# Edge-licensing in chanting contours<sup>\*</sup>

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#### Abstract

This paper looks at the manifestation of downstep in chanting contours, and at the way in which this phenomenon has been accounted for by some models of intonation. Special attention is paid to the analysis in Cabrera-Abreu (1996), where it is argued that toneless boundaries belonging to an empty nucleus are responsible for downstep in phonetic interpretation. However, this proposal cannot be fully formalised unless a strategy is found to license such nuclei. We propose here that empty nuclei can be licensed by the edge of the intonation domain. This analysis allows for both a descriptively and an explanatorily adequate account of chanting contours.

## **1** Introduction

Some current models of intonation (Pierrehumbert 1980, Grice 1995, Ladd 1993) resort to the combination of H(igh) and L(ow) to account for downstep. In the framework of a restrictive phonological theory, this proposal is undesirable, since it assumes that both tones enjoy an equal distribution in phonological representation, something which is clearly not the case (see Cabrera-Abreu 1996 (henceforth C-A)). In order to present an alternative approach to the phenomenon of downstep, and more specifically, its manifestation in chanting contours, we turn to C-A's proposal which is radically different from that presented in former accounts. This is mainly due to two reasons: first, in her model, L is not recognised as a phonological unit, and the only tonal unit available to account for pitch patterns is T(one). Second, her model is based on the assumption that T can be associated to boundaries of prosodic domains exclusively. In this context, a toneless domain — which is integrated into prosodic structure as an empty nucleus — is regarded as the trigger of downstep.

In the specific case of chanting contours, a situation is created whereby some units in phonological representation — the rightmost empty nucleus and the rightmost skeletal position — threaten to violate the fundamental principles of licensing, which control the well-formedness of phonological representation. This situation arises as a consequence

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of the model's inability to identify a unit which would act as a licensor of such units. Obviously, this situation is unacceptable.

In order to solve the situation described above, and to present a coherent account of downstep in chanting contours, we propose that the offending units are licensed by the right edge of the intonation domain. Thus, they no longer constitute a threat to the well-formedness of phonological representation.

Our discussion will be structured as follows. In §2 we introduce the phenomenon of downstep. In addition to this, we present a more detailed analysis of the difficulties encountered by C-A's model in the representation of such a phenomenon in chanting contours. In §3.1 we outline former accounts of downstep in intonation, and also, we discuss some of the problems faced by such analyses. §3.2 is a survey of how Cabrera-Abreu's model works, and what its major components are. In §4 we show how downstep is treated within her framework, and we shall concentrate on her analysis of calling contours. After that, we devote §5 to a longer discussion of the points outlined in §2. Additionally, we present a solution to such points.

## **2** Overview

In many of the world's languages there is a phenomenon whereby the scaling of two H tones can be different; under some circumstances, the phonetic value of one of them can be shifted downwards within a particular pitch range. For instance, consider the following example which is frequently mentioned in the literature on tone languages (see Pulleyblank 1986, van der Hulst and Snider (eds.) 1993, and references therein), but which also illustrates a similar situation found in many other languages at the level of intonation (Grice 1995): in a sequence such as HLHHLH in a given domain (shown by the square brackets), tones can be interpreted as shown in (1).

(1)  $\begin{bmatrix} - & - & - \\ & - & - \\ & & - \end{bmatrix}$ H<sub>1</sub> L<sub>1</sub> H<sub>2</sub> H<sub>3</sub> L<sub>2</sub> H<sub>4</sub>

In (1),  $H_2$  and  $H_3$  are interpreted on relatively lower pitch than  $H_1$ , even though phonologically they are the same H tone. The same effect is manifested in  $H_4$  with respect to  $H_2$  and  $H_3$ ; that is,  $H_4$  is interpreted on a level lower than  $H_2$  and  $H_3$ . The general consensus among researchers is that this type of lowering is conditioned by the existence of  $L^1$  in phonological representation. For example,  $H_2$  and  $H_4$  are downstepped because there is an L tone to their left. On the other hand, the reason why  $H_3$  is not lowered with respect to  $H_2$  is that there is no intervening L.

