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Licensing consonants in the nucleus and onset

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1. Introduction

In this paper I want to provide more evidence for the hypothesis that languages differ as to whether they syllabify word-final consonants as codas or onsets, or whether they avail themselves of both options. I also want to introduce the proposal that coda consonants are not codas or even rhymal complements (pace Kaye 1990a), but *nuclear* complements, whose licensing requirements follow from this status. Let's clarify some terms first.

Harris 1994, following Kaye 1990a's paper on "coda licensing" argues that word-final consonants in English are onsets of empty-headed syllables. There are three pieces of evidence for this claim: a) word-final onsets don't attract stress, as we would expect them to do if they were codas that closed the preceding syllable, creating a heavy rhyme; b) while some languages (the Amerindian language Yawelmani and Australian Aboriginal languages for example) don't allow long vowels before word-final consonants, English has many such VVC# configurations (keep, five....) – whereas internally English does display a certain amount of "closed syllable shortening": /fifty/ vs. /five/, /children/ vs. /child/ and so on. Finally c), the phonotactics of English word-final consonants are unrestricted, compared to internal codas: any segment but /h/ is permitted. This contrasts with internal codas for which a number of restrictions apply: either they are nasal stops homorganic with a following oral stop, or else liquids, or else....and so on. (The reader is referred to Harris 1994 for details). This situation is best captured by assuming that VC# is not the coda of the rhyme dominating V, but the onset of a syllable whose nucleus dominates null material: {V.CØ}.

Evidence for an onset syllabification of English right-edge consonants is thus extremely convincing. The contention of Kaye 1990a, though, is much stronger: right-edge consonants are onsets in all languages. This contrasts maximally with analyses which assume that all right-edge consonants are codas (e.g. Kahn 1976), or analyses which assume a right-edge coda-syllabification is the norm, and that English-type right-edge consonants which display odd properties are extra-metrical appendices (e.g. Borowsky 1985). There is an intermediate view, though, put forth by Piggott 1999. He argues (contra the "Kahn-Borowsky" approach) that the default situation is for languages to syllabify right-edge consonants as onsets – but that there is a marked option to syllabify them as codas. The empirical evidence he brings to support this contention is quite overwhelming, I believe. However, the way he formalizes this insight is somewhat stipulative: I will propose an alternative which models the coda versus onset syllabification more transparently. I will show that the featural content of segments (specifically their Place and Manner content) displaying coda versus onset syllabification is important for modeling right-edge phonotactics in such a transparent manner.

There is another issue here: the question of whether the coda is an independent syllabic constituent. The view of Kaye 1990 is that it isn't – "coda" consonants are linked to a skeletal point which is directly licensed by the maximal rhymal constituent, and they need to be licensed by the preceding nucleus and the following onset (see definitions below). One reason for dispensing with the coda is that on the new "coda licensing" view, all consonants C_1 in a configuration $VC_1.C_2V$ are directly licensed by C_2, so that there is no opportunity for a configuration $VC_1C_2.C_3V$, where

C_3 licenses C_2 and C_2 licenses C_1: a consonantal rhymal complement has to be licensed by the nucleus *and* the following onset. This condition would not be fulfilled by such a string. Branching codas are thus ruled out by GP. As all other constituents can branch, the conclusion is that such post-nuclear consonants are not dominated by syllabic constituents with a separate identity.

Once again, as with Piggott 1999, there seems to be a lot of arbitrary stipulation needed to pull off the admittedly correct result. Why should a rhymal complement have to be licensed twice, once by the nucleus and then again by the following onset? Nuclear complements, after all, are well-formed if they are licensed only by their heads – as the definition of licensing in other contexts would lead us to expect. Furthermore, how do we decide whether a diphthongal glide is syllabified as rhymal or nuclear complement? That is, is the /w/ in /cow/ dominated by a nuclear slot or by the new rhymal complement slot? A Kaye-1990 approach must decide in favor of the former: otherwise we would have a segment that was not licensed by a following onset. But elsewhere, glides can appear in "consonantal" constituents – namely the onset. We might thus be tempted to ask further: can only "real" consonants (obstruents and nasals, not glides) appear in rhymal complements – as the imposed syllabification of /cow/ suggests. If so, why?

This paper will set out to provide whys for the above questions.

2. Piggott 1999

Piggott 1999's contention is that there are languages whose final consonants share an extremely similar phonotactic and tonic profile to word-internal coda consonants, so that unlike in English, they have a genuine coda rather than onset profile. Two brief examples will suffice. In Manam, words can only end in nasal consonants, so that their phonotactics are clearly limited. What's more consonant-final words are stressed (contra the default pattern) on their final syllables. That is, these word-final consonants are stress-shifting: the only way to represent this is if they are genuine codas which close the syllable. Another example given by Piggott is that of Selayarese: in this language only the velar nasal and the glottal stop can appear at right edge. These are precisely the consonants which can appear in C_1 of word-internal C_1C_2 clusters (except for nasal stops homorganic to C_2, whose place can thus be considered derived). Here, therefore, final consonants and internal C_1 share the same phonotactic profile – an oddity if the former is an onset, while the latter is a coda.[1]

A "strong" coda-licensing account (as we can dub the approach of Kaye 1990) would rule out a syllabication of Manam final nasals as codas (or rhymal complements) as Kaye 1990 states the coda-licensing principle as: "Post-nuclear rhymal positions must be licensed by a following onset." Onsets in turn must be licensed by nuclei (Onset licensing principle, cf. Harris 1994). Therefore a final Manam nasal would have to be followed by empty onset and nuclear positions (which would need a license to remain inaudible). And still the stress-bearing capacity of the final nasal would remain unexplained. Best therefore, according to Piggott, to assume Manam final nasals are codas (or rhymal complements) which do not need to be licensed by onsets.

