B are in mutual bleeding relationship if A bleeds B and B counter-bleeds A. That is to say, both rules cannot apply in a single derivation (assuming rules cannot be applied simultaneously). For details of the notion of bleeding rules, the reader may refer to Kisseberth's paper which discusses, in particular, two rules: Vocalization and Nasal Deletion in Klamath.

26 Cf. Anderson, 1969, *op. cit.*

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sonant of the root.[27] Now consider the derivations of the forms [pnãhãn] 'defender' and [pñãwãh] 'farmer', as given in (12) below:

(12) /# pŋ-tahan #/   /# pŋ-sawah #/   Underlying Forms
         pnahan   pñawah   Prefix Assimilation
         pnãhãn   pñãwãh   Vowel Nasalization
         pnãhãn   pñãwãh   Surface Forms

The derivations in (12) show that both Prefix Assimilation and Vowel Nasalization in fact apply, showing therefore maximal application. Thus in these derivations, the order (Prefix Assimilation before Vowel Nasalization) is an unmarked order.

Now consider the derivations of these same forms with the rules applying in opposite order, as shown in (13).

(13) /# pŋ-tahan #/   /# pŋ-sawah #/   Underlying Forms
         -                   -   Vowel Nasalization
         pnahan   pñawah   Prefix Assimilation
        *pnahan   *pñawah   Surface Forms

(13) shows that the ordering of Vowel Nasalization before Prefix Assimilation results in a non-maximal utilization, since only one rule, namely, Prefix Assimilation, could apply. Such order then is considered a marked order.

Looking back at the derivations given in (10) it is clear that under either sequencing of Vowel Nasalization and Nasal Cluster Simplification, both rules will apply. There is no way then, if Anderson's proposed local ordering theory is adopted, to decide which one of the two orderings is said to be unmarked. In other words, the principle of 'local ordering' as expressed in the underlying concept of maximal utilization or application of rules becomes irrelevant in the case cited in (10). Even if we take the case of an underlying form like /# bondo #/ which surfaces as [bono], we will find that the order of application (Nasal Cluster Simplification before Vowel Nasalization) which produces maximal utilization does not give the correct output. Instead, it is the opposite order (Vowel Nasalization before Nasal Cluster Simplification), where only the latter rule applies, that produces the correct output, as (14) illustrates.

(14)   a.   /# bondo #/   Underlying Form
              bono   Nasal Cluster Simpl.
              bonõ   Vowel Nasalization
             *bonõ   Surface Form

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27 Following this assimilation rule, the noncontinuant, if voiceless, is deleted. Some exceptions, however, occur, as in (pncuri) 'thief' not (*pnuri) and (pncatu) 'measuring cup', not (*pnatu). For detailed discussion on this, see Farid, *op. cit.*

b.	/# bondo #/	Underlying Form
	-	Vowel Nasalization
	bono	Nasal Cluster Simpl.
	bono	Surface Form

Clearly, the principle of maximal utilization of rules fails to make the correct prediction in the case of (14), since it turns out that it is the non-maximal utilization of the two rules which produces the correct output.

Kiparsky[28] introduces the concepts of 'rule transparency' and 'rule opacity'[29] which have been claimed[30] to have more general applicability than the concepts of feeding and bleeding (and the underlying concept of maximal utilization of rules).

The crucial difference between the principle of maximal utilization and the concepts of transparency and opacity is that whereas it is the extent of rule utilization that underlies the concepts of feeding and bleeding, it is the extent to which surface forms mask the operation of phonological rules that is crucial to transparency and opacity. Now adopting Kiparsky's proposed rule ordering preference, a form like [mani] 'bathe' which is the output of the correctly ordered rules (Vowel Nasalization before Nasal Cluster Simplification), is therefore said to be opaque, since it contains surface (phonetic) representation which satisfies the structural description of the vowel nasalization rule (i.e., a nasal segment followed by an oral vowel).- Thus, if we adopt the principle that rules are to be applied so as to minimize opacity, then the opposite order of application (Nasal Cluster Simplification before Vowel Nasalization) is to be preferred, since it yields supposedly a non-opaque or transparent output. But it turns out that the transparent output is not the correct one, as evidenced from the surface form [*mãnĩ] in (11). Evidently, the principle of minimization of opacity does not make the correct prediction either. That is, it makes the wrong prediction by selecting the order of rules which produces the transparent output.

