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## **THE NON-EXISTENCE OF THE ONSET-RIME BOUNDARY**

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## **Abstract**

Arguments for the existence of sub-syllabic Onset/Rime constituents have been drawn mainly from phonotactic restrictions, and from processes that appear to manipulate these units in language games or speech errors. If such constituents exist, and if constituency is taken seriously, then each segment must uniquely belong to either Onset or Rime, and the boundary between the constituents should be clear and consistent in any given language. Pre-nuclear glides provide a test-case for this prediction. It turns out that in a single language these glides may behave in some ways as part of the Onset, and in other ways as part of the Rime, casting doubt on the reality of these constituents. We find not only inter-speaker variation, and also intra-speaker variation. A model of syllable structure that makes no commitment to Onset/Rime affiliations does not encounter such problems. The facts succumb to explanations based on simple linear phonotactics, with no appeal to sub-syllabic constituency. These results reinforce the findings of Pierrehumbert and Nair (1995). The data are drawn primarily from English and from Mandarin Chinese, and the analysis is worked out in Optimality Theory.

Keywords: syllable structure, glides, variation

## **Introduction**

There is an extensive literature on syllable-internal structure, and yet there is still no consensus on whether such structure exists at all, or on the nature of the sub-syllabic constituents, if any. The prevailing models can be placed in two main groups: models which divide the syllable into Onset and Rime, and models which allow only the mora to intervene between a segment and its syllable node. In this paper I shall argue that evidence for the existence of Onset and Rime constituents is scanty and inconsistent, and that the simpler models are sufficient to capture the facts.

Arguments for the existence of sub-syllabic Onset/Rime constituents have been drawn mainly from phonotactic restrictions, and from processes that appear to manipulate these units in language games or speech errors. If such constituents exist, and if constituency is taken seriously, then each segment must uniquely belong to either Onset or Rime, and the boundary between the constituents should be clear and consistent in any given language. Pre-nuclear glides provide a test-case for this prediction. It turns out that in a single language these glides may behave in some ways as part of the Onset, and in other ways as part of the Rime, casting doubt on the reality of these constituents. We find not only inter-speaker variation, and also intra-speaker variation. A model of syllable structure that makes no commitment to Onset/Rime affiliations does not encounter such problems. These results reinforce the findings of Pierrehumbert and Nair (1995). The data are drawn primarily from English and from Mandarin Chinese, and worked out in Optimality Theory.<sup>1</sup>

I begin by outlining some popular current models of the syllable. In section 2 I argue that the common lines of argument for Onset/Rime constituents have overstated the strength of the case, and I outline an approach in which the propensity of pre-nuclear glides to survive and copy is held in check by syllable phonotactics and markedness reduction, and in which no reference to

syllable-internal structure is needed. In Section 3, the core of the paper, I discuss two languages, Mandarin and English, in which diagnostics for the Onset/Rime boundary yield contradictory results both between speakers, and within individual speakers. The analysis presented here explains the co-occurrence facts in terms of similarity and proximity, and deals with the speech error and language game facts using the approach outlined in the previous section. . In section 4 I discuss outstanding issues.

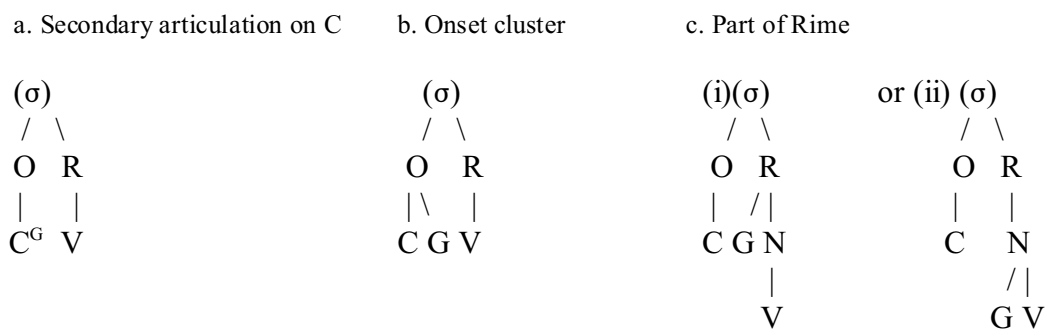
### **1. Possible models of syllable structure**

Blevins (1995) gives a number of arguments for the syllable as a phonological unit, including its use as a domain for phonological rules such as pharyngealization; the fact that it may be the entity that is extrametrical in stress assignment; the fact that it may be the target structure for affixation, and also for reduplication; and last but not least native speaker intuitions. Most (though not all) phonologists accept these arguments, but the internal structure of the syllable is more controversial. We begin with a look at the main current theories, and how they deal with pre-nuclear glides. There are three main theories, each of which comes in several varieties. For reasons of space, I will look only at vowel-final syllables, but the reader should be aware that the various theories make some quite different predictions about post-nuclear constituency as well. Lastly, I shall assume throughout that glides are simply vowels that are not the nucleus of the syllable, so that [i] and [y] have the same features, and [u] and [w] have the same features..

In the first type of theory, the syllable is exhaustively divided into two immediate constituents, Onset and Rime. The pre-nuclear glide must be in one or the other. It can be a secondary articulation on the onset consonant, as shown in (1a). It may form a true constituent

with the Onset, as in (1b), or with the Rime, as in (1c). In the latter case, it may precede the nucleus, as in (i), or be in the nucleus, as in (ii). This allows for it to be weight-bearing (as in (i)), or not, as in (ii). Mandarin and English, the main focus of this paper, both have pre-nuclear glides that are not weight-bearing, and that could therefore be represented by any of the models below except (1ci).

(1) Onset-Rime Model (Pike and Pike 1947, Kaye and Lowenstamm 1981)



Onset-Rime theory comes in various flavors. For example, Government Phonology (Kaye and Lowenstamm 1981) has an O/R or O/N distinction, like (c), but no syllable constituent, which is why the syllable node is parenthesized here. Codas may be in branching Rimes, or in the onset of a following empty-headed syllable. Since much of my data will be drawn from Chinese, it is worth noting that the Onset/Rime division is either argued for or assumed by most Chinese phonologists (e.g. Bao 2000, Chung 1996, and many others), and is the closest of the three theories to the Chinese tradition.

The main competitor in current work is mora-based theory, in which segments may either (i) be dominated directly by the syllable node, in which case they do not count for stress or bear

tone, or (ii) be dominated by the mora, in which case they may count for stress, and may bear tone. However, since a mora may dominate more than one segment, sub-moraic segments do not *have* to be weight-units. Such theories have at least four locations for pre-nuclear glides, shown in (2) below; throughout, G stands for a glide. Again, Mandarin and English whose pre-nuclear glides are not weight-bearing could be any of these except (2ci).

(2) Moraic model: (Hyman 1985)

a. Secondary articulation on C	b. Non-moraic	c. Moraic	
σ	σ	(i)σ	or (ii) σ
/	/	/	/
/ μ	/   μ	/ μ μ	/ μ
/	/	/	/ /
C <sup>G</sup> V	C G V	C G V	C G V

In (a) the glide is a secondary articulation on the onset, an intrinsic part of the onset consonant and thus inseparable from it. This is the only way a pre-nuclear glide can be part of the onset in moraic theory, as becomes clear when we look at (b). In (b) the glide is directly dominated by the syllable. It is not a constituent with any other sub-part of the syllable, and in particular it is not part of an onset constituent. In (c) the glide is dominated by a mora. If it has its own mora, as in (i), it is a weight-unit, but it is not a constituent with any preceding or following segments. If it shares a mora, as in (ii), then it is a constituent with the following vowel. Note however that although moraic models can treat GV as a constituent in a light open syllable like that in (2cii), they cannot treat the heavy sequences GVV, GVG or GVC as constituents, since the final V, G or C would have to be dominated by the second mora of the heavy syllable. There are other variants of moraic theory, but the differences will not concern us here.

Finally, there are flat theories like those of Clements and Keyser (1983), in which each segment is directly dominated by the syllable node. These theories encounter the serious problem that they cannot distinguish between segments which count as weight-units for stress purposes, and segments which do not. I shall therefore not consider them further here, but see §4.1.1 for some discussion.

I shall argue that the evidence for Onset/Rime (O/R) constituency is weak, and that in many cases the facts can be handled at least as well by simple linear well-formedness statements that care about such things as similarity, proximity, and sonority. In the absence of positive evidence for the need to refer to O/R constituent structure, Occam's razor demands that we excise them from the entities available to the grammar, and use an alternative model. Little or nothing in this paper can be construed as a direct argument for any particular alternative, but since the extant competitor is the moraic model, I will use it for concreteness. What I hope to show in this paper is that this model, together with phonotactic requirements definable in terms of sonority, similarity and proximity, is sufficient, and in some instances preferable.

Arguments for the Onset/Rime model rarely question the location of the boundary, but it will be central to this paper to recognize that if the syllable is exhaustively partitioned into Onset and Rime, it follows that each segment in a given language must be committed consistently to one or the other. For most segments, this is not controversial: all phonologists would place the [t] of [ta] in the Onset and the [a] in the Rime in all languages. Pre-nuclear glides are a different matter, and thus a crucial testing ground for Onset/Rime (O/R) theory. In previous analyses they have been argued to be in different places in different languages. For example, Harris (1983) for Spanish and

Bao (2000) for Fuzhou locate them in the Rime; Pike and Pike (1947) for Mazateco and Bao (1990) for Mandarin locate them in the Onset; and Clements (1986) for Luganda and Duanmu (1990) for Mandarin considers them secondary articulations on the onset consonant. I shall show that in some languages, including English and Mandarin, they cannot be consistently allocated to either constituent, raising serious doubts about O/R theory. This suggests that, at best, the O/R distinction may be unnecessary, since the simpler models can accommodate the data. At worst, the O/R distinction is truly problematic because the data do not converge on a consistent position for the Pre-nuclear glide.

## 2. Common diagnostics for constituent structure:

Common diagnostics often overstate the case for the O/R model. There are four main types of argument that have been used to place the pre-nuclear glide in a particular constituent:

### (3) *Common diagnostics for constituent structure, and sources of data:*

1. Glide deletes/moves/copies with either C or V: *redup., secret langs, hypocoristics*  
*speech errors*
2. Glide has tighter co-occurrence restrictions with C or V: *phonotactics*
3. Glide does not count/counts as weight unit and/or TBU *stress, metrics, tone,*  
*compensatory lengthening.*
4. Glide counts with C for alliteration, or V for rhyme: *poetics*

The first two will be the focus of this paper, so I begin with a summary of the traditional O/R arguments based on such facts, and a preview of the alternative OT account presented here. The

last two play little role in this paper, and discussion will be deferred until the final section.

## **2. 1. Copying, deletion, replacement (or failure to copy):**

If a morpho-phonological process copies, deletes, replaces, or fails to copy a sub-syllabic string, this is typically taken as an argument that the string is a constituent. For example, Bao (2000) argues that the replacement of the string /woʔ/ by [i] in the first syllable of the Fuzhou reduplicated form /p<sup>h</sup>woʔ/ > [p<sup>h</sup>i p<sup>h</sup>woʔ] is evidence that /woʔ/ is a Rime, and specifically that the pre-nuclear glide is in the Rime. Conversely, Bao (1990) argues that the fact that only /ɔ/ is replaced by [ay] in the first syllable of the Mandarin secret language form /t<sup>h</sup>w ɔ/ > [t<sup>h</sup>way kwɔ] shows that /w/ is not in the Rime, but in the Onset. Similar arguments are made from speech error data: if the sequence /xw/ replaces /f/ in a speech error, it is used to show that /w/ is in the Onset.

