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**TOWARDS A MODEL OF PHONOLOGICAL ACQUISITION  
IN GOVERNMENT PHONOLOGY**

**BY**

**LUCY TOLSON**

**SUBMITTED IN PARTIAL FULFILMENT  
OF THE REQUIREMENTS FOR THE  
DEGREE OF MASTER OF ARTS**

**in**

**THE DEPARTMENT OF LINGUISTICS AND ENGLISH LANGUAGE,  
DURHAM UNIVERSITY**

**30 SEPTEMBER 1998**



**11 MAY 1999**

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# **Towards a model of phonological acquisition in Government Phonology**

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## **Abstract.**

Child phonology shows some interesting and systematic differences from adult phonology. In child phonology, for example, vowel harmony and consonant harmony are common phonological effects (Ingram 1986). In adult phonology, however, vowel harmony is restricted as a language-specific effect and consonant harmony is widely unattested in languages (Vihman 1978, Stemberger and Stoel-Gammon 1991).

In order to understand the cause of these differences between adult and child phonology, two essential questions must be raised by investigators (Kaye 1997).

1. What is phonology?

2. What needs to be learnt in order to reach a language-specific adult phonology?

Models such as Government Phonology (Kaye, Lowenstamm and Vergnaud 1985 et seq.) are attempts at representing phonology. Government Phonology in particular has not, however, been widely used to yield any such representation of the development of phonology in children. This thesis thus approaches a tentative model of phonological acquisition based in the Government Phonology framework.

In Part one, the model of Government Phonology is set out. In Part two, the principles and parameters that govern this model of phonology are manipulated in order to hypothesize the mechanisms available at four stages of acquisition:  $G_1$ ; the initial state,  $G_2$ ; A stage at which vowel harmony is evident in English and French children,  $G_3$ ; A stage at which consonant harmony is evident in English children, and  $G_n$ ; the adult English state. In Part three, the implications and problems of this tentative acquisition model and the Government Phonology model are assessed. Government Phonology is argued to provide a promising new line of research into phonological acquisition although much further research must be undertaken.

I dedicate this work to both of my parents

and to A.J.K. Costello.

Thank you for your endless support.

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## Introduction

When children acquire the sound system of a language, they begin with a phonology which may seem to only slightly resemble the adult target system. However, they rapidly produce more and more target-like sounds until the adult system is reached. In normal children, this development of phonology is systematic and shows tendencies that span individuals acquiring a common language and, moreover, individuals acquiring different languages. Clearly then, phonological acquisition, both universal and language-specific, requires solid explanation and representation in light of these tendencies.

In order to understand precisely what is going on when phonology is acquired, two questions are raised. A phonologist needs to know both what phonology is, and what needs to be learnt (Kaye 1997). The answers to both of these questions are crucial and inseparable.<sup>1</sup> Kaye (1997) concludes from this that:

"Acquisition models will vary enormously according to the component model with which they are paired." (Kaye 1997: 9).

Phonological acquisition literature to date clearly reinforces this statement. Acquisition models have altered radically in line with new phonological models<sup>2</sup>. Smith's (1973) linear rule-based account of acquisition based on Chomsky and Halle's (1968) SPE<sup>3</sup> phonological framework is radically different

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<sup>1</sup> This is not an uncontroversial claim, however. Some acquisition researchers have attempted to deal with child phonology independent of a phonological model (e.g. Waterson 1971, Macken and Ferguson 1983, Menn 1976, 1983). Child phonology has, thus, been construed as developing articulatory and respiratory motor control or a development of cognition. I agree, instead, with Levelt (1995:26) in that "phonological theory has both the descriptive and the predictive power to handle developmental data."

<sup>2</sup> The integration of new visions of phonology into studies on phonological acquisition are, however, relatively infrequent (Fee 1995). This could possibly be due to the opposition from developmentalist acquisition researchers mentioned in footnote 1.



to Spencer's (1986) non-linear re-analysis using early Autosegmental Phonology and Underspecification Theory (Clements 1981, Clements and Keyser 1983, Kahn 1980). Moreover, Spencer's (1986) model is radically different from recent acquisition models such as Bernhardt and Stemberger's (1998) model using Optimality Theory (Prince and Smolensky 1993). The list goes on and improvements are noted at each change.

In this thesis, I am concerned with both a component model, Government Phonology, and the beginnings of a tentative acquisition model based on the claims made by that model. Government Phonology is a relatively new vision of phonology (Kaye, Lowenstamm and Vergnaud 1985) and has so far not been integrated with a model of acquisition with any great vigour. However, it is essential that a phonological model can serve as an acquisition model. A phonological model which, when paired with an acquisition model, is unduly complex or even impossible is undesirable (Kaye 1997).

Government Phonology, like any theoretical model of phonology claims to represent what phonology is. The phonological component, and the human linguistic system as a whole, is understood to consist of a fixed innate template (Universal Grammar) which under-determines a given linguistic system. Parameter settings determine the precise language-specific nature of a system (Kaye 1997). In theory, the underlying principles and the language-specific parameters are responsible for all phonological phenomena in all languages.

Part 1 of this thesis acquaints the reader with the principles of Government Phonology and some of the parameters which need to be set in order to specify a language-specific model. Vowel harmony effects in adult languages are given particular attention throughout this part and are argued to be advantageously represented in the Government Phonology model.

With the component model in tow, Part 2 approaches the application of this model to acquisition. Some assumptions as to the basic approach to acquisition are set out and questions are stated that are in need of answering. Then tentative hypotheses manipulating the Government Phonology framework are considered for four stages of acquisition;  $G_1$ ; the initial state,  $G_2$ ; a stage at which vowel harmony occurs,  $G_3$ ; a stage at which consonant harmony occurs, and  $G_n$ ; the English final state.

Part 3 concludes this thesis in briefly assessing the hypothesized acquisition model as it stands and the ability of that model to clearly answer the questions that are set out in Part 2. In evaluation, Government Phonology is argued to provide a promising new line of research into phonological acquisition. However, much more research into both the Government Phonology Acquisition model and the Government Phonology model itself is necessary.

## **Part 1. The component model: Government Phonology**

### **Section 1. The Government Phonology Approach.**

The model of Government Phonology (henceforth GP) as proposed by Kaye, Lowenstamm, Vergnaud (henceforth KLV) and collaborators<sup>1</sup> is both formally and substantively different from standard views of phonology (Roca 1994). The following sections present the GP model<sup>2</sup>. GP is an on-going research program (KLV 1985) so there have been and continue to be various changes in the theory. These sections do not, however, attempt to chart all of these developments. The model is presented as as close to an up-to-date working model of phonology as is possible.

Government Phonology was formulated as an attempt to incorporate the view that phonology is to be regarded as a system of universal principles defining the class of human phonological systems (KLV 1985). Some of the principles are the same as those operative in Principles and Parameters / Government and Binding models of syntax (e.g. Chomsky 1981). GP is an attempt to manipulate the principles which, according to pre-Minimalist Chomsky, underlie syntactic organisation in order to explain phonological organisation (KLV 1990). These principles, if shared by both levels of grammar, lead to a more regular and symmetrical language faculty.

---

<sup>1</sup> The most important statements of GP policy are made in KLV (1985) and KLV (1990). Further important work in this framework is contained in, for example, Charette (1988, 1989, 1990, 1991, 1992), Gussman and Kaye (1993), Harris (1990, 1992, 1994), Harris and Kaye (1990), Kaye (1987, 1988, 1990, 1992, 1993), Harris and Lindsey (1995) and Lindsey and Harris (1990) (references from Brockhaus 1995a).

<sup>2</sup> There is no attempt to provide evidence for or against GP. The purpose of this first part is simply to describe the model of phonology in order to begin to deal with acquisition. Data and discussion on the proposed formal tools can be found in the relevant papers cited throughout the sections.

An important aspect of GP is the lack of any kind of rule component in the phonological system. There is no derivation in GP as in an operation by means of which abstract phonological objects are transformed into increasingly concrete physical objects using such concepts as rewrite rules (Harris 1994:96).

E.g.

$$\alpha \longrightarrow \beta / A \_\_ B$$

Rather, GP is a strictly generative function which defines the grammaticality of phonological strings (Harris 1994:96).

The lack of transformation in GP is interpreted formally from the Uniformity Condition.

*The Uniformity Condition* (Kaye 1993:92)

Phonological representations are directly interpretable at every level.

This condition eliminates the need for and purpose of a separate phonetic and phonological level. In GP there is just one level of representation.

The lack of transformation in GP is also interpreted formally from the Projection Principle.

*The Projection Principle* (KLV 1990:221)

Governing relations are defined at the level of lexical representation and remain constant throughout the phonological derivation.

This principle eliminates resyllabification in phonology. A consonant placed in an onset position will remain an onset at all times. A vowel placed in a nuclear position will remain a nucleus. Moreover, the relationships between constituents will not be changed. Thus, a consonant which forms the secondary position in a branching onset will not become the sole consonant in a non-branching onset.

The lack of transformation attained from having no rule component and from the restrictions of both the Projection Principle and the Uniformity Condition have specific implications with regard to processes in adult (and child) phonology.

"Phonological phenomena result from a combination of general principles governing phonological representations and structures and the parameter values in operation in the particular language." (KLV 1985:305)

Processes, e.g. harmony, are therefore not considered active. No agent in the phonology can declare that a process must act. Rather, processes are redefined as constraints manifesting a need within the phonology itself (KLV 1985:324).

"Processes apply whenever the conditions that trigger them are satisfied" (Kaye 1992:141).

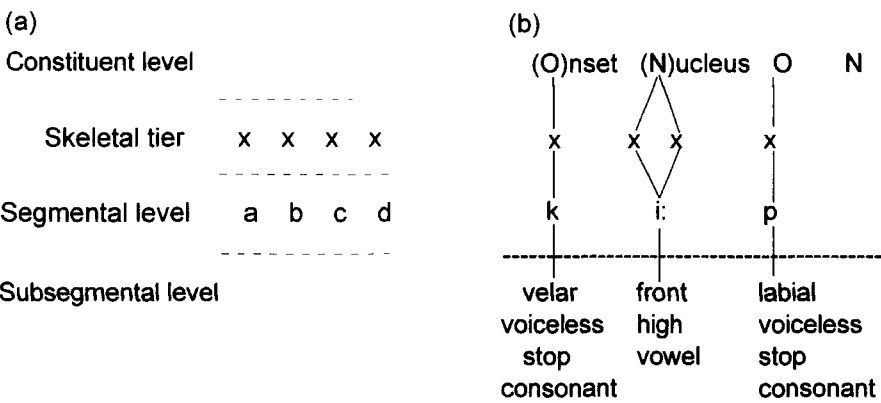
Harmony, for instance, may be viewed as a static constraint on well formed lexical items. This differs from its normal manifestation as a process of spreading triggered by a statement in the grammar.

The primary concepts on which GP is built are subsegmental complexity and segmental licensing. The following sections discuss each of these areas in turn. Section 2 describes the subsegmental level of phonology. Section 3 describes licensing restrictions on the segmental positions in phonology. Section 4, then, brings the first two sections together by describing the link, complexity and a-licensing, between the subsegmental and the constituent levels. Finally, section 5 can more fully illustrate the mechanisms involved in two types of vowel harmony found in adult languages and show that this approach is advantageous over previous attempts at explaining and representing the same data.

Section 2. The internal composition of a sound.

This section describes a GP approach to representing the melody of segments. The melody makes up the structure of the subsegmental level of phonology, in other words, the internal composition of a sound. This structure is placed below the skeletal (timing) tier on a hierarchical phonological representation as is exemplified in Figure 2,1(a). In 2,1(b) the English word 'keep' is illustrated. The description of the segments and the subsegmental structure placed below the broken line is what needs to be represented at the subsegmental level. The structure above this broken line is the topic of section 3.

Figure 2,1.



The subsegments and subsegmental structure building each individual segment are crucial to expressing assimilation / harmony in both adult and child language. Without a separation of the distinct parts making up a segment, phonologists can not express harmony clearly. Although total assimilation, in which a whole segment is copied into an adjacent position, is included by phonologists as a case of harmony, most harmony systems involve the adoption of just one part of a segment, e.g. velarity<sup>3</sup>, or a particular

<sup>3</sup> In GP, segments are broken down into 'elements'. However, until this approach has been introduced in section 2.1, I will continue to refer to these separate parts as either 'features' or 'parts' of a segment. The use of the word 'feature' does not imply that I am working in an SPE (Chomsky and Halle 1968) or related framework.



grouping of these parts, e.g. all place features. The influence of these parts can then manipulate the form of an affected segment in a specific but not total way.

An example of a harmony system utilising individual parts can clarify the need for this breakdown of segments. Uyghur, a member of the Turkic group of the Altaic family of languages (Denwood 1993), has various vowel harmony effects (Hahn 1991). One such effect is labial / rounding harmony. This harmony can be seen on words affixing the first person singular agreement marker '-m'. This marker surfaces as 'vowel+m'. However, the surface vowel is affected by rounding harmony. In the data in Figure 2,2 below, one can see that when the stem is made up of a round vowel, the suffix surfaces as 'um'. When the stem is made up of a non-round vowel, the suffix surfaces as 'im'.

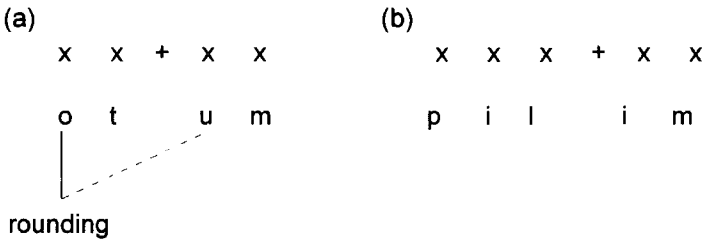
Figure 2,2.

Nominative	Possessive (1st person singular)	Gloss
pul	pulum	money
ot	otum	herb
pil	pilim	elephant
at	itim	horse

This effect is interpreted as an adoption of the rounding part of the segment in the stem by the vowel in the 1st person singular morpheme as can be seen in Figure 2,3. In this figure, the stem vowel in (a) has inherent rounding represented with the unbroken line attaching 'rounding' to the segment. This rounding is also attached via the broken line to the affixed vowel so that the affixed vowel can adopt certain vowel qualities. In (b) no rounding is inherent on the stem vowel thus there is nothing to link to the affixed vowel.

Figure 2,3.

Harmony in Uyghur (simplified)



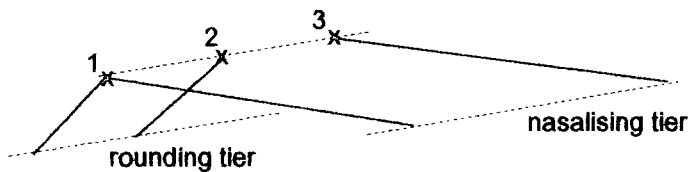
Without a breakdown of the parts making up a segment, the harmony above is difficult to express. Without separate phoneme qualities, harmony could only generate the full [ o ] segment. However, using the rounding quality of the first vowel, the [ i ] effectively surfaces as its rounded counterpart [ u ].

These distinct parts must be organised in an autonomous manner in phonology. A feature of a segment can be disconnected from that one segment or shared between two segments without an influence on any other parts. Each feature of a segment is, thus, envisaged as resting on its own autonomous tier in the phonology<sup>4</sup>. These tiers fuse with a skeletal position in order to influence the phoneme quality of that position.

Figure 2,4 illustrates these autonomous tiers. This diagram shows the three dimensional nature of phonology. The skeletal tier contains three segments (represented as x). These three segments are linked (or 'associated') in various ways to the two autosegmental feature tiers (Rounding and Nasalised). Position 1 is both round and nasal. Position 2 is not associated to the nasal tier so is just round. Finally, position 3 is not associated to the round tier so is just nasal.

<sup>4</sup> In Section 2.3. this statement will be clarified. Language-specific conflation of tiers can occur in languages. In this case, a specific feature of a segment (e.g. 'fronting' (or **I**) in English) may lack autonomy with another specific feature (e.g. 'rounding' (or **U**) in English). They are therefore placed on the same tier and cannot both be attached to a skeletal position (e.g. English has no front round vowels).

Figure 2.4.

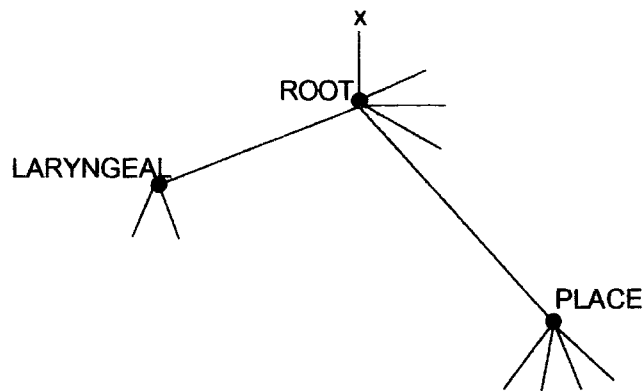


In addition to a breakdown of the parts making up a segment and the placement of those parts onto autosegmental tiers, there is also a structure to the subsegmental level that organises the autosegmental tiers and features into groups. Features of a segment pattern into natural classes determined by shared phonological behaviour and phonetic commonalities (Harris 1994:127). This is reflected in the feature geometry structure at the subsegmental level of phonology<sup>5</sup>. Class nodes; Place, Laryngeal and Root, organise the links between the feature tier of a segment and the skeleton. Figure 2.5 illustrates this GP feature geometry (Modified from Harris 1994:129). The Root carries all the information about a segment including specific features and other nodes. The Laryngeal node is a secondary node which carries information about the voicing or tone of a segment. Finally, the Place node is a secondary node which carries information about the place of articulation of a segment. As yet the features attached to each node have not been specified.

---

<sup>5</sup> Autosegmental tiers and feature geometry are not concepts distinct to the GP model. The GP element geometry was born from previous models of feature geometry set out by Sagey (1986) and Clements (1985). Features, in most modern feature-based models of phonology, are also envisaged as resting on separate tiers (See work on Autosegmental Phonology; Goldsmith 1976, Clements 1976 et seq.)

Figure 2,5.



This subsegmental structure is crucial in GP. Assimilation effects can involve the association of a whole node rather than one or more features of a segment. The Place node is associated for place assimilation. The Laryngeal node is associated for voicing assimilation. And, the Root node is associated for full assimilation otherwise known as gemination. This approach to representing assimilation is advantageous in allowing adherence to the following restrictive principle.

Each phonological process can access only one unit in a representation (Harris 1994:127).

Without any grouping of features into nodes, some assimilation effects would need to refer to more than one element and then this principle could not stand. This reduces the restrictiveness of phonology in general.

The nodes, in GP, are crucial also to calculating the internal complexity of a segment (Brockhaus 1995a).

This will be discussed in due course (see section 2.3.4 for an introduction).

## 2.1. Holistic elements

In Binary Feature models of phonology, vowel harmony systems are represented as the spreading of either the [+feature] or [-feature]<sup>6</sup>. Palatal harmony has been represented as spreading of the feature [-back] (Clements 1981). Labial harmony has been represented as spreading of the feature [+round] or [+high]. Height harmony has been represented as spreading of the features [-high] or [+low] (Mtenje 1985). Nasal Harmony has been represented as the spreading of the feature [+nasal].

The use of binary features as the harmonizing subsegments however, carries few restrictions. Harmony effects manipulating both values of a feature should be equally expected using this approach, but + and - are not equally evident. For example, although nasalisation, spreading of the [+nasal] feature, is a reasonably widespread harmony effect in languages, the opposite case of oralisation which would utilise the [-nasal] feature value is unattested in adult phonology (Backley and Takahashi 1995).

In GP, the elementary particles of phonological analysis are not distinctive features which produce this (and more) massive over-generalisations of phonological effects and expressions (Backley 1993). Instead, undivided basic segments are the phonological primes which can be combined to give rise to more complex segments<sup>7</sup>. The basic primes are called 'elements' and are unary and privative in their oppositions<sup>8</sup>. They are thus more constrained than features or primes which are binary and equipollent in nature (Harris 1994).

---

<sup>6</sup> Spreading is the term used for the association of both an original skeletal position and a second skeletal position to one autosegmental tier. Spreading is generally represented as a broken association line as used in Figure 2,3.

<sup>7</sup> This approach is not unique to GP (See Particle Phonology (Schane 1984) and Dependency Phonology (Durand 1986, Anderson and Durand 1986, Anderson and Ewen 1987) but is the most elaborate and could be regarded as a developed version of the other two counterparts (Roca 1994).

The privative nature of elements is advantageous in many ways including the representation of harmony systems. They restrict the number of spreading effects in the phonology. Privativeness narrows the set of segment classes that are potentially active in phonological processing (Harris 1994:96). Only available elements can spread. No opposite value to an element exists and if that element does not exist, then harmony is impossible to represent. We would therefore expect it to be unattested in languages. This is supported by the nasalisation story mentioned above. Nasality is represented by the element N. This element can spread to cause nasalisation. However, no element exists to represent orality. Orality is the default value. Thus, oralisation is impossible to represent as a spreading effect<sup>9</sup> and is unattested in languages.

The set of elements is universal and comparatively small<sup>10</sup>. Moreover, they are phonetically interpretable at all levels of derivation.

"The element is 'small' enough to fit inside a segment and yet 'big' enough to enjoy stand-alone phonetic interpretability" (Harris 1994:96).

Phonetic interpretability is an implication of the Uniformity Condition formally set out in section 1 and repeated here.

---

<sup>8</sup> A privative opposition is an all or nothing opposition. An element is either realised as part of a segment's make-up or lacks any realisation. This is opposed to an equipollent opposition where an element or feature is always present in the segment's make-up and alternates by differing values, usually in the form of a binary + or - (Harris 1994).

<sup>9</sup> The effect could, in GP, surface as delinking of the N element. However, as we will see in section 4, in order to delink an element there must be the correct surrounding phonological environment.

<sup>10</sup> From a psychological point of view, elements have relatively stable interpretations in articulation, the acoustic signal and audition (Harris 1994:91).

*Uniformity Condition* (Kaye 1993:92)

Phonological representations are directly interpretable at every level<sup>11</sup>.

This condition must, however, be clarified.

"To say that each element is independently interpretable is not to say that it can be targeted by executing a unique articulatory gesture. The performance of a particular elemental pattern typically involves the arrangement of one or more of an ensemble of gestures" (Harris and Lindsey 1995: 70).

In other words, elements (resting on autonomous tiers) fuse together into the geometry structure set out in section 2 above. The fusion of elements will be introduced in due course. Nevertheless, most elements can be directly interpretable if they are a sole head of a simple segment with no other elements involved. In this case, one element can make up a complete phoneme.

---

<sup>11</sup> This consistency of the representation could be particularly advantageous in approaching an acquisition model. Child phonological data is considered problematic since it is never possible to know whether the researcher was illustrating phonetic or phonological facts. Since, in GP, no separate levels can be distinguished, this problem becomes of less importance. Only phonology can be interpreted (Kaye 1997).

2.2. The basic elements

2.2.1. Vowels

Three elements play the main pivotal role in the representation of vowels (and indeed also in consonants) in GP. These can be understood as 'corner' vowels representing the segments [a] [i] and [u] (Harris 1994). These elements are symbolised as A, I and U and can be interpreted as full feature matrices in Figure 2,6 below.

Figure 2,6

Feature matrices for the 'corner' vowels<sup>12</sup>

A:	<div><div>-round</div><div>+ back</div><div>-high</div><div>-ATR</div><div>+low</div></div>	I:	<div><div>-round</div><div><b>-back</b></div><div>+high</div><div>-ATR</div><div>-low</div></div>	U:	<div><div><b>+round</b></div><div>+back</div><div>+high</div><div>-ATR</div><div>-low</div></div>
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Phonology is denied access to these internal features. They are only illustrated in order to express the phonetic interpretability of elements and for use in Matrix Calculus (Roca 1994:124) which is necessary to obtain segments other than the simplex [a], [i] and [u]. This section, however, continues to deal with simplex basic elements.

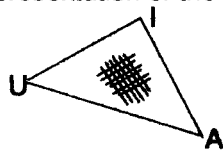
The three vowels [a], [i] and [u] represent the furthest departures from a neutral vowel position. In Figure 2,7, the vowel space is depicted as triangular. The centre of this triangle, the shaded area, is the neutral space.

<sup>12</sup> The reason for the bold feature in the feature matrices will be come apparent in the following sections.



Figure 2,7.

A representation of the vowel space



An element representing this neutral position of the vocal tract is necessary as a base line to other vowel qualities. This element is symbolised as @ in most recent literature and its feature matrix is given in Figure 2,8. (KLV 1985:309)<sup>13</sup>. This segment is devoid of any active elementary content unless it is a head. In a head position, the element generates a schwa-like sound<sup>14</sup>.

Figure 2,8.

The neutral vowel element; @

-round
+back
+high
-ATR
-low

The introduced elements are the ones that can represent vowel harmony in languages. The spreading of the U element represents labial harmony or rounding. The spreading of the I element represents palatal harmony. And the spreading of the A element represents height harmony<sup>15</sup>. A nasal element N is also available in order to form nasalised vowels.

<sup>13</sup> In earlier work, this element has also been represented as v.

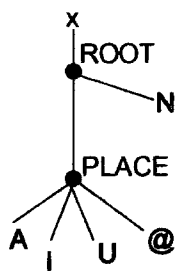
<sup>14</sup> Many languages display a central default vowel. The quality of this vowel however varies from system to system. In English, the vowel materialises as a schwa. In Spanish, it is [ e ], In Japanese, it is [ i ] and in Telugu, it is [ u ] (Harris 1994:109).

<sup>15</sup> The spreading of the @ element has a multitude of effects depending on which precise model of GP is followed. Discussion of this, however, is beyond the scope of this thesis.

These elements are incorporated into the geometry illustrated in Figure 2,9. In this diagram, the choice of either I A U and @ define the place of the vowel. N on the other hand fuses directly with the root node and depicts the manner of articulation. This set up is equivalent to that of consonants with which the next subsection is concerned.

Figure 2,9.

The geometric structure for Vowels



2.2.2 Consonants.

The elements that represent vowels are also part of the set used to represent consonants. Consonants usually involve more than one element in their make-up since most need to be specified for at least manner of articulation, place of articulation and maybe voicing. The elements are thus said to 'colour' a consonant with a certain feature. I colours consonants with palatality and as a simplex element represents [y]. U colours consonants with labiality and as a simplex element represents [w]. A colours consonants with uvularity and pharyngeality. And @ colours consonants with velarity and as a simplex element represents [ x ]. All place dimensions, save for coronality, are relatively uncontroversially expressible in this model.

Coronality, on the other hand, is a much discussed place feature of consonants. It has special features setting coronal segments apart from other segments. The properties are summarised by Harris (1994) and reproduced in Brockhaus (1995a:110).

#### *Coronal Syndrome*

##### Cross Linguistic incidence

- (a) Coronals constitute the most frequent class of consonants of the world's languages.
- (b) All languages have at least one coronal consonant.
- (c) Liquids are overwhelmingly coronal.
- (d) The coronal class shows a greater richness of place and manner contrasts than other consonant classes.

##### Processes

- (e) Consonant harmony occurs exclusively on coronals.
- (f) Coronals, unlike other classes, are never opaque to harmony.
- (g) Coronals are more prone to assimilation than other classes.

##### Phonological distribution

- (h) Coronals (typically / universally?) cannot appear independently in the first C of any internal -C.C- cluster.
- (i) In many languages, a word final consonant can only be coronal.
- (j) In many languages, the margins of word-edge clusters can only be occupied by coronals.
- (k) Coronals are favourite 'fillers' in hiatus-breaking onsets.

These special qualities have led to a great deal of disagreement over coronal representation in element based models of phonology. Some researchers postulate an independent element R (Harris 1994, Brockhaus 1995b). Some researchers, however, argue that a separate element can not reflect the special nature set out above. They argue that the status of the coronal element as phonologically significant remains doubtful. These researchers represent coronality as a place-less consonant which reflects its unmarked nature<sup>16</sup> (Backley 1993, Brockhaus 1995a). I am choosing to follow the

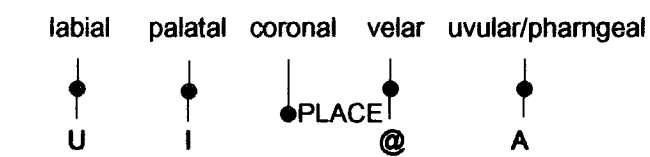
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<sup>16</sup> It will be shown in due course that this approach to coronal place reduces the number of elements in those segments. In GP, this reduction in complexity reflects some of the special restrictions on this place. For example, a word final consonant, and a coda consonant hold less complex expressions

subsegmental consonantal approach of Brockhaus (1995a.) thus coronal will not be represented with a separate element.