Another possible alternative to extrinsic rule ordering is the so-called Universal Sequencing or Unordered Rule Hypothesis as proposed by Koutsoudas, Sanders, and Noll[31] (henceforth, KSN). Quite simply, the

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28 Cf. P. Kiparsky, "Historical Linguistics," *A Survey of Linguistic Science*, W.O. Dingwall (ed.), College Park, Maryland, 1971, pp. 576–649.
29 Briefly, a rule is said to be opaque if there are surface phonetic representations which satisfy the structural description of the rule, or if there are cases where the rule must be assumed to have operated to derive a given phonetic representation, but the conditions which would have required the rule's operation are not present in the phonetic representation itself. A rule is transparent if the structures to which it applies do not appear in phonetic representations and if the conditions which trigger the rule's application persist in the phonetic representation. According to this proposal, a rule ordering which produces transparency is to be preferred over one which produces opacity.
30 Cf. Kisseberth, 1973, *op. cit.*
31 Cf. Koutsoudas, Sanders, and Noll, *op. cit.*

KSN hypothesis requires that rules must apply simultaneously whenever possible or to every representation which satisfies their structural descriptions. Thus recalling the case in UMM, an input structure like /# mandi #/ satisfies the structural descriptions of both Vowel Nasalization (Rule 5) and Nasal Cluster Simplification (Rule 9) without any other principles of applicational precedence being involved. So, adopting the KSN hypothesis, both rules will have to apply simultaneously, and apparently correct output is obtained as, illustrated in (15) below:

(15)   /# m a n d i #/
              | |
             (5) (9)   (KSN Hypothesis)
              | |
           m ã n φ i
           m ã n i
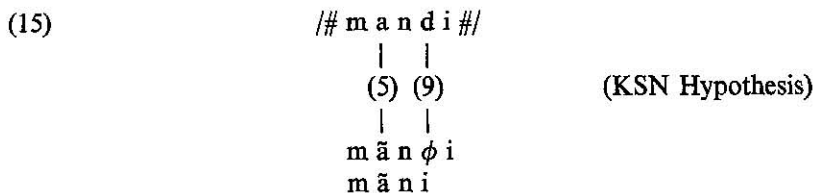
However, it must be noted that the output of (15) cannot be the final output, since the KSN principle claims, among others, the following:[32]

   a. An obligatory rule must apply whenever its structural description is met, unless its application is precluded by some universal principle

   b. All rules are scanned for applicability to each new representation in a derivation.

   c. A derivation is determined when no obligatory rules are applicable.

The form [mãni] which is derived from the simultaneous application of Vowel Nasalization and Nasal Cluster Simplification still satisfies the structural description of Vowel Nasalization. Since Vowel Nasalization is an obligatory rule, it must, according to the KSN principle, reapply simultaneously with (now non-applicable) Nasal Cluster Simplification to the representation [mãni]. The result of this simultaneous reapplication of the rules, however, is an incorrect form [*mãnĩ]. Evidently, the KSN Unordered Rule Hypothesis also fails to account for the UMM facts, and as such, it must be rejected.

As I see it, only the global rule approach offers the most elegant alternative to the extrinsic ordering analysis, since indeed it is the case that the failure of Vowel Nasalization to affect the second vowel of the form [mãni] has to do with the derivational history of the word. What goes on actually in vowel nasality of UMM is that a vowel gets nasalized following a nasal segment provided that nasal segment does not arise as a result of Nasal Cluster Simplification. It is my contention that, within the current phonological theory, only a global rule has the capacity to examine the derivational

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32 Cf. A. Koutsoudas, "Unordered Rule Hypothesis", Unpublished, 1973, p. 8.