[1] The situation is complicated in Government Phonology, if you subscribe as I do to the theory of Licensing Inheritance (Harris 1997). Then one might contend that Selayarese final consonants display phonotactic restrictions due to depleted licensing potential at right-edge. This point will be taken up later.

Piggott 1999 formalizes this by saying that languages can select a coda- or an onset-syllabification of final consonants. This depends on selecting an option for the following parameter:

(1) (R)emote-licensing/Consonant (R-LIC/CONS) [Piggott 1999]:
Final consonants are R-licensed: Yes (unmarked)/No.

In Piggott's scheme Direct-licensing is where a segment's licenser immediately dominates its licensee, and Remote-Licensing is where a segment's licenser does not immediately dominate it (in terms of order in the prosodic hierarchy). The former in effect refers to where a syllable is licensed by a foot and then the word, while the latter refers to where a syllable is licensed directly by the word (what has been called extra-prosodic licensing). Word and syllable are thus "remote" from one another in the prosodic hierarchy (there is no intervening "foot" node). Languages which allow final consonants to be licensed in this remote way will have words that terminate in syllables that branch into {onset-nucleus-coda} or {onset-empty nucleus}, the latter a so-called degenerate syllable. They will thus allow consonants to appear under the onset node or the coda node, the former giving unconstrained phonotactics.

Space does not permit me to go into the precise details of Piggott's proposal. However, by itself, as can be seen, Piggott's division of languages into those which tolerate Remote-Licensing and those which tolerate only Direct-Licensing will not by itself give the difference between languages which have restrictive phonotactics at right edge. This is because even languages which only have Direct Licensing, syllables, licensed directly by the Foot, can branch into Onset and empty nucleus. To bar this, Piggott assumes a D-Licensing Condition, which states that "A final empty headed syllable is not a segment licenser". Thus the only syllabification of a final consonant is into the coda of a syllable with an audible vowel. We are still not quite there, however. For this, Ito 1986's Coda Condition is required, which states that "The Coda cannot license Place features". However, it has been argued (e.g. Harris 1994, 1997, 1998), plausibly in my opinion, that this condition is arbitrary: what is it about the coda that means it cannot license Place features. The picture becomes worse, when we consider that for this analysis to cope with Finnish, Australian and Menomini (see below), coronals have to be considered Placeless (as per Underspecification Theory; see below).

A final flaw in Piggott's approach, which makes seeking an alternative analysis seem a continuing necessity, is this: we know that all languages have Direct Licensing, as Piggott himself emphasizes. We would therefore assume that the default option for languages would be to syllabify final consonants directly, and to only allow them to be syllabified indirectly by a marked parametric choice. Contrary to this expectation, Piggott has to stipulate that *indirect* licensing is the unmarked choice in this case: " D-licensing is instantiated in every grammar where it applies invariably to non-edge elements...This entails that [D-licensing] is in competition with R-licensing for the licensing of final elements, and UG must provide for the choice to be exercised...I propose that R-licensing of final consonants is more highly valued, because UG designates it to be the unmarked choice." That is, the natural state of affairs concerning licensing has to be overturned by a stipulation for the right edge: otherwise, we would expect final consonants to be syllabified by default into codas. This would predict that phonotactic restrictions on final consonants was the unmarked case, rather than as is empirically true, the marked case. In other words, by continuing

to work with a coda, despite the best intentions, Piggott 1999 is unable to explain – other than through stipulation – why consonants would avoid codas and prefer onsets.

Again, a final problem is that the Coda Condition does not exist for Arabic or Ojibwa apparently, in which consonants of all types are syllabified into coda. Below we will try to solve these problems.

3. Clues as to the nature of the coda

Piggott's account thus leaves several unanswered questions. What I would like to do in this section is present some well-documented facts from several languages, which seem superficially unrelated, and give them a unified interpretation in terms of an improved theory of syllable/segment licensing. It will emerge that all these facts are telling us something crucial about the nature of the coda and consonants which can be syllabified therein, as well about the nature of the nucleus-coda relationship. These phenomena will all be crucial in helping to answer the questions we posed in section 1: what segments can appear in codas and why, do codas exists, and why do some languages syllabify right-edge consonants into coda (or rhymal complements), while others syllabify them into onsets. In addition, they throw light on the different licensing powers of codas versus onsets. The architecture of subsegmental structure that sheds light on these phenomena will necessarily have to be sketched briefly. The reader can find more detail in Rubin 2001b. The facts are these:

3.1 English rhotic syllabification

English, as we saw in Section 1, has onset-profile word-final consonants. There appears to be an exception to this: word-final /r/ can plausibly be argued to form a true coda, for three reasons: a) vowel-length contrasts are suspended before word-final /r/; b) vowel-quality contrasts are suspended before word-final /r/; c) slips of the tongue in rhotic dialects treat /r/ as nuclear. (I refer the reader to Harris 1994 Chapter 5 for details). Points a) and b) mean that /r/ has an effect on the phonotactics of the previous vowel, which follows if /r/ is tautosyllabic with it, but is unexplained if /r/ is in the onset of a following heterosyllabic syllable. The same is self-evidently true of point c). Thus right-edge /r/ is not an onset. This reminds us of the conundrum we had over deciding whether a right-edge glide should be syllabified into coda or rhyme, or we might add, onset. We will see soon that there is something in the segmental make-up of /r/ which makes a coda/rhyme syllabification preferable to the onset syllabification preferred for other "consonants".