Figure 2,10. illustrates the consonant place elements discussed so far. As can be seen from this diagram, coronal is represented as an empty Place node.

Figure 2,10.

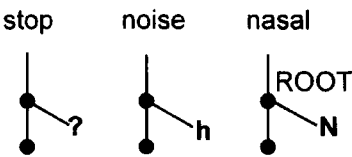


Three elements are recognised as representing manner of articulation in GP. The element ? may be described as edge or stop. Its independent manifestation is that of a glottal stop. The element h may be described as noise. This element is involved in the production of released obstruents (plosives, affricates and fricatives) but is absent from sonorants and unreleased oral stops. Its independent manifestation is that of a glottal fricative [h] (Harris and Lindsey 1995). The element N may be described as a lowering of the velum. This element represents both nasal stops and nasalised vowels.

Figure 2,11. illustrates the precise fusing of the 'manner' elements in subsegmental geometry. All of these elements are fused directly to the Root node in GP.

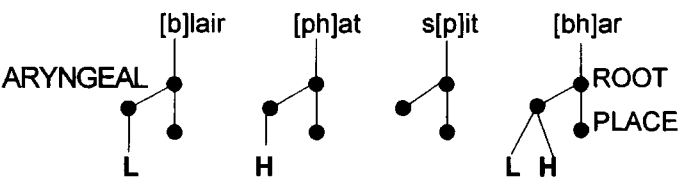
than is possible in other positions. The coronal expression is less complex thus may be the only segment type to be permitted in this position.

Figure 2,11.



Two addition elements are also postulated (Brockhaus 1995a.). **L** and **H** denote slack vocal folds and stiff vocal folds respectively and make up the elements fused at the Laryngeal node. In Figure 2,12. the presence of these elements in the geometry is illustrated. With regard to obstruents, the presence of **L** is often treated as full voicing (e.g. English '**bl**air')<sup>17</sup>. **H** indicates voicelessness with aspiration (e.g. English '**ph**at'). The absence of either element is generally interpreted as neutral voicing (e.g. English '**sp**it'). Finally, both **L** and **H** together in a compound indicate voiced aspirates or 'breathy voice' (e.g. Gujarati '**bh**ar') (Harris 1994:135).

Figure 2,12.

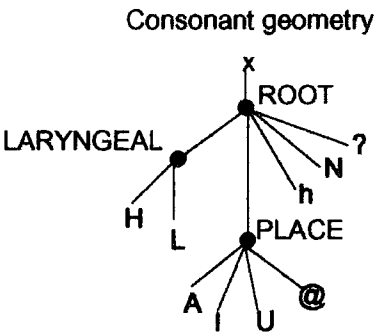


In total then, the element geometry of consonants is made up of the structure in Figure 2,13. One consonant will manipulate a certain number of fusions of these elements and nodes in order to surface as a phoneme.

<sup>17</sup> Voiced obstruents in non-branching onsets do not manipulate the **L** element (Harris 1994:171). Thus the make-up of the voiced obstruent in the English word 'bat' has no element fused to the Laryngeal node. The **L** element is only really necessary in order to strengthen the complexity of a segment when that segment is the head of a branching onset (e.g. in 'blair'). This fact falls out from the phonology itself and will become clearer in section 4.

In total then, the element geometry of consonants is made up of the structure in Figure 2,13. One consonant will manipulate a certain number of fusions of these elements and nodes in order to surface as a phoneme.

Figure 2,13.



## 2.3. Matrix Calculus

It has been suggested in the discussion that a number of elements can 'fuse' into the geometry of one segment. This is a necessary mechanism. There are many more sounds than can be made using just one of the basic elements introduced in the last section. Moreover, consonants in particular need, in most cases, to be specified for more than just one feature.

Elements combine to form complex elements in order to generate a full sound system. This combination is reminiscent of the mixing of different colours of paint from the basic primary colours. A combination of elements and nodes is formally known as an 'expression' (Brockhaus 1995a). These expressions are made-up of various autosegmental tiers fused to shared nodes. This fusion is formally calculated using the principles of Matrix Calculation (KLV 1985).

### 2.3.1. Fusion using Matrix Calculus.

Expressions are built using the principles of Matrix calculus. Each expression is made up of one or more elements in which the elements can be a head and/or one or more operators. Operators contribute only their salient property, which has been appearing throughout this thesis in bold in a feature matrix. A head element contributes all properties not already overridden by salient operator properties<sup>18</sup>.

In an expression consisting of two elements (e.g. **I** and **A**), two possible sounds are derived: one where **I** is the head and one where **A** is the head<sup>19</sup>. In Figure 2,14 the formal representation of these two

---

<sup>18</sup> Two conventions are practiced in GP literature to distinguish the head over its operators. Either the head can follow the operators in an expression, or the head is underlined. I see no advantages to the use of either formalism and will use both or indeed neither if the distinction is not crucial to a discussion.

<sup>19</sup> I will restrict my discussion to vowel fusion. It seems to me that consonantal expressions used in

combinations is given. Square brackets encloses the two elements which will both be fused to the Place node on the geometry structure. A dot stands for the mechanism of fusion (Roca 1994:124). The head is underlined.

Figure 2,14.

$$[A, \underline{I}] = e$$

$$[\underline{A}, I] = ae$$

A complete matrix fusion is illustrated in Figure 2,15. In this representation, the head matrix follows the operator matrix. A dot again indicates fusion. The fusion can be followed step by step. Firstly, envisage an empty matrix placed in the output position. In turn, each line of features is considered. The first line contains no bold feature in either matrix, therefore the value of the feature in the head matrix is placed in the output matrix. The second line contains a bold feature which is automatically placed in the output matrix<sup>20</sup>. The third line also contains a bold feature. This feature is in the operator matrix but since this is that element's salient feature, it overrides the head and is placed in the output matrix. The fourth and fifth lines do not contain any bold features, so the value of the features of the head matrix are adopted.

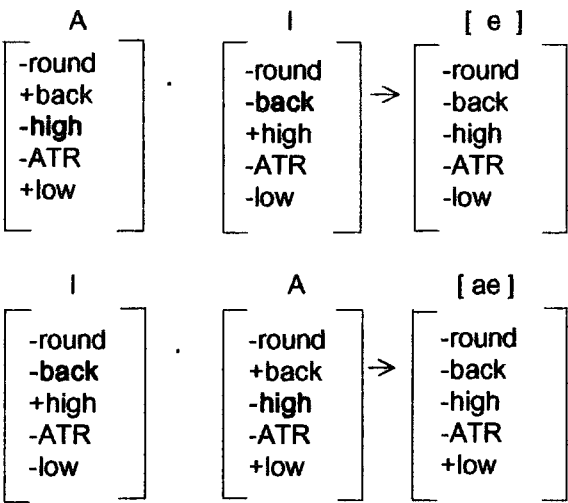
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GP have not been calculated in such a methodical way. A list of the English and certain French expressions used for both consonants and vowels can be found in Appendix 1.

<sup>20</sup> Since this bold feature is also in the head matrix, it would be adopted in the output anyway. Thus, this heading does not actually affect the output at all.



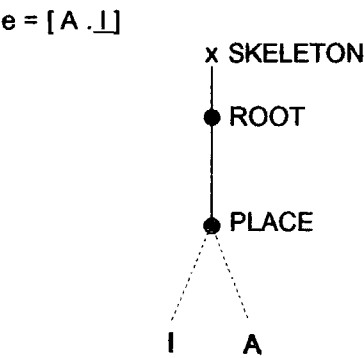
Figure 2,15.



2.3.2. Fusion

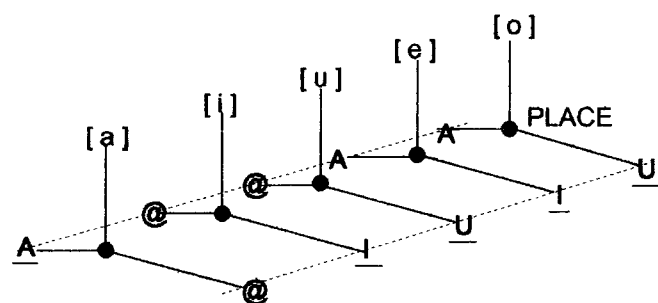
Each element has been described as resting on its own autosegmental tier. Fusion, then, is in fact the linking of two autosegmental tiers to one higher node in the element geometry. Therefore, fusion can be shown to form a three dimensional melodic grid as represented in Figure 2,16 below (Harris 1994:101). In this illustration the segment [e] is derived. The two elements are linked to the same Place node using association lines from the autosegmental tiers (simply represented as the particular element) to that node.

Figure 2,16.



As mentioned in Footnote 4 earlier in this section, tiers are not all autonomous in every language. Language specific collapsing of tiers is permitted to restrict certain fusions of elements. Elements on the same tier cannot both be fused to the same skeletal position. The tiers of I and U are conflated in English to prevent front round vowels surfacing in the phonology (Harris and Lindsey 1995:52). In Figure 2,17 the English autosegmental tiers are illustrated. For simplicity, only the place node is represented. I and U reside on the same tier, A has its own tier. Thus only A and one of either I or U can affect the vowel quality in any one segment.

Figure 2,17.



In Figure 2,17, the element @ has been included in the fusion of the English vowels. @ is considered to be latently present as a dependant in all vocalic expressions and is not resident on its own tier at all. It is placed at any intersections of an association line, an autosegment and a node that is unfilled by some other element (Harris 1994:111). This inclusion does not effect the segment realisation in any obvious ways. This is due to @ being a 'cold' vowel: I.e. this element does not have any salient properties. Therefore, if fused as an operator, no changes result in an expression's manifestation. Only the salient properties of an operator manifest<sup>21</sup>.

<sup>21</sup> In most GP literature, the latent @ element is not included in every representation. This is simply for convenience and simplicity.

### 2.3.3. Headedness

The only time @ manifests itself autonomously is when it is the head of a complex element. If @ is the head of an expression, it is considered active. Headedness (and with it, head alignment) is becoming a crucial concept in GP but will feature only minimally in this thesis due to problems which still need to be ironed out and a lack of great usage of the concept in some languages, for example English.

Briefly however, ATRness,<sup>22</sup> a necessary feature of certain languages, has been structurally defined in GP as a vowel segment with an active @ element. The active @ element represents non-ATR high and mid vowels (Lass 1984:277) A recessive @ element therefore represents ATR high and mid vowels (Harris and Lindsey 1995:64). However, the treatment of ATR remains hotly disputed in element-based models (Harris and Lindsey 1995). In addition and due to the above definition, ATR harmony effects have been re-analysed in GP as 'head alignment'. This concept is problematic in GP. It reduces the restriction in the phonology due to an increase in possible processes. This discussion however is beyond the scope of this thesis.

In English and French, the languages I am concerned with in my data, ATR can be argued to be phonologically indistinctive (Kaye 1997). Vowel length and headedness nevertheless have some importance. The ability of an element or position to be a head or not is parametrically determined. In English, long vowels must be headed by either A, I or U. Short vowels, on the other hand, must be headed by @. In French, both long and short vowels must be headed by A, I or U (Kaye 1997). Figure 2,18 illustrates the vowel qualities of (a) English and (b) French and the determined headedness of these vowels.

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<sup>22</sup> ATR stands for Advanced Tongue Root. An ATR vowel is tense while a non-ATR vowel is lax.

Figure 2,18. (Kaye 1997)

(a)

A @ pat	A part
I @ pit	I pete
U @ put	U boot
A I @ pet	A U boat
A U @ pot	U A bought

(b)

A pas
I cri
U fou
A U faux
A I fé
I A fait
I U fût
A I U feu

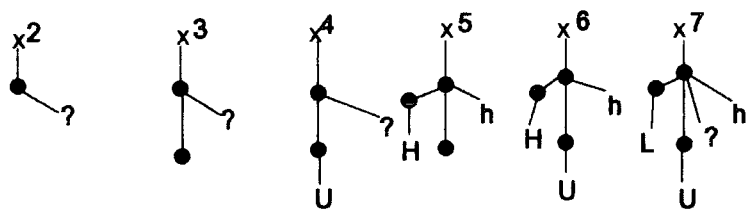
2.3.4. An introduction to complexity

The number of parts to an expression, the complexity, is a crucial concept in GP. The least number of elements in a phonetically pronounceable expression is one. The most elements in any one expression is four. However, in addition to the number of elements, I am following the work of Brockhaus (1995a) in also calculating the number of nodes in the geometry structure of an expression. Complexity is thus calculated on the basis of the number of elements (excluding the cold vowel @ in operator role) and number of nodes of which a segment is composed (Brockhaus 1995a). Complexity is a theory internal calculation of segment status. An expression made up of one element and one node has 2-complexity

etc. Complexity calculations are illustrated in Figure 2,19. The bold text number next to each skeletal position records the complexity of the expression associated to that position.

Figure 2,19.

Complexity Calculations



Complexity replaces a sonority hierarchy in determining which sounds can be adjacent in a syllable. This will be discussed in much more detail in section 4. The precise make up of each consonant will not be detailed in this thesis. The expressions I am using are listed in Appendix 1. One must, however, turn to Brockhaus (1995a.) for detailed discussion on the choice of elements and nodes present to distinguish different phonemes.

It can be seen in the description so far that the GP framework is a highly restrictive model. This restriction is however born not only from the limited available subsegmental structure set out in this section, but also from limited segmental positions and obligatory licensing relations which must exist between adjacent segments. These second two notions are discussed in much more detail in section 3.

### Section 3. Structural organisation

As already stated, GP is a highly restrictive model both at the subsegmental, segmental, and suprasegmental levels of phonology. Restrictions on both segmental make-up and suprasegmental structure are due to 'licensing' requirements. Licensing is the motor which drives phonology in the GP model (Charette 1990). Licensing can be envisaged as a permit passed from one position to another position in order for the latter to form part of the phonology. A permit-giver (the licensor) must have a permit to give (be licensed to govern). A receiver (the licensee) must be able to carry a permit (have equal or reduced complexity than its licensor)<sup>1</sup>.

Distinctions can be made in GP between certain types of licensing and the actions that they can trigger. For example, proper government, inter-onset licensing and magic licensing are specific types of licensing that are involved when an empty position is sanctioned. The following different arrow heads and lines will make certain necessary distinctions clearer although these distinctions are not crucial in most of the discussion.

- General licensing ( ——→ P-licensing vs ——→ A-licensing)
- ▶ Proper Government, inter-onset licensing and magic licensing
- ➔ Parametrical licensing

Harris (1992) claims there to be only two true types of licensing; Prosodic (P-) licensing<sup>2</sup> and Autosegmental (A-) licensing<sup>3</sup>. Although really just facets of the same fundamental mechanism (Harris 1994), these two concepts will be discussed in their own sections. A-licensing sanctions the presence of autosegmental material in the melodic positions and will be the topic of section 4. This licensing

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<sup>1</sup> The figurative use of permits will be used through out this section and the next.

<sup>2</sup> Prosodic licensing (P-licensing) was first discussed in the work of Selkirk (1981).

<sup>3</sup> Autosegmental licensing (A-licensing) was first discussed in Goldsmith (1989)

manipulates the complexity of segments and will be seen to be ultimately responsible for the vast majority of phonological events in languages. For example, segmental weakening, vowel reduction, syncope and consonant lenition are dependant on a-licensing (Harris 1992).

P-licensing, discussed in this section, sanctions the presence of the actual constituents and skeletal positions within a phonological hierarchy (Harris 1992). P-licensing restricts the traditional view of syllabic structure by determining whether a position can exist or not and the relationships that position must enter into if it does exist.

### 3.1. P-licensing

The Licensing Principle clearly states the requisite of P-licensing.

*Licensing Principle* (Kaye 1990:306)

All phonological positions save one must be licensed within a domain. The unlicensed position is the head of this domain.

Licensing, then, is obligatory and links all phonological positions from the head of the highest projection in a domain downwards. This highest domain is the head of the morphological domain (Brockhaus 1995a:173). The projection of the domains up to the morphological domain roughly correspond to the prosodic hierarchy (See Selkirk 1980, Nepor and Vogel 1986 and McCarthy and Prince 1986).

Prosodic Hierarchy (Harris 1994:151)

Phonological phrase

Phonological word

Foot

Syllabic constituent

Skeletal position

In GP, the lowest projection from the skeletal tier is the constituent level where the basic building blocks of the model are licensed, next is the interconstituent level where constituents are linked to adjacent constituents<sup>4</sup>, next is the nuclear projection level where contiguous nuclei are linked<sup>5</sup>. Next is the phonological word level continuing up to the morphological domain.

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<sup>4</sup> These two levels together are equivalent to the traditional syllabic level of the prosodic hierarchy.

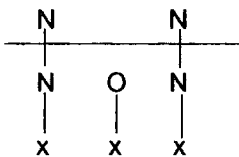
<sup>5</sup> This level resembles the traditional foot level of the prosodic hierarchy.



P-licensing is an asymmetric binary relation. One position licenses and is the licenser (or head). One position is licensed by that head and is a licensee (or dependant). The area over which a licensing relation extends is said to be the licensing domain (Brockhaus 1995a). Licensing is local, i.e. positions must be adjacent, and licensing is directional. The locality of licensing does not however always refer to two strictly adjacent positions on the skeletal tier. Positions can be considered adjacent at their level of projection without being adjacent at the skeletal level. For example, nuclei are adjacent on their projection level where intermediate onsets are not also projected. This level is illustrated in Figure 3,1.

Figure 3,1.

Projection of nuclei to a higher domain in which they are adjacent.

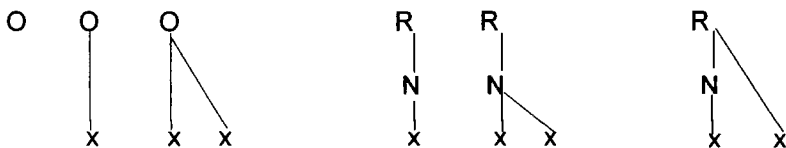


The Projection Principle, introduced in section 1, stated that licensing relations are established at the level of representation. The phonology can not manipulate these relations. Relations may be added with the addition of morphology but not changed or deleted. Therefore, resyllabification is not permitted in GP. This makes GP much more restrictive in dealing with traditional phonological processes.

3.2. Licensing at the constituent level.

There are a limited number of constituents present as building blocks in the GP model. This allows greater restriction of the theory as a whole. Figure 3,2 illustrates the possible basic syllabic constituents that are available in which segments can be placed. These structures represent the only syllabic constituents permitted by the GP model<sup>6</sup>. The constituents divide into three: the Onset (O), the Nucleus (N) and the Rhyme (R)<sup>7</sup>.

Figure 3,2.



The above are arboreal representations which are used in the majority of the GP literature. However, constituents can also be represented using brackets and in this thesis, the bracketed representations illustrated in Figure 3,3 will be adopted as much as possible. This latter choice improves the representation of the licensing, the licensing chains therein and the hierarchical domains.

<sup>6</sup> The standard view of the syllable itself has no status in GP. The status of the syllable as a constituent is doubtful according to KLV (1990). There is a distinct lack of evidence that the syllable behaves like a constituent (KLV 1990). Rather than the syllable constituent, KLV (1990) define a tier of representation which conforms to the pattern O R.

<sup>7</sup> There is no coda constituent in the GP model. KLV (1990) propose a post-nuclear tauto-syllabic consonant attached directly to the rhyme with no intervening constituent. This position is highly restricted. Indeed an onset must follow which can hold an inter-constituent governing relation with the post-rhymal adjunct. Further discussion of this can be found in section 3.3.

Figure 3,3.

[ ]O	Empty Onset
[ x ]O	Non-branching Onset
[ x x ]O	Branching Onset
[[ x ]N]R	Non-branching Nucleus
[[ x x ]N]R	Branching Nucleus
[[ x ]N x ]R	Branching Rhyme

Languages vary with respect to whether they possess the full range of the possibilities in Figure 3,3. Some languages have an obligatory onset position in which case [ ]O would not be permitted<sup>8</sup>. Languages also vary over their permitted branching of constituents. Cross-linguistic differences can be characterized in terms of the following three parameters, Figure 3,4, examining constituent structure.

Figure 3,4.

*Constituent Structure Parameters* (adapted from Harris 1994: 150)

Branching constituent licensed?	[OFF]	ON
a) Onset	Arabic	English
b) Nucleus	Yoruba	English
c.) Rhyme	Zulu	English

Square brackets define the unmarked setting for this parameter. Thus, non-branching positions are unmarked. A language is therefore implicitly assumed to have a non-branching counterpart if the

---

<sup>8</sup> The equivalent [ ]N is impossible in GP. Licensers have to have a skeletal position (Charette 1991). Nuclei always license a preceding onset as stated in the Onset Licensing Principle in the next section so can never lack the x on the skeletal tier (Brockhaus 1995b).

branching parameter is set as ON. Furthermore, a positive setting for (a) depends on a positive setting for (c). No languages have branching onsets without also having branching rhymes (Harris 1994).

All the constituents are at most binary due to the strict nature of licensing relations. This binarity is expressed in the precise universal definition of a syllabic constituent.

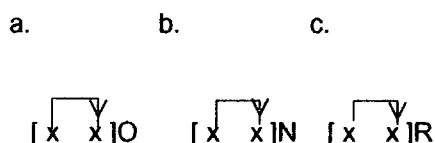
*Syllabic constituents* (adapted from KLV 1990:198).

A syllabic constituent is a licensing domain where licensing is characterised as

- a. Strictly local
- b. Strictly directional: head initial.

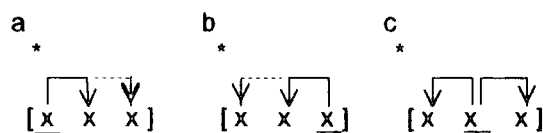
Licensing at the constituent level is shown on the following three structures in Figure 3,5.

Figure 3,5.



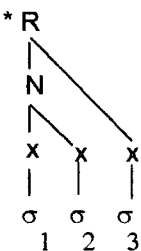
Locality and directionality restricting licensing make ternary constituents impossible as can be seen in Figure 3,6. below. The underlined x represents the head of the constituent. In (a) and (b) strict locality is violated since the furthest x from the head is not adjacent to that head. In (c), strict directionality is violated since the head must license in both directions in order to set up a relation with x slots on either side (adapted from KLV 1990:199).

Figure 3,6.



The strict locality condition logically excludes a long vowel or heavy diphthong from being placed in a closed syllable, i.e. VVC. This structure is termed a super heavy rhyme. The head can not license the third segment in example 3,7. below since it is not adjacent to it. This restriction is a problem in GP since super heavy rhyme structures are present in some languages. The problem is resolved in GP however by a licensing relation at the next level.

Figure 3,7.



3.3. Licensing at the inter-constituent level

Inter-constituent licensing must maintain strict locality and directionality as does constituent licensing. The direction of licensing at the inter-constituent level is not, however, the same as that of the constituent level.

*Inter-constituent Licensing* (Harris 1994:159)

Between constituents, licensing relations are head-final.

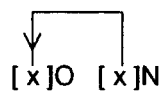
There are two cases of inter-constituent licensing in GP. The first is an implicit assumption of GP expressed in the following principle;

*Onset Licensing Principle* (Harris 1992:380)

An onset head position must be licensed by a nuclear position

This is shown below in Figure 3,8. Note that the licensing line has been heightened to the next level. This graphically represents the inter-constituent level.

Figure 3,8.



This licensing is obligatory in order for an onset in turn to license its complement as is stated in the condition below. When licensed, its complements are either a branching onset or a rhyml adjunct.

*Government Licensing*<sup>9</sup> (adapted from Charette 1990:242)

For a governing relation to hold between a non-nuclear head A and its complement B, A must be licensed to govern by its nucleus.

*Licenser* (Charette 1990:242)

The government licenser of an onset is an unlicensed nucleus.

The second case of inter-constituent licensing brings us back to the problem of allowing super heavy syllables as mentioned in the previous section. In order to permit melodic structure in a skeletal position, licensing is necessary. It was shown above that the ternary branching in a super heavy syllable can not be permitted at the constituent level because the rhyml adjunct can not be licensed. The position is, however, licensed at the inter-constituent level.

*Coda*<sup>10</sup> *licensing principle* (Kaye 1990:311)

Post-rhyml positions must be licensed by a following onset.

Thus, the following universal structure illustrated in Figure 3,9 must appear when a rhyml adjunct is postulated.

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<sup>9</sup> Government, in this definition, can be understood as another term for licensing. 'Licensing Licensing' is not particularly graceful.

<sup>10</sup> The rhyml adjunct is still confusingly called a 'coda' in much of the GP literature. It must be noted that this is not the coda in its original syllable based definition. It is just a shorter name than Post-rhyml adjunct. The two names are interchangeable.

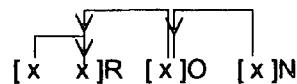
Figure 3.9.

1 'Coda' licensing of a super heavy rhyme



i. The final nuclei are included in the examples

2 Simple 'Coda' licensing



since they are obligatory in order to license the onset to govern as mentioned above.

ii. The rhymal adjunct in example 2 is double licensed.

The implication of this is taken up in section 4.

This structure severely restricts the cases when a rhymal adjunct can be postulated. Not least, word final codas will never be found<sup>11</sup>. In languages without post-rhymal positions, the onset is said to fail to p-license the position. This is set by a parameter where the unmarked setting is NO.

Onsets can license post-rhymal positions YES / [NO]

Thus far, the head nuclei have not been licensed by any other segments. This occurs at the next level of projection in GP and is also the level associated with the representation of vowel harmony.

<sup>11</sup> Word final consonants must surface through other means.



### 3.4. Licensing at the nuclear projection level.

Licensing at the level of nuclear projection is a relation between two adjacent nuclei. Locality requirements are relaxed at projection levels however. Locality is understood as 'adjacent for some projection' (Kaye 1987). Certain nodes are envisaged as able to project to a separate levels allowing them to be either adjacent at that level or not depending on whether an intermediate node also has the ability to project. The level of nuclear projection is one such level.

Another difference between this and the lower levels is in the direction of licensing. No universal direction is set at the nuclear projection. Licensing is parameterised. This is very much reminiscent of foot structure in languages.

*Nuclear Projection licensing* (adapted from Harris 1994:157)

Between the projections of nuclear heads, licensing relations are parametrically head final or head initial.

In French (Charette 1991) and Moroccan Arabic (Kaye 1987) licensing at the level of nuclear projection operates from right to left . In English (Harris 1994) and German (Brockhaus 1995a:92), it operates from left to right<sup>12</sup>. These two directions of licensing are illustrated in Figure 3.9. Again, the licensing at this level have been heightened to clearly indicate this domain.

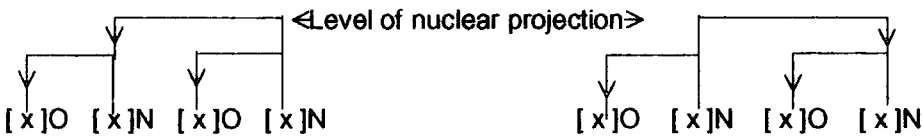
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<sup>12</sup> The direction of licensing at a level remains constant within a language. It can however alter between levels. Thus in German, licensing at the foot level is left headed and at the word level is right headed (Brockhaus 1995a:92).

Figure 3.9.

(a) Right headed licensing

(b) Left headed licensing



The effects of licensing at the nuclear projection are seen in various 'prosodic phenomena' such as stress systems, tonal phenomena and syncopation effects (Kaye 1987). This again tallies with the traditional foot level. It is also at this level that vowel harmony can act<sup>13</sup>.