history of a given structure, and thus can determine whether any given nasal element is derived from Nasal Cluster Simplification or not. Thus by adopting a theory in which derivational history is described in terms of global rules and not in terms of rule ordering, the problem arising from sequencing of the two rules in question could be solved. Global rules can refer to two levels of structure. By incorporating such a condition into the structural description of Vowel Nasalization, the rule can now be reformulated as in (16) below:

(16) Vowel Nasalization (revised)

$$[+\text{syll}] \rightarrow [+\text{nasal}] \quad / \quad \begin{bmatrix} +\text{nasal} \\ -\text{Nasal Cluster} \\ \text{Simpl. Derived} \end{bmatrix} [-\text{cons}]_0 \text{———}$$

(ie., a vowel is nasalized when preceded by a nasal element only if the nasal-vowel sequence is not derived from the application of Nasal Cluster Simplification).

Given a reformulation of the vowel nasalization rule, as in (16), and the nasal cluster simplification rule maintaining its original form, the sequence of these two rules now becomes irrelevant. Vowel Nasalization will not nasalize the second vowel in [mãni] 'bathe'.

Apparently, the Direct Mapping Hypothesis or the Simultaneous Application Hypothesis[33] also offers a correct analysis of the form [mãni]. The hypothesis asserts that all rules apply simultaneously to an underlying form to derive a surface form and so that there can be no intermediate representations between an underlying form and its corresponding surface form in any derivation. Thus given the underlying form /# mandi #/, a direct mapping or simultaneous application of both Vowel Nasalization and Nasal Cluster Simplification (as formulated in (5) and (9), respectively) will give the correct output [mãni], as (17) shows:

(17) / # m a n d i #/
          | |
        (5) (9)   (direct mapping or simul. application)
          | |
        m ã n φ i
        mãni

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33 This hypothesis differs from the KSN version of simultaneous application in that the former requires rules to apply simultaneously only to an underlying form, whereas in the latter, rules can apply to intermediate representations. For a version of the standard theory's simultaneous application, see *SPE*, p. 19, f.n.5.

(17) shows that although the application of Nasal Cluster Simplification to the underlying form /# mandi #/ yields a phonetic output where the second vowel is immediately preceded by a nasal, it is of no relevance (to Vowel Nasalization), since the Direct Mapping Hypothesis claims that only the underlying form determines whether a rule applies or not. While it is true that the Direct Mapping Hypothesis does account for the facts cited above, it is by no means a viable alternative to extrinsic rule ordering. For one thing, the abandonment of extrinsic ordering in favour of the direct mapping application denies the possibility of the rules Vowel Nasalization and Nasal Cluster Simplification being applied in any order but simultaneous. In a way, this is limiting the resources of natural language. As McCawley says, "a great decrease in the complexity of rules and a great increase in the insight which they provide into the working of language is obtained if phonological rules are ordered rather than simultaneous."[34]

As mentioned earlier, the claims of the simultaneous or direct mapping hypothesis are supported by data where indeed it is the underlying representation that governs whether a rule applies, regardless of the effects of other rules in the grammar. These data thus represent cases where the application of one rule R_i destroys the structure that is relevant for determining the applicability of some other rule R_j. Further support for the Direct Mapping Hypothesis is provided by cases where the effect of some rule R_i is to derive a structure identical in essential character to underlying structures that undergo some other rule R_j, but the structures resulting from R_i do not undergo R_j. In such cases, a derived structure is not allowed to undergo a rule that operates upon underlying structures of the same form, thus seemingly establishing that the effect of a rule is not relevant to the operation of other rules in the grammar.