As already indicated, this phenomenon is also attested at the level of intonation. In this case, it has been argued that the factor which triggers downstep is either a bitonal pitch accent involving L (Beckman and Pierrehumbert 1986, Grice 1992, 1995) or a particular branching structure (Ladd 1993), rather than simply L tone.

These analyses contrast sharply with that proposed also for intonation by C-A, in as much as the latter is based on a model in which L is non-existent. Her model is characterised by having a single T(one) only, which corresponds to former H. In addition, T can be associated to boundaries belonging to prosodic domains exclusively (rather than to both boundaries and accented syllables, as was formerly customary). In this context, relatively high pitch is accounted for by the association of tone to a boundary, and consequently, relatively low pitch is accounted for by a toneless prosodic boundary.

In relation to the particular case of downstep, C-A assumes that the presence of toneless boundaries is responsible for creating the sudden drop in pitch height, which may then result in the downstep effect of a following tone associated to a boundary. In this way, a natural connection is established between the target and trigger of downstep. As an illustration of this, let us assume that the large boundaries in (1) correspond to a large prosodic domain, say the intonation phrase, and that each tonal level corresponds to information assigned to smaller prosodic domains within the larger domain. This is graphically represented in (2).

(2)  $1 \quad 2-3 \quad 4 \\ \begin{bmatrix} [abc] & [@] & [abc] & [@] & [abc] \end{bmatrix} \\ | & | & | & | & | \\ T & T & T & T & T \end{bmatrix}$ 

<sup>&</sup>lt;sup>1</sup>L can be manifestly present or floating. Other accounts (see Pulleyblank 1986) suggest that stepping is not related to the presence of L in phonological representation specifically, but to whether or not two Hs belong to the same foot (no stepping) or to different feet (stepping).

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The pitch levels accounted for by  $H_1$ ,  $H_2$ ,  $H_3$  and  $H_4$  in (1) are analysed in (2) as the interpretation of T associated to both boundaries of domains 1, 2-3 and 4<sup>2</sup>. Note that domains 2-3 and 4 are preceded to their left by domains (represented as  $[@]^3$ ) whose boundaries are toneless. The presence of such toneless boundaries in phonological representation is interpreted as having a pulling down effect on the interpretation of tone-bearing boundaries to their right. So, the fact that the phonetic interpretation of domains 2-3 and 4 is lower in pitch compared to that of domain 1 is due to the presence of toneless boundaries in the former case, but not in the latter.

In this paper we present an overview of C-A's account of stepping contours, and we carefully examine the manifestation of downstep in the particular case of calling contours, also referred to as *chanting tones*. In her work, she leaves a series of points unsolved, and in this paper, we shall investigate the way to solve them.

One such remaining point is found when a skeletal position may occur to the right of the ultimate licensor. Such a licensor can license units to its left (due to the directionality of licensing at this particular level, which is from right to left), but cannot license units to its right. This creates a situation in which such a position remains unlicensed, and hence, contrary to our wishes, cannot be integrated into phonological structure. This renders the status of the skeletal position meaningless, and consequently redundant. We illustrate this in (4) below, which is the phonological representation for the contour in (3), in which the horizontal axis represents time in seconds (s), and the vertical axis shows frequency in Hertz (Hz).<sup>4</sup> The utterance is An@na, with a step down between An- and -na.

In An@na there are two levels of pitch, the second being clearly sustained and lower than the first one. Let us now turn to analyse the phonological representation which accounts for this contour.

 $<sup>^{2}</sup>$ The reasons for not associating T to the right boundary of the right domain will become clearer later in §3.2.

<sup>&</sup>lt;sup>3</sup>@ is an informal device to indicate that a domain is empty. We also follow C-A's proposal to show @ in phonetic interpretation as an indication of downstep. For example, An@na.

<sup>&</sup>lt;sup>4</sup>Some of the figures shown in this paper are a simplified version of the same figures included in C-A. For example, here we have decided to exclude the illustration of boundary licensing relations, since these are not directly relevant to the point being discussed.

$$\begin{array}{c|c} (4) & \begin{bmatrix} & \bullet & N & & \end{bmatrix} L2 \\ & & & & \\ & & \begin{bmatrix} & N & \end{bmatrix} \begin{bmatrix} N & \end{bmatrix} & L1 \\ & & & \\ &$$

Tone is associated to both boundaries of the position licensing An-. This accounts for the first level of sustained pitch. Toneless boundaries belonging to the position licensing @ account for the fact that there is a drop in pitch level. Given that there are no further tonal specifications around the skeletal position which licenses *-na*, pitch remains the same as has been specified already, that is, rather low and level.