As has been mentioned previously in section 2.1 and Footnote 6 of that section , vowel harmony can be considered a spreading effect<sup>14</sup>. One or more elements from a specific vowel in a domain, if parametrically determined to be harmonic elements, can spread to other vowels in that domain. With the added descriptive tool of licensing, the harmonic vowel is specified as the head nucleus (licenser), and the latter vowels must all be licensed by that nucleus at the level of nuclear projection.

Barasano has a process of nasal harmony across vowels as shown in the examples in Figure 3,10. In this language, vowel nasalisation spreads rightwards from the head nucleus to the dependant nuclei (Piggott 1998).

<sup>13</sup> Kaye (1993) suggests that the nuclear projection phenomena may cause some latitude in the interpretation of the Projection Principle discussed in section 1.0 and 3.1. Some governing relations crucial to these phenomena may be defined at a later level than that of the lexical representation. However, the Projection Principle still holds in the most part and still bans resyllabification.

<sup>14</sup> Or, in terms of GP, a condition on well-formedness.

Figure 3,10.

m â s î - w î 'I knew'  
? o h a - w i 'I wrote'

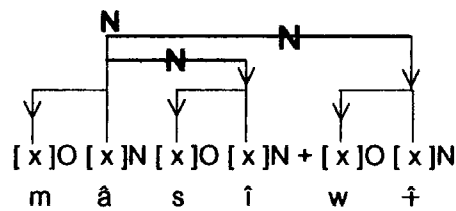
Thus, in Barasano the following parameters are set:

- i. Licensing at the level of nuclear projection: Left to Right
- ii. The element N is harmonic
- iii. The harmonic domain is the word

The harmony can be illustrated as in Figure 3,11. The nasalisation in this illustration can be shown to follow the paths of the licensing at the nuclear projection level and at the word level. The head passes the nasal element to its dependant at both of these levels.

Figure 3,11.

Barasano nasalisation



Kpokolo, an Eastern Kru language has a process of rounding harmony across vowels as can be seen in the examples in Figure 3,12. In this language, rounding spreads from right to left (KLV 1985).

Figure 3,12.

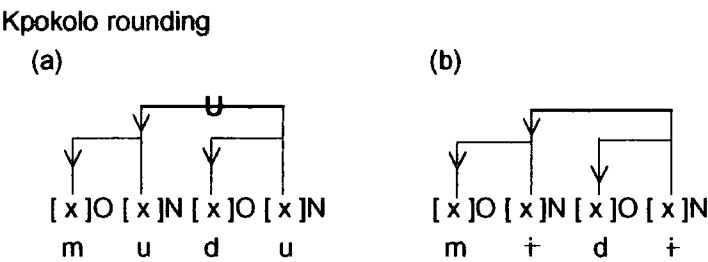
[ g o l u ] - [ g e l i ]  
[ k p o l u ] - [ k p e l i ]  
[ m u d u ] - [ m i d i ]

Thus in Kpokolo, the following parameters are set:

- i. Licensing at the level of nuclear projection: Right to left
- ii. The element U is harmonic
- iii. The harmonic domain is the foot (possibly the word with further examination of data)

The harmony can be illustrated as in Figure 3,13. In (a), the U element is given to the dependant at the nuclear projection level from the head. In (b), no U element is available to spread in the expression [ i ]. Thus, spreading can not apply.

Figure 3,13.



Minimality constraints affect the ability of a licensing relation to hold. Minimality has its roots in syntactic government (Chomsky 1986). The Minimality Condition concerns the idea that some licensing domains resist licensing by a remote licenser (Reuland 1983). In other words, a licensing domain, set up when an arrow links two positions in a representation, can form a barrier to other licensing.

The projection of a head blocks licensing from outside that projection. Complements of heads can therefore never be double licensed. Moreover, branching constituents can project and block certain types of licensing on levels they should be unable to effect. For example, an onset node can, in certain languages and situations, project onto the nuclear projection level. This causes surrounding constituents to behave differently since they are no longer adjacent at their level (Charette 1989).

*The Minimality Condition (Chomsky 1986:42)*

In the configuration ... $\alpha$ ... [ $\gamma$  ... $\delta$ ... $\beta$ ...]

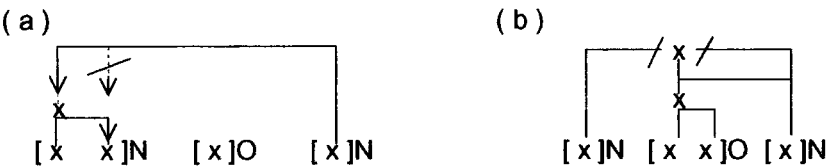
a.  $\alpha$  does not govern  $\beta$  in the above configuration if  $\gamma$  is a PROJECTION of  $\delta$  excluding  $\alpha$

or

$\alpha$  does not govern  $\beta$  in the above configuration if  $\gamma$  is the IMMEDIATE PROJECTION of  $\delta$  excluding  $\alpha$

The following two examples in Figure 3,14 are of the minimality condition acting on the licensing of structures. Firstly, in (a) it can be seen that the licensing of the complement of the first nucleus is not satisfied at the level of nuclear projection because the nucleus and its complement form a separate licensing domain represented as an additional x. Secondly, in (b) a governing domain can, in some languages, have the ability to project on to the nuclear projection level as represented as a second additional x thus blocking certain licensing relations from holding between nuclei.

Figure 3,14.



The minimality condition could effect harmony processes. Harmony is determined by licensing and minimality can block licensing which may be necessary for that harmony to apply. Harmony should be unable to manipulate (directly?) the form of a nuclear complement. A language with a branching onset projection to the nuclear projection may also block harmony. More research needs to be undertaken in order to examine these effects. The research is, however, beyond the scope of this thesis as is any further discussion of minimality in general.

### 3.4.1 The Empty Category Principle.

Due to the structural restriction of GP, empty positions are important and influential. Empty positions can not however be sanctioned wherever they are needed in an analysis. If this was the case the GP model would obviously greatly over-generalise phonological structure. Empty positions must be licensed in specific ways in order to form part of phonology. At the nuclear projection level, empty positions can be restricted using the syntactic principle of the Empty Category Principle which is parametrically ON or OFF in languages<sup>15</sup>.

*Empty Category Principle* (KLV 1990:219)

A position may be uninterpreted phonetically if it is properly governed.

Proper Government is a more restrictive type of P-licensing<sup>16</sup>.

*Proper Government* (adapted from Charette 1990:236)

- a. A licenses B (A and B are adjacent on the nuclear projection)
- b. A is not itself licensed
- c. The domain of proper government may not include an intervening licensing domain<sup>17</sup>.

---

<sup>15</sup> Empty positions are also licensed through Inter-onset licensing at the Onset Projection level (section 3.1.4) and through Magic licensing when analysing s+C(C) clusters (section 4.2.1).

<sup>16</sup> In the spirit of Chomsky's (1981) Avoid Pronoun Principle for syntax, Charette (1991) proposes a principle that imposes the choice of an empty nucleus rather than a phonetically filled nucleus whenever the Proper Government conditions are ON in a language and met.

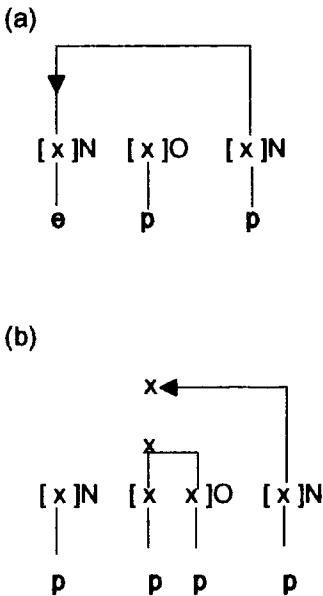
*The Avoid 'Vowel' Principle* (Charette 1991:84)

An empty nucleus remains uninterpreted whenever possible.

<sup>17</sup> A proper governor can only properly govern one and only one empty position (Charette 1991:93)

The direction of proper government seems to be universally right-headed<sup>18</sup>. Figure 3,15 illustrates proper government. In (a) proper government is permitting an empty position (e). In (b), however, proper government is affected by the minimality constraint and is not satisfied due to the intermediate licensing domain formed by the branching onset. This forces a phonetically realised position (p).

Figure 3,15.



Due to the definition of the ECP, two properly governed positions can never surface if adjacent on the nuclear projection. One of the pair must always receive phonetic interpretation. An empty position must either be properly governed by an adjacent phonetically interpreted position on the right or must fail to be properly governed leading to that empty position on the left being filled with phonetic material.

<sup>18</sup> Although acting at the level of nuclear projection, proper government and nuclear licensing can, in theory, be formed from opposite directions.

3.5. Inter-onset Licensing

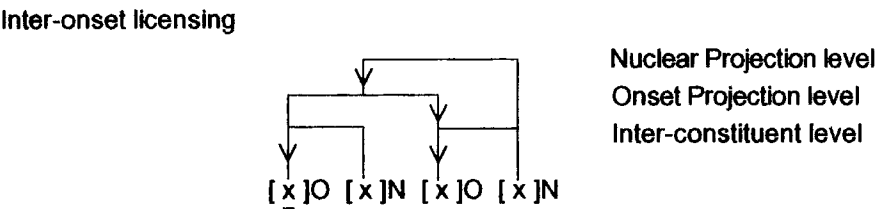
However, the need for two adjacent empty nuclei in some languages, e.g. Polish, has been argued. Gussman and Kaye (1993:451) therefore proposed an additional mechanism for permitting two adjacent empty nuclear positions<sup>19</sup>.

*Inter-onset government*

Inter-onset government p-licenses a nucleus separating the onsets ON / [OFF]

Inter-onset licensing occurs between two contiguous onsets on an onset projection level. The direction of government is left to right. The head onset, on the left, must be more complex than its dependant. Inter-onset licensing is illustrated in Figure 3,16. This licensing is placed on its own level, the onset projection level, represented as a domain between the inter-constituent and nuclear projection levels.

Figure 3,16.



The relation is used to permit an additional empty nucleus. Gussman and Kaye (1993) achieve this by stating that the nucleus separating two onsets in an inter-onset licensing relation can be parametrically licensed by that relation to remain empty. This type of licensing is said to override Proper government if

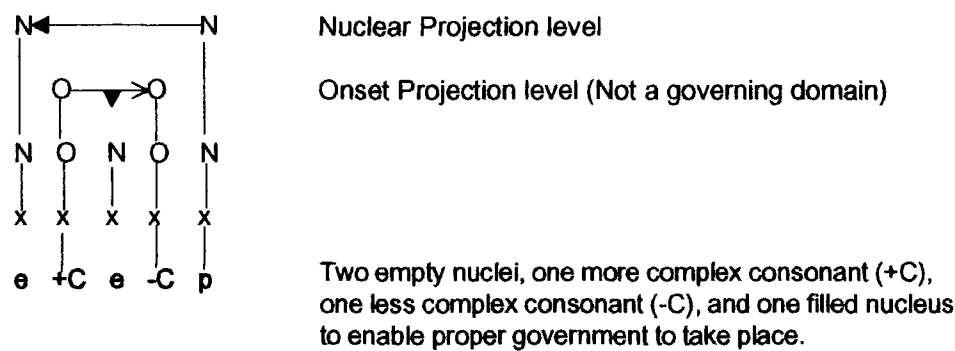
<sup>19</sup> This concept is not given a detailed discussion in GP literature. At first glance it seems to be rather arbitrary in its postulation. However, this tool can be adapted to consonant harmony in children since this licensing involves an onset projection level. In my introduction to this thesis I mentioned that my work would be controversial. It is the use of this concept and the independent projection level that makes it so.



both can act. Inter-onset licensing is stated as the general principle for forming empty positions while proper government can be considered the 'elsewhere' principle (Gussman and Kaye 1993).

In order for there to be two adjacent empty nuclei, however, proper government must also be at work. Gussman and Kaye claim that inter-onset government does not form a governing domain to block proper government from taking place. Therefore, a filled nucleus can properly govern an empty nucleus to the left of the inter-onset governed empty nucleus. This relation is illustrated in Figure 3,17. In this figure, the bold arrow on the inter-onset level represents the proper government that this relation has generated. This relation is not a governing domain, however, which permits the proper government at the nuclear projection level to pass over this relation in order to properly govern the preceding nucleus also.

Figure 3,17.



### 3.6. Conflicting principles

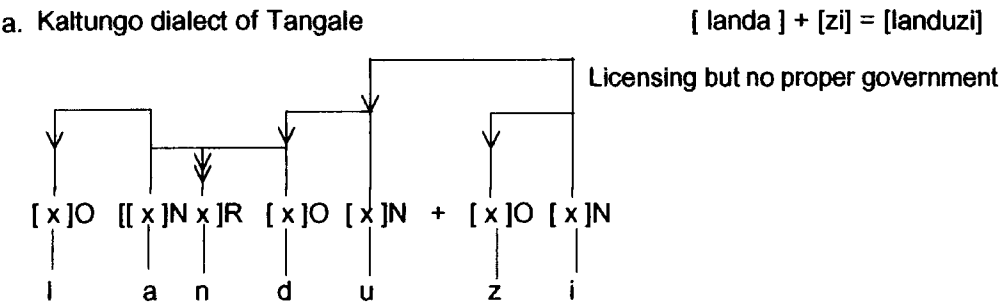
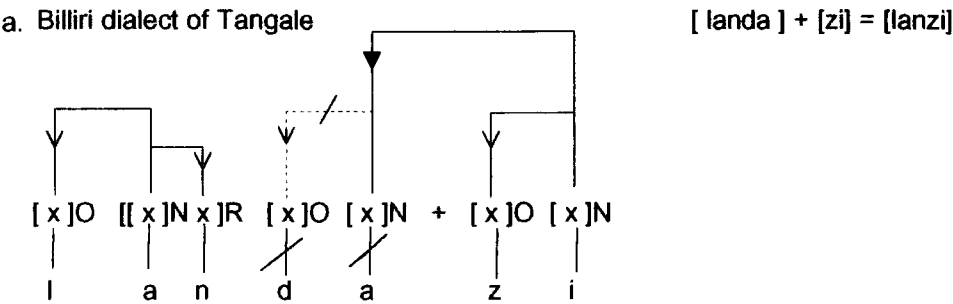
Conflicting principles have been mentioned indirectly in the previous section. Inter-onset government was stated as the general principle and proper government the 'elsewhere' principle in determining empty positions. This was a necessary statement due to the possible clash of these two principles acting on the same nucleus. However, in the situation cited, the 'clash' of the two principles inevitably leads to the same result, an empty position.

Principles do however conflict within a language (Charette 1991) in a more serious way. Two positions may be dependant on the same position but demand an opposing status for that position. The ECP and Government Licensing exemplify one of these conflicts.

- a. An empty nucleus is realised as zero when properly governed by an adjacent unlicensed nucleus.
- b. A non-nuclear head may only license a complement if it is licensed by a non-properly governed nucleus.

The conflicts can be illustrated as in Figure 3,18 below using two dialects of Tangale (adapted from Charette 1991:109 and 111). In this representation, in (a), proper government acts to make the penultimate nucleus empty. This is shown by a line delinking the [a] from the skeletal position. Due to this delinking, the nucleus has no power to license its preceding onset to govern the rhymal adjunct thus one of these positions is unable to surface. The [d] is therefore delinked and the [n] surfaces on its own. In (b), the bold arrow is replaced with a normal licensing arrow showing that proper government does not stand. Thus, the penultimate nucleus is not delinked, and in turn has the power to license its onset to govern the rhymal adjunct.

Figure 3,18.



Parametric ranking of principles is postulated by Charette (1991) in order to find a solution to the conflicts. The Billiri dialect ranks proper government above government licensing. The Kaltungo dialect, on the other hand, ranks government licensing above proper government (and inevitably inter-onset licensing)<sup>20</sup>.

Two language types surface through the alternative rankings. Languages exist which prefer proper government or inter-onset government. These languages permit empty nuclei but in the same structure can not license the onset to enable a branching onset or a rhymal adjunct. On the other hand, languages exist which prefer to government license. These languages permit branching onsets and rhymal adjuncts but the nucleus must be phonetically realised. English tends towards the second language type.

<sup>20</sup> Cyran (1996), on the other hand, postulates the following hierarchy for Munster Irish.

- Inter-onset government
- Government Licensing
- Proper Government

3.7. Word final empty nuclei.

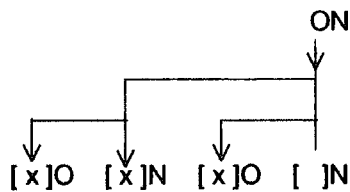
The syllable shapes possible so far in the GP model are limited to being vowel final. This is due to the various licensing relations which must exist in the model. A rhyml adjunct must be licensed by a following onset which in turn must always be licensed by a following nucleus. There are many languages however that permit word final consonants including English. In GP, this CVC structure is satisfied by the postulation of an O N O N structure with a final empty nucleus. The licensing of this final empty nucleus is achieved using a language specific parameter.

*Final empty nucleus parameter*

A domain final empty nucleus is licensed YES / [NO]

The unmarked setting for this parameter is OFF. More languages do not sanction word final consonants than do. If the parameter is set for ON, e.g. in English, the structure in Figure 3,19 is possible.

Figure 3,19.



Additional parameters affecting this word final empty nucleus have also been suggested that determine various language groups. Charette (1991:134) suggests the following parameter which separates languages which permit word final consonant clusters CVC(C) (e.g. French and English) and languages in which only a single consonant CVC can be placed in the position (e.g. Korean, Wolof and Pulaar).

A licensed word-final empty nucleus is a government-licenser YES / NO

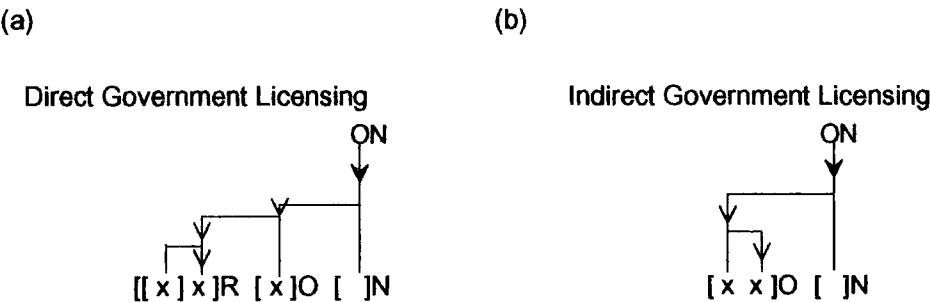
This parameter sets whether the word final empty nucleus can in turn award licensing to the onset to enable that onset to license a complement.

Charette (1991:140) also proposes another parameter which restricts whether a word final consonant cluster can be made from both a branching onset and a rhymal adjunct-onset (e.g. French) or whether the cluster is restricted to a rhymal adjunct followed by an unbranching onset (e.g. English).

A licensed word-final empty nucleus may indirectly government license: YES / NO

Indirect government licensing (Figure 3,20(a)) is the licensing of the onset's complement from the licensing of the onset by the nucleus. The licensing is not adjacent. Direct licensing on the other hand (Figure 3,20(b)) is adjacent licensing (Nikiema 1989). English sets this parameter to NO while French sets this parameter to YES.

Figure 3,20.



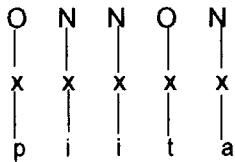
3.8. The Obligatory Contour Principle.

The OCP performs a function in GP which differs from the original idea of what the OCP should do (Brockhaus 1995a:102) (See Goldsmith 1990, McCarthy 1986, Odden 1986 and Yip 1988 for discussion of the OCP). In the standard application of the OCP (Figure 3,21), the OCP prohibits two identical melody units from occurring adjacently. It does this by delinking the offending unit and linking the same unit from the adjacent position.

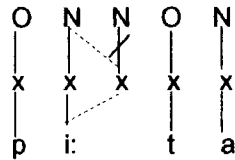
Figure 3,21.

Standard application of the OCP

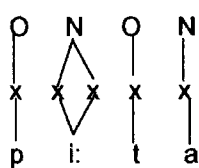
i. Ungrammatical representation of the long vowel in 'Peter' due to identical units occurring adjacently.



ii. The OCP forces delinking of the second N and relinking of the skeletal position to the first N.



iii. Therefore the final representation of 'Peter' does not contain identical adjacent segments.



Above the melodic level however, GP also uses the OCP to eliminate certain positions. It eliminates an empty nuclear position (and a following onset node if unfilled) when it is adjacent (at the skeletal level) to

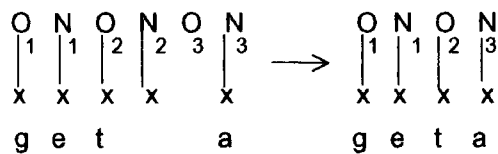
another nucleus. The term OCP may be inappropriate for this mechanism since it is a different application. Gussman and Kaye (1993:433) refer instead to the process of Reduction.

### Reduction

An empty nucleus and an immediately following positionless onset are removed from any phonological representation in which they occur.

The effect of reduction is illustrated in Figure 3,22 below in English. The example is from Brockhaus (1995a:103). N<sub>2</sub> is licensed from the final empty nucleus parameter and O<sub>3</sub> is not obligatorily associated to a skeletal position<sup>21</sup>. These positions are therefore both empty and are therefore both removed from the representation.

Figure 3,22.



This deletion of material conflicts with the definition of the Projection Principle discussed in section 1 and section 3.1 where representations are defined at one level and can not be changed through deletion.

---

<sup>21</sup> Whether an onset must or has no need to dominate a skeletal position is set by a parameter.

*Positionless Onset Parameter* (Brockhaus 1995a:181)

Positionless onset can be licensed : ON / [OFF]

French and English would have this setting at ON, while languages which have been seen to have epenthetic onsets such as German and Wolof would have the parameter set on its unmarked OFF position.

Thus, the postulation of reduction is a definite problem for the GP model. The OCP seems to be restricted to occurring at the phonological phrase cycle of phonology<sup>22</sup>. All the licensing relations hold and all empty positions for all morphemes are distinct before this cycle. The OCP acts on this final cycle where empty positions are reduced (Harris 1994:216). This avoids extreme usage of the principle but is still less than restrictive and is a rather ad hoc restriction at that.

---

<sup>22</sup> Phonology is envisaged as acting in cycles. This is not a concept restricted to GP. The Strict Cyclic Condition (Mascaro 1976, Kiparsky 1982, Halle and Mohanan 1985) is part of a wider theory of phonological cycles. These cycles are basically the phonological operations which occur at the various hierarchical levels.



### 3.9. Licensing at the morphological domain.

The morphological domain is the highest domain in GP phonology and is the only domain where a head is left unlicensed by any higher domain. This unlicensed head is the head of the phonological domain and, as such, bears the main stress of a word (Brockhaus 1995a:173).

The Structure Preservation Principle implies that relations can not change through various phonological derivations at the morphological domain.

*Structure Preservation Principle* (Harris 1994)

Licensing conditions holding of lexical representations also hold of derived representations.

"Derivations are assumed to be 'blind' (in GP) in the sense that no process is aware of the history nor the future of any derivation which is involved" (Kaye 1993:90).

There is, however, some interplay between morphology and phonology in that morphological bracketing can lead to differing interpretations.

Analytic morphology; morphology which can be taken apart and analysed separately, can have a differing interpretation to non-analytic morphology; morphology that makes up part of a word but can not be analysed outside the word domain.

Analytic Morphology: [[A][B]] E.g. [[black][board]]

[[A]B] E.g. [[dark]ness]

[A[B]] E.g. [un[stable]]<sup>23</sup>

Non-analytic Morphology: [ A B ] E.g. [parental]

---

<sup>23</sup> This structure is argued by Kaye (1993:104) to be unattested in phonology. The 'un' morpheme does not surface with a word final empty nucleus as it would if it was a separate domain. Thus these forms could be said to be non-analytic (Kaye 1993). However, discussion of these claims are beyond the scope of this thesis.

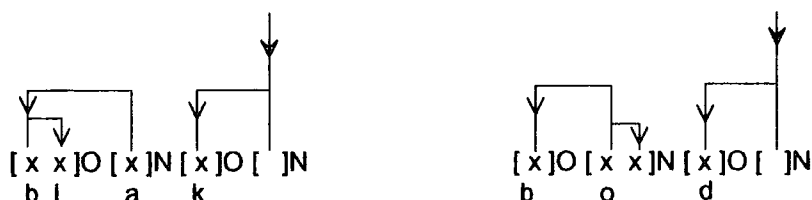
In analytic morphology, phonology acts firstly on each individual domain (Figure 3,23(i,a and b)) and then concatenates those morphemes and the phonology acts again on the full word (Figure 3,23(i,c)). The implication of this is that word-final empty nuclei can be found in the middle of what looks like one word. In fact, the word-final nuclei has been licensed at the first application of phonology, when the nuclei was final, and then the morphemes have been fused. In non-analytic words, no word-final licensed nuclei will be found within the word domain (Figure 3,23(ii)).

**Figure 3,23.**

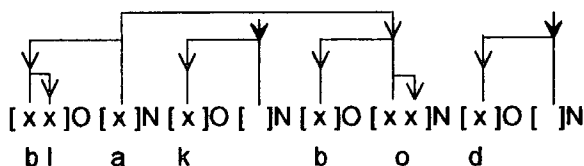
i. **[[black]][board]]**

a.[black]

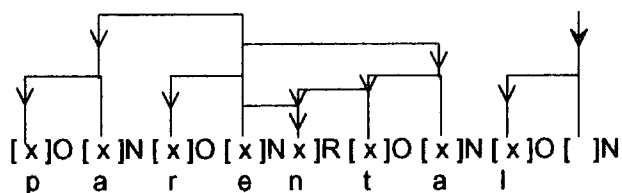
**b. [board]**



c. [blackboard]



ii. [parental]



As mentioned above, the OCP acts when all the morphemes have been added to a structure. The OCP in fact tends to delete the word final empty nuclei within the morphological domain since it is these positions that most often tend to be followed by an unfilled onset position.

This completes the discussion of the positions available in phonology. The following section (4) re-introduces complexity and also introduces a-licensing. These concepts restrict the material which can be held in specific positions and determine the language specific nature of certain relations and restrictions.

## **Section 4. Melodic restrictions**

In sections 2 and 3, the subsegmental make-up of a segment and the restricted positions available in phonology were detailed. In this section, the link between those two sections is discussed. In phonology, there are universal and language-specific restrictions over the types of segments that can be placed in certain positions. In other phonological models, this has been determined using both a sonority hierarchy and language-specific rules. In GP, however, the internal complexity of a segment, a-licensing and the satisfaction of well-formedness takes over. Constraints on positions lead to both static restrictions and, in order to satisfy well-formedness, lead to effects such as reduction, strengthening and harmony.

4.1. The Sonority Hierarchy

A well-formed syllable, in previous phonological models, was determined by whether it conformed to Sonority Hierarchy principles and the sonority scale which is set out in Figure 4,1. According to the Sonority Principles, a nucleus must be the most sonorous segment in a syllable. The surrounding segments must, then, be less sonorous and form a downward slope of sonority on either side of that nuclear peak. As can be seen in Figure 4,1, vocalic segments are said to be most sonorous and thus are possible nuclei. Glides, liquids and nasals are considered to have medium sonority and thus are more likely to be found closest the nucleus. Finally, fricatives and more so oral stops are considered least sonorous and thus placed on the edges of a syllable. So, for example, 'plump' is considered a well-formed English syllable due to its rise-peak-fall pattern of sonority: 1-4-6-3-1. While, 'lpupm' on the other hand would be ill-formed: 41613.

Figure 4,1.

The Sonority Hierarchy (Roca 1994)

Least Sonorous = 1

Most Sonorous = 6

- 1. Oral stop consonants
- 2. Fricatives
- 3. Nasals
- 4. Liquids
- 5. Glides
- 6. Vowels

In GP, there is no need to refer to such a scale. The internal complexity of a segment and licensing are employed as the restrictive measures in the phonological system.

4.2. Complexity

Complexity is calculated on the basis of the number of nodes and the number of elements (excluding @ in an operator role) of which a segment is composed (Brockhaus 1995a). More accurately, complexity is a calculation of the amount of fusion within a segment's melody (Brockhaus 1995a). Complexity is therefore a theory-internal calculation of segment status. The complexity of a segment determines its possible placing within a phonological string. This is formulated as the following condition.