Facts like these, however, can be analyzed quite simply without any reference to Onset and Rime. The same general principles turn out to be at work in controlling whether glides are copied in reduplication, and whether they survive in speech errors. The basic approach is as follows. I assume a basic knowledge of Optimality Theory, but excellent recent background accounts can be found in Kager 1999 and McCarthy 2002.

- (4) a. Base segments all survive if possible. Thus full copy is desirable in reduplication, and retention is desirable in speech errors (such as blends). In OT terms, FAITH-BR, FAITH-IO >> MARKEDNESS.
- b. The first cause of deletion/replacement occurs when an affix pushes out base material, either because the syllable is too small to accommodate them both, or because the two are phonotactically incompatible. In other words retention would violate undominated

markedness constraints. In OT terms, MARKEDNESS >> FAITH-IO, FAITH-BR

c. Reduplication often shows Emergence of the Unmarked (TETU) effects (McCarthy and Prince 1994), and the particular TETU effect in this paper is the loss of pre-nuclear glides, since this removes a marked syllable-type. This is the second source of deletion. Here the markedness constraints in question are violable in the language as a whole, but not in reduplication. In OT terms, FAITH-IO >> MARKEDNESS >> FAITH-BR.

I will illustrate each of (4a-c) in turn. In reduplication or secret languages, a pre-nuclear glide may appear in both copies, or in only one copy. In Southern Min (Chung 1996:87) there are two secret languages, and they differ in their treatment of the Pre-nuclear glide. I discuss each separately. In the Ma-sa secret language, the first syllable is unaltered, and the second syllable substitutes [s] for the first base C, as shown in (5a). The glide appears in both copies, as shown in (5b). Here and throughout tone is ignored unless relevant.

- (5)     a. lim   > lim sim   ‘wood’            ban > ban san       ‘slow’  
          b. kya   > kya sya   ‘ramp’            kwa > kwa swa     ‘to hang’

Focusing on the glides, these data show an instance of full copy as described in (4a), even though the result is many marked syllables with rising diphthongs. In OT, faithful copying is caused by matching requirements such as FAITH-BR. If this outweighs markedness, the marked structures or features will survive and be repeated in the copy, as here. We will see that this tendency of glides to surface if possible is pervasive, and it plays a role in the more detailed discussion of Mandarin language games and Mandarin speech errors in section 3.

Contrast this with the La-mi language. As (6a) shows, the first syllable substitutes [l] for the first C, and the second syllable substitutes [i] for all vocalic material (and the coda becomes coronal). The data in (6b) show that the pre-nuclear glide appears only in the first copy:

- (6)        a. hen > len hin    ‘to turn pages’        ke? > le ki?        ‘to separate’<sup>2</sup>  
             b. kya > lya ki     ‘slope’                kway > lway ki     ‘strange’

Suppose that the glide *were* copied into the second syllable. The output would then be [Cyi] and [Cwi] respectively. [Cyi] is never distinct from [Ci] in Chinese languages, and we could if we desired suppose that the glide is in fact still present in this case. What about [Cwi]? It turns out that S. Min has no syllables with the sequence [Cwi] (Chung: 51), so this is ill-formed, and it is this syllable ill-formedness that blocks copying of the glide, nothing more.<sup>3</sup> We have here, then, an instance of markedness constraints that are undominated (and thus inviolable) blocking copying of the glides, as described in (4b). Facts like these are often described as involving deletion of a GVX sequence, or a Rime, and thus as evidence for placing the glide in the Rime. While the data are indeed compatible with such an analysis, they by no means require it, since syllable ill-formedness alone explains the facts. The role of syllable phonotactics in blocking retention of a glide will be important in the discussion of Mandarin and of English later in this paper.

Although simple syllable-illformedness - as defined by undominated markedness constraints - explains a surprising number of cases in which pre-nuclear glides delete or fail to copy, it does not cover them all. In many other cases, the driving force seems to be a reduction in overall markedness. I begin with the observation that CGV syllables are marked, and they are cross-linguistically rare (see Rosenthal 1994, 1997). It follows then that deletion of the glide reduces

markedness. Having identified markedness as the driving pressure behind glide deletion, we may then ask exactly what markedness constraint is violated by the pre-nuclear glide. Some of the possibilities are given below, all taken from the markedness constraints extant in the OT literature, especially Rosenthal (1994, 1997).

(7) *Markedness constraints violated by Pre-nuclear glides:*

- a. \*SECARTIC: No secondary articulations
- b. ALIGN-L (C, SYLLABLE): Every consonant should be at the left edge of a syllable.

(i.e. \*CLUSTER, \*COMPLEXONSET, NoCODA)

SONORITYPROFILE: Syllables should have a sharp sonority increase early in the syllable.

- c. PEAK: The head mora is the first mora of the syllable.

\*DIPHTHONG: No non-identical tautosyllabic vowel sequences

SONFALL: Tautosyllabic vowel sequences cannot increase in sonority

\*BRANCHINGMORA: Moras must not branch

Returning to deletion, does the deletion of a glide then tell us which of these constraints was violated before deletion, and therefore perhaps whether the pre-nuclear glide is in Onset or Rime? The answer, I think, is often no. Consider these Fuzhou data from brief, casual durative verbal reduplication (data from Bao 2000:97) where a GV(G) sequence is replaced by [i], resulting in a first syllable with no apparent pre-nuclear glide. Bao uses this to argue that the pre-nuclear glide must be in the Rime, but another explanation is available.

(8) *Fuzhou reduplication*

/kwɔŋ/ > kiŋ kwɔŋ 'to roll up'  
 /tʂʰyaʔ/ > tʂʰi tʂʰyaʔ 'to slide in'

Suppose that this is an instance of The Emergence of The Unmarked (TETU: McCarthy and Prince 1994), attributed to the ranking FAITH-IO >> MARKEDNESS >> FAITH-BR , which removes marked structures or features in the reduplicant, but not in the base. There is no way to tell *which* structural markedness constraint from (5) is violated in the base, only that the reduplicant violates none. The glides disappear because all marked vocalic features are removed in favor of the least marked vowel /i/ (see Yip (2001) for a similar phenomenon in Chaoyang), an instance of glide copying being blocked by markedness, as described in (4c). The moral here is that we cannot conclude from Fuzhou and other similar data that the glide is in the Rime.

Hypocoristics provide another fruitful place to observe the loss of pre-nuclear glides, but again it can be seen as an Emergence of the Unmarked effect which offers no evidence for an Onset/Rime distinction. Consider these data from Spanish (Piñeros 2000), Roca and Feliu (2001):

(9)	a.	<i>Daniel</i>	da.njél	nél	<i>Manuel</i>	ma.nwél	né.lo
		<i>Octavio</i>	ok.tá.bjo	tá.bo	<i>Ofelia</i>	o.fé.lja	fé.la
	b.	<i>Victoria</i>	bik.tó.rja	tó.ri	<i>Daniel</i>	da.njél	dá.ni
		<i>Manuel</i>	ma.nwél	má.nu	<i>Julia</i>	xú.lja	xú.li
	c.	<i>Atanasio</i>	a.ta.ná.sjo	ná.čo	<i>Antonio</i>	an.tó.njo	tó.ño

With only two exceptions (Dionisio ~ Djoni; Ezequiel ~ Chequiel ~ Chequel) glide-vowel

sequences are simplified. Either the glide drops, as in (9a), or the glide vocalizes and the nuclear vowel goes, as in (9b), or the glide and consonant coalesce, as in (9c). All these are ways to eliminate Pre-nuclear glides, and the choice is at least partly phonologically conditioned. The coalescence in (9c) is only possible for coronals followed by the front glide, since this produces palatalized segments that occur in Spanish. Vocalization of the glide as in (9b) is only possible if it is unstressed in the hypocoristic form: there are no forms like \*Núlo for Manuel or \*Nílo for Daniel. In all other cases, the glide is lost in favor of the nuclear vowel. There is no space here for a full analysis, but it should be clear that nothing in these data provides an Onset/Rime argument, and the generalization is simply that hypocoristics prefer unmarked syllables with no pre-nuclear glides, and that this markedness preference over-rides the pressure to retain all base segments, MAX-BT.

## **2.2 Co-occurrence restrictions:**

The most convincing arguments for constituency come from phonotactics and co-occurrence restrictions. The central idea is that these will be stricter inside a constituent than between constituents. Unfortunately, they are often overstated. First, similarity and proximity evaluated across the syllable as a whole must always first be excluded as the possible source of co-occurrence restrictions. For example, in many American English dialects [ti] is fine, but [ty] is not, probably because both are Coronal. One could appeal to an Onset constituent, but the alternative is that [ty] is worse because [y] is more “consonant-like” than [i], and thus more similar to [t]. Recent work has shown that many co-occurrence restrictions in languages seem to be based on rather general cognitive notions of similarity and degree of proximity, and also on statistical frequency (Frisch 1997, Pierrehumbert 1993, Frisch and Zawaydeh 2001, Zuraw 2001 and

others). It would be of great interest to extend this approach to a full range of cases where O/R constituency has been held to be central, but such a study is beyond the scope of this paper. What we can say is that the cited works show that languages may evaluate acceptable outputs by inspecting a whole word or perhaps a syllable, and therefore any argument for Onset-Rime constituency must first exclude this alternative approach. See section 3.1 for an analysis of Mandarin along these lines, and also section 4.1.3 on Cantonese.

Second, arguments for an onset or coda constituent based on sonority sequencing restrictions among its members are never convincing, because in reality sonority inspects a demi-syllable-sized CV or VC window that includes the nucleus, ensuring that sonority peaks with the nucleus, and declines as we move out from the nucleus (Clements 1988): see §4.4 for further discussion.

Third, many arguments are neutral between O/R and moraic models. For example, if G in the frame C---V shows greater co-dependence with V than with C, this can be understood in either an O/R model or a moraic model, where G and V may be tautomoraic.<sup>4</sup>

As far as I can see, the only real argument for the O/R model would be the *existence* of co-dependence between the Pre-nuclear glide and post-vocalic material, such as an off-glide or coda, simultaneously with the *non-existence* of co-dependence between a clear onset C and that final off-glide. For example, in a language that disallows two labial glides, if the glide is a true onset, as in [waw], the sequence would have to be acceptable, but if the glide was a pre-nuclear glide, as in \*[kwaw], it would have to be banned. In such a case, no appeal to similarity or proximity would help, because the two [w]'s are identical and separated by a single vowel in both cases. At present I know of no such examples.

### **2.3 Summary**

To sum up, arguments for Onset/Rime constituency based on copying, deletion, replacement, and failure to copy can be explained in terms of general pressure to copy, reined in by syllable phonotactics, and a preference for unmarked structures. Arguments based on co-occurrence restrictions may succumb to a similarity and proximity-based approach.