Other units to observe in this representation are the arrows, which show the directionality of licensing relations. At L2 and L1 licensing goes from right to left (this is parametrically conditioned), so that, had there been any units to the left of the nucleus, these would have been licensed by the nucleus itself.

The important point to notice about the representation in (4) is that the skeletal position belonging to -na, which is part of the larger domain at L2, falls outside the reach of any of these licensing relations. Thus, we must search for a strategy which will succeed in the licensing of the rightmost skeletal position.

A preliminary solution is proposed by C-A for another case which is extremely similar to the one under discussion here, and is also illustrated in (4). Observe that the constituent represented by N at L1 does not participate in a licensing relation with another unit, and more importantly, is not itself licensed. A possible candidate to act as a licensor could be N, since this is the only unit which has enough licensing power to do so. Yet, N can only license other constituents to its left, but not to its right, due to the directionality of licensing at L1 or L2 (see (17b) below). In these circumstances, C-A suggests tentatively that the empty nucleus may be licensed by the right edge. Unfortunately, C-A does not fully commit herself to this proposal as she sees this as a solution only for a marginal case.

Nevertheless, we now suggest that this may not be the case. In this paper, we propose that, in the same way as an empty nucleus can be edge-licensed, so can skeletal positions be licensed by the edge<sup>5</sup>. One of the benefits of this account is that it allows us to

<sup>&</sup>lt;sup>5</sup>In these cases, the skeletal position fails to be projected onto the next level of structure. Therefore, it is not integrated into a constituent. We shall have more to say about this point later, in §5.2.

generalise about edge-licensing, and consequently, the edge-licensing of final empty nuclei would not have to be treated as a unique case.

Another point left unsolved in C-A is the account of downstep within a monosyllabic word in a calling contour, such as the one illustrated below. The utterance is Jo@ohn, with a step down inside it.

In Jo@ohn there are two different levels of pitch (like in the case of An@na), and the duration of the second level with respect to the first one is clearly perceived as longer.

C-A's preliminary analysis of cases such as this suggests that toneless boundaries within a word may count as the trigger for downstep. Thus, the phonological representation which accounts for the contour in (5) is as follows<sup>6</sup>:

(6) 
$$\begin{bmatrix} N & ] L2 \\ | & [N] & [L1] \\ | & X & | & X \\ | & | & | \\ John & @ \\ T & T \end{bmatrix}$$

The presence of the rightmost skeletal position conveys the information that a unit to the right of the position licensed by  $\mathbb{N}$  is the target of the downstep effect.

As already pointed out above, the presence of the rightmost skeletal position is difficult to justify, although it is not impossible. However, what is even more problematic to defend is the fact that this position has no melodic content associated to it (at least in the example of An@na, it was clear that *-na* was docked onto such a position, and this made a strong case for justifying it).

In view of this difficulty, we shall study the validity of an alternative representation, which is not considered in C-A. This is illustrated in (7).

<sup>&</sup>lt;sup>6</sup>Note that C-A is not satisfied with this representation for reasons we shall mention shortly. Hence, she indicates that an alternative structure may suit better. We also discuss this below.



As can be seen, the rightmost skeletal position has been excluded from (7). Unfortunately, this representation is not free from problems either. For instance, it fails to achieve descriptive adequacy. Note that, from the perception of this contour, the hearer receives the impression that, as stated earlier, the step down is encoded within the domain of Jo@ohn, and not, as our understanding of the above structure still seems to suggest, at the end. In order to defend (7) as the better representation of (5) we would have to assume that, for some unclear reason, the effect of @ is 'felt' within Jo@ohn.