Although the Direct Mapping Hypothesis does account for a significant range of data, there is considerable evidence that its basic premise — that the effects of phonological rules are totally irrelevant to the application of other phonological rules — is misguided. Indeed, there has been much evidence that phonological rules do create structures that then undergo yet other phonological rules. That is, phonological rules apply not just to structures occurring in the underlying forms but also to structures resulting from the operation of other rules. Thus given the Direct Mapping Hypothesis, it becomes obvious that it will run afoul in cases where rules do apply to the output of other rules. To illustrate, recall the case of the under-

34 Cf. J.D. McCawley, *The Phonological Component of a Grammar of Japanese*, The Hague: Mouton, 1968, p. 22.
35 Cf. Kenstowicz and Kisseberth, *op.cit.*, for some arguments against direct mapping or strict simultaneous application of rules, where evidence from Tonkawa and Hariri is given.

lying form /# pŋ + tahan #/ in UMM, which surfaces as [pnãhãn][36] 'defender' following the application of Prefix Assimilation and Vowel Nasalization. In order to obtain the correct output, the two rules must be ordered so that Prefix Assimilation applies before Vowel Nasalization. This ordering is necessary since the nasal element which triggers the nasalization of the following vowels occurs only as a result of the operation of the prefix assimilation rule. In other words, Prefix Assimilation must operate so that it feeds Vowel Nasalization. Now, given the Simultaneous or Direct Mapping Hypothesis, the vowel nasalization rule could not affect the underlying vowels of /# pŋ-tahan #/, since the structural description of the rule is not met. Only Prefix Assimilation will apply, yielding the incorrect form [*pnahan]. To preserve the Direct Mapping Hypothesis, which requires that Vowel Nasalization must apply directly to the underlying form /# pŋ-tahan #/, it would be necessary to revise the rule so that it contains sufficient information to identify a nasal which nasalizes the following vowels as one that comes from Prefix Assimilation. Surely such a rule is not to be desired, since there is already in the language a very general rule of Vowel Nasalization which nasalizes one or more vowels when preceded by a nasal element, and this nasal-vowel cluster does not necessarily come from Prefix Assimilation. Thus to accept the Direct Mapping Hypothesis into a phonological theory would mean accepting the claim that there are many complex and unnatural rules operative in a given language.

4.0 Conclusions

We have seen that of the many (logically) possible hypotheses of rule application which have been proposed to replace extrinsic ordering of rules, only the hypothesis which introduces global conditions on rules appears to offer the most elegant alternative. Earlier, it has been shown that

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36 The rule of prefix assimilation may also be viewed as a rule of nasal cluster reduction, which incorporates a morpheme-final velar nasal into a following stem and merges it with a stem-initial consonant to form a nasal homorganic with the original consonant. Prefixes which show a final velar nasal before vowel-initial roots show nasal cluster reduction before most voiceless consonant-initial roots. Thus, the nominalizing prefix /pŋ +/ forms *pŋajar*[6] instructor', from a root/ ajar/, but *pnulis* 'a writer' (not *pntulis*) from / tulis/. The rule of nasal cluster reduction which appears to be very common among languages of the Malayo-Polynesian group (see R. Wilbur, *The Phonology of Reduplication*, 1973, Indiana University Linguistics Club) may involve one, two, or three processes, depending on how one chooses to apply it. In my present analysis, I assume that all the three prosesses: nasal regressive assimilation, nasal progressive assimilation and nasal cluster reduction, are involved. The operation of these three sub-rules of Nasal Cluster Reduction (NCR) is given below:

		'defender'
		/# pŋ +tahan#/
	Nasal Regressive Assimilation	pn +tahan
NCR	Nasal Progressive Assimilation	pn +nahan
	Nasal Cluster Reduction	pnahan
	Other rules	pnãhãn

nasalized vowels are not phonemic in UMM, but rather a phonetic realization of the vowel nasalization rule.

It is clear from our analysis that the process is one of progressive nasalization[37] and that this process has certain constraints, one of which being that the nasal element which triggers nasalization does not come from the simplification of clusters of nasal plus voiced stop. If this constraint on the vowel nasalization process is incorporated into the structural descripton of that rule, so that the rule blocks if the cluster of nasal plus a vowel/vowels is derived, then the ordering of Vowel Nasalization and Nasal Cluster Simplification becomes superfluous.

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37 Cf. L. Schourup, *A Cross-Language Study of Vowel Nasalization*, M.A. thesis. Ohio State University, 1972. To appear in *Working Papers in Linguistics*, Ohio State University.