3.2 Manam and Indo-European-style coda nasals

We saw above that right-edge nasals in Manam fit a coda-profile. In Indo-European languages (as well as non-IE languages like the Australian family and Selayarese for example), nasals that are homorganic with following oral stops are very common in internal codas. This well-known distribution can allow us to state a descriptive generalization: codas like nasals.

3.3 The case of Finnish: an excursus

Here we will have to engage in a bit more motivating argument when considering Finnish syllable structure. Finnish shows striking asymmetries in right-edge phonotactics: only the coronals {n,s,l,r,t} can appear word-finally (e.g."samal, talot, vieras" = "moss, houses, guest" but no such words as hypothetical *{samak, talop, vieram} exist). Now points (2) and (3) above have told us a little bit more about the profile of coda segments: rhotics seem to fit well in codas, as do nasals. (Is that

troubled property "sonority" the explanation, maybe?). Could the restriction of final consonants to coronal Place be because these consonants are syllabified in codas? Yip 1991 makes such a suggestion, following earlier proposals, formulating a Modified Coda Condition that states that "Codas may not have Place features", and following the venerable assumption of Underspecification Theory whereby Coronality is the absence of Place. Odd as it may seem from a GP perspective which incorporates Strong Coda Licensing, I agree with Yip that Finnish word-final segments are indeed codas, and that the restriction to Coronal place does indeed follow from this. Unlike Yip, I eschew the notion that Coronality is the absence of feature specification (on the grounds that Underspecification brings insoluble derivational paradoxes in its wake, cf. McCarthy & Taub 1992, Rubin 2001 for details), and unlike Yip, because coda syllabification of right-edge consonants is marked (following Piggott 1999), I will have to argue quite vigorously for this.

The arguments come partly from theory-external and partly from theory-internal considerations. While the latter are obviously not as convincing as the former, they do allow a simple and economic explanation of the Finnish data, which do convincing work on similar facts in other languages, as I will discuss below.

Starting with theory-external considerations, we can note that internal Finnish obstruent clusters consist of the following (where /a/ stands for any vowel): {a**t**ka, a**t**sa, a**st**a, a**sk**a, a**ps**a, a**ks**a}(data from Sherer 1993). (I ignore geminates). Now, what is odd about this is that the coronal stop should be allowed as the first consonant in such clusters: this configuration is disallowed in English coda-onset clusters, where there is good grounds to analyse strings which seem to fit this pattern as onset-empty nucleus-onset strings (i.e. "Watkins" would be /wat∅kins/) (cf. Harris 1994, Rubin 2001a for arguments). That is, English does not allow /t/ in coda. Conversely, it does allow clusters such as /kt, pt, ps/ ("act, apt, apse") in which the non-coronal stop is in coda and the coronal stop is in onset. This asymmetric state of affairs is captured in GP by saying that /t/ can govern /p, k/ but not vice versa. (This is a stipulation, but cf. Rubin 2001b for a solution to this). No such asymmetry exists for Finnish, apparently. Indeed, looking at Finnish further, we find that coronal obstruents seem to be ideally suited to appear in a coda, as opposed to the non-coronal counterparts. For on examining VVCC clusters we find only the following occur: {aa**t**sa, aa**st**a, aa**sk**a}. That is, whichever theory we choose to ultimately model the facts, in loose, fairly theory-neutral terms we can say that the distribution of obstruent clusters after vowels in Finnish displays a quite different asymmetry from that displayed in English: in the former /t/ is preferred after the vowel (sequence), in the latter /k,p/ are preferred after the vowel.[2] Given that the internal post-vocalic slot for all theories here is the coda (or rhymal complement), we can say that Finnish prefers coronal obstruents in coda, while English prefers non-coronal obstruents in coda (we confine this discussion to obstruents). This then is a theory-external finding about Finnish. A further theory-external connection can now be made: namely, that word-final consonants in Finnish are co-extensive with those segments which are preferentially found in internal codas

[2] For /apsa/ versus /atka/ I say that /t/ is preferred over /p/ after /a/ because in the more difficult context /aatsa/ only /t/ is allowed (cf. */aapsa/). That is, the asymmetry only reveals itself once the stakes are upped. To generalise we might say: A segment s_1 is preferred to a segment s_2 in a context C, if for a more difficult context C' only s_1 but not s_2 appears. (C' could be judged more difficult than C if C' is a superset of C). Seeing as the competing theories here shared common assumptions such as syllable-weight, Place, features and so on, there is enough common ground for theories to be fruitfully compared and compete.

(except for /h/). For /r, l, n/ are also found after the VV context in Finnish.(/h/ is found after VV but not finally).

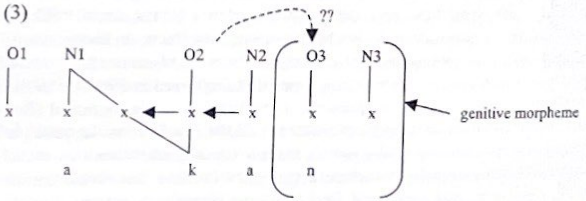
Now this latter point could be overridden when we return to GP: we could uphold Strong Coda Licensing and say that while internal codas and right edge consonants share the same preference, this is due to other reasons. Another theory-internal mechanism which could capture right-edge asymmetry is Licensing Inheritance (cf. fn.1). However, I posit on theory-internal grounds, that the phenomenon of Finnish gradation is better captured if final consonants are codas and not "weak onsets" (as we can term onsets whose licensing potential has been depleted due to distance from the phonological head).