Still, the justification for this representation is unclear, and far from convincing from the phonological point of view. Therefore, we continue our search for another alternative, and this leads us to analyse a structure also mentioned by C-A, but of which she does not include an evaluation. This is illustrated in (8).

$$(8) \qquad \begin{bmatrix} N & ] L2 \\ | & ] \\ [N] \begin{bmatrix} N & ] \begin{bmatrix} N \end{bmatrix} & L1 \\ | & | & | \\ X & | & X & x \\ | & | & | \\ Jo & | & @ ohn \\ T & T \end{bmatrix}$$

In §5.3 we assess the validity of this representation in the context of what has been established above in relation to edge-licensing for the case of An@na. That is, we shall propose that, in the same way as the skeletal position which licenses *-na* is edge-licensed, so is the position which licenses *-ohn*. A benefit of this representation is that with the presence of the rightmost position, we can generalise about the phonological structure of calling contours; note that the representation for Jo@ohn is phonologically equivalent to that of An@na. The only difference arises when we consider the melodic content, which is *-na* in the latter case, and *-ohn* in the former case. Another aspect which renders this representation desirable is that it achieves descriptive adequacy on two counts: first, it clearly captures the fact that the downstep effect occurs within Jo@ohn, and second, it

also accounts for the observation that the vowel in *Jo@ohn* is consistently lengthened in this type of contour.

## **3** Downstep in intonation

## 3.1 Pierrehumbert (1980), Ladd (1993), et al.

There are two trends clearly defined in former accounts of downstep. On the one hand, those mainly represented by Ladd (1993), which we shall discuss later. On the other, those lead by Pierrehumbert (1980) and colleagues (Beckman and Pierrehumbert 1986, Grice 1992, 1995), and which are characterised by treating a particular sequence of tones as the trigger for downstep. Normally, such tones are grouped together either as a bitonal pitch accent of the type  $(T^*+T)^7$  and  $(T+T^*)$ , or under a single tonal root node. The latter analysis is followed by Grice (1995) only.

Let us now turn to an example of an account of downstep in a chanting contour in terms of a bitonal pitch accent. An illustration of this contour can be seen in (3), and we present its analysis in (9) below.

(9) An- -na | H\*+L H- L%

According to Pierrehumbert and colleagues, the phonological representation of a contour is made up of a linear sequence of tones. The starred tone, H\*, of the bitonal pitch accent, H\*+L, is associated to the accented syllable, An-. L is not interpreted phonetically as low pitch (as we might have expected), but instead is treated as floating. The actual grouping of tones into a bitonal pitch accent triggers the effect of downstep on the following H-tone, referred to as the phrase accent. This tone is in charge of pitch specifications between the accented syllable and the rightmost tone. As illustrated in (3), the interpretation of the phrase accent is not as high as that of the starred tone, but lower. Finally, the boundary tone (L%) accounts for the fact that pitch remains level, rather than

 $<sup>^{7}</sup>T$  is used here as a cover term for both H and L. This is not to be confused with C-A's use of T as the only tone in her model.

showing a final rise (which, had this been the case, would have been accounted for by H%). Thus, its interpretation is manifested around the edge of the intonation phrase.

Grice's (1995) analysis of (3) is rather similar to that presented in (9). As far as the sequence of tones is concerned, it is exactly the same. However, the grouping of the first two tones into a pitch accent is rather more elaborate, as can be seen in (10).

While tones were organised in a linear sequence in Pierrehumbert's model (as shown in (9) above)), in Grice's model, they are integrated into a hierarchical structure which contains various independent tiers. For example, the accented syllable stands on a tier separate from the tonal root level. This is indicated by the horizontal dashed line. Tones are directly associated to the tonal root level by means of slanted lines. In the particular case of branching structures or *melodic units* (such as the one shown above), the starred

(10)

Tonal root level

case of branching structures or *melodic units* (such as the one shown above), the starred or strong tone of the pitch accent is associated to the left branch, and the weak or trailing tone is associated to the right branch. Presumably, the rest of the tones are integrated into the structure at a higher level, which could be the intonational phrase.

According to Grice, the unit which is responsible for triggering the effect of downstep on the phrase accent, H, is the melodic unit  $(H^*+L)^8$ .