*The Complexity Condition* (Harris 1990:274)

Let  $\alpha$  and  $\beta$  be segments occupying the positions A and B respectively. Then, if A governs B,  $\beta$  must be no more complex than  $\alpha$ .

In adjacent segments in a licensing relation then, the dependant segment must be no more complex than the head segment. For example, at the constituent level, a branching onset is placed in a licensing relation where the head is on the left and the dependant is on the right. According to the complexity condition, the head, then, must have an equal or higher number of elements and nodes in its make-up. In Figure 4,2 this relation is illustrated. [t] has been defined as having 6 complexity and [w] has 3 complexity. Thus, only the [t] can be a head in this pair. [tw] is therefore a possible onset while \*[wt] is not (diagram adapted from Harris 1990).

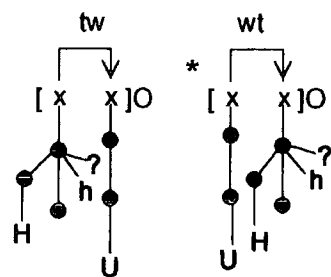


Figure 4,2. Well-formed and ill-formed onset pairs due to complexity restriction.

In GP, the number of elements forming a segment is crucial, then, to the well-formedness of a licensing relation. It is this that has led to the numerous debates over whether certain elements, e.g. R and t, are to be included in the element set. If included, they influence the complexity of a segment which alters the possible claims that can be made in GP. The debate has not yet subsided and is beyond the scope of this thesis. The expressions used by Brockhaus (1995a) are however devised specifically for the purpose of their complexity. These expressions are more malleable than the expressions used by other researchers and are more fitting to the analyses I shall be developing in part 3. This then is reason for my choice of expressions.

#### 4.2.1. s+C(C) clusters

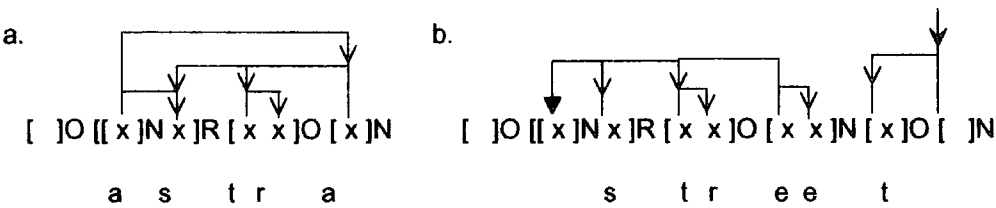
Words in many languages can contain word-initial 's' and up to two other consonants. E.g. the English words; 'string', 'snip', 'school', 'slide' etc. At a glance, s+C(C) clusters (KLV 1990:204) violate the complexity condition. 's' is less complex (5complexity) than some consonants that can occur in the C positions (t = 6complexity, k = 7complexity) but 's' seems also to be in a head position.

These clusters are not a problem specific to GP. Any phonological models in which onset maximisation is postulated represent these clusters as [ x x (x) ]O. Onset maximisation states that word-initial consonants form a branching onset. And, if the onset is possible word-initially then the same structure should be postulated word-internally. This causes problems when applied to s+C(C) clusters that do not then comply with the obligatory sonority increase of onset participants or moreover, with binary branching.

The problem is eradicated completely from GP in which s+C(C) sequences are no longer defined as tautosyllabic. A universally heterosyllabic analysis of s+C(C) clusters is proposed (Kaye 1992). 's' is, in fact, considered to be a rhymal adjunct in both word initial and word internal position (See evidence given in KLV 1990: 204-5). Word initially the 's' is thus represented in an x slot with no dominating structure which may then be attached to the rhyme of a preceding word. This structure is illustrated in Figure 4,3.

Figure 4.3.

The structure of s+C(C) clusters



Since all empty positions must be specifically licensed in order to be permitted (section 3.4.1), this structure would seem problematic in GP. An empty nuclear position must be allowed in word initial s+C(C) clusters as seen in Figure 4,3 (b). Kaye (1992:306) postulates 'magic licensing'<sup>1</sup> however to permit this otherwise impossible structure. This licensing can be seen in Figure 4,3 (b) as the bold arrow licensing on the first nucleus of 'street'. Magic licensing is still poorly understood (Brockhaus 1995a) and remains a rather unconvincing postulation so no further discussion will be presented. For the purpose of this thesis, it is enough to remark that the complexity condition remains fulfilled in these circumstances.

The complexity condition is a universal principle. It is not set by parameters. However, the precise segments that can appear in a specific position in one language as opposed to another does differ. A position in one language can demand a more complex head, and disallow equal complexity. Moreover, some languages not only have to have a more complex head but the dependant may have to be exactly 2 elements less complex, or may have to be homorganic with the head. In GP, these restrictions are specified using the concept of a-licensing (section 4.3) and a-chains (4.4). In particular, language-specificity arises from differing a-licensing restrictions, a-licensing potential and binding restrictions (section 4.5.). There is still not a great deal of literature which subsumes all of these concepts together although they do seem to be related. I shall deal with each of these concepts in turn.

<sup>1</sup> Kaye's title for this licensing- 'magic licensing' - suggests the arbitrary nature of this principle.



### 4.3. A-licensing<sup>2</sup>

P-licensing sanctions positions at various hierarchical levels of projection from the constituent tier upwards. This was the topic of section 3. A-licensing, on the other hand, regulates just how many elements can be held in any position. This is determined through consideration of the p-licensing status (a-chains) and language-specific restrictions.

The precise definition of a-licensing is given below.

*A-licensing potential* (Harris 1992:384)

The A-licensing potential of a skeletal position refers to its ability either

- (a) to directly a-license a melodic expression. (i.e. carry elements)
- (b) to confer a-licensing potential to another position. (i.e. give a permit to another position to carry elements)

Any skeletal position that holds melodic material must have a-licensing potential. For clarity, I shall use the graphical representation in Figure 4.4 to illustrate that a position is a-licensed, the square represents the permit which has a potential to carry a total of 3 items made up of elements and nodes<sup>3</sup>:

---

<sup>2</sup> The concept of autosegmental licensing originated with Goldsmith (1989). It has been accommodated into the GP framework in the work of Harris (1990, 1992), Yoshida (1990) and Brockhaus (1995a). It was Harris who first drew a distinction between p-licensing and a-licensing (Brockhaus 1995a) although as has been mentioned in section 3, the two types of licensing are tenets of the same mechanism.

<sup>3</sup> This calculation of potential will become clear in due course to be built into the licensing chain.

Figure 4,4. An a-licensed skeletal position



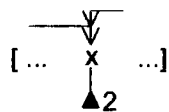
The potential of a position depends on language-specific specifications, and in particular, on the type of licenser i.e. a head nucleus or a head onset and its place in the a-chain (section 4.5.). The former specification is formally set out as licensing inheritancy.

*Licensing Inheritancy* (Harris 1992:384)

A licensed position inherits its a-licensing potential from its licenser.

The latter specification for the potential of a position concerns its place in the prosodic hierarchy (Brockhaus 1995a:172). An a-licensing chain (section 4.4.) forms when p-licensing has been set up properly. This allows an additional calculation of potential involving the distance from the domain head. For clarity, I shall use the graphical representation in Figure 4,5 to illustrate the chain status of a segment<sup>4</sup>:

Figure 4,5. Chain status



<sup>4</sup> See footnote 3.

#### 4.4. A-licensing chains

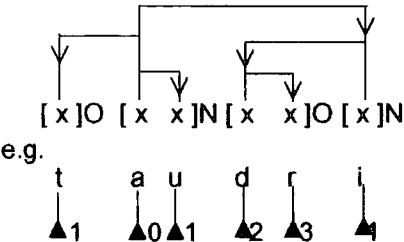
In GP, a-licensing potential has been said to be affected by a licensing chain/path. A licensing path can be traced from the head of a domain to a position within that domain (Brockhaus 1995a). This tracing involves counting the number of arrows in sequence from the head of the morphological domain to another position. Each arrow represents one 'dose' of p-licensing. And, each remove from the head depletes the a-licensing potential of a position (Harris 1992). As a general principle, the higher the number of p-licensing removes from the head of the morphological domain, the lower the complexity of the melodic segment must be.

The words in Figure 4.6. exemplify the tracing of removes in English (adapted from Brockhaus 1995a:173-175). In this illustration, the chain status is shown beneath the phoneme. In (a), the onset complement [ r ] is furthest from the head and indeed has low complexity (4complexity). In (b), the rhymal adjunct [ m ] is not given the same rating as the onset complement [ l ]. This is due to it being both 1 remove from the head and also 3 removes from the head. The chain calculation is thus balanced at 2 removes. This means that this rhymal adjunct position can be more complex (5complexity) than its neighbouring rhymal adjunct (3complexity). In (c), both the onset complement [r] and the rhymal adjunct [ n ] are 3 removes from the head and thus have to have the same complexity (4complexity). In (d), the final onset [ n ] is neither a complement nor an adjunct but is considered the furthest removed from the head. This is due to the effect of word-final licensing which depletes the potential of a segment by an additional 1 remove<sup>5</sup>.

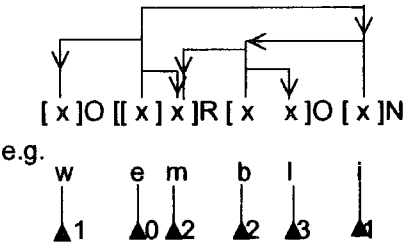
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<sup>5</sup> This is the reason for many languages having a process of word final devoicing. This devoicing reduces the complexity of a segment allowing it to surface in this distantly removed and weak position (Brockhaus 1995a).

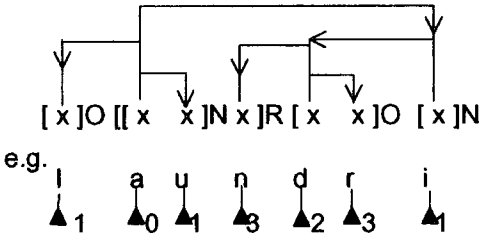
Figure 4.6. A-licensing chains



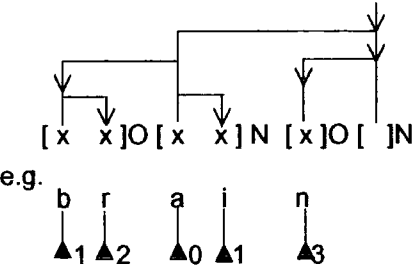
The head = a  
One remove = t, u, i  
Two removes = d  
Three removes = r



The head = e  
One remove = w, i  
Two removes = b,m  
Three removes = l



The head = a  
One remove = l, u, i  
Two removes = d  
Three removes = n and r



The head = a  
One remove = b and l  
Two removes = .r  
Three removes = n

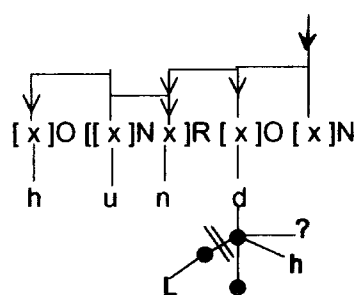
One can not calculate the complexity requirements of position in a language purely from the a-chain calculation however. Language-specific restrictions are also in force.

4.5. Language-specific restrictions.

4.5.1. a-licensing and a-chain restrictions

Restrictions on the number of elements in a position can alter between languages. Some languages have greater restriction especially on complement, adjunct and word-final positions than other languages. In German, for example, word-final positions can not hold the Laryngeal node and any elements attached to that node. This leads to word final devoicing as is illustrated in Figure 4,7 (adapted from Brockhaus 1995a). The delinking of the Laryngeal node alters the [ d ] to [ t ].

Figure 4,7.

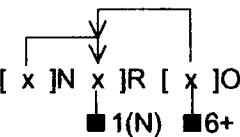


In 'Prince' languages (Prince 1984), rhymal adjunct positions do not have the a-licensing potential to a-license place elements and certain other elements. In these languages in fact, the rhymal adjunct node can only possibly license a nasal element. It needs help from its licensing onset to license place and any other features<sup>6</sup>. This restriction accounts for the fact that only geminates or nasal + homorganic stop clusters may occur in such languages (Brockhaus 1995a). Figure 4,8 illustrates this restriction in 'Prince' languages. The onset position can have 6+complexity, while the rhymal adjunct has either 1complexity (the root) or 2complexity where the second element can only be N.

<sup>6</sup> This restriction will be further discussed as 'binding' in section 4.5.2.

Figure 4,8.

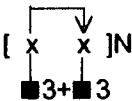
Restriction in Prince languages



Turning to English, a dependant vowel in a branching nucleus can only a-license one element and its two nodes (i.e. 3-complexity). The head, however, can a-license one or more elements (i.e. 3+complexity) as is illustrated in Figure 4,9.

Figure 4,9.

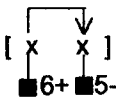
Nuclear restriction in English



A dependant consonant in a branching onset, in English, a-licenses at most two elements and its nodes (i.e. 5-complexity). The head, however, must a-license at least three elements and its nodes (i.e. 6+complexity) as illustrated in Figure 4,10 (Adapted from Harris 1990).

Figure 4,10.

Onset restriction in English

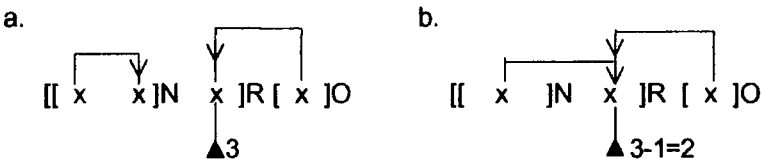


Also within English onsets, a labial voiced stop consonant [b] in a non-branching position (in which it does not have to license another position) lacks the laryngeal node and the element L (in line with word final consonants in German) and hence is weaker than if it is in a branching head position. This was mentioned in Footnote 7, section 2.2.2.

A rhymal adjunct, in English, has two possible forms. It can be part of a super heavy structure and thus be licensed only by the following onset, or it can be part of a simple rhymal adjunct in which it is licensed both by the following onset and the preceding nucleus. This structure, then, is one in which both a-licensing chains and the specific requirements of the position are interlinked. If double licensed (Figure 4,11 (a)), the rhymal adjunct has more a-licensing potential than if singly licensed (Figure 4,11 (b)). As mentioned in section 4.4, this is due to the double licensed adjunct being both 3 removes from the head, as is the super heavy rhymal adjunct, but also being 1 remove from the head which ultimately balances out at two removes from the head. The two forms are thus illustrated in Figure 4,11.

Figure 4,11.

Rhymal adjunct differentiation in English



The implications of these structures is seen in the a-licensing potential of the two positions. The double licensed head being closer to the head in the a-licensing chain can hold more melodic material than the single licensed rhymal adjunct. A lower a-chain calculation leads to a stronger a-licensing permit. A double licensed adjunct can have its own place of articulation. It can hold at most two elements and three nodes, but if one of these elements is nasal then the position needs help licensing other elements from its head<sup>7</sup>.

A super heavy syllable has much greater restriction on its melodic content. In English, super-heavy rhymes have the following restrictions (Harris 1994:77):

- (a) The 'coda' position is restricted to a sonorant or fricative.
- (b) A coda sonorant is unable to support a distinctive place contrast.
- (c) The favoured place category determined by the following onset consonant is coronal.

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<sup>7</sup> Shared melody will be specified in more depth as a case of binding in section 4.5.2.

Both English rhymal adjunct positions can license neither H nor L (in the Laryngeal node) (Harris 1990:280) However, the adjunct position can share the Laryngeal node with a licensing onset. These two restrictions are set as parameters

*Coda Parameters* (Brockhaus 1995a:136)

Coda Parameter I

A coda position licenses a LARYNGEAL node: ON / [OFF]

Coda Parameter II

A coda position may share the LARYNGEAL node of its governing onset: ON/OFF<sup>8</sup>

English have ON for this second parameter whilst German and French have OFF.

4.5.1.1 Phonological implications due to a-licensing potential and a-chains.

The a-licensing potential of segments in a word can alter with the addition of morphological structure. The addition of structure can distance a position further from its domain head thus increasing the a-chain calculation and reducing the a-licensing potential. If the a-licensing potential of a position is reduced or withheld, phonology responds by delinking elements in order to correlate with the a-licensing potential. The delinking of an element reduces the complexity of that segment as was shown in the case of German devoicing in Section 4.5.1, Figure 4,7.

A-licensing restrictions thus leads to dynamic processes such as reduction. A position can be phonetically realised in one situation, weakened in a second situation and unrealised in another situation all due to a change in the licensing potential or the a-chain. In section 5, it will be illustrated that this effect can also lead to the appearance of certain types of harmony in a language. However, a second effect must be introduced before any in depth discussion of harmony can take place. This effect is dependant on binding restrictions in GP.

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<sup>8</sup> Again, this sharing of nodes or elements will be defined in section 4.5.2. as binding.



4.5.2. Binding

In combination with a-licensing specifications, there are a set of universal and language-specific parameters which limit or force an amount of shared material in adjacent positions. These principles and parameters can be thought to tie in with the Obligatory Contour Principle (Goldsmith 1976) This principle was introduced in section 3.8.

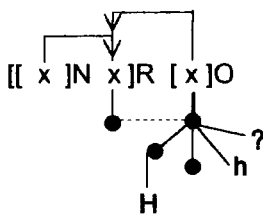
*Obligatory Contour Principle (OCP)*

At the melodic level, adjacent identical units are disfavoured

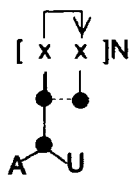
Any adjacent skeletal points carrying melodic expressions can be influenced by the OCP. This principle is not restricted to work in GP. It is a general principle<sup>9</sup> applying to autosegmental tiers and associations. If two identical adjacent units appear in the phonology of a language, one unit is erased and an association line instead links both melodies to the one unit remaining. Geminates and long vowels are thus represented as two skeletal points associated to one root node holding all the melodic information. This effect is illustrated in Figure 4.12. The OCP effect (or binding) is represented as a broken line joining the root nodes of the two positions.

Figure 4.12.

i. Geminate Consonants [tt]



ii. Long Vowels [o:]

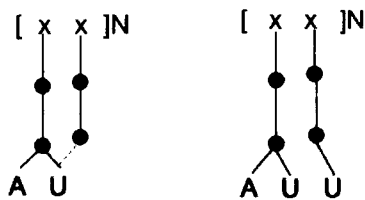


<sup>9</sup> The OCP is not evidently enforced in all languages. It is therefore more appropriate to think of the OCP as embodying a strong tendency rather than a rigid principle (Harris 1994).

The OCP can also effect single shared elements in a structure as illustrated in Figure 4,13. In this figure, the broken line in (a) joins an element in the head to the Place node in the dependant position. In (b), the unbound adjacent identical segments are not considered representational.

Figure 4,13.

(a) The diphthong [ow] (b) An ungrammatical representation



There are universal restrictions limiting the amount of segmental material that can be shared by two skeletal points in certain positions. In onset position, complete identity is ruled out. Geminates in this position are universally disallowed. This is stipulated in KLV (1990:212) as:

Elements may not spread within an onset.

Homorganic clusters are also ruled out in onset position due to this stipulation. Therefore 'l' can not be dominated by a coronal plosive; any tautosyllabic 'tl' or 'dl' sequences must form contour (lateral fricative) segments (Harris 1990).

This type of restriction on shared elements is characterised as binding constraints<sup>10</sup> on contiguous positions (Rice 1990). They are constraints on the amount of feature geometry structure for which two positions can be bound. An onset, therefore, can only be bound for at most one element and no nodes.

*Onset Binding Condition*

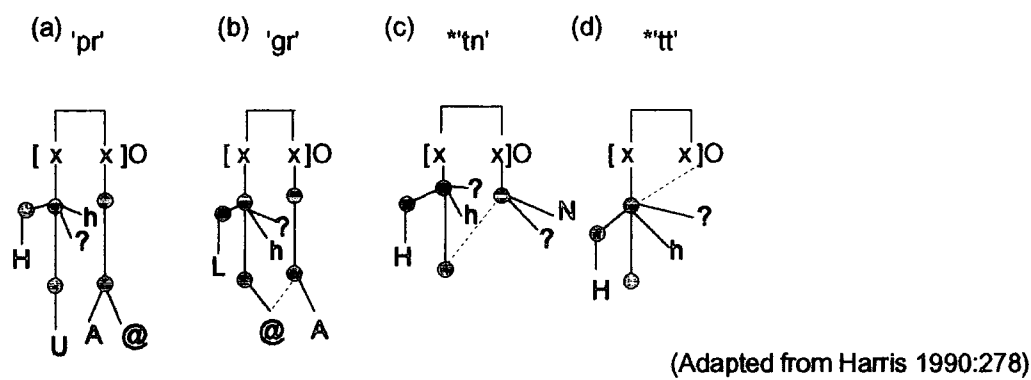
An onset can be bound for at most one element and no nodes

---

<sup>10</sup> Binding is a concept based in syntax which originated as the definition of restrictions on the references of anaphors, pronominals and R-expressions (Van Riemsdijk and Williams 1986).

This principle is exemplified in the following examples in Figure 4,14. The binding is again represented as a broken line joining elements or nodes with an adjacent segment. In (a) 'pr' is well formed. No elements are bound. In (b), 'gr' is well formed. Only one element is bound. In (c), 'tn' is ruled out as a well formed onset. A node is bound. Finally in (d), 'tt' exemplifies complete identity and is prohibited since again a node is bound.

Figure 4,14.



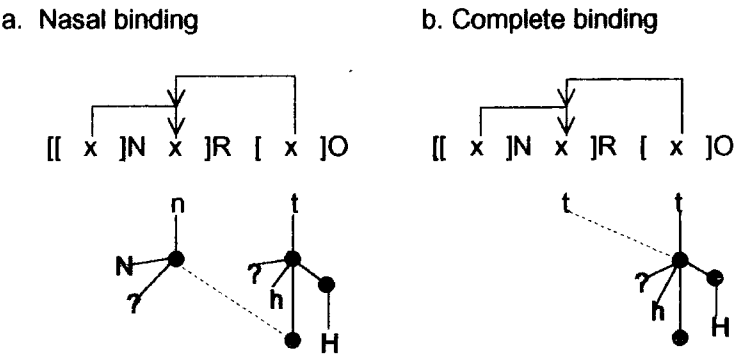
Binding is not just a restriction in languages, it can also be obligatory. In rhyml adjuncts, the obligatorily associated segmental material varies from language to language. In English, a nasal's place must be linked to the head as shown in the examples in Figure 4,15 (a). 'Prince' languages as mentioned in section 4.5.1. have even greater restriction (Prince 1984). They require that the dependant position link both place and constriction specifications with the head as shown in the examples in Figure 4,15 (b).

Figure 4,15.

(a) English	(b) Finnish
<u>s</u> imple	kip <u>p</u> is 'cheers'
<u>i</u> mpossible	hel <u>p</u> po 'easy'
<u>d</u> ental	pol <u>t</u> ta 'burn'
<u>i</u> ndirect	
<u>i</u> nclude	

The GP representations of the binding in (a) 'nt' and (b) 'tt' are given in Figure 4,16 below (adapted from Harris 1994).

Figure 4,16.



#### 4.5.2.1. Implications of binding.

A harmony effect is not necessarily one of 'spreading' as was thought to be the case in Autosegmental accounts of harmony. It can arise through both binding and also through delinking.

Binding generates harmony and assimilation effects in the same way as spreading. Indeed, binding could be considered another name for spreading. However, more restriction is intrinsic to binding in GP. In rhyml adjunct-onset positions, the assimilation is cued by the inter-constituent licensing relationship between the onset and preceding rhyml adjunct and language-specific parametrised restrictions.

At the nuclear projection level, binding of the elements or nodes of a head and dependant can be said to generate vowel harmony effects. Therefore, in harmonic languages, contiguous vowels may have binding restrictions on certain elements or nodes. This approach could also be extended to the onset projection level, in which consonant harmony would be the result. However, binding restrictions are not the only method of gaining a harmony effect. A mismatch in complexity as discussed in section 4.5.1.1 can cause a delinking of a certain element or cause a shared element or node. This can in

turn force a harmony effect. The delinking of the element N from a dependant position that is more complex than its oral head segment appears in phonology as a case of oralisation

In the final section of part one, I shall represent two adult vowel harmony systems in which a-licensing and complexity play a part.

## Section 5. Vowel Harmony in Adult Languages

This final section of Part 1 illustrates a complete GP analysis of height harmony in the adult languages of Chichewa and Pasiego Spanish. These two languages have been chosen due to the opposing types of harmony they manifest: vowel 'raising' in Pasiego Spanish and vowel 'lowering' in Chichewa. The GP analyses of these effects are considered improvements on previous analyses of the same phenomena by other researchers (McCarthy 1984, Vago 1988, Katamba 1984, Mtenje 1985, Harris and Moto 1989). The discussion and analyses are based generally on but adapted and extended further than the ones in Harris and Lindsey (1995) The elements of phonological representation.

5.1. Chichewa

Chichewa (Mtenje 1985) is one of a number of central Bantu languages in which lowering harmony is attested. In this language, mid vowels appear in derivations of certain suffixes as a result of high vowels lowering under the influence of a mid vowel appearing in the stem. Mid vowels are never lexically present in these suffixes. See the data set out in Figure 5,1 (Harris and Lindsey 1995).

Figure 5,1.

	Causative	Applied	
(a) pind-a	pind - its - a	pind - il - a	'bend'
put-a	put - it - a	put - il - a	'provoke'
(b) lemb-a	lemb - el - a	lemb - el - a	'write'
konz-a	konz - el -a	konz - el - a	'correct'

Feature-based accounts of this effect manipulate the rightward spreading of the features [+high] and [-high] (Katamba 1984, Mtenje 1985). The manipulation of two opposing values of the same feature is, however, far from advantageous. Harris and Moto (1989) re-analysed this double spreading within an Underspecification framework in order to avoid the problems faced by this approach. In this re-analysis, [+high] is stated as the default and [-high] spreads from mid root vowels if the feature is unfilled by this default. Nevertheless, underspecification carries with it its own set of problems including a lack of reasoning as to why one feature remains unspecified and thus why spreading occurs.

### 5.1.1. A GP analysis of the facts.

Chichewa can be both described and the harmony effect explained using the concepts I have introduced in previous sections of this thesis. Harris and Lindsey (1995) represent alternations between mid and high vowels in GP simply as a presence versus absence of the A element in an expression. They claim that, in Chichewa, mid vowels in harmonically recessive suffixes<sup>1</sup> arise through rightward spreading of A from a mid vowel in the root nucleus (Harris and Lindsey 1995).

This statement can be further elaborated in GP leading automatically to the generation of both the complete phonology of Chichewa and in particular the harmony effect. Concentrating solely on the harmony effect, the following parameters are utilised.

P1. Licensing at the nuclear projection is rightward

The licensing domain formed between the dependant nucleus and its head nucleus at the nuclear projection level is the domain in which harmony acts. The direction of licensing tallies with the direction of 'spreading' in harmony. Thus, no additional statements concerning direction or domain of spreading are necessary (see section 3.4).

The language-specificity of Chichewa harmony can be determined through one binding and one complexity restriction (section 4.5.2). These are the crucial parameters to both produce the harmony effect and restrict it.

*Complexity restriction (Chichewa)*

A head and dependant at the nuclear projection level must have equal complexity.

*Binding Restriction (Chichewa)*

Binding is called on to satisfy complexity restrictions at the nuclear projection level.

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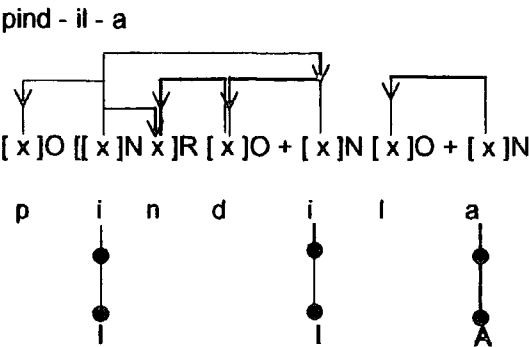
<sup>1</sup> It is not stated what determines a harmonically recessive suffix. It may be possible to determine the suffixes through the universal principles born from the phonology. This question is, however, beyond the scope of this thesis.