In the detailed case studies of Mandarin and English presented below, these mechanisms will be used again and again, but two additional points emerge. First, not only are O/R constituents unmotivated, but within a single language different ‘diagnostics’ yield contradictory conclusions, making an internally consistent O/R analysis impossible. Second, with or without O/R constituents it is necessary to assume that different speakers of a single language may treat medial glides differently, and even then much of the data remain problematic for an O/R analysis.

### **3. Contradictory diagnostics**

This section will show that proponents of an O/R analysis will encounter problems because the medial glides do not behave consistently as being in one or the other. One possible response to this would be to appeal to inter- and intra-speaker variation, and suggest that in any given production the glide is in one or the other, but speakers may move it around at will. The data in this section will show that this is not a plausible proposal, and in any case it would leave open questions as to why variation in syllabification is not more widespread than it apparently is. I will also show that analyses are available for all these data that do not make use of the O/R division.

Generative phonologists have traditionally worked on pooled data, and paid little attention to inter-speaker variation let alone intra-speaker variation. In some cases this does not matter. As far as I know, all speakers of English syllabify *guitar* as [gi.ta] (or [gi.tar]), satisfying ONSET and

NOCODA, and allowing the unstressed initial syllable to remain light. Nevertheless, inter-speaker variation is widespread, both among large groups who therefore speak what we would call different dialects, but also between members of the same speech community. In the case of different dialects, the data available to the child differ from dialect to dialect, so the grammars are unsurprisingly different. But what about cases where the data are (roughly) the same? Can we then assume that every child learns an identical grammar? Or might there be cases where the data leave more than one possibility open to the language learner, and where they then reach different conclusions? If so, it might be possible to detect these differences by asking the speakers to undertake a new grammatical task, and inspecting the output. In this section these issues will arise in two ways.

First, when we look at Mandarin speech errors, we will see that glides do not behave consistently as being in either Onset or Rime. The data, however, is pooled across speakers, and so we cannot tell whether this variation is intra-speaker, or only inter-speaker. If the latter is the case, it is logically possible that one group of speakers places the glide in the Onset, and another group places it in the Rime. Nevertheless, because two other data sets for Mandarin - phonotactics, and secret languages - hold for all speakers, and show that an O/R analysis is untenable, and because the speech error facts are analyzable without recourse to the O/R division, I shall conclude that the lack of individual data does not undermine the argument.

In the case of English Pig Latin, individual data is available. Secret languages are exactly the kind of novel task that can be used as a probe, and they expose differences in the treatment of glides by different speakers of the same speech community, but intra-speaker consistency. Interestingly, an O/R division is not needed to explain the treatment of the glide by any sub-group.

### **3.1 Mandarin: Schizophrenic Pre-nuclear glides in a single language:**

Mandarin is of interest because multiple sources of well-studied evidence contribute to our understanding of pre-nuclear glides. In addition to the familiar lines of argument from co-occurrence restrictions and secret languages, I will also look at speech errors. In each case, I will argue that analyses couched in O/R terms encounter serious empirical problems, because the pre-nuclear glides behave sometimes as if they are in the Onset, and sometimes as if they are in the Rime. I will conclude that although it is useful descriptively, constituent structure does not seem to be necessary, and in some cases it is truly problematic, especially if it is claimed to hold true for all speakers in all circumstances.

#### **3.1.1 Labial Co-occurrence Restrictions: conflicting evidence**

One of the best-studied aspects of Mandarin phonology is the labial co-occurrence restrictions. They are sometimes claimed to support an O/R division, or more often such a division is assumed without comment, and used in the analysis. I shall contend that in fact the data show no consistent evidence of such a division if one focuses on the O/R boundary, and uses the pre-nuclear glide as a probe. If the O/R divide is real, it should be possible to show that the glide is clearly in one or the other, but in fact the data are contradictory. Since all speakers of Mandarin share all the phonotactic facts in this section, the differing behaviors of the glides cannot be understood as arising from inter-speaker variation alone, unlike the English data in the next section.

I begin with the restrictions from the perspective of the medial glide itself. The following summary shows that it is heavily restricted, being unable to occur with any labial segment anywhere else in the syllable. So strong are the restrictions that they apply irrespective of the position of the

other segment, and tell us nothing about the placement of the glide.

(10) *Medial /w/: NO Onset-Rime asymmetries:*

- not with preceding Labial C, \*/pwa/
- not with following Labial vowel, \*/twu/
- not with following Labial coda, \*/twaw/

Secondly, let us look at the restrictions from the perspective of an initial labial consonant. Here an asymmetry becomes apparent: the restrictions between the initial consonant and a following glide are stronger than those between the consonant and a following vowel, suggesting that the glide might be in the onset with the consonant, unlike the vowel:

(11) *Labial initial C: POSSIBLE Onset-Rime asymmetry, /w/ in Onset.*

- acceptable with following (back) Labial vowel, /pu/
- not with following Labial glide, \*/pwa/

Finally, let us look at the restrictions on a final labial glide. Here we find that the final glide is acceptable with a labial initial consonant, but not with a preceding labial glide, suggesting that the pre- and post-nuclear glides might be co-constituents of the Rime.

(12) *Final Labial glides, /w/: POSSIBLE Onset-Rime asymmetry, /w/ in Rime.*

- acceptable with preceding Labial C onset, /paw/
- not with preceding Labial glide, \*/twaw/

We thus arrive at a contradiction: if we resort to O/R constituency to explain these restrictions, one set of restrictions demands that the Pre-nuclear glide is in the Onset, and another that it is in the Rime. The poor language learner might be excused for being confused! We conclude that O/R constituents are of no help here. Instead, the likely answer lies in the relative influences of degrees of similarity, and degrees of proximity, along the lines of Frisch and Zawaydeh's 2001 analysis of Arabic co-occurrence restrictions. The following sketch is in many ways similar to Wu's (1994) C-Place vs. V-Place solution. (See 1990, Goh 1997, Kaye 2000, Windrow 2000 for recent alternative accounts.)

The core idea is that the illicit combinations should be those where the segments are most similar, and in closest proximity. So [wu], with two adjacent vocalic labials, should be very bad, but [myuŋ], with a non-adjacent labial consonant and labial vowel, should be acceptable. Following Walker and Rose (2002) I assume that phonetic factors, such as release, can play a role in similarity and dissimilarity, so that [w] and [u], although featurally identical, have a degree of phonetically based dissimilarity too.<sup>5</sup> The similarity scale I propose has  $u \neq w \neq m, p$ , and is essentially based on degree of closure. So the pairs {u,w} or {w,m} differ by one degree, but {u,m} differs by two degrees. The following chart shows all possible labial pairs across the top ([m] and [p] cannot end a syllable in Mandarin), with the most dissimilar pairs on the right. The three rows show increasing linear distance as one moves down the table. V stands for any non-labial vowel, and X for any non-labial segment, or zero. A dash denotes a sequence that cannot arise for reasons of syllable structure, such as [wXXw], where two segments separate two glides. The shaded cells are non-occurring sequences.<sup>6</sup>

(13)

Degree of dissimilarity	∅	1	1	1	2	2
# of intervening segments	ww	wu uw	mw	pw	mu	pu
0	-	* XwuX * Xuw	* mwVX	* pwVX	muX	puX
1	*XwVw	-	mVw	pVw	myuX	pyuX
2	-	-	myVw	pyVw	-	-

We see that as pairs become less similar, and further apart, the acceptability increases. Two vocalic labials are never allowed in the same syllable. A labial consonant and a labial glide are allowed if non-adjacent. A labial consonant and a labial vowel are always allowed. For those who like a precise metric, illicit combinations are those where (degree of similarity + # of intervening segments)  $\leq 1$ .

I conclude that the labial co-occurrence restrictions not only can be handled without reference to Onset/Rime constituency, but that an O/R account is problematic.

### 3.1.2 Speech errors:

A second possible source of relevant data comes from speech errors. The data that follow come mainly from Shen (1992), with a few from Wan and Jaeger (1998). I assume a theory of speech errors along the lines of Garrett 1984, Shattuck-Hufnagel 1986, Bock and Levelt 1994, in which the type of errors that concern us here arise after lexical insertion, during the assignment of phonetic form - i.e. in the phonology. As such they work on phonological representations, presumably including syllable structure. They are contextual, in that the error is influenced in some

way by some other portion of the utterance. The class of errors I shall consider affects from one to three adjacent segments. The multiple segment cases are usually assumed to manipulate sub-syllabic constituents and are traditionally described as Onset or Rime anticipation or perseveration, implicitly endorsing the O/R model. If the O/R model is rejected, another analysis of these data must be offered. I shall argue that the O/R model is in fact problematic for these data, and that the errors are in fact the result of a combination of two other common speech error types: complete syllable repetition followed by blending. Kubozono (1990), Bat-El (1996), Pineros (2002) give cogent arguments based on English, Japanese, Spanish and Hebrew that the mechanism of blending in these languages is a morpho-phonological mechanism, analyzable by an OT grammar, and here I extend this observation to speech error data, and offer an OT analysis.

There are four sub-types of errors given in (14). In (14a) the initial consonant(s) of the second syllable is substituted for the first consonant(s) of the first syllable, (14b) substitutes the second nucleus (and coda if any) for the first. (14c) copies the initial consonant(s) from the first syllable into the second. (14d) copies the nucleus (and coda) from the first syllable into the second:

- (14) *a. Onset Anticipation* tʂ<sup>h</sup>ow k<sup>h</sup>e > k<sup>h</sup>ow k<sup>h</sup>e 'shameful..can't be' A2  
*b. Rime anticipation* tswey tʂ<sup>h</sup>ow > tsow tʂ<sup>h</sup>ow 'mouth smell' (bad breath) A12  
*c. Onset perseveration* pey kwan > pey pan 'life..accustomed' B4  
*d. Rime perseveration* kwey ts<sup>h</sup>wo > kwey ts<sup>h</sup>wey 'kneel .twist' B17

I would now like to look more closely at the behaviour of the medial glide in these types of errors. Recall that if it is in the Onset or the Rime, it should behave consistently in this regard,

but this is not what we find. In the examples in (15a) glides behave like Onsets, or fail to behave like Rimes (15 b). For example,

(15) *Glides behave like Onsets and not like Rimes:*

- |                            |                            |   |
|----------------------------|----------------------------|---|
| a. fa xwey                 | > xwa xwey:                | Onset transposition, /xw/ replaces /f/            |
| pey kwan                   | > pey pan :                | Onset transposition, /p/ replaces /kw/            |
| b. şan tş <sup>h</sup> wey | > şan tş <sup>h</sup> wan: | Rime transposition, /an/ replaces /ey/, not /wey/ |
| k <sup>h</sup> way ta      | > k <sup>h</sup> wa ta     | Rime transposition, /a/ replaces /ay/, not /way/  |

In a second set of examples, glides behave like Rimes in (16a), and not like Onsets in (16b):

(16) *Glides behave like Rimes, and not like Onsets:*

- |                            |  |   |
|----------------------------|--|---|
| a. ye ɕwan                 | > ywan ɕwan :                              | Rime transposition, /wan/ replaces /e/                                      |
| le xwo                     | > le xe :                                  | Rime transposition, /e/ replaces /wo/                                       |
| tswey tş <sup>h</sup> ow   | > tsow tş <sup>h</sup> ow :                | Rime transposition /ow/ replaces /wey/                                      |
| b. tş <sup>h</sup> wan şaw | > tş <sup>h</sup> wan tş <sup>h</sup> aw : | Onset transposition /tş <sup>h</sup> / not /tş <sup>h</sup> w/ replaces /ş/ |

The affiliation of the glide cannot be predicted from the specifics of neighbouring segments. In the following examples the glide of the sequence /wan/ behaves like part of the Onset in (17a), and like part of the Rime in (17b), even though in both cases it is followed by /an/.