Let us now turn to the problems which, according to C-A are present in this type of analysis. C-A claims that the proposal to treat bitonal pitch accents as the trigger for downstep is grossly arbitrary, since they do not share anything in common with the tone which undergoes downstep. As an illustration of this, note that even the sequence L+H can trigger downstep on the following tone. At least in the case of H+L, the fact that L occurs to the right, and therefore adjacent to a possible following tone, could be understood as **the** trigger of downstep. The same cannot be said about the case of L+H.

Another argument against the proposal put forward by Pierrehumbert and colleagues is that they show a clear tendency towards the elaboration of tonal units, either by

<sup>&</sup>lt;sup>8</sup>Grice (1995) uses parentheses to indicate that a pair of tones constitutes a melodic unit.

assuming that tones are grouped into pitch accents (rather than maintaining single tones), or by assigning an internal hierarchical structure to the pitch accent<sup>9</sup>.

Let us now briefly direct our attention to Ladd's proposal. He suggests that downstep is due to a particular metrical relationship between tones. He represents this relationship by means of an arboreal structure, whose nodes are labelled *high* and *low*, as shown in (11) below<sup>10</sup>. These represent the register specification for two successive pitch accents.

A condition for the occurrence of downstep is that the node to the left is labelled h, and consequently, the one to the right is l. Only under these circumstances does l trigger a lowering of the register.



The structure in (11) illustrates a sequence of high pitch accents, in which the second is downstepped with respect to the first. Such a structure accounts for a chanting contour over a phrase like, for example, *Mari@anna*, in which there are two accented syllables, *Ma-* and *-an*. The horizontal lines are merely a notational device to illustrate how register is lowered; they are not part of either phonological representation or phonetic interpretation.

Grice (1995:207) mentions two disadvantages with this proposal. One has to do with the fact that, by scaling whole pitch accents in a given register (and not parts of them), Ladd's model is unable to account for downstep on the second part of an initial pitch accent. Second, with such an account it is impossible to deal with contours in which an initial pitch accent has undergone downstep. The reason for this is that Ladd's condition on the shape of metrical structure excludes any chance for the target of downstep to be in initial position.

<sup>&</sup>lt;sup>9</sup>It must be pointed out, however, that Grice (1995) constitutes a step towards constraining the internal structure of the pitch accent, after she had presented an even more elaborate structure in Grice (1992).

<sup>&</sup>lt;sup>10</sup>Note that *l* and *h* are not tones themselves. They are better understood as equivalent to s(trong) and w(eak).

Another drawback is admitted by Ladd himself and reported in C-A; that is, that there is no reason for why the order h-l should trigger downstep, whereas the reverse order does not. In other words, this is a completely arbitrary decision.

One of the aims of this paper is to introduce the reader to an alternative account of downstep with a degree of coherence greater than the ones we have just described. We assume that there must be a clear connection between the trigger and the target of downstep, and also that the nature of tonal units must be much simpler than formerly suggested. In the following section we present the foundations of a rather different type of intonational model, and we show that, indeed, there is such a natural connection between the target and trigger of downstep. In addition to this, we argue that tonal units are simply made of a single tone.

# 3.2 Cabrera-Abreu (1996)

**3.2.1 Introduction.** C-A proposes a radical view of what a phonological model of intonation should look like. Embedded to a great extent in the framework of Government Phonology (henceforth GP), she puts forward a highly impoverished model, of which the main characteristics are as follows:

- (12) a. A single tone, T, constitutes the flesh of phonological representation of intonation contours.
  - b. The 'skeleton' of such representation corresponds to a prosodic structure built in terms of the principles of licensing (Kaye, Lowenstamm and Vergnaud 1990) (henceforth KLV).
  - c. Such principles are also in control of the association of tone to the structure. Mainly, they define which boundaries of prosodic domains are entitled to bear tone. This entails that such boundaries act as T(one) B(earing) U(nits).
  - d. In the absence of any tonal specifications in phonological structure, it is assumed that pitch will have the tendency to drop. This is metaphorically referred to as *Gravitation Effect* (Cabrera-Abreu & Takahashi 1993).

In the following section, we shall discuss and illustrate (a)-(c) above. In relation to (d) it suffices to say that, as a rule of thumb, T associated to a boundary is interpreted as high pitch, and that the absence of tone is interpreted as low pitch<sup>11</sup>.