Keyser and Kiparasky 1984 summarize the context for the consonant lenition phenomena in Finnish known as gradation as happening in "the onset of a non-initial closed syllable within the word if that syllable contains a single vowel or vowel-i sequence." (Elsewhere they show that vowel-i sequences behave like single vowels). Examples of gradation are (cf. Yip 1991):

(2)	akka	akan	"old woman (nom/gen)"
	takki	takiksi	"coat (nom/transl)"
	sukka	sukaksi	"sock (nom/transl)"

What happens, with /akka/ is that the geminate /k/ reduces to a single /k/ when the case-morpheme /n/ is added to the word. The "second" (orthographic)[3] /k/, finding itself in the onset of the syllable which was /ka/ but is now closed by the /n/, becoming /kan/, disappears, and we get /akan/. Now according to Kaye 1990, this would not really be a closed syllable, as the /n/ would syllabify into a domain-final onset. Government Phonologists are rightly cautious about the term "closed syllable". However in this case, when one comes to analyze why it is that /k/ should degeminate, one has two representations to hand (now that Piggott 1999 has reopened the possibility of final /n/ really being a coda here), and it turns out that a coda analysis of /n/ is better theory-internally for transparently representing causes of degemination.

(3)

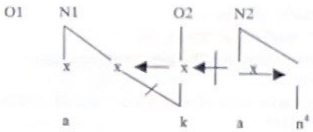


Let's assume that geminate /k/ is a coda-onset linked /k/ segment. We can imagine N2 government-licensing O2 (in the sense of Charette of 1991, 1992), so that /k/ has the licensing power to link up to two skeletal positions. Now the genitive morpheme is added: there is no necessary licensing relationship between incoming N3 and N2, though one might imagine an internuclear licensing relationship symbolized by the dotted arrow. However, it might be more plausible to assume that N3 is p-licensed parametrically, or that it is licensed at another projection by the head nucleus of the

[3] Which /k/ disappears is a moot point, and autosegmentally we might say there is only one doubly linked /k/. The representations we adopt will clarify this.

domain N1 (N1 always bears primary stress in Finnish, and stress is a way to identify the most prominent head vowel of a word). The reason one would look for another licensing relationship being contracted by N2 is that it would detract from the licensing potential it expends on O3 in giving it a license to govern the "coda". (Such a mechanism is exploited effectively to explain the licensing of different strings cross-linguistically by Charette). But such a licensing relationship is far more transparent if the morpheme /n/ enters into the coda of N3:

(4)



In that case N2 has to license an immediate complement and the repercussions for O2 are transparently clear: retraction of a government license, and only a license left for a single /k/ segment.

That is, on the assumption that /n/ is a "coda"[5] there is a clear causal relationship between addition of a post-vocalic consonant and deletion (or rather, delinking) of the prevocalic consonant.

4. Initial deductions

What the data in 3.1-3 is intended to show is that certain segments are preferred in coda or rhymal complement. These segments are /r/ (as evidenced by English), nasals (Manam) and coronals (Finnish – other languages which follow the Finnish pattern will be given later). Furthermore, if we can generalize from the Selayarese data, it appears that /?, ng/ are also preferred in coda.

When I say "coda" here, I mean a position which closes the nucleus, or is tautosyllabic with it; I have taken pains to show that this position is not in fact underlyingly an onset position of a new empty-headed syllable.[6]

Now, due to the ambiguities inherent in the notion of rhymal complement sketched in section 1, I am going to propose that "coda" consonants are in fact syllabified into the nuclear complement. (This means that the whole rhymal constituent is now redundant). The situation of a "coda" consonant will look as follows[7]:

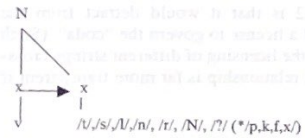
[4] We can imagine the morpheme having the phonological shape of a nuclear complement and being fused onto the vowel-final (nuclear head final) root. In GP vocalic affixes are lexically attached to independent nuclei; the root-final empty nucleus of a consonant-final word has to be deleted to make way for the affix. Thus I do not see that this proposed form of morphophonological affixation is any better or worse than that currently countenanced in GP.

[5] The coda here is represented merely as a nuclear complement, for reasons which will become all too clear shortly.

[6] This point is confirmed for Finnish when we consider that internally a string of form aTCa (T= a coronal obstruent, C any obstruent with the right phonotactics) will attract secondary stress; cf. Yip 1991, Rubin 2001b for discussion.

[7] Details of the following consonant – if there is one – and its relationship to the coda will be discussed shortly.

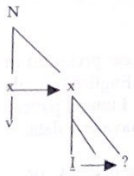
(5)



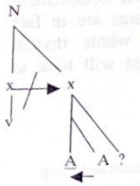
As indicated only coronals, nasals (= N) and the glottal stop can be licensed by the nuclear head. Non-coronals can't be. Space will only permit me to deal with the representation of coronal segments here, so I will henceforth leave aside discussion of nasals and /?/ (cf. Rubin 2001b for more information).

The basic insight regarding coronals, I have argued elsewhere (Rubin 2000a, 2000b, 2001a, 2001b), is that the coronal element has greater licensing powers than the non-coronal elements. This can be felicitously represented by making the coronal element head in a subsegmental element-geometric tree. Then the contrast between a coda coronal and a coda noncoronal becomes the following[8] (the head element is underlined):

(6)



(7)



In these representations, the elemental content of the consonantal subsegmental tree needs to be licensed by the nuclear head. We can imagine that a normal vocalic expression in the nuclear complement needs less licensing than a consonant: the latter expression contains more melodic primes – both Place, Manner and distinctive Voicing will be present. In this respect then, if a consonantal expression contains a

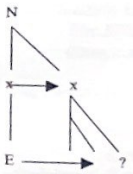
[8] The coronal element is I, the velar element is A (cf. van der Weijer 1994, Rubin 2001b).