- (17) a. pey kwan > pey pan: /p/ replaces /kw/, w in Onset  
b. ye ɕwan > ywan ɕwan: /wan/ replaces /e/, /w/ in rime

Conversely, the glide of the sequence /xw/ behaves like part of the Onset in (18a), and like part of the Rime in (18b), even though in both cases it is preceded by /x/:

- (18) a. fa xwey > xwa xwey:        /xw/ replaces /f/, /w/ in Onset  
      b. le xwo > le xe :            /e/ replaces /wo/, /w/ in Rime

I conclude that these speech errors do not manipulate Onset and Rime constituents, because there is no consistent division of the syllable into Onset and Rime at the point of the pre-nuclear glide. So what are the alternatives? These errors are clearly not single segment errors, since either target or error both may involve two or more segments, but a reviewer points out the possibility that different speech errors might well access different levels of structure. This does not seem to help here. Consider *pey kwan* > *pey pan.*, where /p/ replaces /kw/. We could suggest that the /p/ is an instance of a single segment error, not an Onset error, but then we have to explain why it replaces /kw/, not just /k/. Or consider *tswey tɕʰow* > *tsow tɕʰow*, where /ow/ replaces /wey/. Since both target and error are two or more segments, this cannot be a single segment error, so in an O/R approach it has to mean that /wey/ is a Rime. Another option might be to suggest a structure in which [w] belonged to both Onset and Rime, and the speech errors sometimes manipulated the Onset, and sometimes the Rime. Under this view, glides in the source syllable should copy with either the Onset as in *fa xwey* > *xwa xwey*, or with the Rime, as in *ye ɕwan* > *ywan ɕwan*. Although this is often true, it is not exceptionless: the glide fails to copy with the onset in *tɕʰwaŋ ɕaw* > *tɕʰwaŋ tɕʰaw*.

—Add an eg where GVC fails to copy the G??

There is one way that an Onset/Rime account might be rescued. Given the contradictory indications from the phonotactics, one might wonder whether language learners arrive at different conclusions as to the placement of the glide, as we shall see in the next section they have in English. It would therefore be of great interest to see individual data for Mandarin speech errors. Suppose it were the case that individual speakers were in fact consistent in their treatment of these glides as in either Onset or Rime, and that the inconsistency in the published data results from pooling errors from multiple speakers. One could then maintain an Onset/Rime model, and suppose that different speakers make different choices in their assignments of the glide. No such data is available to me, but this remains a possibility. In the rest of this section I will offer an analysis based on the assumption that individual data would not radically change the picture.

I suggest that these errors are the result of complete syllable repetition, followed by blending. This is overt in the following example, where the entire first syllable perseveres into the second, with which it then blends, and the original [u] becomes the glide [w]: tʂ<sup>h</sup>u faŋ > tʂ<sup>h</sup>u tʂ<sup>h</sup>waŋ 'kitchen'. Wan and Jaeger counted 50 cases of simple blending ('lexical blending' and 'telescoping') errors in their database, and an unspecified number of cases of complete syllable repetition. Blending is also found in fast casual speech in Mandarin: the following examples are from Ren 1989, with the exception of the final step reducing /wo xay/ all the way to [way], which comes from personal observation.

- (19) ti an                    → tyan  
      wo xay                → wo ay            → way

Perhaps more relevantly, both syllable repetition and blending are common speech errors, although

syllable repetition is often not recorded, since it does not appear to be phonologically interesting. The combination of the two, however, straightforwardly gives rise to the types of speech errors we have seen above. The idea goes like this. Let us break the error down into a series of tiny slow-motion frames, none of them of course under the speaker's conscious control. Suppose that the speaker is intending to produce [fa xwey]. By mistake, she begins to say /xwey/ first, realizes her mistake, and switches quickly to /fa/. If the switch is fast enough, the result will be a blend of the sequence /xwey-fa/ into the surface syllable [xwa]. She then continues with the utterance, correctly pronouncing [xwey]. the overall result will be that instead of [fa xwey] she will produce [xwa xwey], or so-called "Onset anticipation". The scenario for "Rime anticipation" is only slightly different. Suppose the intended utterance is [ye ɕwan]. The speaker begins normally, with [ye], but goes too fast, and blends it with the second syllable [ɕwan] to give [ywan]. To recover from the error, the second syllable is then produced cleanly on its own. All four error types can be understood along these lines, as shown below:

(20) *Towards a Syllable-Repetition and Blending Analysis:*

1. 'Onset' Anticipation:  $\sigma_2$  wrongly produced first, quick switch to  $\sigma_1$  results in blending.  $\sigma_2$  then repeated clearly.

tʂʰow kʰe > kʰe-tʂʰow kʰe > kʰow kʰe

2. 'Rime' Anticipation:  $\sigma_2$  produced too soon after  $\sigma_1$ , resulting in blending.  $\sigma_2$  then repeated clearly.

ye ɕwan > ye-ɕwan ɕwan > ywan ɕwan

3. 'Onset' Perseveration:  $\sigma_1$  produced clearly, then mistakenly repeated. Quick switch to  $\sigma_2$  results in blending.

tʂʰwaŋ ʂaw > tʂʰwaŋ tʂʰwaŋ-ʂaw > tʂʰwaŋ tʂʰaw

4. *'Rime' Perseveration*:  $\sigma_1$  mistakenly repeated after  $\sigma_2$ , resulting in blending.

le xwo > le xwo-le > le xe

The last type of error seems somewhat less likely than the first three, but if it is viewed as the start of an aborted repetition of the entire bisyllabic word, it is perhaps less surprising.

If this is on the right lines, the problem now shifts to the realization of a blended syllable. Can we correctly predict which portions of each contributing syllable will surface in the blend, with particular reference to the pre-nuclear glide? Before turning to the details, some general considerations must be addressed. The particular data given here are only one type of speech error. Other types occur, and are either not recorded as errors, or are categorized as quite different error types. Specifically, there are three statements that define the class of cases taken as errors of this type:

- (21)
1. Different Output: The output must be different from both input syllables. If this were not so no speech error (except simple repetition, or hesitation) would be detected.
  2. Material from both syllables: It must include material from both syllables, rather than just reduction of one syllable, because otherwise it would be categorized simply as fast speech shortening
  2. Single Syllable: The output must be one blended syllable (plus one unchanged syllable) or again this would not be categorized as a speech error of the type under investigation .

Having restricted our area of inquiry to single blended syllables, its content and shape are governed by three principles, all statable as OT constraints that must be part of the normal grammar of Mandarin and are not specific to speech errors. See Bat-El 1996 for a similar approach to Hebrew blends.

(22) *Three generalizations that govern the precise nature of the reported output:*

1. OK- $\sigma$ : A cover-term for all the constraints that define a well-formed Mandarin syllable, (C)(G)V(C). Speech errors do not typically create new syllable types not found in the target language (although if impossible syllables are created, field workers may not always notice or record them).
2. MAXIMALITY: As much base material as possible is used, constructing the largest possible syllable, preferably CGVC. This can be formally couched as satisfaction of MAX.
- 3: ALIGN ( $\sigma$ , morpheme). Material from the two edges is used first, a result that can be achieved by Edge-In Association (Yip 1988), as noted by Chung (1992) in his discussion of syllable contraction. Beneath this formal procedure lies the deeper insight that blends are the result of trying to squash too much material into a prosodic straitjacket, a single syllable. The favoured output preserves edge material, thus aligning the edges of the output syllable with the edges of input morphemes.

We are now ready to return to the pre-nuclear glides. The principles above will have several relevant effects. MAX will try to preserve pre-nuclear glides whenever possible, without caring which syllable they originate in, or whether they come from the ‘Onset’ or the ‘Rime’. However, the requirement for well-formed syllables may sometimes make preservation impossible, for example if it would result in a syllable with more than one pre-nuclear glide, or one with too

many labials. Lastly, ALIGN gives preference to segments at the edges, so if a syllable cannot accommodate both a pre-nuclear /w/ and a coda /w/, the coda /w/, being at the edge, will win.

Our first two examples are cases where the glides are retained. The syllables that include the glide best satisfy MAX, without violating either of the other two constraints. There is thus no reason for the glide not to survive. The syllables that are blended are shown in parentheses above each tableau, and the tableau itself considers only the blended syllable. Violations of MAX are shown by listing the number of segments that fail to surface. The first tableau shows the survival of a glide from the second syllable of the input, which becomes the first syllable of the blend. Only the blending phonology is shown in the tableau, acting on the output of the error itself:

(23) *Onset anticipation, with glide retention*

Input: /fa xwey/ → (xweyfa) xwey → xwa, not \*xa.

/xweyfa/	OK-σ	MAX	ALIGN(σ, Morpheme)
☞ xwa		eyf	
xa		weyf!	

Our second tableau shows retention of a glide from the second syllable of the input, which is also the second syllable of the blend.

(24) *Rime anticipation, with glide retention*

Input: /ye ɕwan/ > (yeɕwan) ɕwan → ywan, not \*yan or \*wan

/yeɕwan/	OK-σ	MAX	ALIGN(σ, Morpheme)
☞ ywan		eɕ	
yan		eɕw!	
wan		yeɕ!	*

The reader may run through the other two cases for themselves: in every case MAX will encourage retention of the glide if the resulting syllable is acceptable. In no case can we tell where the pre-nuclear glide is structurally located, since the faithfulness constraint MAX dominates whatever markedness constraints are violated by the glide, allowing it to surface.

The picture is very different when glide retention would create an illicit syllable. The most common circumstance in which this happens is when the glide in question is labial, and the blended syllable includes another labial originating in the other syllable of the blend. Each syllable, then, potentially contributes one labial to the blend, but both cannot survive without violating the phonotactic prohibition on two labials per syllable, a part of the umbrella OK-σ constraint. The preferred candidate is the one that best satisfies ALIGN, retaining the labial /p/ from the edge of the first syllable in preference to the medial /w/.

(25) *Loss of glide when retention would violate OK-σ*

Input: /pey kwan/ > pey (peykwan) -> pan, not \*pwan or \*wan

/peykwan/	OK-σ	MAX	ALIGN(σ, Morpheme)
☞ pan		eykw	
wan		peyk	*!

pwan	*!	eyk	
------	----	-----	--

The speech error data tell us three things. First, pre-nuclear glides show schizophrenic behaviour as to their O/R affiliation. Second, a full account of the data is available without any reference to an O/R distinction. Third, these data provide no diagnostics for O/R membership.

### 3.1.3 Two secret languages that differ in their glide treatment

The third source of evidence for the position of the pre-nuclear glide in Mandarin is language games. Chao's famous 1931 paper discusses three secret languages based on Mandarin, and they have frequently been analysed in O/R terms, for example in Yip 1982, Bao 1990. The most interesting aspect, for our purposes, is that one of the secret languages treats the pre-nuclear glides differently from the others. I shall assume that the speaker keeps his or her lexical representations intact, and that any difference must either reside in the secret language's own rules, or in the general principles of the phonology. It will turn out that the difference in the segmental make-up of the secret language affixes is sufficient to explain the difference in treatment of the glides.