**3.2.2 Phonological representation of pitch and TBUs.** Evidence drawn from the behaviour of tone in tone languages (Goldsmith 1976, 1988, Carter 1973, Pulleyblank 1986 and references therein), and from the behaviour of boundary tones in English (Pierrehumbert 1980, Lindsey 1983, 1985) leads C-A to claim that H is the only phonological unit necessary to account for pitch patterns, and that L can be excluded from phonological representations of pitch. This is done in keeping with loyalty to the privative approach adopted by GP. In fact, after having rejected L, there is then no longer sufficient motivation to retain H as the label of the phonological property which represents pitch, as this could lead to the misconception that L may still be referred to. Thus, after discarding L, she represents the phonological property of pitch as T. In this context, as mentioned earlier, high pitch is accounted for by the presence of T, and low pitch by the absence of T. This may be represented informally as shown in (13), where *x* stands for a syllable.

The rejection of L from the model obviously raises the fundamental question of how to account for contour tones (a falling or rising movement on a single syllable), since earlier models propose the combination of H and L. Notice that, with only the presence or absence of T as a means of showing phonological contrasts, it appears to be impossible to capture any sort of pitch movement. This proposal allows the model to go as far as capturing what is shown in (13).

With the goal of finding a satisfactory solution to this shortcoming, C-A analyses previous models of intonation (Pierrehumbert and colleagues) which suggest that some tones can be associated to the edges of intonation domains, and — following a proposal

<sup>&</sup>lt;sup>11</sup>From now onwards we refer to relative high pitch and relative low pitch in phonetic interpretation as high pitch and low pitch, respectively.

by Hirst (1988) — she extends this idea to all tones. Thus, the boundaries of prosodic constituents will be the tone bearers from now onwards.

This idea contrasts sharply with former proposals, in which a dual-type of association was preferred. That is, tones could be associated either to accented syllables or to the edges of prosodic domains (or even remain floating). Obviously, this led researchers to postulate different principles in the association of tones, depending on the unit they were associated to. By contrast, C-A's single-type of association renders the model more coherent and capable of drawing a greater number of generalisations.

By treating boundaries as TBUs, C-A's model can capture elegantly a four-way distinction as follows:



This proposal is certainly attractive, but would be worthless if we had to resort to stipulative rules as a mechanism for showing boundaries in phonological representation. That is, we may well wonder whether the exclusion of L has been replaced by the insertion of toneless boundaries. If this were, in fact, the case, then nothing much would have been achieved in the way to reduce arbitrariness and to increase restrictiveness in the present model. In order to clear any doubt about the integrity of her own model, C-A devotes a whole chapter of her work to show how boundaries constitute an integral part of the prosodic structure, and how the construction of such a structure (with its domains) is governed by the well established principles of licensing. This is the topic of the following section.

**3.2.3 The prosodic hierarchy and some principles of licensing.** Boundaries belong to the edges of prosodic domains which arise as a consequence of head-dependent relations between the items within that domain. In order to illustrate this point, C-A presents a simple example from the field of stress, which we also include here for the purposes of

clarity. After that, we turn to a summary of the formalisation of this idea in terms of licensing principles.

Given a pair of positions,  $(x_1 \text{ and } x_2)$  in which the first one is stressed (as indicated by the stress mark) and the second is unstressed, the model captures this asymmetry by assuming that there is a relation between them.

$$(15) \qquad \mathbf{'}_{\mathbf{X}_{1}} \quad \mathbf{X}_{2}$$

The fact that ' $x_1$  is more prominent than  $x_2$  is captured by means of the arrow originating from ' $x_1$ . It can also be said that, in the relationship between these two positions, ' $x_1$  is a head and  $x_2$  counts as its complement. In addition to this, let us assume that each prosodic domain must have a head. If ' $x_1$  is a head, as stated above, then it is possible to claim that ' $x_1$  and  $x_2$  constitute a domain, which is represented by means of boundaries in (16):

(16) 
$$\begin{bmatrix} \mathbf{x}_1 & \mathbf{x}_2 \\ \vdots & \vdots \end{bmatrix}$$

The important point to notice here is that boundaries arise as a direct consequence of a relation between units. So, the whole structure of the prosodic hierarchy generates from the definition of such relations.