"natural head"[9], i.e. the coronal element, this element will a) not itself need licensing, and b) will be able to license any dependent Manner elements. This is shown in (6). The opposite situation, where a velar stop appears in nuclear complement, is shown in (7). (The first two branches are Resonance Phrase, head and nonhead position; the last branch is Manner Phrase. The full details of the subsegmental tree are abbreviated for convenience; cf. fn 9).

In (7), the element [?] needs licensing by [A]. But [A] itself needs licensing. In fact, the idea is that a nonhead Place element (i.e.{A,U}) needs licensing to move into the head position to license in turn its Manner dependent. Such "movement-licensing" of Resonance elements is given automatically in Onsets, which naturally dominate consonantal subsegmental trees. It is not granted by nuclear constituents. The result is that velar and labial obstruents cannot be licensed in the nuclear complement, while coronal obstruents (in circumstances to be further clarified) can.

The representation of /r/ and the glottal stop will make clear why these segments can also appear in the nuclear complement:

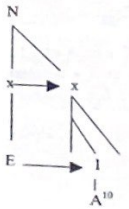
(8)



→ /v?/

(E = any vocalic element)

(9)



→ /vɾ/

(E = any vocalic element)

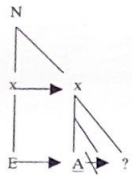
[9] The subsegmental tree consists of a Resonance, Manner and Voice Phrase. I ignore the latter here. Resonance is taken to be the head phrase of the whole subsegmental tree. Manner Phrase its complement. Within Resonance Phrase, there is a head position – where [I] is generated – and a nonhead position, where {A, U} are generated. The latter have to move into head phrase to license/govern Manner elements. It is this movement of nonheads – their inability to license themselves and their dependents automatically – which makes them unsuitable for "coda" position. For more details of this schema, cf. Rubin 2001b.

[10] The rhotic is represented as a fusion of palatality (I-nonhead) and velarity (A). This is based on Dickey 1997's arguments for the complex resonance of liquids (also cf. Rubin 2001a for details as to element-tree modeling).

The idea which is being developed here is that all the elements in the nuclear complement need to be licensed somehow. We can assume that elements are indeed licensed if they are themselves "natural heads" and thus self-licensing (as we saw), or if they are immediately adjacent to the head of the vocalic subsegmental tree. The glottal stop, consisting of only /?/, fulfills the latter criterion. (Incidentally the glottal fricative /h/ would fit the bill too: /h/ does appear in (internal) coda in Finnish. It is also the only segment allowed at right edge in the Amazonian language Macushi. But I will not investigate its properties here). The rhotic is modeled by an element tree which has no Place-head, only [I] in nonhead role[11], combined with [A]. [I] is immediately adjacent to E (the vocalic head) – and it does not have to in turn license any Manner material. The content of the rhotic is thus also licensed by the nuclear head's element tree (this licensing is all subsegmental).

Taking these concepts on board, we can return to the ungrammaticality of coda /k/:

(10)



The real reason for the ungrammaticality of this configuration, we can now see, is that [A] fails to license [?], because it has itself to be licensed by E. Following a principle of the non-transitivity of licensing (which we see in the formulation of Proper Government: a p-licensed position cannot properly govern another position in turn, cf. Kaye 1990a), this means it cannot license its own dependent.

From all this we can see the following: if a language has words which end in branching nuclei, then the complement of that nucleus will be able to host a limited range of consonants: coronals (including /r/ whose licensing follows for different reasons), ?, h, and nasals[12].

Clearly, this overshoots a bit: the only consonant allowed in nuclear complement in English is /r/. Selayarese allows only /?, ng/. Finnish only allows the coronal consonants. In the next section, we tease out the conditions underlying these different distributions. The initial achievement has been to reduce the stipulation on coda-licensing (pace Kaye 1990) to facts about subsegmental licensing within the nucleus.

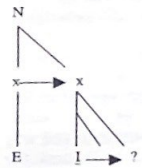
[11] In Rubin 2000b, 2001b, I argue in detail that coronality is best represented by [I] in head role, and palatality by [I] in nonhead role.

[12] The representation of nasals, and their appearance at right edge regardless of Place in Manam, is still a problem for the theory under construction. Cf. Rubin 2001b for discussion. Space permits no discussion here.

5. Parametric differences in nuclear licensing

We will start by comparing Finnish with English, whose asymmetries regarding the licensing of consonant strings is in some respects polarly opposite, as we saw in section 3. In our terms Finnish allows the following, while English doesn't:

(11)



I propose to capture the difference by means of a simple parameter:

(12) Nuclear Licensing Parameter (NLP):
The HDA holds strongly (unmarked) / weakly between a nuclear head and its complement.

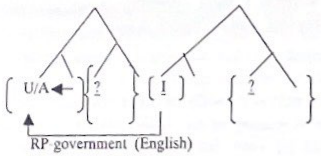
The H(ead) D(ependent) A(ssymetry) principle (Dresher & van der Hulst 1995, 1998) states that a head has greater freedom/power than its dependent. Here I interpret the principle as being parametrically set to a strong and weak version: if strong, a head must be stronger than its dependent, if weak a dependent can be as strong as its head. (Prohibited of course is the option whereby a dependent is *stronger* than its head). The strong version is default. Here this will mean that an "NLP-strong" language will not tolerate a situation where a nuclear complement is equal to its nuclear head: where a natural head ([I]) licenses itself and a complement ([?]), we have exactly such a situation – the licensing powers of the nuclear complement's subsegmental head are equal to that of the nuclear head's subsegmental head. An NLP-strong language will prohibit this. Thus English, which sets the NLP parameter to "strong" will disallow coronal obstruents in its nuclear complements. Note that, the rhotic will still be allowed: the rhotic is headless in its Resonance Phrase, and does not license Manner – it is thus "weaker" than its licenser in the nuclear head. This is the correct distribution for English. The facts of Finnish are derived by setting the NLP to weak.