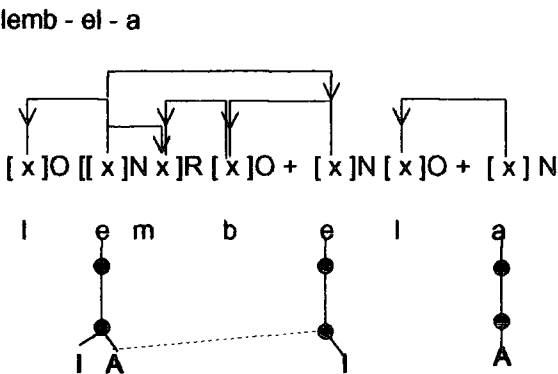
The structure in Figure 5,2 (a) and (b) is intrinsic, then, in Chichewa phonology.

Figure 5,2.

(a)



(b)



In 5,2(a), the dependant nucleus at the nuclear projection level is of equal complexity to its head. All phonological restrictions are satisfied, nothing else need be elaborated. However, in 5,2(b), the nucleus licensed at the nuclear projection level is less complex (3complexity) than the head nucleus (4complexity). Well-formedness conditions are not satisfied.

In order to satisfy the well-formedness conditions in Chichewa, an element could either be delinked from the head, or an element could be bound from the head to the dependant. The latter option is preferred as stated in the Binding Restriction.

The particular bound element A also falls out from the structures of the words. No other possible element can be bound. Binding must from the head to the dependant. The make-up of the head gives a choice of either A or I in this binding role. However, I is already present in the dependant expression. A remains the only possible choice. The binding initiates the fusion of [A.I] in the dependant expression which forms the mid vowel [e] in the skeletal position (section 2.3.)

In sum, harmony in Chichewa, when it occurs, can be viewed as the satisfaction of constraints on well formed lexical items. There is no need to refer to spreading at all (Kaye 1993).

5.2. Pasiego Spanish

Pasiego Spanish manifests an opposing harmony effect to Chichewa. In Pasiego, there is a vowel 'raising' harmony effect. All non-low vowels to the left of a high vowel in a stressed syllable surface as high vowels. See the data in Figure 5,3 below (Harris and Lindsey 1995).

Figure 5,3.

Infinitive	Future 1st person singular	Future second person plural	
bebér	beberé	bibiri:s	'drink'
komér	komeré	kumiri:s	'eat'
koxér	koxeré	kuxiri:s	'take'

In previous analyses, this process has needed to incorporate the operations of both spreading and delinking. A vowel holding the double valued feature [+high] is said to firstly delink that feature and secondly to pick up a [+high] feature through spreading (McCarthy 1984). Two operations to generate one process is not advantageous. An underspecification re-analysis has also been attempted (Vago 1988) however this again is subsumed under a problematic model with no explanatory basis.

5.2.1. A GP analysis of the facts.

Pasiego Spanish, like Chichewa, can be both described and the harmony effect explained using the concepts I have introduced in previous sections of this thesis<sup>2</sup>. In this language, however, the language-specific parameters differ from and are more simple than those of Chichewa.

In Pasiego Spanish, licensing at the nuclear projection level and word level are parametrically set:

P1. Licensing at the nuclear projection is leftward.

P2 Licensing at the word level is leftward

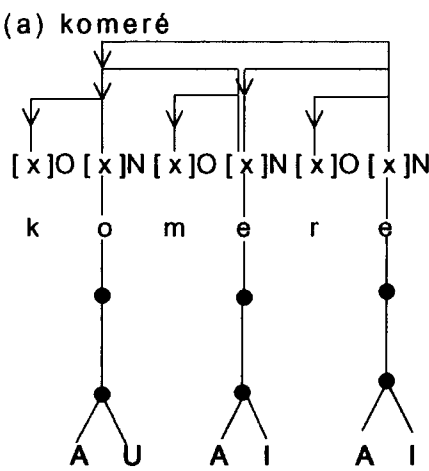
All other principles of the phonology hold including a particular and crucial complexity condition.

*Complexity Restriction*

A head nucleus at the nuclear projection level and at the word level must be equally or more complex than its dependant.

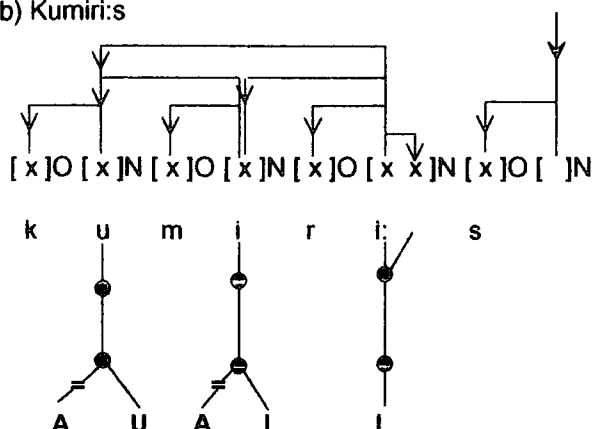
The structures in Figure 5,4(a) and (b) are set up then in Pasiego Spanish.

Figure 5,4.



<sup>2</sup> The analysis of Pasiego Spanish parallels one of weak stress reduction in various languages. This phenomenon is not within the scope of this thesis but is both an adult and child phonological effect which appears also to be well represented in the GP model.

(b) Kumiri:s



In (a), each dependant nucleus has equal complexity to the head. Well-formedness conditions are satisfied. In (b) however, the head has 3complexity whilst its dependants at the nuclear projection level and at the word level are more complex (4complexity). The conditions on well-formedness are not satisfied.

Either licensing at the two levels fails, or an element must delink from the dependant positions to lessen the complexity of the expression. Only the second option is actually possible in the phonology. Licensing relations must hold in GP. Therefore, delinking of the A element is triggered in both dependant nuclei<sup>3</sup>.

<sup>3</sup> Why the A element is chosen as the delinking element is as yet not derivable from the basic principles of GP. Further research is needed.

### 5.3. Discussion

In sections 2,3 and 4 of this thesis, the GP model has been introduced and illustrated using vowel harmony data from adult languages. The discussion of the various principles, parameters and approaches have been necessarily brief and lack explanation and argumentation due to space restrictions. It is hoped, however, that the interested reader will turn to the cited material in which much more specific discussion is provided.

Vowel harmony in adult languages has been exemplified above using the GP model and has been shown to make use of a variety of the principles of GP. It has been shown that a process which, on the surface, looks like a case of the Autosegmental concept of 'spreading', can, in the GP model, be represented as in-built into the principles and constraints of segments and relations. This is advantageous as an approach to harmony. Harmony can manifest as either a binding effect in order to satisfy a demand on complexity, or a delinking effect in order to satisfy a demand on complexity (Harris and Lindsey 1995) in order that licensing relations can be successfully set up.

I now turn to acquisition in GP. My investigation encompasses a general approach to acquisition including a representation of the initial state of phonology and a partially set out English final state using the GP model. Moreover, it considers the representation of two stages of acquisition in which harmony effects, vocalic and consonantal, are generated using GP. The approach towards adult harmony systems set out above is readily transferable to an approach towards child harmony systems.

## Part 2. The acquisition of phonology in GP

### Introduction

In introducing this thesis, I stated that in order to understand the acquisition of phonology in children, one must be equipped with two pieces of knowledge. Firstly, there must be knowledge of what phonology is. And secondly, there must be knowledge of what aspects of phonology must be learnt (Kaye 1997). Phonological models attempt to represent what phonology is. Therefore, in Part 1 of this thesis, I have specified a phonological model: Government Phonology.

GP, I am claiming, represents the human phonological system. This model places phonology alongside syntax, within Universal Grammar. It derives phonological systems from a restricted set of principles and parameters some of which are shared with syntax. These principles and parameters include the obligatory licensing of positions and melody, the satisfaction of complexity restrictions and binding constraints and overall a highly restrictive phonological system.

" The ultimate theory of phonological behaviour will account for all phonological data, whether diachronic or synchronic, from adults or children, or from first or second language acquisition" (Bernhardt and Stemberger 1998:2)

There is research into the influence of principles-and-parameters in Second Language Phonology (Lleó 1995, Young-Scholten 1992). Moreover, in syntax, this principles-and-parameters approach has led to a substantial amount of research into acquisition (see for instance, Chomsky 1981, Flynn 1987, Roeper and Williams 1987). On the other hand, the role of Universal Grammar in the First Language Acquisition of phonological knowledge has largely been ignored (Brown and Matthews 1997:67). This may be due to the controversial nature of evidence and approaches to child phonology (see section 1.1 below). It may also be due to problems with the actual GP model as it stands (see Part 3).

I am choosing, however, to oppose the tentativeness in this research area in order to go some way towards a complete theory of phonological behaviour based in the GP framework. In order to begin though, a number of basic assumptions must be accepted if applying phonological theory to child data (Bernhardt and Stemberger 1998:2). If unsubstantiated, these assumptions would directly halt any application of phonological theory to acquisition data.

1. developed (adult) and developing (child) systems are sufficiently similar to show such an enterprise.
2. the language(s) on which the theory is based are sufficiently similar to the child's ambient language.
3. data from children are interpretable in the context of abstract phonological theory.

(Bernhardt and Stemberger 1998:2)

As mentioned previously, these assumptions are not agreed upon by developmentalist acquisition researchers and are considered debatable. However, they do underlie the work of many phonologists investigating acquisition (see Bernhardt and Stemberger 1998:2-4, Levelt 1995 etc.) and permit me to agree with their strong arguments and follow this line of research.

The study of child phonology is worthwhile from both a theoretical and an acquisition point of view.

"(I)linguistic behaviour may actually reflect the default operation of principles and parameters of UG or result from their operation on impoverished phonological representations" (Brown and Matthews 1997:73).

One can produce new interpretations of child phonology data using the GP model. In addition, one can evaluate the GP theory, i.e. the current framework and the improvements that must be made.

In the second part of this thesis then, I am taking the bull by the horns and am considering the question of what aspects of the phonology must be learnt presuming phonology *is* the principles-and-parameters model of GP. I am concentrating particularly on harmony systems in



children which may be found to reflect some of the default operations or impoverished phonological representations as mentioned above.

The possible basic foundations of an acquisition model must be set out before specific investigation can be initiated. There have been limited foundations set in GP. I am therefore at liberty to initiate some hypotheses concerning these basic foundations. A more in depth investigation into harmony can then be considered a bidirectional test of GP. This thesis can both begin to test the possible basic foundations of the model, and begin to test the suitability of GP as an acquisition model.

### **A preliminary note.**

Evidence backing each and every one of the basic foundations I am proposing is much beyond the scope of this thesis. These hypotheses, it is hoped, will be tested in their own right through further research if and when the GP model attains greater credence within the phonological world. In the present state of both the GP model and knowledge of phonological acquisition, postulation of an acquisition model can only be tentative.

Moreover, the acquisition of phonology is a complex and deeply interwoven area of language. Due to the necessarily limited scope of this thesis and the lack of solid principles in GP, this web of phonological parts can not be considered in total. Therefore:

- implications of the various postulations of stages of acquisition are not considered in comparison with other stages of acquisition.
- surrounding segments, the subsegmental make-up, and the alteration of these during the acquisition of phonology are all disregarded.
- and, when a harmony process may call on further effects in phonology, this discussion remains concise and not further investigated.

Even within these limits however, the attempts of this thesis are justified as they at least raise issues which provide new bases for discussion and research (Waterson 1981).

## **Section 1 Acquisition issues**

Approaches to first language acquisition are often debatable and controversial. Many basic issues in this research area are still not resolved. This has made researchers hesitant to work in this area at all (e.g. Kaye 1997). Any researcher working in the realm of first language acquisition must make assumptions concerning these debatable issues and the choice of assumptions can greatly influence the interpretation of data (Bernhardt and Stemberger 1998:8). This section briefly sets out some of these debates and the positions taken in this thesis.

### **1.1. Levels of representation.**

The language input received by a child and the language produced by a child have been thought of in various ways. Although crucially dependant upon the theoretical model subscribed to, the child could be receiving either surface adult phonological input or the underlying adult phonological input. The child could also be producing either underlying phonology affected by rules or processes, or surface phonology in which internal constraints are in use.

In early generative phonology (Chomsky and Halle 1968), underlying phonology was manipulated by rules generating surface adult forms. This approach was then carried over into acquisition models (Smith 1973) in which adult surface structure was taken to be a child's underlying structure which was converted using ordered rules or processes into a child's output.

Due to the single level of representation central to the nature of Government Phonology (Part 1, section 1), one can assume that the manipulation of underlying and surface forms in acquisition are not an issue. Internal constraints on the child's output inhibit the child's production. Only adult surface structure can be used as input and evidence to set parameters to generate a language-specific phonology. There is no underlying structure in either the adult or child system.

In analyses of data then, it is assumed that the child's input is the adult surface form. This assumption is used directly in my analyses in sections 3 and 4.

## 1.2. The Innateness Hypothesis.

The postulation of an in-built language faculty -Universal Grammar- affecting acquisition (Chomsky 1986) is opposed by empiricist researchers. The field of linguistics as a whole, in fact, is polarised between Chomskian linguists who back the innateness hypothesis and anti-Chomskian linguists who do not believe in an innate language faculty. However, as in the issue of levels of representation, this in-built language faculty is a basic tenet of adult GP and therefore must also be intrinsic to an acquisition model based in this theory. Therefore, principles and parameters of GP are the assumed innate mechanisms forming UG.

### 1.2.1. Parameters.

The structure of the parameters placed within UG form another issue. Parameters may, on the one hand, be unset and inactive in UG, the triggering and setting of which would be achieved with language-specific input (Figure 1,1(a)). On the other hand, parameters may emerge as active and unmarked in UG. Those parameters would thus be reset in languages with marked settings (Figure 1,1(b)).

Figure 1,1.

(a)

Initial state *Word final empty nuclei licensed?* : SETTING REQUIRED

Final state *Word final empty nuclei licensed?* : ON

(b)

Initial state *Word final empty nuclei licensed?* : [OFF] / ON

Final state *Word final empty nuclei licensed?* : [OFF] / ON

In the approach in Figure 1,1(a), only language-specific settings would ever surface in child phonology. In order to obtain the incorrect settings, parameters would have to be wrongly set in the first instance and then set for a second time through further language input and negative evidence.

The use of negative evidence is strongly opposed, however, by acquisition researchers (Berwick 1985). I am thus following the second of these two approaches, illustrated in Figure 1,1(b), in which setting to the marked value is achieved with language input and an underlying unmarked setting is available from the onset. This approach generates predictions as to the reflection of unmarked settings in child forms.

#### 1.2.2. Markedness.

Due to the structure of the parameters discussed above, it is assumed then that unmarked settings for parameters will surface early in child phonology with marked settings surfacing later and with language-specific input. Unmarked settings must be universally widespread (Maddieson 1984). There is, however, debate over the validity of 'statistical' universals (i.e. 'widespread') as opposed to absolute universals (Macken 1995). Markedness relations are complicated and need further research both in general and in the realm of an acquisition model based in GP.

### **1.3. A developmental model.**

The issue of the development of phonology from the onset of acquisition to the final language state is not considered in any great detail in this thesis. However, one must still take into account certain basic assumptions.

#### **1.3.1. Continuity.**

The Continuity hypothesis is a much debated issue in the development of language-specific phonology from UG. Discontinuity has been described as the "tadpole to frog" hypothesis (Gleitman and Wanner 1982) in which development can leap due to maturation cues or triggers in the phonology. Continuity, on the other hand, is a relatively smooth transition from UG to an adult language following stages in which parameters converge more and more with the adult settings. The beginning and end states of development thus form part of a coherent whole (Bernhardt and Stemberger 1998). Continuity as opposed to discontinuity is linked more closely with the innatist hypothesis (Pinker 1984 for syntax, Stampe 1969 for phonology) and will be followed in this thesis.

#### **1.3.2. Stages.**

Moreover, assuming continuity, a 'stage' will not be defined as a great leap from one child phonology to another, but will be a gradual development in the phonology. In this thesis, however, the stages considered ( $G_1$ ,  $G_2$ ,  $G_3$  and  $G_n$ ) are not placed in a developmental model. They are considered simply as synchronic states of language. More research is needed in order to build the stages into one developmental model.

#### **1.3.3. Variation**

It is accepted by phonologists working in acquisition that variation in child phonology must be taken into account in the postulation of stages. Invariant stages (Jakobson 1941 / 1968) are not sufficient.

There is a great deal of variation both between and within children's phonology (Ferguson and Farwell 1975, Macken and Ferguson 1983). I recognise that this is an important issue but will not enter into this debate due to limited scope in this thesis.

1.3.4. Building vs Pruning.

Finally in this section, there are two logical possibilities for determining UG-based acquisition that is continuous and defined in stages as I am assuming. These determine the form of the initial state ( $G_1$ ) and the subsequent stages. These possibilities are set out by Brown and Matthews in consideration of the phonological acquisition of feature geometry (1997:74).

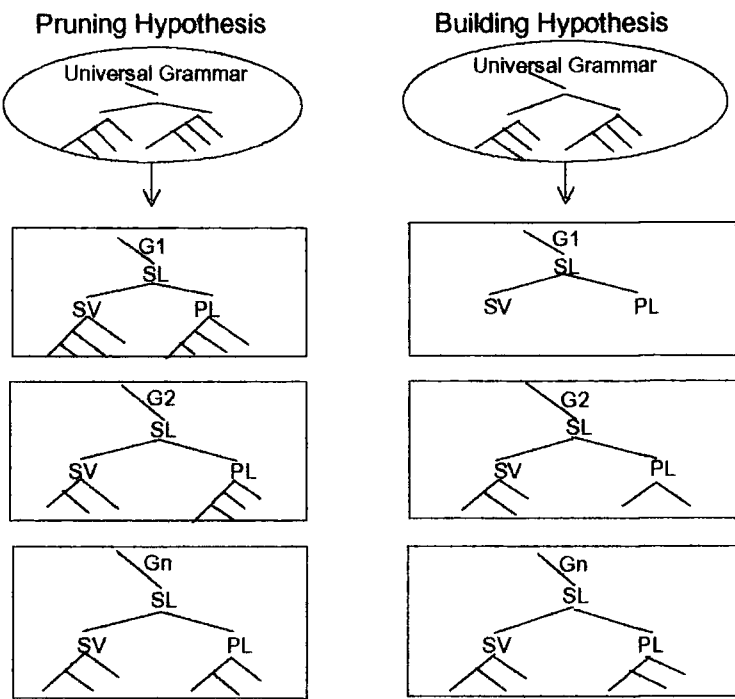
Pruning Hypothesis: Universal Grammar provides the child's emerging system with a fully elaborated feature geometry which subsequently retracts or is 'pruned' where the input does not support phonological contrasts.

Building Hypothesis: Universal Grammar provides the child's emerging grammar with only minimal structure which is further elaborated based on the detection of phonemic contrasts present in the input.

Brown and Matthews (1997) illustrate these hypotheses using the following schema in Figure 1.2. This schema illustrates the two opposing acquisition models based either on 'pruning' or on 'building' structure. The Universal Grammar module is shown to include the full structure in both cases. In the 'pruning' hypothesis, this UG is present in total at  $G_1$ , the initial state. The structure is then pruned in accordance with the specific language structure input and negative evidence until the final state,  $G_n$ , is reached.

In a 'building' approach, on the other hand, the initial state contains minimal structure which is manipulated by every natural language. This structure is then added to with both guidance from UG and positive evidence from the language input. When the structure is completely built,  $G_n$  is reached.

Figure 1,2.



These hypotheses are equally valid when approaching GP phonological acquisition above as well as below the skeletal tier. Universal Grammar would carry all of the principles and parameters set out in Part 1 of this thesis. If the 'pruning' hypothesis is adopted, at the onset of acquisition each and every possible principle and parameter would be evident in the phonological system. Acquisition would then be a case of both resetting parameters, and eradicating unnecessary and unused principles and parameters from this structure. On the other hand, if the 'building' hypothesis is adopted, the initial state would involve a limited number of universal principles. These principles would then be elaborated by the child, guided by UG, based on the detection of other principles and parameters at work in the phonology.

Evidence in Brown and Matthews leads towards the postulation of the building hypothesis at the subsegmental level of phonology (see test and discussion in BM 1997). This evidence is convincing and can be extended to the general GP model. This debate thus completes the general issues which must be considered in order to approach acquisition data and analysis.



#### 1.4. Questions

The basic assumptions have been set out which a GP model of acquisition needs to follow. These assumptions include an innate language faculty, preset unmarked parameters, continuity and the building of structure during development. There has not been great debate in this thesis over these basic assumptions. Each of these issues deserves a separate research program that can, when agreement is reached, be integrated into one model. I do not, however, believe that the problems should stop researchers looking beyond these basic issues and considering the implications that arise from these matters.

A phonological model manipulating these basic assumptions generates specific questions which must be answered through the hypothesized acquisition model. These are set out below.

1. Which mechanisms of GP are available from the onset ( $G_1$ )?

In other words, which principles and parameters are evident at  $G_1$  without the influence of language input.

2. Which mechanisms of GP universally develop with time?

In other words, are there any principles and parameters that are triggered by the manipulation of other principles and parameters in the phonology.

3. Which mechanisms of GP are reset due to primary input?

In other words, are there parameters that are reset from the unmarked initial setting due to language input to inevitably reach  $G_n$ .

In this thesis, I am concentrating particularly on two stages of harmony in child phonology. Thus, these effects must also be explicable through the hypothesized model. Straightforward answers to what seem to be complex questions support both GP as a phonological model and as an acquisition model.

4. Why does vowel harmony surface in the English child phonological system when it is not an effect found in the adult system?

5. Why does consonant harmony surface in any child phonological system when this is not a widely attested effect in adult phonology?

6. What is learnt to allow a child to deharmonise segments?

My approach will be as follows. In section 2, I will develop hypotheses for  $G_1$  and English  $G_n$  which although needing deeper investigation, are nevertheless not unreasonable assumptions as a base point to an acquisition model of GP. These hypotheses thus are an attempt at answering the first three questions set out above.

In section 3, vowel harmony (VH) in child phonology will be investigated and in section 4, consonant harmony (CH) will be investigated. These two sections are thus an attempt at answering the second set of questions above and show intermediate acquisition stages ( $G_2$  and  $G_3$ ) between  $G_1$  and  $G_n$ . Discussion and calls for further research are left until part 3 of this thesis.

## **Section 2 A tentative acquisition model**

Universal Grammar and the primary linguistic data must interact to produce the adult phonological component. As discussed in section 1, this interaction is thought of as a continuous development based on the building of structure from a restricted set of innate principals and parameters of UG to the final state in which all the language-specific principles and parameter settings are at work.

In considering a model of acquisition then, one must first take on board both what is at work in the adult system, and what may be causing differences in the child system. These differences are caused by the immature state of the emerging system.

The universal principles of UG were the topic of Part 1 of this thesis. In 2.1, I wish to specify some of the parameters that join these principles in forming a model of adult English ( $G_n$ ). I can then consider a hypothesized initial state ( $G_1$ ) set out in 2.2. In sections 3 and 4, from the basis of this section, I can then consider the two stages,  $G_2$  and  $G_3$  at which VH and CH occur. These stages each fall somewhere in between the initial stage ( $G_1$ ) and the adult language ( $G_n$ ).

## 2.1. English<sup>1</sup> Phonology ( $G_n$ )

A detailed approach to English Phonology in the GP framework can be found in Harris's (1994) text book English Sound Structure. This includes more specific information on English parameter settings than is found in most of the literature. From this source and other literature on GP, the parameter settings can be stated that influence English Adult Phonology<sup>2</sup>. These parameters join the influencing principles defining GP as the phonological system. For example,

Principle: Each phonological process can access only one unit in a representation

Principle: Within constituent licensing, licensing relations are head-initial

Principle: Complexity Condition

These principles do not have to be repeated as most of them are set out in Part 1 of this thesis. Only the parameters need be specified in this section. These are set out in Figure 2,1. Discussion follows this figure, however discussion of the hypothesized unmarked values is delayed until I consider the initial language state ( $G_1$ )<sup>3</sup>.

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<sup>1</sup> Certain French settings are also mentioned since some French data is analysed in the course of this thesis.

<sup>2</sup> A language-specific setting is determined using underlining of that choice. No underlining determines the unmarked option as the setting. This unmarked option is represented with square brackets.

<sup>3</sup> A setting at  $G_n$  which does not tally with a bracketed parameter setting is claimed to indicate markedness in that specific language. This is as much as needs to be understood in this section.

Figure 2,1.

English Parameters at G<sub>n</sub>

1. *Constituent structure parameters*

Branching constituent	[OFF] / ON
Onset	—
Nucleus	—
Rhyme	—

2. *Final empty nucleus parameters*

Final empty nucleus licensed?	[OFF] / <u>ON</u>
Direct licensing from final empty nucleus?	[OFF] / <u>ON</u>
Indirect licensing from the final empty nucleus?	<u>[OFF]</u> / ON

3. *Projection licensing* [ON] / OFF

Onset	—
Nucleus	—
Direction of projection licensing	[>] / <

4. Head a-licensing: FULL

5. *A-licensing potential of heads* FULL / REDUCED

Onset	—
Nucleus	—

6. *Melody well-formedness effects* [ON] / OFF

Binding effects	—
Delinking effects	—

7. *Tier conflation in vowels*

Autosegmental tier available?	YES / [NO]
I	—
A	—
U	—

8. *Headedness* A I or U / @

Long vowels	—
Short vowels	—

Parameters 1, 2 and 3 affect the syllabic and word level structure of English. Positive settings for parameter 1 triggers constituent licensing, inter-constituent licensing and government licensing principles. In English, all constituents can branch. This is also true of French. This makes both these languages highly marked with regard to their structure. The syllable structures generated from these settings are: CV, CCV, CVV, VCC and any combinations of these.

In English, parameter 2 states that final empty nuclei are licensed and can directly, but not indirectly<sup>4</sup>, license. This again makes this language more marked compared to many other languages. The syllable structures generated from combinations of these settings are: V.C, VC.C but in English \*V.CC.

Parameter number 3 is repeated here for clarity.

- 3. *Projection licensing* [ON] / OFF
  - Onset \_\_\_\_\_
  - Nucleus \_\_\_\_
  - Direction of projection licensing [----->] / <-----

In English (and French), no onset projection is manipulated in the phonology, thus no licensing or complexity restrictions affect onsets in this domain. For example, in [mumi], there is equal complexity between onsets. In [dumi], there is a more complex first onset (d= 6complexity, m= 5complexity). However, in [mudi], this pattern is switched. There is a less complex first onset, however no problems are generated in the phonology due to this switch. On the other hand, nuclei are projected and the direction of licensing is left to right<sup>5</sup>. This reflects the foot structure of English in which trochaic feet (SW) are evident<sup>6</sup>.

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<sup>4</sup> French can indirectly license.

<sup>5</sup> In French, the direction of licensing at the nuclear projection is right to left.

<sup>6</sup> Foot structure is much more complex than just pairs of trochaic feet in English. However, foot structure has not been fully investigated in GP and can not be discussed any further in this thesis.



Parameters 4, 5, 6, 7, and 8 influence the subsegmental structure of English. Statement 4 is more of a principle rather than a parameter however.

4. Head A-licensing FULL

The complexity of a segment in adult English is calculated from the elements and nodes fused to form the particular segment. In consonants, this complexity can reach a total of 7 in a head position. In vowels, the complexity can reach 4. If a position is a licenser, i.e. a head, it must have full a-licensing in order to carry a full amount of elements. Full a-licensing of a head then triggers the a-licensing potential parameter below.

5 A-licensing potential of heads FULL / REDUCED

Onsets	_____
Nuclei	_____

According to the setting of parameter 5 for English then, a dependant to a head in onset position must be weaker than that head. A dependant to a head nucleus, on the other hand, can be equally as complex as that head.

Parameter 6 states that both binding and delinking can be used in order to generate well-formed phonology from restrictive conditions. Both of these effects manipulate the complexity of a segment. Delinking reduces the complexity of a segment, while binding permits complexity in positions that are not a-licensed to hold that complexity.

Parameter 7 is repeated here for clarity.