In relation to the formalisation of such an idea, C-A has recourse to phonological licensing, which is one of the main principles in GP. Phonological licensing is defined by KLV<sup>12</sup> as follows:

## (17) **Phonological licensing**

- a. Within a domain, all phonological units must be licensed save one, the head of that domain.
- b. Licensing relations are local and directional.

Let us now focus on how phonological licensing works for our initial example of stress. A domain is defined by the fact that there is only one head,  $x_1$ , which acts as a licensor for  $x_2$ , and therefore, establishes a licensing relation between these two units. The condition of locality in (17b) requires that the units which participate in a licensing

<sup>&</sup>lt;sup>12</sup>It must be made clear that C-A adopts the view of GP developed by Harris (1994), unless stated otherwise.

relation be adjacent at some level of representation. This is the case of ' $x_1$  and  $x_2$ , since there are no intervening units. The condition of directionality (in (17b) (b)) dictates that, at a given level in the structure, licensing relations must be unidirectional. In relation to our example, the directionality of licensing is indicated by the arrow, which goes from left to right. An example of a violation of this principle would occur if there were another position to the left of  $x_1$ , say  $x_0$ , and this was licensed by  $x_1$ . Thus, this would create a situation in which  $x_1$  would be licensing two units in different directions. This is illustrated in (18) below:

$$(18) * \mathbf{X}_0 \mathbf{Y}_1 \mathbf{X}_2$$

Before we move on to illustrate the construction of the prosodic structure in C-A's model, it must be made clear that she is forced to relax the condition of locality, in the sense that a licensor can license a unit to which is not immediately adjacent. We shall see an example of this case shortly.

We start building up the prosodic structure in (19) by showing how licensing relations work for a phrase such as *Mary has a big lamb* at the lowest level of the prosodic hierarchy.

(19) 
$$\begin{array}{c|c} X \rightarrow x & X & x & x \\ & & & \\ & & & \\ & & & \\ \end{array} \begin{array}{c|c} X \rightarrow x & X & x & X \\ & & & \\ & & & \\ & & & \\ \end{array} \begin{array}{c|c} X \rightarrow x & X & x & X \\ & & & \\ & & & \\ & & & \\ & & & \\ \end{array} \begin{array}{c|c} X \rightarrow x & X & x & X \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ \end{array} \begin{array}{c|c} X \rightarrow x & X & x & X \\ & & & &$$

In (19), each syllable nucleus is licensed by a skeletal position at L0. As can be seen, some skeletal positions differ from others in size. This is an informal device to show that the larger ones are stressed, while the smaller ones are unstressed. This relationship is formally captured by means of arrows, which also represent the directionality of licensing — from left to right at L0. Note, by the way, that, in this particular example, the skeletal position which licenses *big* is not strictly adjacent to its licensor, which is the position which licenses *has*. Thus, this illustrates a situation in which locality is loosened.

Given that in (19) there are three positions which are not themselves licensed, we now proceed to project them onto the next level, L1, in order to abide by (17a):



There are still two positions at L1 which themselves are not licensed. In order to see the licensing relation between them, we project them onto L2:



The crucial point to notice here is that, at L2, licensing goes from right to left. Also, all positions at L2 are licensed, save one, the ultimate head.

By phonological licensing, each head and the positions it licenses constitute a domain, so that (21) shows the following domains:<sup>13</sup>





So far, we have presented part of the 'skeleton' of phonological representations. Before we move on to discuss which boundaries can bear tone in the following section, it must be pointed out that C-A proposes another licensing relation between other units of such a 'skeleton'. More specifically between the domains at L1. Thus, licensing between

<sup>&</sup>lt;sup>13</sup>As already indicated, C-A treats L0 as the level of sentence-stress. In these circumstances, such a level plays no role in the assignment of tone to prosodic structure. In other words, boundaries at L0 do not count for tonal purposes.

domains at L1 identifies the rightmost domain as the licensor, and the domain to its left as the licensee. This entails that the directionality of licensing between constituents is different from that between skeletal positions at L1. We illustrate this in (23) and we also show an example of inter-constituent licensing for the phrase *Mary has a big lamb*. Observe that such constituents are labelled as n(ucleus) (the licensor) and o(nset) (the licensee)<sup>14</sup>.