Another significant result is that the ambiguity as to whether glides are really rhymal or nuclear disappears. Only the nuclear option (!) exists.

Some further obvious facts about English phonotactics still await explanation under the present scheme. Why is that non-coronals and non-rhotics do appear in "coda" in words like /act/ (syllabified as per Kaye 1990 as ac.t∅)?

The explanation is simple: when non-coronals appear in nuclear complements (formerly "rhymal complements/codas"), their Place heads need to be neutralized by subsegmental government by a following natural Place head. This is represented (subsegmental structure of "coda" and following onset only) as:

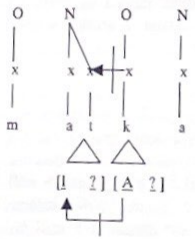
(13) {k,p} ← /t/



This is referred to as RP (Resonance Phrase) Government. The need for RP-government, coupled with a Strong setting for the NLP, tells us why "coda" consonants in English are (have to be) followed by another onset consonant and why if the coda consonant is non-coronal the onset consonant will have to be coronal: the function of the latter is to govern the former. Government implies asymmetry: only the natural coronal head can govern the "non-natural" noncoronal head. Hence the ungrammaticality of strings like /akp, apk/[13].

Now a further interesting point arises. Finnish allows strings like /matka/, where coda /t/ is followed by onset /k/. But if the headedness of the coronal element is universal, surely /k/ cannot govern /t/, and /matka/ would be banned?

(14)



Finnish clearly tolerates subsegmental government between coda material and onset material as strings like /apsa/ testify (this can only be licit if the [U] of /p/ is neutralized under s-government from the [I] of following /s/). The answer is again simple: as the diagram above in implies, /k/ does fail to govern and neutralize /t/ -- but this does not matter. Finnish licenses /t/ in coda (nuclear complement) anyway, as it sets the NLP to "weak". The appearance of /t/ and other coronals at right edge, where no following onset occurs or is needed, confirms this, for the reasons we argued in section 3.

[13] For /ask, rasp/, where /s/ is in coda, followed by noncoronal /k,p/, the excessively headed content of the coda is neutralized by the Manner element of the stop governing the Manner element of the coda. Subsegmental government is phrased disjunctively (cf. Rubin 2001b). Part of the definition runs: "Let α and β be element-geometric trees occupying positions A and B respectively. Then if α s(ubsegmentally)-governs β,
(i) the head of Manner-α governs the head of Manner-β *or* the head of Resonance-α governs the head of Resonance-β...."

In sum, strong coda-licensing can be decomposed into two components: the NLP parameter and subsegmental government between nuclear complement and onset. A more subtle array of facts can thus be derived in Finnish, English and Selayarese. A proper account of Manam needs further research, as indicated. (The current account of the mechanisms here is necessarily brief, and further details of the system and the languages being modeled can be gleaned in Rubin 2001b).

In the following section, I will apply these two devices to Menomini and Australian Aboriginal phonotactics.

6. Menomini and Australian

Menomini, an Algonquian language, and the broadly similar Australian Aboriginal languages, give striking confirmation of the above approach.

6.1 Menomini

Menomini (Bloomfield 1962, Yip 1991) has the following inventory:

(15)

p	t	c	k	
		s		
m	n			
w		j	h	?

Words can end in any of these consonants, e.g. napo:p "broth", me?tek "tree", apec "to that degree."

The following are the only intervocalic clusters allowed:

(16)

cp			ck		
hp	ht	hc	hk	hn	hs
	?t	?c	?k	?n	?s
sp			sk		

Only coronal obstruents, /h/ and /?/ can appear in internal codas. Menomini, like Finnish is NLP-weak: it permits [I] into the nuclear complement, where it can license its Manner dependent [?] or [h] (stridency). It is like Selayarese in allowing /?/ into coda as well. (If a language allows a strong head in coda, it will *a majore* allow a dependent Manner element like /?/), and like Finnish in also allowing /h/. Unlike Finnish (and English), however, no noncoronal stops can appear in "coda" followed by a "neutralizing" coronal stop. This is best explained if we assume that Menomini lacks the mechanism of s(ubsegmental)-government between nuclear complement and onset. There would thus be no means of neutralizing noncoronal stops. That is the option of s-government is parametric:

(17) S-government between N-comp and Onset: Y(unmarked)/ No.

We can assume that the lack of s-government is marked (further research would be needed to determine this). The default situation would be that two adjacent subsegmental trees automatically contract a governing relationship.

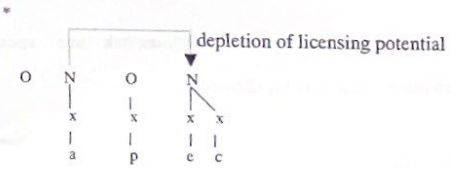
But there is a further difference between Menomini and Finnish: the former allows words to end in any consonant: /napo:p, apec/.

Here we are looking at parameters determining syllable structure. Clearly, if Menomini right-edge consonants have no phonotactic constraints and thus do not resemble internal C_1's, they must *pace* Kaye and Piggott, be onsets. Thus /napo:p/ will have this structure:

(18)

But how to represent /apec/? Will /c/, a coronal, appear in onset as well, or in nuclear complement? In fact, I would argue that the latter syllabification is wrong for Menomini, as the onset syllabification is less marked. This follows because the power of nuclei to license complements recedes at right edge. This can be captured by saying that licensing power decreases with distance from the nuclear head:

(19)



Now while Menomini can evidently license vocalic complements in nuclear complements towards right edge (cf. /napo:p/), this power vanishes for consonantal complements. It seems that the selection of a marked setting for the NLP in a prosodically marked environment bars its implementation. In this sense, Finnish – which licenses consonants in nuclear complements even at right edge – is more marked than Menomini. The option of syllabifying a right-edge consonant into an onset, as in (18), is an open unmarked option, given that the default syllable structure is assumed to be CVCV, i.e. ONON, where neither O nor N branch. The only parameter setting needed for /apec/, syllabified as /a.pe.c∅/, is for domain-final nuclei to remain inaudible.