7. Tier conflation in vowels

Autosegmental tier available: YES / [NO]

I	_____
A	_____
U	_____

I and U do not reside on separate tiers. It is presumed from this that they have to share a tier. This single-handedly restricts front round vowels from appearing in English. In French each element

resides on its own tier thus allowing front round vowels in this language. On the other hand, corner vowels are the ones that are present in all languages. The fusion of elements on separate tiers is therefore more marked. French is more marked than English in this respect.

Parameter 8 states that short vowels must be headed by @ while long vowels must be headed by A, I or U<sup>7</sup>. Headedness in English replaces the ATR / nonATR distinction. The combination of headedness and ATRness and any further parameters of English are beyond the scope of this thesis. More parameters could be listed in this section, however, the crucial ones and the ones that have gained at least a little discussion in GP have been listed. I now wish to turn to a hypothesis regarding the initial state of phonology (G<sub>1</sub>).

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<sup>7</sup> Improvements on the phrasing of this and other parameters is required in GP.



2.2. The initial state (G<sub>1</sub>)

From universal patterns in child phonology one can predict the principals and unmarked parameter settings that can be claimed to be part of UG and the initial language state. This hypothesis is set out in figure 2,2. I follow this figure with a brief discussion of each of these hypotheses and some of the implications following from them.

Figure 2,2.

The initial state (G<sub>1</sub>)

- 1. *constituent structure parameters*  
    Branching constituents   [OFF] / ON
- 2. *Final empty nucleus parameters*  
    Final empty nucleus licensed? [OFF] / ON
- 3. *Projection licensing*    [ON] / OFF  
    Onset  
    Nucleus  
    Direction of projection licensing [--->] / <---
- 4. Head a-licensing: MINIMAL
- 5. *A-licensing potential of heads* INACTIVE
- 6. *Melody well-formedness effects* [ON] / OFF  
    Binding effects

The CV syllable and the reduplicated CV syllable<sup>8</sup> are widely attested as the primary syllable shapes in children acquiring many if not all languages (Jakobson 1941/1968; Branigan, 1976; Ingram, 1978; Stoel-Gammon and Dunn, 1985; Macken, 1992; Bernhardt, 1994; Oller and Steffens, 1994; Vihman, Velleman and McCune, 1994; Vihman, 1996). CV has been claimed by a multitude of phonologists to be the universal core syllable (e.g. Lleó and Prinz, 1996). It is argued to be the most basic, least

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<sup>8</sup> The reduplicating syllable is one in which the two onsets are of the same type and the two vowels are of the same quality (e.g. 'baba' 'gaga' 'dudu' 'papa' etc.).

marked structure in natural languages (Cairns and Feinstein, 1982; Clements and Keyser, 1983; Demuth 1996). One could assume then, that this structure is generated from the mechanisms of UG available from the onset of acquisition.

In GP, I hypothesize that the CV syllable and the reduplicated CV syllable are reflected in the presence of a head onset node and head nucleus node that have the ability to a-license a certain limited amount of melodic structure. The restricted nature of the CV shape is reflected in the first two unmarked parameter settings. These ban branching and therefore p-licensing of dependants (statement 1) and ban licensed empty nuclei (statement 2).

1. *Constituent structure parameters*

Branching constituent [OFF] / ON

2. *Final empty nucleus parameters*

Final empty nucleus licensed? [OFF] / ON

The restricted reduplicated CV shape is also reflected and governed by the third group of unmarked parameter settings.

3. *Projection licensing* [ON] / OFF

Onset

Nucleus

Direction of projection licensing [---->] / <-----

In contiguous onset and nucleus pairs then, an obligatory head will be on the left and its dependant will be on the right.

Both onset and nuclear projection licensing and the direction of licensing are claimed to represent the least marked system. This needs further consideration. Most languages have more than just one O-N pair determining a word and foot structure is acquired very early in acquisition (Archibald 1995). This is evidence towards the unmarked nuclear projection level. Moreover, a 'trochaic bias' has been argued to be present in early foot structure (Allen and Hawkins 1978) which could be evidence for the

marked structure in natural languages (Cairns and Feinstein, 1982; Clements and Keyser, 1983; Demuth 1996). One could assume then, that this structure is generated from the mechanisms of UG available from the onset of acquisition.

In GP, I hypothesize that the CV syllable and the reduplicated CV syllable are reflected in the presence of a head onset node and head nucleus node that have the ability to a-license a certain limited amount of melodic structure. The restricted nature of the CV shape is reflected in the first two unmarked parameter settings. These ban branching and therefore p-licensing of dependants (statement 1) and ban licensed empty nuclei (statement 2).

1. *Constituent structure parameters*

Branching constituent [OFF] / ON

2. *Final empty nucleus parameters*

Final empty nucleus licensed? [OFF] / ON

The restricted reduplicated CV shape is also reflected and governed by the third group of unmarked parameter settings.

3. *Projection licensing* [ON] / OFF

Onset

Nucleus

Direction of projection licensing [---->] / <-----

In contiguous onset and nucleus pairs then, an obligatory head will be on the left and its dependant will be on the right.

Both onset and nuclear projection licensing and the direction of licensing are claimed to represent the least marked system. This needs further consideration. Most languages have more than just one O-N pair determining a word and foot structure is acquired very early in acquisition (Archibald 1995). This is evidence towards the unmarked nuclear projection level. Moreover, a 'trochaic bias' has been argued to be present in early foot structure (Allen and Hawkins 1978) which could be evidence for the unmarked rightward directional setting. However, the postulation of the onset projection as unmarked is controversial.

unmarked rightward directional setting. However, the postulation of the onset projection as unmarked is controversial.

From cross-linguistic evidence it could be argued that the manipulation of an onset projection level is marked. Few adult languages utilise this projection level which leads to the lack of widespread consonant harmony effects in adult languages. On the other hand, planar segregation, the separation of the vocalic and consonantal levels to two separate planes in phonology, has been argued to be a feature utilised greatly in acquisition (Macken 1992) and has been argued to be a feature of phonological structure in general (McCarthy 1981, 1989). This will be discussed further in Part 3 since it is necessary and crucial to my analysis of child consonant harmony.

In following the work of Brown and Matthews (1997), I am assuming the acquisition of sub-segmental phonology to be a gradual building of contrastive nodes making up the element geometry. This tallies with the gradual building of the rest of phonology. At the onset of acquisition, then, the limited number of phoneme contrasts produced by young children is due to a lack of structure in the feature geometry.

In terms of GP, this supposition allows us to assume minimal a-licensing of the two positions at  $G_1$ . There may be only two nodes to contrast at this initial stage. Therefore, although a stop, which in adult phonology is of high complexity (6 or 7), is produced by a child, it will only have the contrastive complexity of 2 or 3 (e.g. contrastive ROOT node, PLACE node and nasal element). Therefore the following principal is affected.

#### 4. Head a-licensing: MINIMAL

The implications of this minimal a-licensing on heads is crucial to both the generation of the reduplicated syllable and to my hypotheses at  $G_2$  and  $G_3$ . Minimal a-licensing is the reason for the lack of the following dependant parameter at  $G_1$ ,  $G_2$  and  $G_3$ .

#### 5 (inactive). *A-licensing potential of heads* FULL / REDUCED

This parameter is triggered only when head a-licensing gains enough power to have potential as well as a-license its own melody.

A complete lack of a-licensing potential, however, is predicted to cause a problem in phonology. A dependent onset and nucleus can be p-licensed at  $G_1$ . If p-licensing is in place, then the dependant position is part of the structure and must surface phonetically unless properly governed. Proper government has not been stated as a principle at work in the early phonology in figure 2,2 however. Thus a clash is apparent. To surface phonetically, a position must a-license a melody. However, the dependant position is licensed by a position with no a-licensing potential to pass to this dependant position in order for that position to carry any melody. Well-formedness effects must be called on.

#### 6. *Melody Well-formedness effects* [ON] / OFF

##### Binding elements

Binding is the only way that both zero complexity of the dependant position can be twinned with a p-licensed position. This binding mechanism at both the nuclear projection level and the onset projection level makes the CV structure reduplicative. At  $G_1$ , I am assuming that delinking is not present as a melody well-formedness effect as it is at  $G_n$ . This is necessary in order to generate the harmony effects at  $G_2$  and  $G_3$ . I am however aware that a theory internal argument is unacceptable in phonological claims. This postulation will be discussed further in the relevant sections (3 and 4) and in Part 3.

The structures in Figure 2,3 and 2,4 can be generated from the limited hypothesized principles active at  $G_1$ . Binding in Figure 2,4 is represented with a broken line. Minimal a-licensing is shown on the left-most onset/nucleus pair. Only a skeletal position is indicated on the right-most onset/nucleus pair. The direction of binding follows the direction of p-licensing.

Figure 2,3.

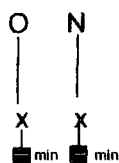
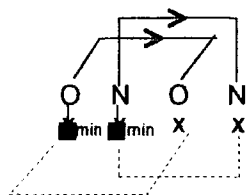


Figure 2,4.<sup>9</sup>



This section has set out hypotheses for the state of the language faculty at  $G_n$  and  $G_1$ . In doing so, this phonology generates an answer to the first set of questions listed in section 1.2.  $G_n$  answers questions 2 and 3 while  $G_1$  answers question 1. How well these questions have been answered is the topic of Part 3. The hypotheses at the very least form a good basis for the sections 3 and 4, however, in which VH and CH are represented.

<sup>9</sup> An attempt has been made to represent the three dimensional nature of the two separate levels.

### **Section 3 Vowel harmony in child phonology (G<sub>2</sub>).**

Vowel Harmony (VH) is an early harmony effect both to surface and to be lost in child phonology. It typically characterises only the stages before age 2 (Macken 1995:691). In most children, vocalic effects are therefore passed over unnoticed. However, vocalic acquisition and VH in children acquiring various languages has been reported in isolated cases.

### 3.1. Data

Although there is a lack of data concerning the acquisition of vowels both in English and in other languages, it has been possible to find certain studies in which vocalic acquisition and effects have been reported. Joan Velten (Velten 1943) is one such English case and Ferdinande (Roussey 1899-1900) is one such French case in which vowel assimilation was reported to remain part of the phonological system for longer than usual (Ingram 1986).

The VH most commonly reported and needing representation and indeed explanation in the GP framework comes under Ingram's (1986) title of Progressive Vowel Assimilation in Figure 3,1. This VH effect can surface in children anywhere between 1;6 and 4;0 although it is always early in the stages of acquisition and rapidly lost.

Figure 3,1.

*Progressive vowel assimilation.* An unstressed vowel will assimilate to a preceding (or following) stressed vowel.

#### *English*

Joan Velten: 2;0 (Velten 1943)

*bacon* [bu:du]; *birdie* [bu:du]; *flower* [fa:wa]; *hammer* [ha:ma]; *table* [du:bu]

#### *French*

Ferdinande (Roussey 1899-1900) 1;7

*oiseau* 'bird' [pog'o]; *pomme de terre* 'potatoe' [tɛ tɛ t]

(Ingram 1986)

The effect is illustrated by a limited data set making my analyses preliminary and inconclusive. Much more data must be recorded and accounted for. However the data used in this thesis can at least form a starting point.



In previous accounts of the phenomenon, the vocalic effects in child phonology have been represented as processes manipulating the adult surface forms. These processes are usually rules acting on the phonology. In Part 1 (section 1) of this thesis, however, it was stated that in GP there are no such active processes in phonology. Phonological effects are always generated within the system due to well-formedness constraints and restrictions on the general principles and parameter values operative in a particular system.

The effect of VH must therefore be generated from the particular principles and parameters restricting the stage ( $G_2$ ) of child phonology. My hypothesis for this restriction is thus as follows.

3.2. G<sub>2</sub> Hypothesis

The hypothesis I am aiming to test is that of the principles and parameters available in phonology at G<sub>2</sub>. English Phonology (and French Phonology) at this early stage of phonological acquisition manipulates limited principles and parameters of GP. These principles and parameters are listed in Figure 3,2(a) and (b)<sup>1</sup>.

Figure 3,2.

(a) English Parameters at G<sub>2</sub>

- 1. *Constituent structure parameters*  
Branching constituents [OFF] / ON
- 2. *Final empty nucleus parameters*  
Final empty nucleus licensed? [OFF] / ON
- 3. *Projection licensing* [ON] / OFF  
Nucleus  
Onset \_\_\_\_\_  
Direction of projection licensing [---->] / <----
- 4. Head A-licensing: minimal  
Nucleus: Root, Place, A or U
- 5. A-licensing potential: INACTIVE
- 6. Melody well-formedness effects [ON] / OFF  
Binding

---

<sup>1</sup> It is presumed that the basic principles and tenets of GP are also part of this phonology. These include the non-linear nature of phonology, autosegmental tiers, the availability of onset and nucleus positions, constituent and inter-constituent licensing directions etc. It is the more specific principles and parameters on which I have concentrated.

(b) Differing French Parameters at G<sub>2</sub>

2. *Final empty nucleus parameters*

Final empty nucleus licensed? [OFF] / ON

3. *Projection licensing* [ON] / OFF

Nucleus

Onset —

Direction of projection licensing {---->} / <----

4. Head a-licensing: minimal

Most of these statements are unchanged from G<sub>1</sub> hypothesized in section 2.2. These are the settings that remain at the unmarked status at G<sub>2</sub>. Only a limited number of parameters are hypothesized to have been affected by language-specific input. I suggest that the cohesion between the unmarked initial settings and the marked settings derive VH.

Statements 1 and 2 remain at the default settings in English. Both parameters are OFF and force non-branching structure<sup>2</sup> and a lack of closed syllables at G<sub>2</sub>. In French, on the other hand, word-final empty nuclei are licensed (Statement 2) so in this language the parameter is reset to ON<sup>3</sup>.

Projection licensing at both the onset and nuclear levels, Statement 3, is ON by default. At G<sub>2</sub> however I hypothesize that through language-specific input the onset projection is switched to the marked OFF setting. This tallies with the setting at G<sub>n</sub> hypothesized in section 2.1. The nuclear

---

<sup>2</sup> Some nuclei are recorded as long vowels in children's VH data. However, researchers have argued that length is non-contrastive in early acquisition and is not included as part of phonology. Moreover, records of vowel length may be unreliable. I am thus not going to account for vowel length in the data. As an aside, length may be interacting with stress in young children's production since long vowels can not be unstressed (Bernhardt and Sternberger 1998).

<sup>3</sup> French G<sub>2</sub> may be closer to adult French than English G<sub>2</sub> is to adult English. English must also reset the word final empty nucleus parameter but at English G<sub>2</sub> the phonology has not yet had the language-specific input to do so.

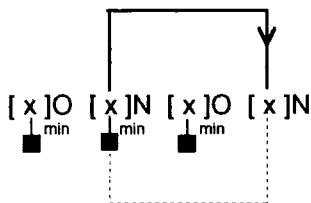
projection at  $G_2$ , on the other hand, remains at the unmarked setting ON. Licensing in English remains set in the unmarked rightward direction, one can not predict whether language input has played a role. However, in French, this direction is set through language-specific input in the leftward direction so it may be that language-specific input has had influence in English to reinforce the unmarked setting.

Head a-licensing is still considered minimal at  $G_2$  with some language-specific information stated concerning English nuclei. Only the Root node, Place node, and either A or U can be a-licensed by a nucleus position in English. In French, this restriction is not stated and thus it is assumed that fusion is more free. Minimal a-licensing as at  $G_1$  means there is a lack of a cue for a-licensing potential which is therefore inactive. Moreover, as at  $G_1$ , only binding is available as a well-formedness effect which will be called upon if clashes occurs between p-licensing and a-licensing in a position.

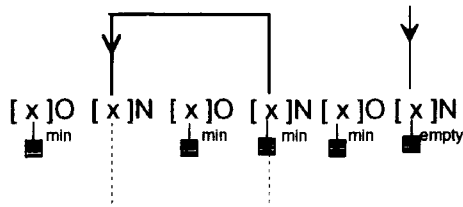
The most complex phonological structure present at this stage in acquisition can thus be illustrated as in Figure 3,3 below.

Figure 3,3.

(a) English



(b) French



The structures in Figure 3,3 are generated precisely from the statements in 3,2. Only p-licensing at the nuclear projection level is set up. No a-licensing potential is available which leads to no a-licensing at all on the licensed nucleus. The head nucleus on the other hand has a minimal a-licensing permit, in English made up of either A or U with a place and root node. Onset positions are not being considered in this analysis, the a-licensing of these positions is not crucial and is simply stated as minimal.

In order to test these statements, one needs to consider the adult target production, and the effects implemented by the limited active principles and parameters in the child phonology when this adult target is attempted by the child. This test is applied in the following pages.

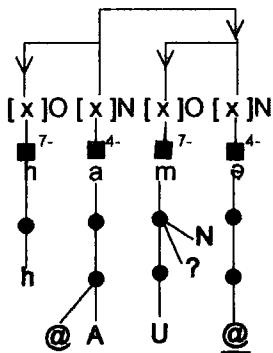
3.3. The effects of the hypothesis

By considering the adult surface forms of the data in section 3.1, and predicting the effects that the reduced phonology generates, one can test the hypothesis that the statements in section 3,2 may be a step towards a GP acquisition model. If the child's forms are not the ones generated by the statements, then the hypothesis may be disproved.

3.3.1. 'Hammer'

A complete adult GP representation of the word 'hammer' is illustrated in Figure 3,4.

Figure 3,4.

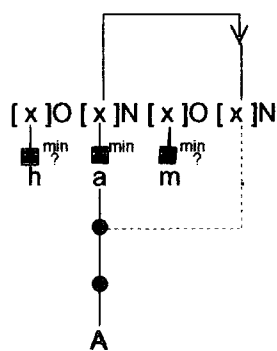


This word manipulates few principles and parameters of the adult English system<sup>4</sup>. P-licensing and full a-licensing (4 or less and 7 or less) are indicated on each position. Full a-licensing is passed from the head to the dependant nucleus via a-licensing potential at the level of nuclear projection. The potential is not reduced by either a-licensing of the head or by one remove from the head on the a-chain.

<sup>4</sup> I am assuming a non-rhotic variety of English in these representations. I am not, however, concerned with the GP analysis of non-rhoticity in which the melody for the rhotic segment is available but unlicensed. This is beyond the scope of my analyses.

In a child production of this word at G<sub>2</sub>, the hypothesis suggests that a-licensing potential will instead be inactive. The dependant position will hold no a-licensing. P-licensing will however demand a melody in the position. Binding will therefore be called upon in order for melodic material to surface in this p-licensed position. A rightward VH effect is thus generated. Moreover, since in English one of only A or U can be fused to the place node of a nuclear expression at G<sub>2</sub>, the vowel will surface simply as A at this stage of acquisition. This is represented in Figure 3,5<sup>5</sup>.

Figure 3,5. [hama]



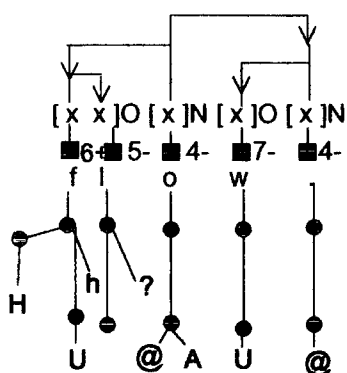
Assuming that vowel length is non-contrastive, this is the precise form produced by Joan Velten (Ingram 1986).

### 3.3.2. 'Flower'

The second word with which I am choosing to test my hypothesis is the adult word [flawə]. It can be seen in Figure 3,6 that the adult production manipulates further principles of GP than in the previous example.

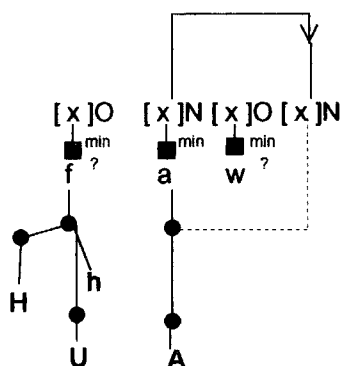
<sup>5</sup> A question-mark below the a-licensing of the onsets in my representations simply indicates that I am not considering these positions in this thesis. They do, however, deserve further investigation.

**Figure 3,6.**



In this representation, it can be seen that onsets are licensed to govern from the head nucleus, and when linked with licensing at the constituent level, this generates branching onsets. However, from the predictions made in my hypotheses, branching onsets will not surface. Furthermore, the head vowel will only hold the **A** element and the dependant vowel will only surface through binding.

Figure 3,7. [fawa]



This is again precisely Joan Velten's production of the word.

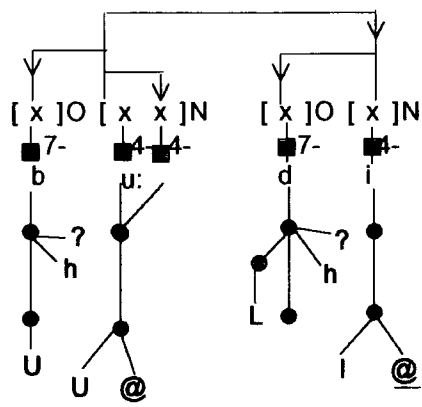
### 3.3.3. 'Birdie'

The GP representation of [bu:di] is given in Figure 3.8. I do not wish to dwell on the quality of the vowel in the head nucleus position in this example. The vowel can be thought of as a centralised round vowel represented with an expression containing a @ element as head and a U element as an



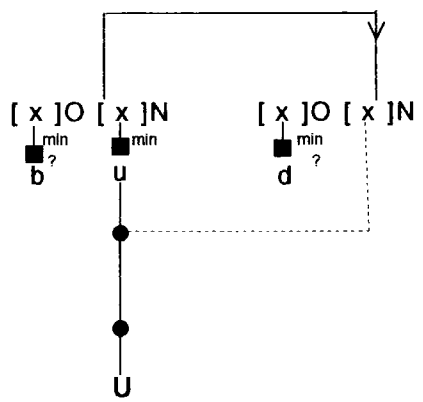
operator. The quality of this vowel is being influenced by the non-rhotic nature of this English variety which is beyond the scope of this thesis and therefore not represented.

Figure 3,8.



As predicted, the reduced principles and parameters of the early stage of language acquisition generate a much reduced form. The branching nucleus is unlicensed so only a head nucleus can surface. Moreover, the head vowel can only possibly hold the U element. And, the dependant vowel can only surface through binding. The structure in Figure 3,9 is generated.

Figure 3,9. [budu]

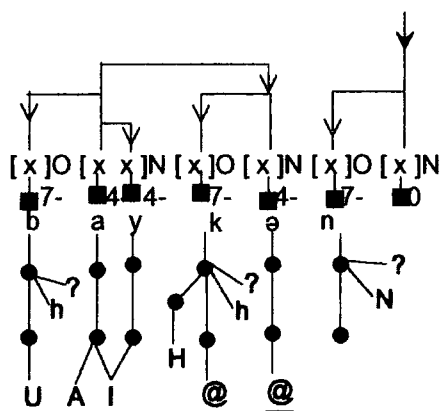


Again, this is the form generated by Joan Velten.

3.3.4. 'bacon'

The example in Figure 3,10 exemplifies the GP representation of a word with a licensed word-final empty nucleus [baykə n]. This parameter is set to ON in adult English but at G<sub>2</sub> in English it is set to OFF.

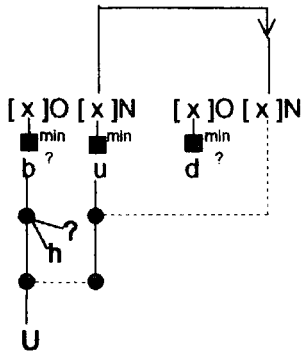
Figure 3,10.



From the hypothesis, the child form is predicted then, not to include the final onset-nucleus combination. The complement to the head nucleus will also not be included. Only either A or U will be supported in the head expression and the dependant nucleus at the level of nuclear projection will surface through binding.

A problem occurs in this representation however. It would be predicted that the simplex A would remain fused to the head nucleus and thus the child form would be produced as [C a C a]. Joan Velten's production however is [C u C u]. This form is inexplicable from the principles and parameters set out so far. This will need further investigation. The form may be caused by variation effects in the child's parameters. It could also be an effect caused by assimilation of the vowel to the preceding onset place. This possibility is not born out from the principles of GP stated for this stage. I have not predicted any licensing between these two positions which may influence assimilation. Nevertheless, a possible representation is set out in Figure 3,11.

**Figure 3,11. [budu]**

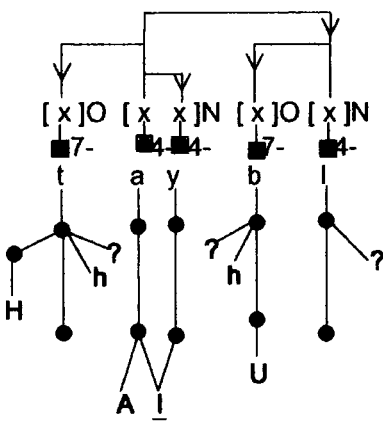


This is Joan Velten's generated structure.

### 3.3.5. 'table'

The final English example (Figure 3,12) is also interesting in that it shows a syllabic liquid in nucleus position [tayb<sub>l</sub>]. This liquid is possible in a nucleus position due to its low complexity calculation (3complexity).

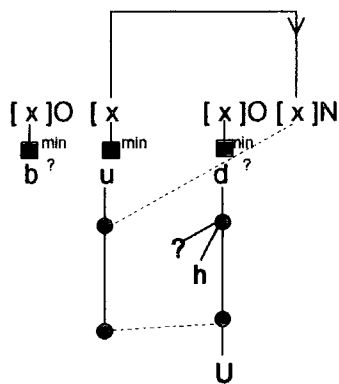
**Figure 3,12**



Again, from the  $G_2$  hypotheses, it is predicted that the constituent and government licensing are unavailable along with the potential of the final nucleus to hold any melodic material without turning to binding from the head. The head, again, would be predicted to reduce to a simplex **A** expression giving the form [C a C a].

The actual form generated by Joan Velten, as in the example in 3.3.4 above, does not compare with this prediction. The form, [C u C u], is again the actual generated output. This could only surface in the representation by delinking both vocalic elements and with assimilation from the following onset, see Figure 3,13.

Figure 3,13. [budu]



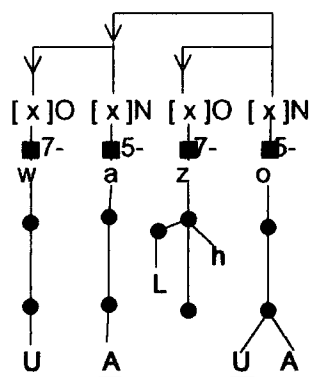
Further investigation is again obviously needed since this action does not tally with licensing demands. One might argue that the variation inherent in child phonology has, in both the instances of the problematic vowel quality, obscured the results and therefore the prediction. That is, the prediction isn't wrong, but happens not to be fulfilled at these times (Hannahs, p.c.). Therefore, with further insight into variation this problem may disappear. In English, it can at least be seen though, that the VH effect is generated in each instance from the lack of a-licensing potential on the dependant nucleus and the binding that is forced in this situation.

Two French examples reinforce the hypotheses further. In French, however, VH is shown to occur at a more advanced stage of acquisition when the word-final empty nucleus parameter has been set and when a full set of fused elements can be a-licensed by the head nucleus.

3.3.6. 'oiseau'

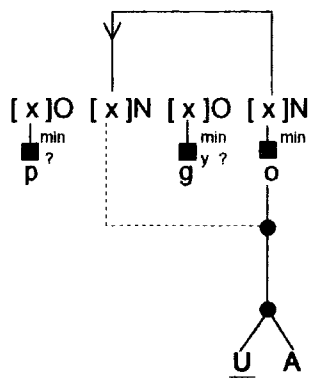
The first example, [wazo], uses few principles and parameters of the phonology. This representation is illustrated in Figure 3,14.

Figure 3,14.



In the adult system, the dependant nucleus has a-licensing potential to carry full French vocalic expressions. This is not the case at G<sub>2</sub>. At this stage, the dependant is predicted to surface only due to its binding to the head. The VH form is thus predicted to surface in the form of the representation in Figure 3,15.

Figure 3,15.