The facts are as follows. In two of the secret languages, all medial glides surface in both halves of the output. In May-ka, the syllable is reduplicated, and in the first half the sequence [ay] with a low tone replaces the nucleus and anything that follows it. In the second half [k] replaces the initial consonant, and the tone is unchanged. Before high front vowels and glides this [k] subsequently palatalizes, as part of a general Mandarin process. The sequence [yay] is ultimately realized as [ɛ].

(26) *May-ka*:

pən > pay kən      ‘book’      pey > pay key      ‘north’  
xwey > xway kwey      ‘meeting’      lyəŋ > lyay kyəŋ > [lyɛ - tɕyəŋ] ‘two(persons)’

In *Man-tʰa*, in the first half the sequence [ən] replaces the nucleus and anything that follows it. In the second half [tʰ] replaces the initial consonant. Both syllables have the base tone. The exact realization of the inserted vowel is quite complex. The lowness of original low nuclei is preserved, but frontness and backness are controlled by the surrounding segments. See Chao for full details.

What is crucial here is that medial glides surface in both copies.

(27) *Man-tʰa*:

tʰŋ > twən tʰŋ      ‘east’      taw > tan tʰaw      ‘path’  
xwey > xwən tʰwey      ‘meeting’      lyəŋ > lyɛn - tʰyəŋ ‘two (persons)’

It is generally agreed that these secret languages involve reduplication (Yip 1982, McCarthy and Prince 1986, Steriade 1988, Bao 1990) and infixation of the fixed segments /ay-k/ and /ən-tʰ/ respectively. So long as the infix is accommodated, as much material as possible survives in both syllables, including the glides. Under an OT analysis, FAITH-IO ensures that the affix surfaces, and FAITH-BR >> MARKEDNESS will value outputs with glides in both syllables over removal of the marked structure. Again, the question of exactly what type of marked structure is involved is irrelevant to the analysis, and the data does not allow us to decide.

In the third secret language, *Mey-ka*, only the labial glide is repeated in both syllables. The front glide occurs only in the second copy. The syllable is reduplicated, and in the first half the

sequence [ey] with a falling tone replaces the nucleus and anything that follows it. In the second half [k] replaces the initial consonant, and the tone is unchanged.

(28) *Mey-ka: medial /w/ repeated, but not /y/:*

liŋ > ley kiŋ 'order'      taw > tey kaw 'path'  
xwey > xwey kwey 'meeting'      lyɑŋ > ley - kyaŋ (\*lyey, \*lyɛ)

It seems unlikely that the difference is caused by the two glides occupying different positions in syllable structure, especially given that they behave identically in the other two secret languages. Instead, it seems likely that this is an instance of a phonotactic constraint blocking glide copying: the front glide is lost because retention would create \*[yey], an impossible post-consonantal sequence in Mandarin. It is true that the sequence produced by retention in May-ka, \*[yay], is also unacceptable, but this secret language allows a fix-up in which it surfaces as a sort of blended [yɛ], whereas the also unacceptable Mey-ka sequence \*[yey] apparently has no better option. Let us look more closely at why this should be so. \*[yay] and \*[yey] are unacceptable because the language does not allow two front glides in a syllable. The blended and acceptable [yɛ] still successfully realizes the lowness of [a] and the frontness of the final glide in the new mid-low front nucleus [ɛ], whereas any attempt to do something similar with \*[yey] would produce the unacceptable \*[ye], an impossible syllable-final sequence in Mandarin. For the labial glide, the outputs in all secret languages, [wey], [way] and [wən], are all fine. One further note in support of the view that the high vocalic features of medial glides will be copied into both syllables unless the phonotactics disallow that particular sequence: in all three secret languages, nuclear /u/ also ends up in both syllables, as in this Man-tʰa example tun > twən tʰun, *unless* this would violate the

constraint against a sequence of labial consonant-labial glide. So /pu/ becomes pən t<sup>h</sup>u, not \*pwən t<sup>h</sup>u in Man-t<sup>h</sup>a, and /mu/ becomes mey ku, not mwey ku, in Mey-ka.

Let us now look at a typical O/R analysis, that of Bao (1990). The following are the key aspects of his analysis of May-ka, which repeats both glides.:

(29) *Bao's O/R Analysis of May-ka:*

- a. Assume glides are in the Onset.
- b. Substitute /ay/ for the Rime of the first syllable.
- c. Substitute /k/ for the first consonant of the Onset of the second syllable.

These operate as follows; (b-c) above the arrows refer to the rules in (29):

(30)

	b	c	
xwey	-> xwey	xwey	-> xway xwey -> xway kwey 'meeting'
lyəŋ	-> lyəŋ	lyəŋ	-> lyay lyəŋ -> lyay kyəŋ 'two'

There are two problems with this approach. First, front glides that constitute onsets on their own also surface in both syllables, even though onset replacement as stated by Bao should eliminate one of them:

(31)            yəŋ    > yay kyəŋ    \*yay kaŋ    'sun'

Bao's solution is to posit a “zero onset” which precedes this glide and protects it from replacement, but the formal nature of this “zero onset” is problematic, and unstated. In the approach advocated here, the survival of the glide in both syllables is exactly as expected if the faithfulness constraint MAX is high-ranked, without further stipulation. A full analysis follows shortly.

The second problem is that high vowel nuclei are not lost under Rime replacement, but instead surface as Pre-nuclear glides in the first copy:

- (32)            liŋ       > lyay kiŋ       \* lay kiŋ       'order'  
                  k<sup>h</sup>uŋ    > k<sup>h</sup>way kuŋ    \* k<sup>h</sup>ay kuŋ    'empty'

Bao's solution here is to suggest that high vowels in the Rime are also linked to the Onset, so that /liŋ/ and /k<sup>h</sup>uŋ/ are really /lyiŋ/ and /k<sup>h</sup>wuŋ/ respectively. Thus when the Rime is replaced by /ay/, the glide survives in the form of the Onset-linked portion. The obvious issue here is that phonetic co-articulation does not necessarily imply phonological double linking (cf English *soon* [s<sup>w</sup>u:n]), so the only evidence for the Onset affiliation comes from the secret language, and is caused by the commitment to analysing it in O/R terms.<sup>7</sup>

In the remainder of this section I offer a May-ka analysis within OT that makes no reference to sub-syllabic constituents. The essential elements are given below:

- (33) *A May-ka analysis that makes no reference to sub-syllabic constituents:*

*Morphology:*

- a. Reduplicate
- b. Affix /ay/ to the first syllable, and /k/ to the second (Yip 1982)

*Phonology:*

- c. REALIZE MORPH
- d. OK- $\sigma$
- e. MAX

The analysis relies on the same basic ideas that were used to derive the speech error facts. After reduplication, the affix and copy must surface as a single well-formed syllable, and within its limits as much base material as possible surfaces, as required by MAX. In any given syllable, the affix has priority, since any base material that will not fit in one syllable has another chance to surface in the other copy. This affixal priority can be handled by a constraint REALIZEMORPH, along the lines of Lin (1993), Samek-Lodovici (1993), Akinlabi (1996), Benua (1997), Kurisu (2000, 2001), Walker (2000) and others.

Let us see how this works in a May-ka example. Looking only at the first syllable, /swan/ must make room for the affix /ay/, but this can be done without deleting the glide. I assume an overriding constraint that the affix must merge into one syllable, rather than forming a bi-syllable.

(34) *swan > sway kwan, looking only at the first syllable*

/swan + ay/	REALIZEMORPH	OK- $\sigma$	MAX
a. swan	*!		ay
b. swayn		!*	a

c. say			wan!
☞ d. sway			an

Looking now at the second syllable, priority goes to the affix /k/, but this can fit into the syllable provided /s/ is sacrificed, so /w/ is again free to survive.

(35) *swan* > *sway kwan*, looking only at the second syllable

/k + swan/	REALIZEMORPH	OK-σ	MAX
a. swan	*!		k
b. ksan		*!	w
c. kan			sw!
☞ c. kwan			s

The last tableau shows the survival of high nuclear vowels in the form of pre-nuclear glides as in the words in (32b).

(36) *liŋ* -> *lyay kiŋ* First syllable only:

/liŋ + ay/	REALIZEMORPH	OK-σ	MAX
a. liŋ	*!		ay
b. liŋy		*!	a
c. lay			iŋ!
☞ d. lyay			ŋ

Lest one think that these facts are restricted to secret languages, the following data from diminutive Er-suffixation in Anxiang (Ying 1990, Yip 1994) show very similar retention of glides

and high vowels in the second syllable, which must accommodate the affix /ər/, but retains as much base material as possible along with it:

(37) *Anxiang Er-Suffixation*

a. tye	tye tyər	'small dish, plate'
myan	myan myər	'face'
tay	tay tər	'belt'
paw	paw pər	'bud'
o	o ər	'bird's nest'
b. tin	tin tyər	'nail'
p <sup>h</sup> u	p <sup>h</sup> u p <sup>h</sup> wər	'spread'
tçü	tçü tçüər	'pearl'

This study of Mandarin has shown that not only is there no evidence for an O/R structure in co-occurrence restrictions, speech errors, or language games, but that an O/R analysis is often problematic in that pre-nuclear glides sometimes behave as if they were in the Onset, and sometimes as if they were in the Rime. Alternative analyses depending on linear phonotactics, similarity and proximity do not encounter these problems. The next section, on English, reinforces this point, but adds an additional factor: the role of individual variation.

### 3.2 Pig Latin: Individual variation in treatment of medial [y].

It is not only linguists who disagree on the treatment of the pre-nuclear glide. We now turn to a language in which speakers differ dramatically in their analysis of the pre-nuclear glide:

English.

The status of the pre-nuclear glide [y] in English is quite controversial. Co-occurrence restrictions present a confusing picture. It occurs only before the vowel [u], as in *puce* or *cute*, suggesting that it may be in the Rime. This is compatible with the observation that in speech errors it forms an error-unit with [u] (Shattuck-Hufnagel 1986). However, it is also true that it does not occur after clusters, \*[kly], and in American English it occurs only after non-coronal consonants, suggesting that it may be in the Onset. Consistent with this, it is not moraic, since as mentioned earlier it is treated as light by the stress rules, so that we have antepenultimate stress in *mércury*. See Anderson 1988, Davis and Hammond 1995, and especially Harris 1994 for a useful summary.

Barlow (2001) has looked closely at the behavior of this glide in Pig Latin, an English language game in which the first consonant or consonant cluster is moved to the end of the word, and the suffix [ey] is added. So *pig* becomes [ɪgpey]. The American English subjects differ as to whether they move just one consonant, or a cluster, so that depending on the speaker we get *blue* becoming [lubey] or [ubley]. In the latter case the usual description claims that the Onset is moved. For such speakers, then, we have a potential diagnostic for the onset-hood of the pre-nuclear glide. Barlow asks whether /Cy/ sequences behave exactly like /bl/ sequences, or not, and the picture turns out to be complex and nuanced. The analysis presented here differs from Barlow's in many respects, but the data and many of the insights are taken from her most interesting paper. The situation and my basic conclusions are summarized below:

- (38) ● For some speakers, [Cy] never move together, to avoid creating illicit \*[Cyey].