That is, several marked parameter settings are needed to get a right-edge coda consonant, namely allowing nuclei to branch, allowing nuclei to branch even towards right edge, allowing nuclear complements to contain "strong" heads, and allowing that configuration at some distance from the domain head (presumed to be at the beginning of the word[14]). This contrasts with the single marked setting to get this consonant into a right-edge onset. To summarize:

[14] This is true for Finnish which has initial stress. I do not know how to determine the head nucleus for Menomini, not knowing enough about its stress patterns. This is thus an assumption which needs further investigation.

(20)

(Weak) nuclei branch: Y (marked).
NLP: weak (marked).
NLP for weak nuclei: weak (marked).
} Parameter settings for right-edge coda consonant

Final nuclei p-licensed: Y(marked).
} Parameter setting for right-edge onset consonant

This explains why Selayarese, Finnish and Manam appear to be such infrequent language types. It also opens up the mystery of Strong Coda Licensing by decomposing it into Licensing Inheritance, the NLP and s-government.

6.2 Australian

Variation in right-edge phonotactic across Australian languages confirms this view. Hamilton 1996 provides a list of Australian languages and the consonants that different languages allow words to end in. The pattern that emerges is this (for detailed discussion cf. Rubin 2001b):

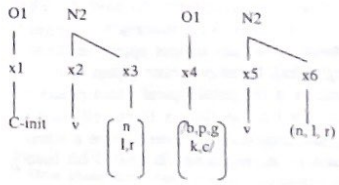
(21) *Trajectory for word-final consonantal contrasts in Australian*

(1) no consonants >> (2) coronal liquids and coronal nasals >> (3) coronal liquids and coronal nasals and coronal oral stops >> (4) coronal liquids and coronal nasals and coronal orals stops plus peripheral nasals >> (5) coronal liquids and coronal nasals and coronal orals stops plus peripheral nasals and peripheral oral stops.

That is, there is an implication regarding right-edge phonotactics: if peripheral (noncoronal) oral stops are allowed, all other segment-types are allowed there (21.5), while the reverse is not true, and so on. The most impoverished languages (as regards right edge) allow no final consonants, while the minimal set of consonants allowed in this context (as shown in 21.2) is coronal liquids and coronal nasals. Given that we have said that coda consonants are NLP-weak nuclear complements, we might suspect that language types exemplified by 21.2 and .3 syllabify their right edge consonants in a nuclear complement (as they fit nuclear complement profile). Language types (4) to (5), which contain peripheral segments would have to have onset consonants at right edge. The only way of confirming this is by comparing right-edge consonants with internal "codas".

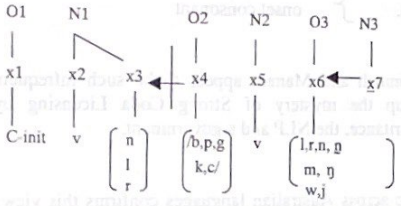
Here we find that for some languages the overlap is exact. Watjari (Hamilton:309) is an example of such a language. We could thus represent it as follows:

(22)



A language such as Agghu-Tharnghalla, however, in which right-edge consonants contain peripheral nasals, while its internal codas maintain the same profile as in Watjari, can be represented as follows:

(23)



That is, the difference in the languages is a result of switch of underlying syllabic structure.

However, the assumptions we have made in the previous sections cannot be implemented straightforwardly. There is a problem: firstly, we said that right edge nuclear consonants were more marked than right edge onset consonants. This raises a learnability issue: a learner confronted with right-edge {l,n,r} – which are consonants after all – would be expected to assume a default syllable structure for them. This will be an onset syllabification, we argued. According to Pinker 1997, learners cannot deduce structure from the *absence* of evidence – in this case, the Watjari acquirer should not be able to deduce from the absence of {p,k,m...} at right edge, that the language has right edge nuclear complements. There should, in other words, be a trigger for a marked parameter setting (e.g. long vowels tells the acquirer that nuclei branch). The same of course will hold for Finnish. For Finnish, we can say that the positive evidence comes from gradation: the structure which most economically represents the causal link between degemination in the previous syllable, and addition of a consonant in the next syllable is a "closed syllable" or in our terms, "nuclear complement" syllabification of the added consonant.

There might indeed be positive evidence for Watjari acquirers to go for the marked structure in (22). Firstly, there is the fact that a coronal nasal in internal coda does not undergo assimilation to a following heterorganic oral stop (words like /anpa/ are permitted). This indicates that, as opposed to English where homorganic coda nasals are underlyingly unspecified for Place and gain it from the following onset, Watjari internal coda nasals are fully specified for coronal Place. A marked setting of the NLP is thus definitely triggered *word-internally* for a Watjari acquirer. Internally, Watjari words resemble Finnish, which has forms like /matka/, containing ungoverned /t/ in coda. (As remarked, nasal manner is preferred regardless of Place in codas, so that Watjari has /n/ but not /t/ in internal codas. Other languages do have /t/. The generalization concerning coda nasality remains descriptive at the moment).