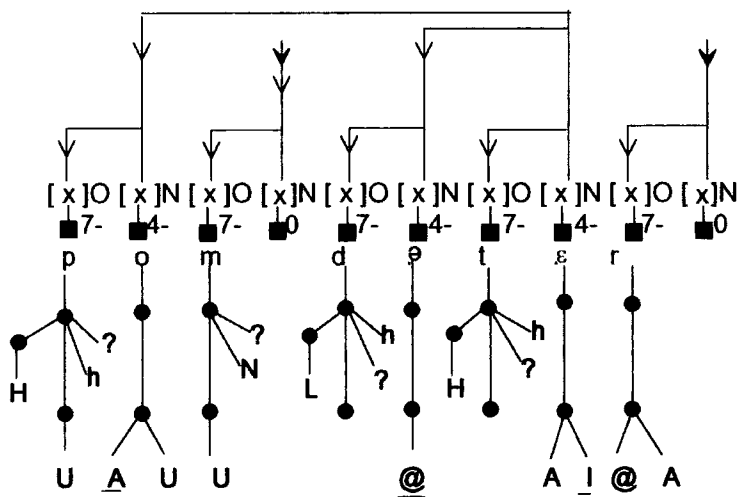


Ferdinande (Roussey 1899-1900) does in fact generate a form that fits to this schema. The form [pogʷo] is produced. I do not wish to speculate on the consonant forms surfacing in this example, however, the vowel forms and the VH tally perfectly.

### 3.3.7. 'Pomme de terre'

This final example manipulates the tri-morphemic structure of 'Pomme de terre' which has the combined semantic meaning of 'potato'. Since the interpretation is of one semantic entity, this structure is analysed as one word. Licensing at the morphological level is therefore involved in the adult production of this word which can be seen in the representation in Figure 3,16 below.

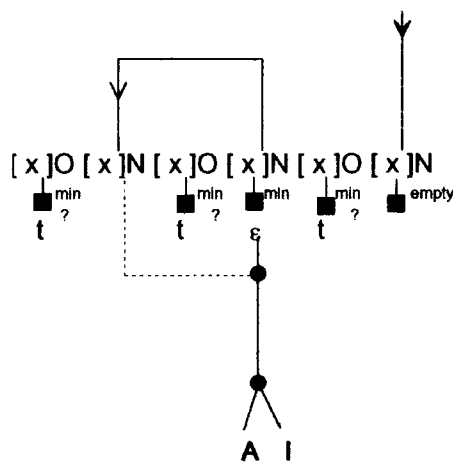
Figure 3,16.



In this word, then, two word-final empty nuclei are included in the one semantic structure. 'pomme' and 'terre' are both analysed with word-final empty nuclei, while in 'de' the word final nuclei surfaces.

One would predict that the full structure will not be analysed by the child. Licensing at the morphological level is not hypothesized as available in the child phonology. Therefore, I would predict that only 'de' and 'terre' will surface since 'pomme' is the dependant in the morphological domain.

Moreover, only the word-final empty nucleus licensing and licensing at the level of nuclear projection will act. Thus the structure represented in Figure 3,17 is predicted.



This is precisely the form generated by Ferdinande. The vowel forms fit to the predicted structure,  $[t_{\varepsilon} t_{\varepsilon} t]$ .

Section 4 Consonant Harmony in child phonology (G<sub>3</sub> )

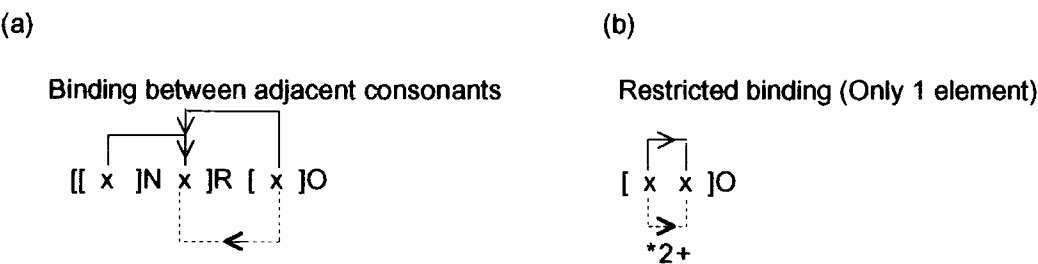
In many adult languages of the world, consonants are found to assimilate to an adjacent consonant to form either geminates or homorganic clusters. In English, for instance, the nasal in the negative prefix 'in' assimilates to the first consonant of its stem as exemplified in the data in Figure 4,1. The assimilating consonant is strictly adjacent to its head and calls on the place node of feature geometry.

Figure 4,1.

- Velar assimilation: *incomplete*
- Labial assimilation: *impossible*
- Base morpheme: *inevitable*

In GP, this type of assimilation can be specified as binding of the rhyml adjunct to its head. In Part 1, it was stated that universally no more than one element can be bound in a branching onset. This condition eradicates possible assimilation in onset position. There remains only rhyml adjunct-onset adjacency in which consonant assimilation can appear. In Figure 4,2 (a), binding between the onset and rhyml adjunct is illustrated. No restrictions are declared. In (b), on the other hand, binding between a head and complement in onset position is illustrated. The condition ' \*2+ ' is included as a restriction. This states that two or more bound elements lead to ungrammaticality.

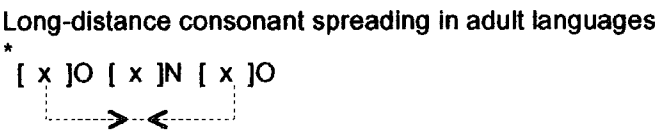
Figure 4,2





Consonant assimilation between two onsets separated by an intermediate nucleus is largely unattested in adult languages<sup>1</sup>. Figure 4,3 below illustrates the form that this harmony would take. Neither direction is specified and the domain can not be determined as local due to the intermittent nucleus.

Figure 4,3.



This harmony is precisely the type witnessed in child phonology.

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<sup>1</sup> Some adult languages have been claimed to include a long-distance consonant spreading effect including Temier; a language of Malaysia, Arabic, Chaha, Modern Hebrew, and Yoruba (Gafos 1998). However, Gafos (1998) argues that this effect can and must be eliminated from phonology and that the effect is one of segmental copying as in reduplication. Chuvash, a Turkic language, has also been reported to have CH (p.c. Phil Harrison, p.c. John Harris). More research needs to be employed in a GP analysis of these effects. This research could well strengthen the postulation of inter-onset licensing and the claims surrounding this licensing on which my analysis of CH is dependant.

#### 4.1. Data

Ingram (1986) sums up two CH effects in English child language in Figure 4,4.

Figure 4,4.

*Consonant harmony.* In  $C_1V C_2(X)$  contexts, consonants tend to assimilate to each other in certain predictable ways. Two frequent patterns are:

(i) Velar assimilation. Apical consonants tend to assimilate to a neighbouring velar consonant.

Jennika 1;7 *duck* [gʌk]; *sock* [gʌk]; *tongue* [gʌn]

Amahl (Smith 1973) 2;2 *tickle* [gigu]; *truck* [gʌk]; *taxi* [gɛgi:]

(ii) Labial assimilation. Apical consonants tend to assimilate to a neighbouring labial consonant.

Daniel (Menn 1975) *tub* [bʌb], *table* [bʌbu], *steps* [bɛps], *tape* [bejp]

All of the data presented by Ingram (1986) is that of Smith's regressive harmony in which harmony is from right to left. Progressive harmony, left to right, is also reported by researchers. Lateral harmony and progressive labial harmony (Figure 4,5.) are two such cases discussed by Spencer (1986) taken from Smith (1973).

Figure 4,5.

(i) progressive labial harmony

Ahmal (Smith 1973) *Queen* [ki:m], *Kick* [kip]

(ii) Lateral harmony

Ahmal (Smith 1973) *Lorry* [loli], *Yellow* [lelo]

Only regressive harmony is to be investigated in this thesis. Spencer's (1986) analyses of lateral harmony and progressive labial harmony are exemplified in the next section. However, these harmony effects need further investigation in GP which is beyond the scope of this thesis.

#### 4.2. A previous approach: Spencer (1986)

Spencer (1986) concentrates quite heavily on CH in his reanalysis of Smith's (1973) SPE-based (Chomsky and Halle 1968) work on phonological acquisition<sup>2</sup>. He includes a possible reanalysis of the process of lateral harmony and regressive labial and velar attraction, as well as considering both progressive velar and labial harmony using the more modern approach of Autosegmental Phonology (McCarthy 1984) and Underspecification theory.

In this approach, the non-linearity of phonology and a special feature of coronals as underspecified are manipulated. This leads to an analysis in which a feature can spread on its autosegmental tier using association conventions to segments unspecified for place features, i.e. coronals. Rules are still behind this approach but set out instead as paradigms of certain types. The paradigm for an autosegmental analysis of vowel harmony (Clements and Sezer 1982:217) is presented in Figure 4.6.

Figure 4.6. The Paradigm for the analysis of harmony.

Set the parameters for:

- (a) The class of P-segments (melody units) which constitute the autosegmentally-represented harmony features.
- (b) The class of P-bearing units (melody bearing units) defined as the class of units to which P-segments are associated under the universal Well-Formedness Conditions.
- (c) The (possibly null) class of opaque segments, defined as those which are underlyingly associated with a P-segment.
- (d) The (possibly null) class of transparent segments which must be formally excluded from the class of P-bearing units.

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<sup>2</sup> Smith's (1973) work can be considered a description of his child's acquisition. Formalised realisation rules manipulate underlying representations of the child's phonology that correspond to adult surface forms. Together this produces the child's surface form. This can not be considered a psychologically real representation of acquisition. His observations are *about* the grammar not coded as a *property* of the grammar (Spencer 1986:7)

(e) The domain within which the Well-formedness conditions initially apply.

The paradigm for Association Conventions.

(a) Associate free (i.e. as yet unassociated) P-segments with free P-bearing segments from left to right across the mapping domain, until no further such associations can be made.

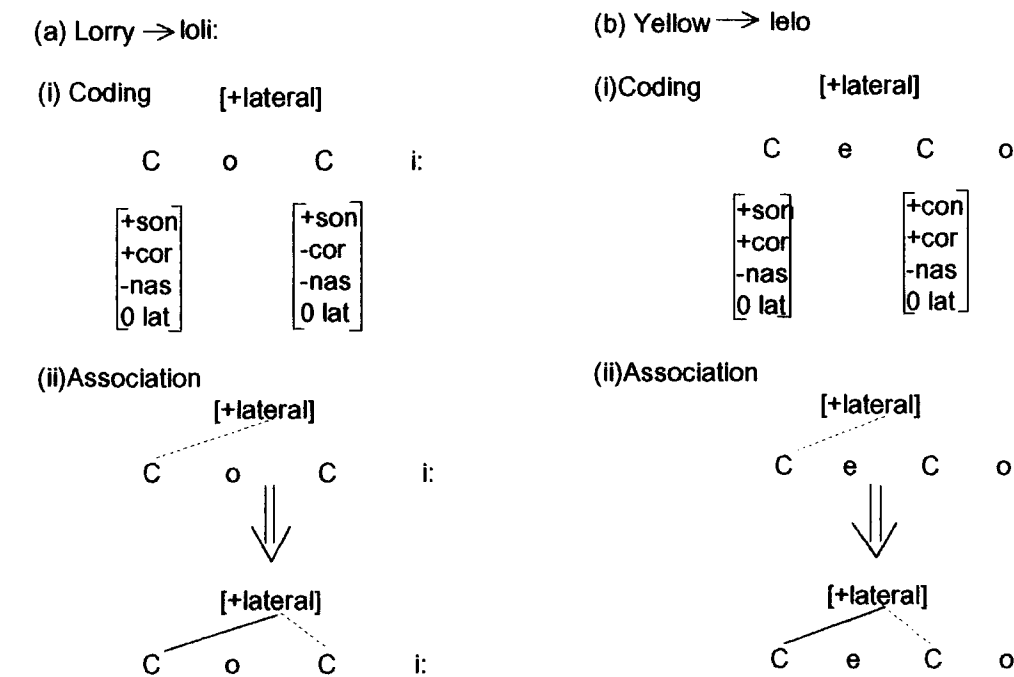
(b) Associate any remaining free P-bearing units with a P-segment, giving precedence (in case of indeterminacy) to the P-segment on the left.

(Spencer 1986:9-10)

For lateral harmony, in which a target /r,j/ becomes // when there is a token of // in the same word, the P-segment is the autosegment [+lateral], the class of P-bearers is the class of sonorant non-nasal coronals, and the domain is the word. Association conventions thus associate the autosegment with appropriate slots on the CV tier. See figure 4.7.

Figure 4.7.

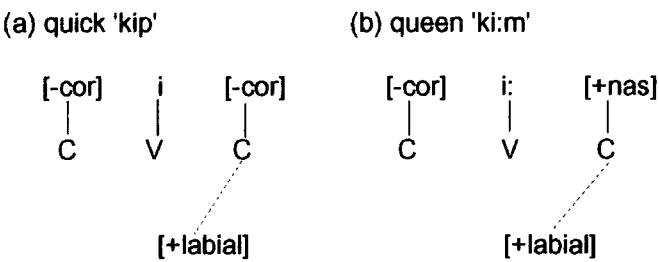
Spencer's (1986) Lateral Harmony



'ki:m' is produced simply through underspecification in the same way, see Figure 4.8. The [+labial] autosegment is considered available in all the child's words. It can dock rightwards onto underspecified segments as and when that segment is underspecified, i.e. the last C.

Figure 4.8.

Progressive Labial Harmony



Progressive velar harmony and regressive labial/velar harmony are problematic for Spencer. He is aware that directionality in harmony is a difficulty in this approach. Spencer leaves open the question of determining direction in both labial and velar harmony. Although the non-linear nature of Spencer's approach is a great improvement, it is not, therefore, satisfactory for lateral harmony or the other cases of harmony he discusses.

One of the main criticisms of analyses of child CH effects such as that of Spencer (1986) is that the analyses do not explain why the effect is most notably a feature only of child language. The postulation of P-segments, P-bearing units, and association conventions could as easily be stated for adult systems. Moreover, the analyses are considered just as descriptive as Smith (1973). The postulations are a means to an end, not part of an inclusive grammar<sup>3</sup>. Thus, the analysis is also far from learnable.

<sup>3</sup> Harmony has also been approached as an effect residing in the development of the subsegmental level of phonology. That is as an absence of contrast in the feature geometry of a developing child phonology (Heijkoop 1997). I do not wish to enter into a discussion of this approach. I do, however feel that although this approach has merit, a GP explanation of the facts should also be considered.

### 4.3. G<sub>3</sub> Hypothesis

CH, approached from the GP model, can be expressed quite simply and effectively. The analysis at G<sub>3</sub> (Figure 4,9) manipulates much the same principles as those at G<sub>2</sub> although the mechanisms called upon are slightly different.

The effect of CH at G<sub>3</sub> must, like VH at G<sub>2</sub>, be generated from the particular principles and parameter settings at that stage of child phonology. I aim to test the hypothesis in Figure 4,9 which predicts the principles and parameters at this stage.

Figure 4,9.

English Parameters at G<sub>3</sub>.

1. *Constituent structure parameters*

Branching constituents [OFF] / ON

2. *Final Empty nucleus parameters*

Final empty nucleus licensed? [OFF] / ON

3. *Projection licensing* [ON] / OFF

Nucleus

Onset

Direction of projection licensing [--->] / <---

4 Head A-licensing.

Nucleus : full

Onset : full

5. A-licensing potential [FULL / REDUCED]

Nucleus :

Onset :

6. Melody Well-formedness effects [ON] / OFF

Binding

Constituents are still non-branching at  $G_3$  as derived from the unmarked setting of statement 1. This setting remains in line with the settings at both  $G_1$  and  $G_2$  discussed previously. On the other hand, at  $G_3$ , licensed word final empty nuclei are generated in English. Statement 2 is therefore set through language-specific input to the marked ON parameter in line with the French setting at  $G_2$ .

Projection licensing at  $G_3$  is the first crucial parameter at this CH stage of acquisition. It is claimed to be at the unmarked ON setting in line with  $G_1$ . Both onset projection licensing and nuclear projection licensing are thus obligatory. This is not the claim made however at  $G_2$  in which the onset projection was set to OFF. This is a place in which I do not wish to speculate on a developmental model of acquisition. The manipulation of both these stages in one system may be problematic. However, within the scope of this thesis it is possible to overlook this and maintain a simplified analysis.

Nuclear projection licensing generates foot structure at  $G_3$ . This is not particularly crucial at this stage since the head and dependant are not manipulated by well-formedness conditions. The onset projection level is particularly crucial to the CH analysis however.

It is the onset projection that generates adjacent onsets without intermediate nuclei being involved. Accounting for adjacency and non-adjacency in adult and child phonology has always proved a problem for phonologists (Bernhardt and Stemberger 1998). This will be discussed further in Part 3. However, in GP, the onset projection is an integral part of adult phonology and can thus be applied automatically to child phonology.

In GP, the onset projection level is the level at which inter-onset licensing occurs. Inter-onset licensing was introduced in section 3.5 of Part 1. It has been described as a relation between two onsets in which the left most one is more complex than the rightmost one. This licensing, if generated in a language, can properly govern an intermediate nucleus in order for that position to be empty (Gussman and Kaye 1993). This relation has had limited discussion in the literature and more research is necessary concerning its effects in adult language. Child data may be able to add to this

research, however, in that the onset projection seems to fit comfortably into analyses of CH in child phonology.

The head and dependant at projection levels must obey well-formedness conditions in order for licensing to be set up and for structure to be generated. This is the second crucial point in an analysis of CH. Onset projection licensing at  $G_3$  triggers well-formedness conditions. These conditions are derived from statements 4,5 and 6 in Figure 4,9.

At  $G_3$ , a-licensing of head nuclei and head onsets is stated as FULL. I am hypothesizing therefore that the feature geometry at  $G_3$  is fully or at least almost fully acquired<sup>4</sup> and therefore triggers the dependant maturational parameter concerning a-licensing potential (statement 5). I am claiming that full and reduced a-licensing potential are unmarked on both nuclei and onsets when this parameter first surfaces in phonology. This is not the final state setting. From language-specific input, onsets will gradually have this setting switched in English to restrict the a-licensing to reduced potential. The fact that the unmarked setting is active in English at  $G_3$ , however, affects the generation of CH.

Statement 6 is the final and most crucial of my  $G_3$  hypotheses. Binding (and still not delinking) is suggested as available to manipulate well-formedness of the principles of phonology. Delinking of elements, I am claiming, does not become an active effect of well-formedness until a later stage in acquisition. This is a controversial claim. One could argue that delinking is one of the most manipulated effects in child phonology. If a complement can not be supported by licensing, then the melody must be delinked leading to unbranching surface structure. However, I would like to argue that if licensing is not present then melody can not form part of a phonology at any level. A

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<sup>4</sup> Complexity of consonants is crucial to this discussion and reopens debate on the precise elements that make up the consonant expressions. As stated in Part 1, section 2.2.2. I have chosen to follow the work of Brockhaus (1995a.) in which elements are placed in Harris's (1994) feature geometry. Coronal is not represented as a separate element and complexity calculations include awareness of geometry nodes.



complement position is simply not generated. With only binding to effect well-formedness, harmony and assimilation can be predicted to be highly apparent in child phonology. This is the case.

Binding will be triggered in phonology only when the head onset is less complex than its dependant due to statement 5. P-licensing between the two positions must be set up and can not do so if this pattern is evident. On the other hand, if the head onset is more complex than or equally complex to its dependant, p-licensing can occur without problems.

The most complex hypothesized phonological structure present at the CH stage of acquisition can thus be illustrated as in Figure 4,10 below. In this illustration, the effect of a coronal licenser<sup>5</sup> generates the binding effect due to its lower complexity than the dependant onset. A non-coronal stop licenser will not generate this effect since this licenser has the complexity to p-license without call for well-formedness effects. The onset and nucleus projections are represented as previously in a three dimensional fashion in order to indicate the separate nature of these two levels. Each position holds a-licensing potential indicated by the blocks and the number indicated at the side of those blocks. The a-licensing potential of 6- indicates all consonants but non-coronal stop expressions while 7- indicated those non-coronal stops<sup>6</sup>.

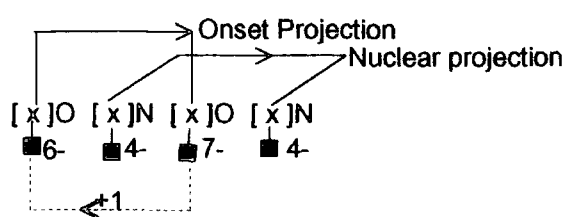
Figure 4,10.

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<sup>5</sup> Or any other consonants with less than 7 complexity.

<sup>6</sup> In Brockhaus (1995a), the Laryngeal node is manipulated to define voicing of various kinds. This node, however, complicates this initial discussion of CH. Voicing contrast, like length contrast mentioned and omitted in the VH analyses in the previous section, may be non-contrastive in early child phonology or be erroneously reported by researchers (Macken 1995). The acquisition of this node, therefore, demands further research in its own right. The harmony I am investigating can be approached without consideration of the voice quality of the consonants thus, in my analyses, I am choosing to omit the Laryngeal node. Since I am omitting the Laryngeal node and any elements fused to that node, complexity in my examples will be reduced by 2. This does not affect the analysis of stops and the harmony.

Figure 4,10.

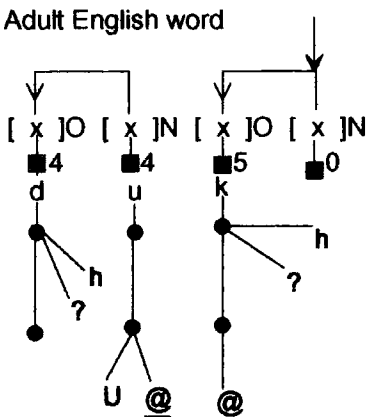


According to an analysis based in GP then, CH is an effect in the phonology to increase the complexity of the head in line with its dependant. Binding is initiated at the onset projection level to increase this complexity. This effect and structure is generated from the statements and can be tested by considering the adult production of the examples of velar and labial regressive assimilation listed as part of section 4,1.

4.4. The effects of the hypothesis.

The complete GP representation, minus Laryngeal node, of the adult production of the English word 'duck' is illustrated in Figure 4,11 below.

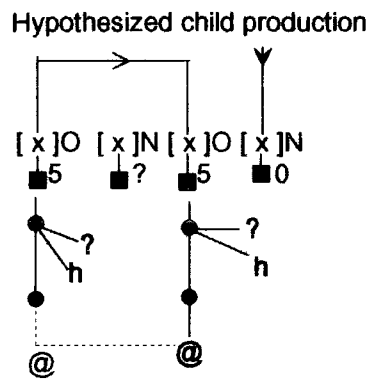
Figure 4,11.



One can see in Figure 4,11 that in the adult English word, the potential head of the inter-onset relation would be less complex (d= 4complexity) than its complement (k= 5complexity). However, this is not a concern in the adult phonology since inter-onset licensing does not hold between consonants. In the hypothesis for the child's production, on the other hand, inter-onset licensing is required. One would predict, therefore, that a call for well-formedness must arise.

Two possibilities would be available in universal GP. Firstly, delinking of elements in order to weaken the dependant position generates possible licensing. However, this is not an option at G<sub>3</sub> as stated in statement 6. Thus secondly, binding can be manipulated and is the only option. This binding has to act at the inter-onset licensing domain, but the direction appears opposite to that of the licensing. This is not the best option in the phonology but is the only one available due to the limited number of principles available at G<sub>3</sub>. The hypothesis will thus generate the structure in Figure 4,12 for the production of 'duck'.

Figure 4,12.

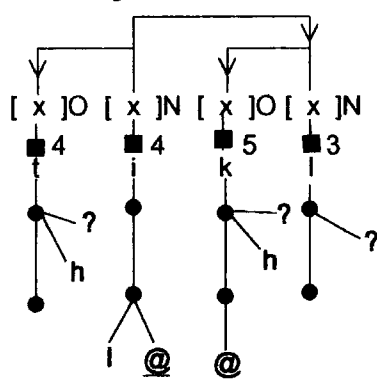


Jennika's production [gʌk] can precisely fit in this hypothesized structure. Ahmal's production [g k] for 'truck' also fits. With N in place of h in the dependant onset, Jennika's production [gʌn] for 'tongue' is a further structure that fits this prediction. And without licensing of the word final nucleus [gigu] for 'tickle' (see Figure 4,13.) and [gɛ gi] for 'taxi' also fit in this predicted structure.

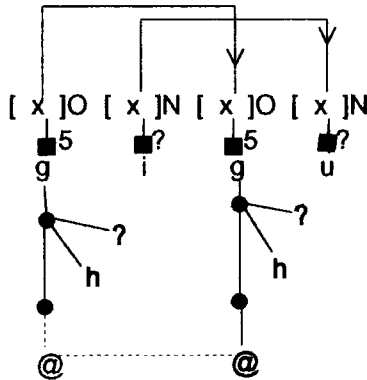
Figure 4,13.

Velar harmony 'tickle'

Adult English word



Child production



Moreover, labial harmony fits in the same analysis with one alteration, @ is replaced by U in the dependant position. All of Daniel's forms [bʌb] for 'tub' (see figure 4,14), [bubu] for 'table' (see figure 4,15), [bɛps] for 'steps' and finally [bejp] for 'tape' fit into the structure.

Figure 4,14.

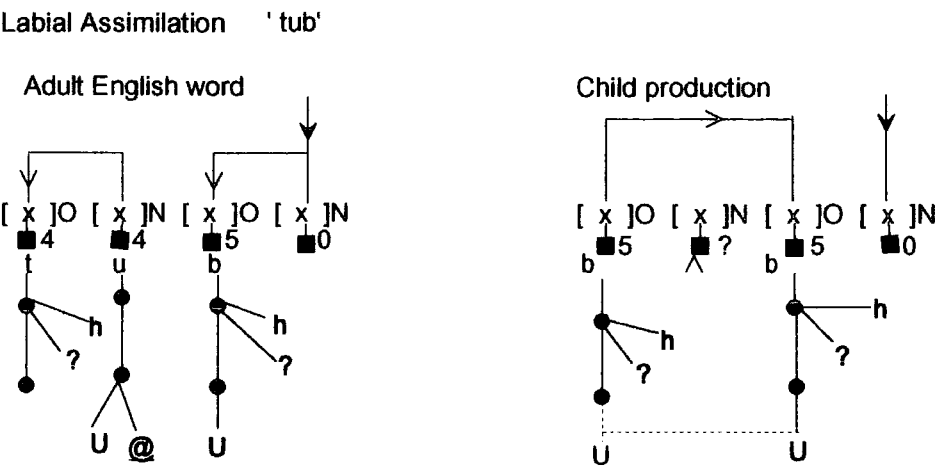
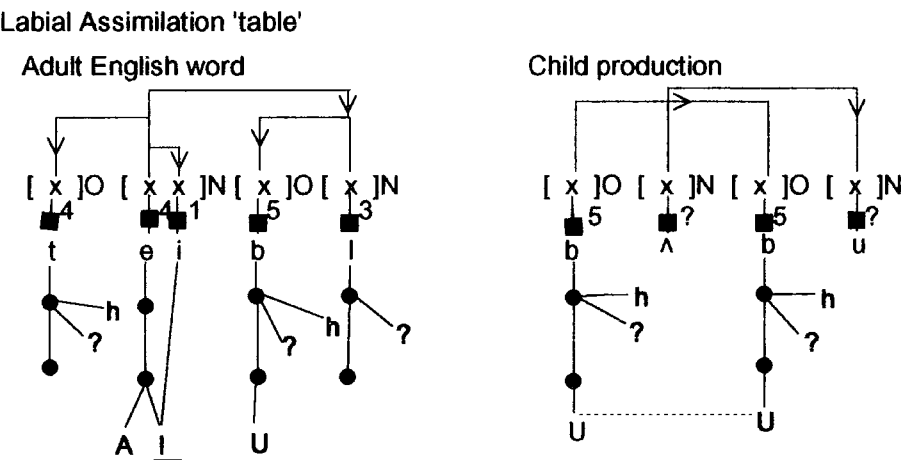
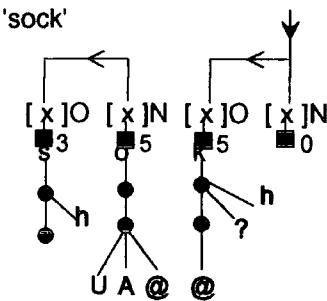


Figure 4,15.