- Some speakers locate the glide as part of a complex segment  $C^y$ , and treat this exactly like a single segment such as [b].
- Others treat them as a non-moraic pre-nuclear segment,  $Cy$ , and treat them exactly like true clusters. However, there is no need to assume that they form a constituent with the preceding  $C$ .

Let us look more closely. As I mentioned earlier, speakers initially differed in whether they used Dialect A (20%), in which only the first consonant was moved, or dialect B (80%), in which the whole cluster was moved. Interestingly, the treatment of  $Cy$  sequences differed from speaker to speaker, independently of dialect. The following data show some mismatched cases, where /bl/ and /Cy/ differ. Subject 13, in the first column, moved only the first consonant of true clusters, but moved /Cy/ as a unit. Conversely, subject 9, in the second column, moved the whole of the /bl/ clusters, but just the /C/ of a /Cy/ cluster.

(39)	<i>Subject 13</i>	<i>Subject 9</i>
	<i>Dialect A</i>	<i>Dialect B</i>
	‘blue’ [lubey]	[ubleey]
	<i>but</i> /Cy/	/yu/
	‘cute’ [utkyey]	[yutkey]

It is immediately clear that our account must allow for this kind of inter-speaker variation, either by assuming different Pig Latin rules, or by assuming different structures for the /Cy/ inputs, or both.

Barlow then trained speakers on one or other dialect. The training either reinforced the same dialect, or taught the opposite dialect. Opposite-dialect training did not necessarily affect the subjects' placement of the glide, as shown by the data below. Subject 4, in the first column, changed after training from moving a complete /bl/ cluster to moving just the /b/, but continued to move a /Cy/ sequence as a unit. Subject 8, in the second column, changed after training from moving just the /b/ of a /bl/ cluster to moving the whole cluster, but continued to move just the /C/ of a /Cy/ sequence.

(40)	<i>Subject 4</i>	<i>Subject 8</i>
	<i>Dialect B → Dialect A</i>	<i>Dialect A → Dialect B</i>
	'blue' [ublej] → [lubej]	[lubej] → [ublej]
	<i>but /Cy/ invariant</i>	<i>/yu/ invariant</i>
	'cute' [utkyej]	[yutkej]

Lastly, some speakers did change their glide treatment when they changed dialect. Subject 5 in the first column below changed from moving a complete /bl/ cluster to moving just the /b/, and simultaneously changed from moving the complete /Cy/ sequence to moving just the /C/. Subject 11, in the second column, did the reverse. Both subjects at both stages treated /Cy/ exactly like /bl/.

(41)	<i>Subject 5</i>	<i>Subject 11</i>
	<i>Dialect B → Dialect A</i>	<i>Dialect A → Dialect B</i>
	'blue' [ublej] → [lubej]	[lubej] → [ublej]

*but* /Cy/ → /yu/

/yu/ → /Cy/

‘cute’ [utkyey] → [yutkey]

[yutkey] → [utkyey]

If we look across these speakers three separate patterns emerge. First, subjects 4 and 13 never, under any circumstances, split up a /Cy/ sequence. It is treated exactly like a single consonant /b/, and not at all like a cluster /bl/. For these speakers, the simplest assumption is that the /y/ is a secondary articulation, and their underlying representations are /C<sup>y</sup>/. This cannot ever be split up, so in OT terms the constraint \*SECARTIC is low-ranked, and the constraint INTEGRITY (No Fission) is undominated, as it is many (if not most) languages.

Second, there are speakers like subjects 8 and 9 who never, under any circumstances, move the whole /Cy/ sequence. Here the explanation lies in the observation that if the whole sequence were to be moved, the final syllable of the output \*[utkyey] would be the normally unacceptable English syllable [kyey], where [y] is followed by a vowel other than [u]. Stating this as a rough-and-ready phonotactic constraint \*[KYEY] must be high-ranked for most speakers, so that even if their Pig Latin grammar normally moves all consonants, they make an exception in the case of /Cy/. We cannot discern the underlying placement of /y/, because all we know is that they accommodate it somehow before /u/, but never allow it anywhere else.

Third and last, there are speakers like subjects 5 and 11 who move /C/ or /Cy/ depending on their Pig Latin dialect. They treat /Cy/ exactly as they treat /bl/, suggesting that /Cy/ is a true cluster. They allow violations of \*[KYEY], which must thus be low-ranked, and they move whatever portion of the cluster the Pig Latin requirements dictate. The change in treatment of /Cy/

is triggered by the change in dialect, suggesting that the underlying representations stay constant, and the change in dialect rule itself is responsible for the change.

If there is any evidence for O/R constituency, it will lie with these speakers. One might suppose that Dialect B speakers, who move the entire cluster, require a Pig Latin rule “Move Onset”, and that the existence of this dialect is thus evidence for O/R constituency. However, there is an alternative output-based analysis which says that what defines Dialect B is a high-ranked alignment constraint which requires Pig Latin outputs to be vowel-initial, ALIGN-L (WORD, V). To satisfy this, all consonants will move rightwards away from the beginning of the word. There is much precedent in OT for alignment constraints between word-edges and either consonants or vowels, and even for constraints that encourage vowel-initial or consonant-final words. For example, Lardil (Prince and Smolensky 1993) likes C-final words, and Arrernte (Breen and Pensalfini 1999) likes V-initial words (and syllables). A full grammar of Pig Latin would take us too far afield, but it is clear that an analysis is entirely possible without any reference whatever to an onset constituent.

Let me sum up the variation in OT terms as follows. First, there are two cross-cutting divisions: (i) whether the speaker considers /y/ to be a secondary articulation or a segment, instantiated in OT as the relative rankings of \*SECARTIC and \*CLUSTER, and (ii) whether \*[KYEY] is high-ranked or not. Second, for all speakers INTEGRITY is undominated. This latter means that no matter what other rankings obtain, speakers who take /y/ to be a secondary articulation can never split it off from its host C. This gives us the following typology:<sup>8</sup>

(42)

Ranking	U.R.	Pig Latin dialects	Data	Subjects
A. INTEGRITY, *[KYEY] >> *SECARTIC, *CLUSTER	Cy	A & B	yutkey	8, 9
B. INTEGRITY, *CLUSTER >> *SECARTIC, *[KYEY]	C <sup>y</sup>	A & B	utkyey	4, 13
C. INTEGRITY, *SECARTIC >> *CLUSTER, *[KYEY]	Cy	A	yutkey	5, 11
		B	utkyey	

What lessons can we learn from these data? First, as Barlow points out, this kind of inter- and intra- speaker variation makes it impossible to assume a single grammar for all members of a speech community. It seems that some aspects of the grammar such as the rightful home of /y/ are under-determined by the usual data, leaving room for variation. When a new mechanism, Pig Latin, is introduced, these differences become apparent. Second, data that at first glance provide evidence for constituent structure, on closer examination may not, such as Dialect B of Pig Latin. In sum these Pig Latin facts offer evidence for secondary articulations in some speakers, and an unaffiliated non-moraic /y/ in others, but not for an O/R distinction. Speakers opt for different structures in the absence of conclusive evidence for either.

#### 4. Discussion:

This paper has argued that pre-nuclear glides are an important probe into O/R structure, lying as they do at the constituent boundary, and assuming that a commitment to an O/R

distinction requires a commitment to assigning the pre-nuclear glide to either Onset or Rime in each language. I have shown that the O/R distinction is not nearly as motivated in many languages as most linguists have assumed, and that it is in fact quite problematic in others. If it exists, different members of a speech community may lack the evidence to converge on the same structure, and their different chosen structures may have consequences when a new mechanism, such as a secret language, is introduced. In this section I discuss some implications and outstanding issues.

#### **4.1 Other arguments for Onset and Rime**

I have focussed in this paper on arguments involving the medial glide, but of course there have been arguments for the existence of Onset and Rime based on a variety of other phenomena. If there are no Onsets or Rimes, we need to consider how to handle these other facts. Some of what follows amplifies points touched on in earlier sections, and some of it introduces new arguments.

In section 2 I listed four traditional arguments for O/R constituency, and I have deferred discussion of the last two arguments until now because they have not played a central role in this paper. The first argument is based on which sub-string counts towards calculating weight and the second is based on whether strings match in poetic rhyme or alliteration,

##### **4.1.1 Weight units:**

Any theory must distinguish between pre-nuclear glides which act as weight units or TBU's, and ones which do not. For example, the data in (44a) below come from languages in which pre-nuclear glides are clearly weight units. In Slovak (Rosenthal 1994) certain long vowels

diphthongize, and the output is still clearly bi-moraic. In Spanish (Harris 1983) stress counts from the right edge, and cannot skip a heavy syllable: [fio] but not [gra] counts as heavy. In Mizo (Vijayakrishnan 1994), syllables are minimally bi-moraic, and a pre-nuclear glide automatically renders the syllable bi-moraic. It also acts as a tone-bearing unit, allowing for a contour tone on a stop-final GVO syllable, but not on a plain VO syllable. The data in (44b) show that pre-nuclear glides may be non-moraic. In English, stress skips the penult syllable [kyʊ], showing that it is light. In Luganda high vowels in hiatus become glides, and their weight-unit is then annexed by the following vowel, which lengthens.

(43) a. Glides as weight units: Slovak: /e:/ > [ie]

Spanish: [te.lé.gra.fo] vs. \*[te.lé.fio.no].

Mizo: \*ta, OK taa, hua. \*rokHL, OK iakHL

b. Glides as weightless: English: *mércury*, [kyʊ] is light.

Luganda compensatory lengthening :/li-ato/ > [lyaato]

These distinctions can certainly be handled in an O/R model, but they can equally well be handled in a moraic model, so they do not provide crucial evidence for constituency. The relevant moraic structures for the two language types are given below:

(44) a. Slovak/Spanish/Mizo:

$$\begin{array}{c} \sigma \\ / | \backslash \\ / \mu \mu \\ / | | \\ C \ i \ o \end{array}$$

b. English/ Luganda/Mandarin:

$$\begin{array}{ccc} \sigma & \text{or} & \sigma \\ / | & & // | \\ / \mu & & // \mu \\ / / \backslash & & // | \\ C \ y \ u & & C \ y \ u \end{array}$$

Notice that if a pre-nuclear glide is a weight-unit, as in Spanish, it should behave consistently as part of the Rime using any diagnostic, but we shall see in section 4.1.2 that this is not in fact true. Note also that if the glide is not a weight-unit, as in English, an O/R model might place it in the Onset, but it could also place it in the Rime, but outside the nucleus. These are the languages, then, where real doubt arises about the placement of the glides, and Chinese dialects fall into this group, since unlike in Mizo pre-nuclear glides are not TBU's.

#### 4.1.2 Matching in poetry:

The term Rime is of course the same as the poetic Rhyme, but this is a dangerous analogy, which is why I have spelt the syllabic constituent Rime, to discourage equating the two. Poetic matching frequently involves things that are not constituents in any theory of syllable structure: (Holtman (1996:203), data from Zwicky 1976). Some simple examples from English are given here; rhyming portions are underlined.