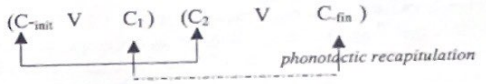
Another piece of evidence is that the rhotic in Watjari cannot appear in word-initial onsets (a common ban in Australian languages). It can however appear at right-edge. I would argue that the initial onset position is the prototypical onset position (being the onset of the whole word), and that the ban on rhotics there reflects an unsuitability of rhotics for the onset slot. We saw this in English too: there is clear evidence that rhotics at right edge are coda, not onset, segments. If this is so, then

again Watjari speakers will set up a nuclear complement syllabification for final /r/, rather than an onset slot.[15]

The first piece of evidence (a highly characteristic feature of Aboriginal Australian phonotactics) indicates that once the acquirer has evidence that nuclear complements can host self-licensing consonantal material, the NLP is switched to weak across the board for all nuclei regardless of position. This means a modification of the assumption in (20) that three marked settings are needed to get this configuration; in fact only two settings will this distribution (no "NLP for weak nuclei").

To develop this point: Dixon 1980 and Hamilton 1996 show that the Australian word is divided into two similar "syllables" as regards the phonotactics[16] of initial consonants and the second consonants of clusters, and that of final consonants and the first consonants of internal clusters, as follows:

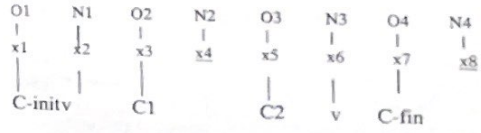
(24)



One witnesses a convergence in the phonotactic profile of the relevant consonants. Thus a certain set of languages will have words of the form /papkap/. As (24) shows, internal clusters like /pk/ do not seems to be (just) a function of a C1-C2 relationship: rather the phonotactics of C1 can be read of the position of that consonant in the first CVC string, and that of C2 from its position in the second CVC string. (This ties in with non-assimilating /n/ -- coronals are allowed in C1 regardless of "assimilatory pressure" from C2). Thus I would argue that once /p/, for example is licensed in C1, an acquirer of this type of language will have a trigger telling them that internal onset-empty nucleus strings are licensed. That is, /papkap/ will have structure [pap∅kap∅] (where ∅ is an empty nucleus). This in turn means that speakers of "papkap" languages will not receive evidence for an NLP-weak nucleus. The right-edge syllable structure assumed will be Onset-Nucleus, therefore. The linking of evidence for the properties of internal and right-edge nuclei and internal and right-edge onset-nucleus pairs will derive the phonotactic template in (24).

The structure underlying /papkap/ will be:

(25)



[15] As yet, I have no answer as to why the intervocalic position licenses /r/ where initial onset position doesn't; in GP this position is also merely an internal onset position.
[16] These phonotactics concern strict implications of Place and Manner, cf. Hamilton 1996.

There is thus a pure "coda" structure[17] (22), a pure onset-onset structure (25), and an intermediate structure (23). Once the acquirer hears non-assimilatory internal /n/, (s)he will assume NLP-weak nuclei across the board, thus setting up (22). This will be maintained as long as only coronals appear in C1 and C-fin. (There are languages which only have words like /patkal/: i.e., where C1 stretches to coronal oral stops, but no further on the trajectory in (21)). As soon as a non-coronal is introduced in C-1 or C-fin, an onset-nucleus structure will be assumed there: this will be used for all onset-type segments, even coronals; but note that /r/ will, as in English, probably maintain a coda syllabification, due to its inherent coda profile.

A final point: once this onset-nucleus syllabification is triggered, there will then be displays of "weak onset" behavior, as the onset is licensed by an empty nucleus. This, too, involves some restriction on Place (Hamilton shows that the preference is for labial >> velar >> coronal in C-2/C-fin).

7. Conclusion

What the above account achieves hopefully is an explanation of why "codas" display the precise phonotactic constraints that they do. This is because a) codas are nuclear complements, and b) due to the subsegmental structure of "coda" segments, all of which can be licensed by the nuclear head or, failing that, are self-licensing: coronals (naturally Place-headed), glottal obstruents (Place-headless) and nasals (described, but not explained yet), and the rhotic (Place-headless). This approach explains why a language like English can syllabify one segment into coda (the rhotic) and all the rest into onset at right-edge.

The markedness of coda-syllabification derives from a principle which seems to recur throughout linguistic structure: the HDA. Allowing a consonantal segment into a nuclear complement makes a complement as strong as its head, contra the preferred option of maximal discrepancy between heads and dependents (cf. Clements 1988's Sonority Dispersion Principle, along the same lines). However, once this parameter is set it acts as a device to generate marked configurations throughout the phonological word, as we saw in Finnish and some Australian languages. It appears, though, that there is a conflict between the NLP and onset syllabification. We should really consider those Australian languages with free right-edge phonotactics the less marked ones: in which case onset syllabification eventually overrides the NLP-weak setting at right edge. But there is good cause for this: it seems that though the NLP setting spreads through the word, in licensing-depleted sites like right-edge, the less marked onset-nucleus setting eventually takes over. Then languages of type 21.2 and .3 will then start to "ascend" the right-edge trajectory (which in fact will be a decrease in markedness).

A further insight of this approach is to explain why languages like English have the precise "coda"-onset phonotactics they do: coda obstruents of peripheral Place are permitted, as long as they are followed by onset obstruents of precisely coronal Place. The latter serves to neutralize the former's presence in the nuclear complement, when the natural head, [I], s-governs the peripheral Place elements [A] or [U].

These explanatory insights concerning the interaction of segmental and syllabic structure make the present approach to "codas" a viable alternative to Kaye 1990a or Piggott 1999 as a way of modeling the phenomenon of "coda licensing".

[17] That is, a structure with internal and right edge consonantal nuclei.

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