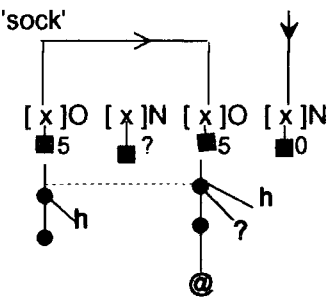
The analysis in Figure 4,12 in fact extends to all but one of the pieces of datum listed in section 4.1. Jennika's production [gok] of 'sock' needs further consideration. The adult form of this is presented in Figure 4,16.

Figure 4,16.



The head onset in this word has much lower complexity (3complexity) than its dependant (5complexity). In order to gain equal complexity, binding in this example has to be predicted to be from the full root node. This is illustrated in Figure 4,17.

Figure 4,17.



With this slight alteration and without consideration of the voicing contrast this structure predicts the surface form [gok] which is Jennika's production. And gives us a full prediction of all the forms of regressive labial and velar assimilation listed from Ingram (1986) in section 4.1.

The data has fitted comfortably into the hypotheses set out for  $G_3$ . Part 3 of this thesis assesses the hypotheses for  $G_3$  as well as  $G_1$ ,  $G_2$  and  $G_n$ . The answers to issues raised in section 1.4. are also assessed from these hypotheses. This final section points out the problems with the analyses and the many areas in need of further research both in the GP model itself and the acquisition model suggested in the thesis.

### Part 3. Discussion and Conclusion

This thesis has set out some preliminary suggestions regarding a model of child phonological acquisition in Government Phonology. The application of GP to acquisition seems to me to be an interesting research area. Crucially, the model of GP is highly restrictive in its mechanisms. This is a requirement that any model of phonology must meet and one that a model of phonological acquisition must be able to follow. An unrestricted model says nothing about phonology because it can say everything. On the other hand, a model that is restrictive can say little, but if able to explain and represent acquisition, must be regarded with respect. GP is precisely this type of model as has been illustrated in this thesis<sup>1</sup>.

Acquisition data generates a number of questions which must be considered in a model of acquisition. The questions specific to my research scope were set out in Part 2, section 1.4. These are repeated below as Figure 1,1 for convenience.

Figure 1,1.

1. Which mechanisms of GP are available from the onset ( $G_1$ )?
2. Which mechanisms of GP universally develop with time?
3. Which mechanisms of GP are reset due to primary input?
4. Why does VH surface in the English phonological system when it is not an effect found in the adult system?

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<sup>1</sup> Government Phonology is also advantageous as a model of acquisition since it eradicates debate over levels of representation. In GP, phonological representations are directly interpretable at every level. There is no need to debate between the manipulation of either underlying forms or surface forms in this model. This can be argued to radically simplify the approach to acquisition in which discussions on the manipulation of levels of representation have tended to hold a primary position.

5. Why does CH surface in any child phonological system when this is not a widely attested effect in adult languages?
6. What is learnt to allow a child to deharmonise segments?

In an optimum model of acquisition the answers to these questions must be straightforward. In the GP framework, the answers are indeed so. The application of the principles of GP and the default setting and subsequent language-specific setting of parameters of GP answer these questions in a simple and logical way.

The first three questions can be considered the core questions needing consideration regardless of the specific phenomena of child phonology investigated. Answers to these questions are necessary in any innatist model of continuous acquisition<sup>2</sup>. These questions have been answered in the hypotheses at the initial state of phonology ( $G_1$ ) and the English adult state ( $G_n$ ) (Part 2, section 2). The second three questions are specific to the harmony effects found in child phonology and have been answered by the research undertaken on two intermediate stages in which consonant harmony ( $G_3$ ) and vowel harmony ( $G_2$ ) are evident (Part 2, sections 3 and 4).

In this final part, these answers are considered in order to see if a model of acquisition using GP is truly advantageous or even worthy of further investigation. Section 1 considers each question in turn and the approach taken in GP to find a satisfactory solution to that question. In each case the answer is quite straightforward thus could be argued to be an advantageous one. However, there are various problems that must also be considered in the course of the discussion and many areas of the acquisition data and model that are in need of further research.

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<sup>2</sup> The acquisition issues, such as the Continuity Hypothesis, and the assumptions adopted in this thesis (section 1.1 to 1.3) are not further assessed in this section as they are all tenets of major research programmes which await agreement between linguists. Rejection of the basic approach by linguists; an innate, continuous, building phonology with initially unmarked parameter settings, would render this whole thesis untenable. Innatism in particular is crucial to the theory behind Government Phonology. If innatism was disproved, Government Phonology would be automatically disproved also.



In section 2, I feel it necessary also to list some of the many problems that I have become aware of within the GP framework. These problems are in need of further research and discussion which has been beyond the scope of this thesis.

Overall, this final section is mainly negative in its assessment of both the GP model and an acquisition model therein. However, even with the problems within the model of GP and the tentativeness of the research topic, I feel able to end in section 3 with a positive conclusion based on a call for further research.

## Section 1 The acquisition questions answered

Acquisition is a continuous development of structure built from an innate set of reduced principles and unmarked parameters to a full set of principles and language-specific parameters (Part 2, sections 1.1. - 1.3.). Thus, solutions to all of the questions set out in Part 2, section 1.4 and repeated above in Figure 1,1, rely on the initial language state for the principles and parameters that are easily available, the triggering of parameters due to other fully developed mechanisms, and the unmarked or marked settings of parameters.

GP, it has been shown, has been easily manipulated to these assumptions in order to postulate both an initial and a final language state, and moreover, the intermediate stages at which CH and VH apply. The solutions to the questions simply are the postulations of  $G_1$   $G_2$   $G_3$  and  $G_n$ .

### 1.1. Which mechanisms of GP are available from the onset?

In section 2.2 in Part 2, the principles and parameters that are available at the onset of acquisition ( $G_1$ ) were predicted. The reduced number of principles and parameters and the default unmarked value of these parameters account for the surface structure of phonology at the early stages of acquisition and directly answers question 1.

The hypothesis for the principles and unmarked parameters is, for the most part, reasonable. It generates the CV and the reduplicating CV syllable shapes that tend to be the earliest surfacing structures in most child phonologies<sup>3</sup>. The hypothesis should make for an interesting start point to an acquisition model. However, certain problems with the hypothesis have been pointed out throughout this thesis.

#### a. Onset projection licensing - default setting ON

Projection licensing at work in early phonology is crucial to my analyses at both  $G_1$ ,  $G_2$  and  $G_3$ . Default nuclear projection licensing can be argued. Most, if not all languages form some kind of binary foot structure which can be interpreted at licensing at the nuclear projection. As discussed in section 2.2, to claim that onset projection licensing is unmarked, however, is controversial. There has been limited manipulation of an onset projection level from a cross-linguistic perspective<sup>4</sup>. A consideration of

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<sup>3</sup> It may be considered controversial to generate the reduplicating syllable through binding of the two heads to their dependants. This approach allows continuity between  $G_1$ ,  $G_2$  and  $G_3$  in my hypotheses but does need further investigation.

<sup>4</sup> Onset projection licensing is a concept with limited backing in Government Phonology. It has, therefore, been manipulated in few languages. With further research it may be applicable to more languages which would be advantageous to my hypotheses. However, with more research it could also be totally discredited as a mechanism of phonology which would be devastating to my hypotheses. Only time will tell.

statistical universals would suggest that onset projection licensing would be marked. Onset licensing requires further cross-linguistic investigation but does not inspire confidence.

The separation of consonants and vowels on to two planes in phonology has, however, been argued outside the realm of GP and the GP acquisition model<sup>5</sup> (McCarthy 1981, 1989). The onset projection level and the nuclear projection level could be considered GP equivalents to this planar segregation. There are problems with planar segregation which I do not wish to discuss in this thesis<sup>6</sup>. However, with its manipulation and universal status, child phonological data is far more explicable (Bernhardt and Stemberger 1998). The unmarked ON setting can thus be argued to reflect the universal status of planar segregation and explain child consonant harmony (see section 1.5). I thus feel that my hypothesis is reasonably motivated from both acquisition data and other phonological theories.

#### b. Onset and nucleus licensing direction - default Rightward

Default rightward licensing at the nuclear and onset projection levels is another crucial but only weakly supported hypothesis of phonology at G<sub>1</sub>. Onset licensing has been stated to be only ever rightward in adult languages (Gussman and Kaye 1993). Nuclear projection licensing however, can be either rightward or leftward depending on the adult language. The default rightward setting in this thesis is backed only by the postulation of a 'Trochaic Bias' in stress acquisition (see discussion in Bernhardt and Stemberger 1998:446-7). It has been noted by researchers (e.g. Allen and Hawkins 1978) that children often initially produce trochaic stress rather than iambic stress even if input from the ambient language is of right-headed foot structure. This bias however has generated much

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<sup>5</sup> Although usually still within the realm of acquisition.

<sup>6</sup> It is difficult, for example, to account for interaction between consonants and vowels in phonology. Assimilation between adjacent consonants and vowels is evident in some adult phonological systems and in child phonology. With planar segregation, these segments are not considered adjacent. In GP, however, this may involve turning to inter-constituent licensing where links between these adjacent segments are set up. Further research is needed into this solution.

debate in the literature and has been strongly opposed (e.g. Paradis, Petitclerc and Genesee, 1996). If the trochaic bias is discredited, the hypothesis for the onset and nucleus licensing direction would be questionable.

#### c. Minimal head a-licensing

A third crucial principle of the GP model of acquisition is the minimal head a-licensing hypothesis at  $G_1$ , which is really just a speculation through consideration of studies on the development of subsegmental acquisition (Brown and Matthews 1997). It is reasonably logical to assume that a-licensing would be depleted at early stages of acquisition, however, with limited research completed on the acquisition of subsegmental phonology and none looking specifically at the acquisition of GP subsegmental structure, the hypotheses could be considered unsubstantiated. Further research is necessary based on the work of researchers such as Brown and Matthews (1997), but adapted to or influencing the GP framework.

Three crucial problems have been mentioned for this first and most manipulated hypothesis then. Taking into account the present state of knowledge on acquisition and Government Phonology, however, I feel that this first question has been provided with an interesting solution and allows progression to question 2.

## 1.2. Which mechanisms of GP universally develop with time?

Two parameters can be seen to be dependant on the previous acquisition of other parameters or principals in my hypotheses at  $G_1$  to  $G_n$ .

### a. An inactive a-licensing potential parameter.

It is hypothesized that a-licensing potential is an inactive parameter in phonology until it is triggered by full a-licensing on heads. As mentioned above, a-licensing and with it a-licensing potential has no substantiated backing. It does have a certain realistic edge to it however making me persevere with the claims. At initial stages the a-licensing is minimal and does not trigger the dependant parameter. At  $G_3$  and at  $G_n$ , this parameter is active. At  $G_1$  and  $G_2$  it is inactive.

The lack of this parameter at  $G_1$  and  $G_2$  leads to the clash between p-licensing and a-licensing of the dependant positions which calls on binding in order for satisfaction. It must be admitted that the postulation of this parameter and its dependency on head a-licensing is really a theory-internal postulation. Further research will have to be undertaken and is necessary in order to motivate this hypothesis properly.

### b. Inactive delinking as a well-formedness condition.

Delinking as a well-formedness effect is also hypothesized to be triggered in some way. Binding is the initial well-formedness effect that is unmarked and set ON. Only at  $G_n$  of my stages am I claiming that delinking appears as an option for well-formedness. This is discussed in more detail in Part 2, section 4.3. Again there is limited argumentation to back up this hypothesis. Further research must be done.

The solutions to question 2, then, must be accepted to be even more problematic than the first solutions set up for question 1. They are, however, crucial assumptions that generate consonant harmony and vowel harmony in the stages they are needed. This is in no way compelling reasoning and much further research into these types of hypotheses is needed.

### 1.3. Which mechanisms of GP are reset due to primary input?

Parameters set to the marked options in phonology are the mechanisms that are accessed through primary input. Throughout the discussion of these hypotheses it has been acknowledged that some of the unmarked parameters are unmotivated in the wider scope of phonology. Cross-linguistic study of patterns can motivate an unmarked structure. Non-branching constituents are found more frequently in languages than the marked branching constituents. Open syllables are found more frequently than closed syllables. This is motivation for the settings of the first two parameters hypothesized. However, as discussed in section 1.1. unmarked onset and nucleus rightward projection licensing is less attested.

Markedness assumptions are crucial in my model of phonological acquisition in order to predict the structure of the initial state of language and subsequent development from language-specific input<sup>7</sup>. The markedness values must be correct. Further research into them could make or break a model of phonology.

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<sup>7</sup> It must be noted in this section that the analyses for  $G_2$  in French and English manipulate different parameter settings. This is not the best solution which would be to postulate that CH in French and English surface at different stages. The use of one stage ( $G_2$ ) was used simply for convenience and could be argued to illustrated continuity in acquisition although this is beyond the scope of this thesis.

#### **1.4. Why does VH surface in the early English phonological system but not in the adult English system?**

In the Government Phonology model of acquisition hypothesized in Part 2, section 3, VH appears in child phonology at  $G_2$  due to minimal head a-licensing and binding. Minimal head a-licensing implies that there is no a-licensing potential. P-licensing, however, calls for melody to surface in the position which holds no a-licensing due to this lack of a-licensing potential. Binding must be called upon in order for melody to surface in a p-licensed position at the nuclear projection level.

Vowel harmony is not part of English adult phonology since a-licensing at this final stage is full. Therefore a-licensing potential is triggered and the dependant nuclear position can a-license its own melody without need for other well-formedness effects.

As discussed in the previous three subsections, problems arise with many of the hypotheses manipulated to generate this explanation. For example, minimal head a-licensing not triggering potential. Much more research is needed. I still think, however, that the hypothesis for  $G_2$  is an intriguing reason for the generation of VH.



### **1.5. Why does CH surface in child phonological systems when it is not widely attested in adult systems?**

In the GP model of acquisition, CH is represented at  $G_3$ . A requirement that the head onset is at least as complex as the dependant is stated in order to set up obligatory licensing at the onset projection. In order for an increase in the complexity of the head to that of the dependant, binding is called upon.

CH is widely unattested in adult phonology, then, for two possible reasons. In many languages that have been investigated licensing at the onset projection could be said to be switched to the marked OFF setting. The marked setting, OFF, would be generated from a resetting in most languages through language-specific input. Without onset projection licensing, CH can not be generated, thus explaining the lack of attested cases of consonant harmony in adult languages. The head onset and its possible dependant would have no restrictions on their well-formedness at the onset projection level. This possibility brings us back to the claim, however, that onset projection licensing is unmarked. The widely unattested nature of CH in adult languages would suggest that onset projection licensing ON should be the marked setting. This requires further research and I accept that the doubtful nature of this area of the research may lead to abandonment of the theory.

A second possibility could also be at play making CH widely unattested in adult languages. With the triggering of delinking in phonology, this well-formedness effect would be chosen over binding. Binding generating CH occurs in the opposite direction (right-to-left) to the licensing (left-to-right). This, I am claiming, is possible as a last resort. However delinking, if available, would take precedence. In languages with onset projection licensing, delinking of elements in the dependant onset may be called upon instead of binding between this dependant and its head. Delinking may not, then, necessarily generate a harmony effect. Thus CH would not be reported. Again, this requires further research.

### **1.6. What is learnt to allow a child to deharmonise segments?**

In both cases, what is learnt by a child to deharmonise is that the licensing between the two positions either onset and onset or vowel and vowel do not have to call on binding as a well-formedness constraint in order to surface in phonology.

To eradicate VH, a-licensing between vowels becomes full, therefore a-licensing potential is triggered and the dependant nuclear position can a-license its own melody without need for other well-formedness effects. To eradicate CH, onset projection licensing may be switched to OFF in English and in many other languages or binding may be usurped by delinking as the well-formedness effect. As mentioned in the previous sub-section this need further research.

This section sets out some interesting possibilities and suggestions as to the nature of harmony effects in child and adult phonology. I acknowledge the need for much more research into the statements made but feel that this is a good beginning towards what I have admitted is a tentative model of acquisition in GP. The greatest problems in this thesis, I feel, are the ones formed by the actual model of GP itself. The next section discusses this in a little more detail.

## Section 2. A glance at areas needing further research.

The model of Government Phonology is taken as the basis of the acquisition model suggested in this thesis. At the onset of my research, I felt that this framework was a promising phonological model making some exciting claims over the nature of the universal phonological system and language-specific details of languages. With more in-depth consideration of this model in order to approach an acquisition model, I have however come across many areas of this model that are problematic, lack solid foundation and are not detailed in explanation.

Throughout this thesis then, suggestions have been made for further research into areas of GP. Some of these are suggestions are not as crucial to my model but nonetheless lead to a weaker component model in which to work. These are listed below with reference to the page on which they are mentioned.

The binary phrasing of parameters (pp.104)

The spreading and influence of the @ element (pp.16).

Headedness, ATR, and head alignment (pp.26).

A GP specification for harmonically recessive suffixes in Chichewa (pp.79)

Magic licensing (pp.63)

The possible lack of \*[ A [B ]] morphological structure (pp.56)

Foot structure and stress (pp.101)

The second set, listed below, could however, greatly improve or totally discredit the model of acquisition set up in this thesis.

The parametric ranking of principles (pp.50)<sup>8</sup>.

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<sup>8</sup> Krisztina Poldargi's (1998) doctoral thesis proposes to combine GP with OT (Prince and Smolensky 1993) in general, and then specifically for vowel harmony in adult languages (Poldargi 1998). OT concerns the language-specific ranking of universal principles. This may be prove to be an interesting direction in which to take an acquisition model of the kind proposed in this thesis. A GP-OT

A set of principals and parameters needed to generate a complete adult phonology (pp.103).

The complexity of consonants (pp.62)

Effects of the Minimality Condition on harmony (pp.44)

Inter-onset licensing (pp.47)

Long-distance consonant harmony in adult languages (pp.127)

Moreover, within the realm of acquisition I have noted throughout Part 2 that further research is necessary, and again could either provide further support towards or counter-evidence against my acquisition model. These areas are listed below.

A GP analysis of weak stress reduction (pp.83), progressive harmony and lateral harmony (pp.128)

Further evidence towards markedness relations (pp.92).

Consideration of the development of phonology (pp.93, 133).

Dealing with variation in child phonology (pp.93, 122).

A subsegmental acquisition model and its effects on a-licensing and potential (pp.106).

Vowel length contrasts in child phonology (pp.113).

Voicing contrasts and the Laryngeal node (pp.135.)

Effects of non-rhoticity in language (pp.116).

Effects of adjacent segments (pp.122)

Triggering parameters and dependant parameters (pp.106, 134, 148)

A trochaic bias (pp.105)

Planar segregation and an onset projection (pp.106, 133)

I do not wish to enter into a discussion on all of the problems associated with either the model of Government Phonology or the acquisition model. These areas are beyond the scope of this thesis. These problems do, however, lead to a positive conclusion.

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GP-OT theory may integrate well with Bernhardt and Stemberger's (1998) work on acquisition in a constraint-based nonlinear model.

### **Section 3. A positive conclusion.**

A negative slant is apparent throughout this thesis. I have had to acknowledge that basic problems with the theoretical model pass down to an acquisition model and thus both could be discredited. Some of these basic problems are listed in the previous section.

However, this thesis can have a positive outcome. More research needs to be undertaken both on Government Phonology itself and on an acquisition model in Government Phonology. If nothing else, this thesis proves this need.

The research of both of these areas together can aid the development of the theory, the re-analysis of some of the problematic principles of that theory and maybe some new and improved principles evident after looking at acquisition and theory side by side. I hope there will be many further instalments in this story.

## **Appendix**

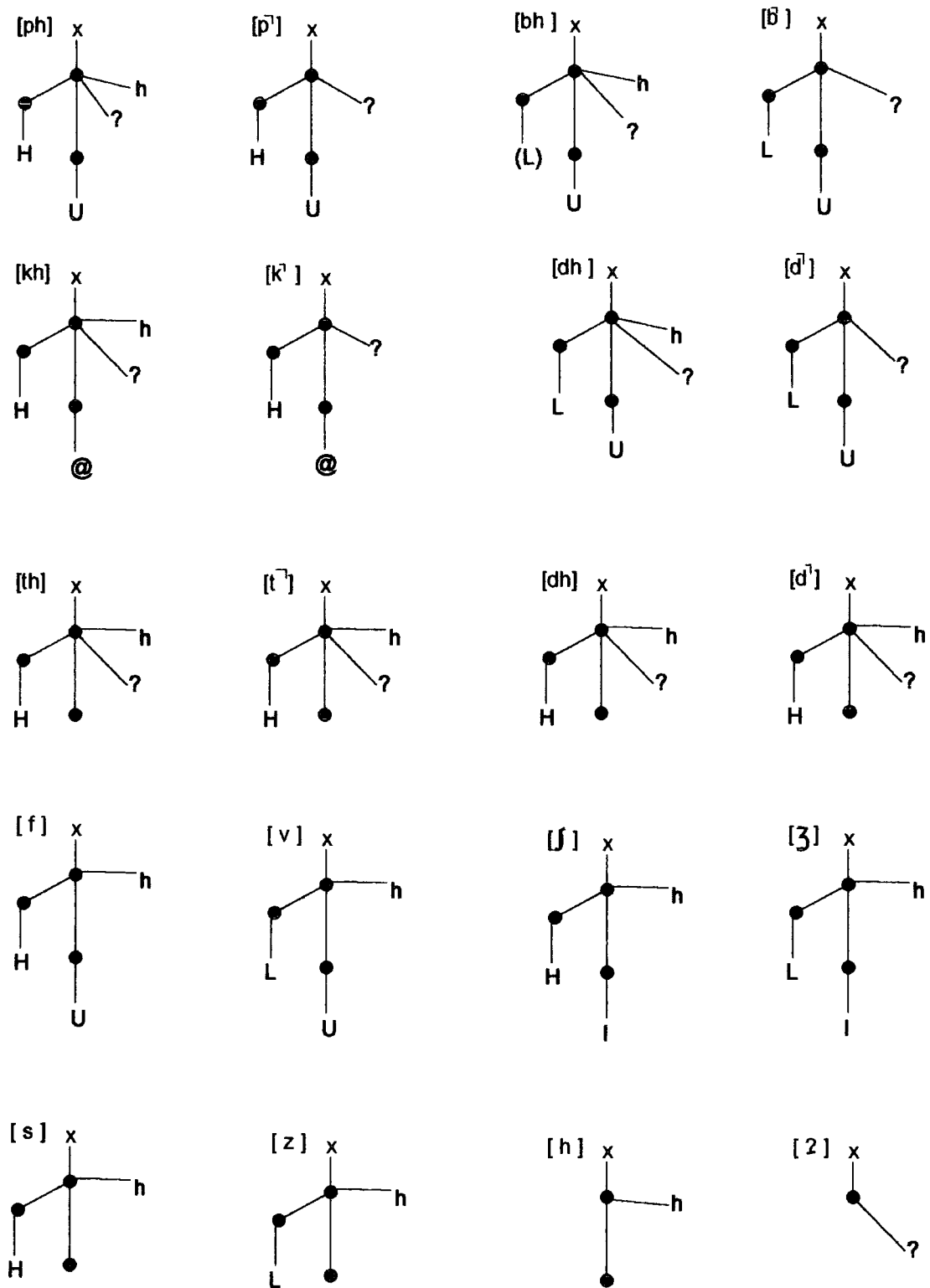
### **A list of expressions**

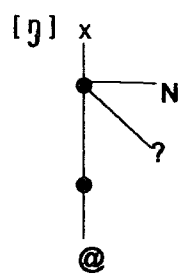
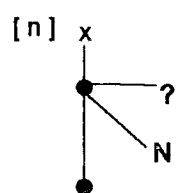
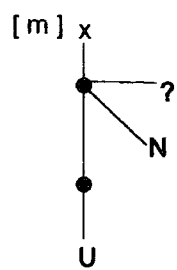
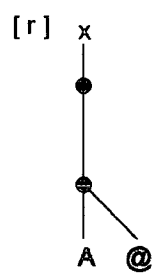
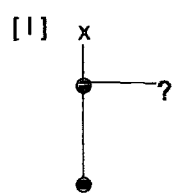
The following list of element combinations covers the vowels and consonants of English necessary for the analyses of child phonological data in this thesis. The examples come from two sources. The vowels are adapted from Kaye (1997). The consonants are those of Brockhaus (1995a). Discussion of the precise representations can be found in the literature of these two phonologists.

An attempt has been made to keep the representations constant although a variety of different approaches can be found within the GP literature. Within the examples of harmony processes in other languages, the expressions are those of the researcher and are thus may not all be featured in this appendix. A number of French vowels are included in this list due to there inclusion in some of my research data.

I have not included the latently present @ element since this makes the combinations more difficult to analyse. Some examples of English and French words manipulating the vowel qualities are given as a guide to the pronunciation of each expression.

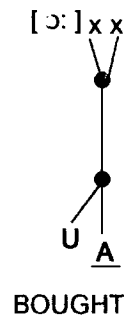
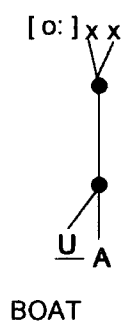
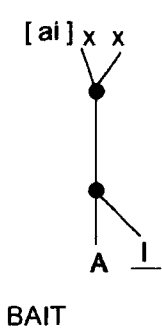
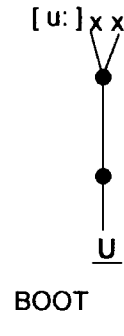
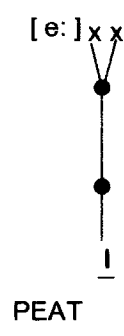
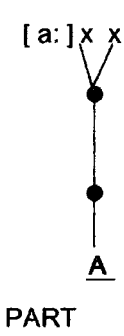
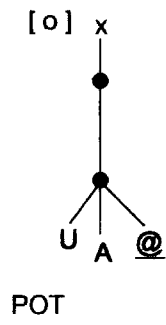
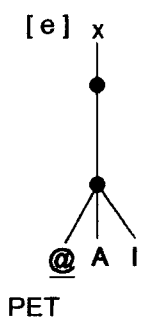
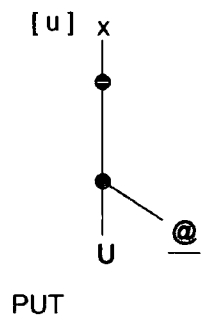
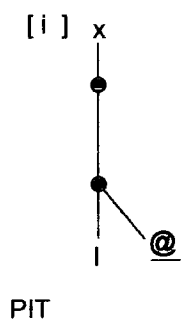
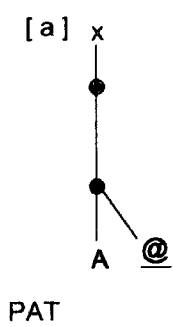
Consonants

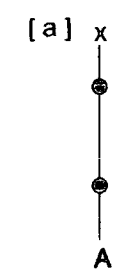






Vowels

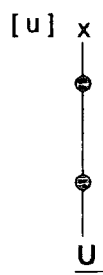




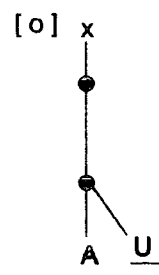
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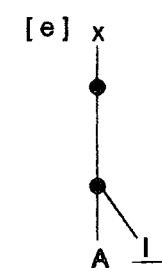
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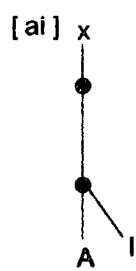
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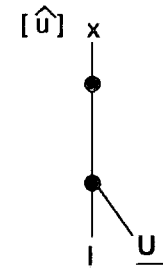
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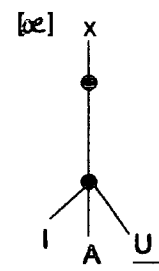
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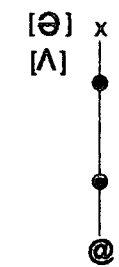
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