(45) a. A polysyllabic string, excluding the first onset

but including medial onsets:

tanner:banner:spanner

b. A discontinuous sequence including the second C

of the initial cluster, the nucleus, and the final C:

proud:ground

c. A discontinuous sequence of nucleus and coda, but

not intervening offglide:

small:soul [ɔ:l]: [ɔw]

I conclude that poetic matching matches strings, not necessarily constituents, and the apparent constituent effect comes because the strings are usually continuous, and usually start at

one edge of the word, foot, or phrase, or with the stressed nucleus. Returning to pre-nuclear glides, if the string GVC rhymes, we cannot conclude that G is in the Rime. We may simply be observing right-edge rhyming. Conversely, if GVC does not rhyme, we cannot conclude G is *not* in the Rime. Right-edge rhyme may go only in as far as the head of the syllable, the nucleus, in a manner exactly parallel to English “foot” rhyme, which actually only goes as far as the head of the foot, as seen in (a) above. Data from Spanish illustrates this point more dramatically. Based on the stress facts, we saw in the last section that Spanish pre-nuclear glides are in the Rime. However, in poetic rhyme the pre-nuclear glide is ignored, as if it were in the Onset (Roca, p.c.). So *Juan* rhymes with *pan*, and *bien* rhymes with the second syllable of *(sar)ten*. Since stress and poetic rhyme conflict on the constituency of the pre-nuclear glide, proponents of the Onset/Rime theory would presumably have to concede that rhyme, at least in Spanish, cannot be used as an argument for the constituency of the pre-nuclear glide!

#### 4.1.3 Other arguments

There are a few other arguments extant in the literature that bear on the O/R issue. Davis (1989) discusses evidence that overlaps with some presented in this paper from word games and speech errors, including substitutions and blends, and suggests that the most one can say is that the manipulated pieces may provide evidence for the Onset, and “the rest of the word”, but not for the Rime. After the Onset has been moved/blended, the residue may be polysyllabic, so it is clearly not a Rime. Consider the underlined portions in each of his examples:

- (46) a. *left hemisphere*      heft lemisphere      *Roman Jacobson*      Yoman Racobson  
b. *scale + salary*      scalary      *recognize + reflect*      recoflect  
*adjoining + adjacent*      adjoicent

c. *Latin*                      atinlay                      *criminal*                      iminalcray

In the transpositions in (a), initial consonants (perhaps Onsets) are switched, but one certainly could not alternatively suppose that Rimes were switched. In the blends in (b), all one can really say is that the beginning of one word is blended with the end of another. The pieces can be Onsets (sc), polysyllabic sequences (reco, adjoi), or polysyllables without the first onset (alary). Lastly, in (c) the Onset may be moved to the end, but the residue is again polysyllabic. Davis concludes that these data, while not providing evidence for the Rime, do at least provide evidence for the Onset. However, our discussion of Pig Latin and Mandarin speech errors shows that these transpositional and blending phenomena can usually be understood without recourse to constituent structure of any kind, in which case they do not provide evidence for the Onset either.

A slightly different argument on the Onset front can be found in Davis (1990) who argues that the allomorphy of the definite article in Italian is sensitive to whether the initial consonant is in the Onset or not. Before single consonants and stop-sonorant clusters we find *il*, (*il sale*, *il cratere*), but before s-initial clusters we find *lo* (*lo studente*). Before vowels we find *l'*, (*l' affare*) which Davis derives from *lo*. Treating initial /s/ as attached directly to the syllable node, Davis suggests that “*il* occurs before words that begin with a consonant that is syllabified as part of the onset; otherwise, *lo* occurs.” In moraic theory, no such formulation is readily available, since all pre-vocalic consonants are non-moraic and directly attached to the syllable node. However, the moraic proponent could suggest that /s/ is extrasyllabic, not just outside the Onset, and re-phrase Davis’s statement as follows : “*il* occurs before words that begin with a consonant that is not syllabified; otherwise, *lo* occurs.” It would be desirable to go further and unify these two allomorphs, and I sketch one possibility. Suppose the article is /l/, which is how it surfaces pre-

vocally [laf.fa.re]. Before single consonants and obstruent-liquid clusters, epenthetic /i/ is inserted to allow syllabification of /l/: [il.sa.le]. The choice of epenthesis site may be driven by a requirement that the article be adjacent to its noun. Before /sC/ clusters, there are two ‘spare’ consonants: the /l/ of the article, and the extrasyllabic /s/. The minimal epenthesis to allow both these to be syllabified is to epenthesize between them, giving [los.tu.den.te], even though this separates article and noun. Something further must be said to explain why the two epenthetic vowels are different.

Blevins (1995) gives a clear summary of arguments for Onset and Rime constituency, and concludes, contra Davis, that the arguments for the Rime are strong, but those for the Onset less convincing. Among the strongest arguments are phonotactic restrictions, which may make reference to weight, features, or sonority. Of these, the weight-based arguments, involving complementarity between vowel length and the presence of a coda, can usually be translated fairly straightforwardly into a moraic approach. The featural and sonority-based arguments are more interesting. I begin with featural arguments, an instance of which was discussed in §3.2.1 for Mandarin, where it was shown that a similarity and proximity account showed promise. However, there are other cases that are less susceptible to such an approach. Consider the Cantonese version of the labial restriction. Unlike Mandarin, Cantonese can end syllables in [m] or [p], so we can compare the acceptability of syllables matched in all relevant respects: [put] vs [tup], or [mun] vs [num]. A constituency analysis predicts that with two labials in the Rime, [tup] and [num] should be worse than [put] and [mun]. This is correct: in Cantonese [put] and [mun] are actual syllables, but \*[tup] and \*[num] are not. An approach based on similarity and proximity alone cannot explain this difference, but an O/R analysis can.

Even here, though, another explanation suggests itself, one that attributes the restricted set of consonants allowed in the coda to the greater difficulty of perceiving place contrasts in coda

position, in the spirit of work by Steriade (1995, 2000, 2001) and others). Final consonants in Cantonese are not released. As a result the only perceptual cues come from cues within the segment, and the transitions from the preceding vowel. After a back rounded vowel, the F2 and F3 transitions into a following labial consonant are rather small (Stevens 1997:482). Now consider the initial consonant. These are released, so there are at least two extra cues available: the burst, and the stronger transitions going into the following vowel. Based on transitions alone, then, labial consonants will be hardest to perceive in coda position, and after a labial vowel: exactly where they are not found in Cantonese.

Further facts support the perceptual view. For fricatives, and for the nasal, there are also internal cues. They should thus be slightly easier to perceive than the stops next to labial vowels, and we might expect them to be more common, if perceptibility is one of the traits that licenses the occurrence of segments. Consider some data from Hashimoto (1972). Before non-labial vowels [ei], [a:], [a:ŋ] and [a:k], where all of the labial consonants [p, p<sup>h</sup>, f, m] would be relatively easy to perceive because the transitions would be quite dramatic, [f] is the rarest of the four labials. This presumably accidental fact does not hold, however, before labial vowels, where it is roughly reversed. In the simple Cu syllable, only [f] is found, and before [σk] and [σŋ] we get mostly [f] and [m]. [p] and [p<sup>h</sup>] are rare. Apart from the absence of [mu], all of this is consistent with the notion that labials are avoided precisely in the circumstances where they would be hardest to perceive: (i) in coda position after another labial, or (ii) in onset position before another labial if they lack their own internal cues. Along similar lines, Steriade (1995) has argued that the distribution of retroflexes in many languages is similarly restricted to positions where the retroflex/apical cues are strongest, which happens to be post-vocally. If these rather speculative proposals hold up for Cantonese, many phonotactic arguments for internal syllable structure may also be dubious.

Turning to sonority-based phonotactic arguments, Blevins makes one point that is at first glance convincing, but does not hold up on examination. She observes that the Onset and the Rime are the domains of sonority-based generalizations about the syllable, requiring an onset that increases in sonority and a rhyme that starts with a sonority peak, and then decreases. She then states that we do not find sonority-based generalizations that cross the Onset-Rime boundary. There is a general sense in which this seems wrong. The *reason* that the Onset increases in sonority is because it must arrive at a peak when it encounters the nucleus. The upwards sonority incline thus straddles the (C) CV demisyllable, rather than stopping at the last onset consonant. This notion of demi-syllable is due to Fujimura and Lovins (1978), and is defined by Clements (1988:25) as follows:

- (47) A demi-syllable is a maximal sequence of tautosyllabic segments of the form  $C_m \dots C_n V$  or  $VC_m \dots C_n$ , where  $n \geq m \geq \emptyset$ .

The subscripts denote sonority values, and the demi-syllable captures the observation that “the sonority profile of the first part of the syllable is independent of the sonority profile of the second part.”

Blevins also argues that we do not find languages in which the relative sonority of the nucleus has effects on the preceding onset, so that a sequence like [wa] is acceptable, but [wi] is not. Notice that if sonority is defined over the demi-syllable, then such cases should exist. In fact, Mandarin Chinese, is arguably an example of exactly this situation. The glides [w, y, and u] can occur before the low vowel nucleus [a], but not before a high vowel nucleus. There is no syllable [wi(C)] or [yu(C)] in Mandarin. It is true that there are syllables that have been analyzed by some

researchers as having such sequences underlyingly, but they do not surface like that. For example, the syllables sometimes given as [yʊŋ] and [win] are in fact pronounced as [ɥəŋ] and [ɥən] respectively. There are many analyses of Mandarin syllables, some extremely abstract, but if one looks just at surface forms, the only syllables with a glide onset followed by a high vowel nucleus are those where the two are completely homorganic, such as [wu] and [yi]. These are analyzed by virtually all researchers as having a single vocalic segment filling both onset and nuclear slots, a view which is confirmed by (i) the lack of a contrast like English *yeast* vs. *East* and (ii) the failure of [w] in these circumstances to undergo the common strengthening to [ɥ] that is found before non-high vowels. If sonority inclines are defined across the demi-syllable or the syllable, Mandarin can be easily handled: the glides are too similar in sonority to the high vowels to provide sufficient distance on the sonority scale, so that [wi(C)] and [yu(C)] are ruled out.<sup>9</sup>

It is not only sonority inclines that are best handled by looking at demisyllable chunks. Some language games also seem to operate on this basis. British English has a children's language game called *Urupu*, in which the sequence [rəp] is infixated to each syllable. At the same time the nucleus is repeated, so that the net effect is that the sequence before [rəp] is the first demisyllable, CV, CGV or CCV, and the sequence after [rəp] is the second demisyllable, VC, VGC, or VCC. Stress is on the first copy of the vowel.

- (48) *cat* [kæt] [kæ-rəp-æt] *twɪn* [twɪn] [twɪ-rəp-ɪn]  
*saʊnd* [saʊnd] [sa-rəp-awnd] *kju:t* [kyuwt] [kyʊ-rəp-uwɪt]  
*laɪnɪŋ* [laɪ.nɪŋ] [la-rəp-ay.nɪ-rəp-ɪŋ]

Notice especially that the sequence before [rəp] is bigger than the Onset but smaller than the

syllable, although the sequence after [rəp] could perhaps be defined as the Rime, provided the pre-nuclear glide is considered part of the onset. The simplest analysis, though, would be to make use of the demi-syllable, and say that [rəp] is inserted after the first demi-syllable and before the second demi-syllable, thus producing the reduplication of the nucleus as a side-effect. I find this quite convincing evidence for the psychological reality of the demi-syllable.

I now turn to two cases where one might expect to find evidence for syllable-internal structure, but where it is apparently absent: early phonological awareness, and stylistic emphatic lengthening

#### **4.3 Psycholinguistic evidence: early phonological awareness**

There is a substantial body of psycholinguistics literature that has investigated the psychological reality of syllable-internal structure in children, and it turns out to be quite inconsistent. A recent paper by Geudens and Sandra (2001) provides a useful critical summary of previous studies, in which they argue that much of the psycholinguistic data that has been adduced in support of the Onset-Rime division has been over-interpreted, and instead is the result of quite different factors such as global acoustic similarity. Their own experimental data suggest that Dutch-speaking pre-reading children between six and seven show no evidence of Onset and Rime units in their explicit phonological awareness, defined as a “conscious and intentional ability to segment and manipulate the continuous speech stream on demand”. More particularly, they point out that in order for the data to show clear evidence of onset-rime structure, the children must not only be “able to consciously manipulate strings that correspond with onset and rime, but also... prefer this manipulation to one with equally sized strings that do not correspond with onset and rime.” For reasons of space what follows is necessarily a brief summary of their experiments. When asked to segment CV and VC syllables (by producing the component sounds, as in pə - o: for a stimulus po:

and o: - pə for a stimulus o:p) the children found it significantly easier to segment them within the Rime, rather than between Onset and Rime, and this was true both for CV versus VC syllables, and for CVC syllables that could be broken as CV-C or as C-VC.<sup>10</sup> The other task (given to children with one month of reading lessons) was phoneme substitution into CV or VC syllables. For example, the child would be asked to replace the pə of po: with a kə to make a new word. If the Onset-Rime division is real, one might expect substitution to be easier into the CV syllable, where a syllable constituent (the Rime) is being replaced, but no such preference was found.

#### 4.4 Stylistic emphatic lengthening in English:

The extent to which syllable-structure may be ignored can also be seen by looking at a phenomenon in English which I will call “sonorant maximization”. Consider the following facts. In contexts where particular prominence is desired, such as at the peak of a song (“*Mud, mud, GLORious mud!*”, or in extreme emphasis (“*How SPLEndid!*”, or as Tigger says “Gr-r-r-reat!”), two strategies are available. The most obvious is to greatly lengthen the nuclear vowel or following tauto-syllabic sonorant or fricative consonant. In what follows, the colon marks some degree of increased length on the preceding segment, and the number of colons represents the amount of extra length. The judgements are my own.

(49) gl[ɔ:]rious      spl[ɛ::]ndid / spl[ɛn::]did      fant[æ:s:]tic

This could plausibly be described as lengthening the rime, but now consider a further option, shown by the first pronunciation of each example below (In homage to Flanders and Swann’s Hippopotamus Song, and Lewis Carroll. They work even better to music). An epenthetic vowel can be inserted into stop-liquid clusters, as in (48a), or into stop-glide sequences, as in (48b)

- (50) a. Mud, mud, g[əlo]rious / [glo::]rious mud  
Mud, mud, f[əru]mious / [fru::]mious mud  
How sp[əl:ɛ]ndid / [splɛ::]ndid!
- b. Mud, mud, f[əyu]rious / [fyu::]rious mud  
Mud, mud, k[əwɛ]rulous / [kwɛ::]rulous mud  
Mud, mud, t[əwɛ]ntieth / [twɛ::]ntieth mud

Instead of lengthening the ‘Rime’, a complete new syllable is created by epenthesis into the ‘Onset’.  
The epenthesis can only take place if it serves to create a span from epenthetic vowel to stressed vowel that is composed entirely of sonorants, as evidenced by the unacceptability of the first pronunciation of each of the following:

- (51) Mud, mud \*[səkæ]ndalous /sc[æ::]ndalous mud  
Mud, mud \*s[əkru]pulous /sc[əru]pulous /scr[ʌ::]pulous /sc[r::u]pulous mudMud,  
mud,\*s[əplɛ]ndiferous /sp[əlɛ]ndiferous /spl[ɛ::]ndiferous / sp[l::ɛ]ndiferous  
Mud, mud \*[səpyu]rious /sp[yu::]rious mud

Note that we cannot simply say that sC clusters cannot be separated by schwa, since [sl] and [sm] may be separated.

- (52) Mud, mud, s[əlɪ]thery / sl[r::]thery / s[l::ɪ]thery mud  
Mud, mud, s[əmʌ]thery / sm[ʌ::]thery / s[m::ʌ]thery mud

What is going on here? The output sequence is not an easily definable constituent. We might call

it an iambic foot, but English is a trochaic language. In any case, the unacceptable \*[səplɛ]ndid also begins with an iambic sequence, so we would have to somehow distinguish between them. Rather, what seems to be crucial is that there must be an entirely sonorant sequence, as long as possible, and just about any method that allows lengthening these sonorants is acceptable. It may even include the onset sonorant, as in s[l:ɪ]thery, or the post-stress sonorant, as in qu[ɛr::]ulous, or fr[um::]ious, thereby closing the preceding stressed syllable, and adding sonorant weight.. The process pays no attention to constituent structure, whether intra- or supra- syllabic. I conclude that speakers do not decide on the acceptability of vowel epenthesis on the basis of syllable structure, being equally willing to split stop-liquid, stop-glide, and fricative-nasal sequences, but balking at splitting fricative stop sequences. These data certainly offer no evidence for any Onset/Rime division, although of course they do not prove its absence, just its irrelevance to the phenomenon.

#### **4.5 ONSET and \*COMPLEXONSET in OT**

The alert reader may well have been wondering how an OT phonologist can eliminate Onsets from the vocabulary of the grammar, given the pervasive use of the constraints ONSET and \*COMPLEXONSET in OT. There are two answers to this. Firstly, the constraints are probably shorthand for sonority-based requirements that syllables begin with sonority below some threshold (ONSET), and that syllables have a steep and abrupt sonority increase from start to nucleus (\*COMPLEXONSET). Secondly, ONSET has been re-stated as an alignment constraint requiring the left-edge of the syllable to line up with a consonant, and \*COMPLEXONSET as a constraint requiring every consonant to line up with the left-edge of some syllable (Ito and Mester 1999). Importantly, the use of the constraint ONSET does not, as far as I can see, make any claims about syllable-internal constituent structure at all: it just demands a certain sort of start to a syllable. It is a useful shorthand, nothing more. \*COMPLEXONSET, as a reviewer points out, *does* seem to imply an Onset

constituent, but if it can be re-stated in terms of sonority profiles and/or alignment, it too is merely a useful descriptive term.

#### **4.6 Other options within O/R theory**

I close by briefly mentioning two other possible ways of dealing with medial glides in O/R theory, but not yet discussed in this paper. Pre-nuclear glides could be in both Onset and Rime, just as “ambisyllabic” segments have been argued to be in two syllables. In the case of ambisyllabicity, Harris (1994) has shown that the phenomena that had been taken to justify ambisyllabicity can all be reformulated by reference to the independently motivated higher constituent, the foot. This strategy is quite similar to that used in this paper, where it has been argued that many of the arguments that purport to demonstrate membership in either onset or rhyme can be restated in terms of the higher level constituent, the syllable (and the mora) only. The proponent of an alternative in which glides were members of both Onset and Rime would have to show that there were generalizations that could only be captured under this assumption.

Another possibility is that there could be an O/R distinction, but the pre-nuclear glides might be in neither, hanging directly off the syllable node. Quite apart from the lack of any empirical evidence for this approach, there is also a conceptual problem here, in that the prosodic hierarchy is usually thought to demand exhaustive parsing of entities into the immediately higher constituent, which would mean that segments should all be parsed into Onset or Rime. The only sanctioned departure from this typically comes at the edges of the next higher constituent, so that at the edge of the word syllables may fail to be parsed into feet (extrametrical syllables), and segments may fail to be parsed into syllables (syllable appendices, like English coronals). Countenancing medially unparsed glides weakens the theory in potentially far-reaching ways, and should be treated with caution.<sup>11</sup>

I conclude that these hybrid options seem to be more complex, and evidence justifying such an increase in complexity would be hard to find. Instead, I have tried to show that many phenomena need no reference to sub-syllabic structure at all, and that at most the simple moraic structure needed for weight calculations suffices.

## Endnotes:

1. An earlier version of this paper appeared under the title of “Non-arguments for sub-syllabic constituents” in the *Journal of Chinese Phonology*, Vol 11s. Student Book Co. Taipei. I am very grateful to the editor, Yuchau Hsiao, for permission to publish this extended version here. The paper has benefited greatly from the comments of two anonymous reviewers, and the comments of audiences at National Chengchi University, University College London, the University of Manchester, and the University of Durham. All errors are of course my responsibility.
2. The loss of glottal stop on the first syllable is a general property of non-final syllables in Southern Min.
3. It remains to explain why the glide cannot be copied, occupy the nucleus, and push the new vowel [i] into the coda, giving /kway/ > lway kuy, which contains only possible S. Min syllables. It seems that the affixal vowel /i/ must be nuclear.
- 4.(Moraic theory even makes an interesting prediction that in such cases the glide must not be a weight-unit, a prediction I do not have space to test here.)
5. A reviewer observes that English too distinguishes between glides and vowels in its phonotactics. In many dialects \*ty, \*pw, but [ti] and [pu] are found. A similar analysis seems worth exploring.
6. I adopt the usual assumption that \*[pü] is underlyingly \*/pwi/ (Wu:208), and is thus ruled out by the general prohibition on \*[pw]. \*[pyu] is ruled out by an independent and unrelated prohibition that also rules out \*[tyu].
7. Bao’s solution to the different treatment of glides in May-ka and Mey-ka is to assume that both glides are copied in both language games, and that the outputs /yay/ and /yey/ are then fixed up in different ways by rules specific to the two secret languages. May-ka merges everything to [yɛ], and Mey-ka deletes the pre-nuclear glide. Such a derivational approach is impossible in OT.
8. A reviewer correctly points out that the underlying representations in (42) are misleading, in that the three grammars will produce the right output whether the inputs are Cy or C<sup>y</sup>, a necessary result in OT where the set of possible inputs cannot be restricted (“Richness of the Base”). However, Lexicon Optimization will produce these as the preferred and presumably internalized inputs for these words, given the grammars as stated. In other words, a speaker with grammar A or C will store *cute* with [ky], but a speaker with grammar B will store it with [k<sup>y</sup>].
9. A reviewer points out that the absence of [wi#] is not as telling as the absence of [wiC], since [wi] in [wi#] is a constituent, (a syllable), whereas it is not in [wiC]. Since Mandarin bans both, it is particularly interesting.
10. Syllables in the segmentation task were all legal Dutch syllables made up of the eight consonants /p,t,f,s,m,n,l,r/ and the long vowels /o:, a:, e:, i:, y:, u:, ø:, œy/.
11. A reviewer quite rightly observes that in OT exhaustive parsing, like anything else, is in principle violable. This changes but does not eliminate the problem. In general languages require parsing of syllable-internal segments, suggesting that very few constraints are able to outrank PARSE-SEG, and force a violation. We would have to propose a plausible constraint responsible for the special treatment of glides. This might be an interesting tack for future research, but I shall not explore it further here.

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