The nucleus, *lamb*, licenses the onset, *Mary has a big*, since the directionality of licensing goes from right to left.

C-A's motivation for formally labelling constituents derives from the distribution of focus (which refers to that part of the intonation domain which conveys new information, or highlights some information). She argues that the nucleus constitutes the domain in which the distribution of focus information is defined, whereas the onset does not play such a role. Another observation which confirms C-A's proposal is the fact that, depending on whether T is licensed by a nucleus or an onset, a falling pitch movement shows a sharp or a gradient slope, respectively.

**3.2.4 Boundary licensing and Licensing Inheritance.** The last step in the construction of the prosodic hierarchy is the definition of licensing relations between boundaries. The reader is reminded that this is a necessary condition for boundaries to be integrated into prosodic structure. In addition, such licensing relations define the settings for tones to associate to boundaries. In other words, they identify potential candidates for bearing tone. This ensures that tone association is not performed arbitrarily, but under the control

<sup>&</sup>lt;sup>14</sup>For the purposes of clarity, we use terms *nucleus* and *onset* in lower case to refer to O'Connor and Arnold's (1969,1973) *head* and *nucleus* respectively. We shall use *Nucleus* and *Onset* in upper case to refer to these constituents in GP, (that is, constituents below the foot level).

of some fixed principles. This is accomplished by abiding to the principle of Licensing Inheritance, which we shall define and illustrate shortly.

C-A proposes that licensing between boundaries behaves in the same way as licensing relations observed at other levels of structure. Thus, licensing between boundaries at L1 goes from left to right, and at L2 goes from right to left, exactly in the same fashion as licensing between skeletal positions. This is shown in (24) below.



As already indicated, the association of tone to boundaries is not performed randomly. Phonological licensing ensures that this is the case, but it does so only partially. In order to control fully the association of tone to prosodic boundaries, C-A has recourse to the Licensing Inheritance Principle (Harris 1992), which is defined in (25).

## (25) Licensing Inheritance Principle (henceforth LI)

A licensing position inherits its licensing potential from its licensor.

This is understood as follows: a licensor has enough licensing potential to bear a wider set of contrasts (by virtue of being the licensor). A licensee receives a reduced amount of licensing potential, and therefore its capacity to bear phonological contrasts is diminished. Let us turn to an example from intonation: given a pair of boundaries in a licensing relation as shown below,

(26)



the head position, that is, the left boundary, has enough licensing potential to bear only a single tonal contrast: T versus absence of T (informally shown in the diagram as  $\emptyset$ ). The dependent position, that is, the right boundary receives less licensing potential, due to LI (this is graphically shown by the fading arrows). This creates a situation in which the licensee is unable to support a similar degree of tonal contrast, thus only  $\emptyset$ . For, if T is allowed to appear in this position, then this would entail that we can still expect to find absence of T in some instances. In order to exclude this possibility, it is preferable to allow only for  $\emptyset$ , and in this way, we do not expect T to be a possible option in the first place.

Note that the example illustrated in (26) corresponds to LI at L1. At L2, however, the directionality of licensing goes from right to left. Accordingly, LI looks as shown in (27):<sup>15</sup>

(27)



Given that the directionality of licensing is from right to left, then, by LI the rightmost boundary can bear a presence/absence of T, while the leftmost boundary can only bear absence of T.

The principles presented thus far allow us to generate a comparatively small set of structures. However, it must be pointed out that, so far, among such structures, not one of them can account for a contour in which there was a rising movement over the onset constituent. For example, let us assume that *Mary has a big lamb* is uttered, with a rising movement in the onset and a falling one in the nucleus. Such a structure would have to look something like (28), that is, with T associated to the onset's right boundary, and also to the nucleus's left boundary.

<sup>&</sup>lt;sup>15</sup>Note that, by LI, T cannot be associated to L2's left boundary. Given this, it is understood that, in C-A's model there is no equivalent to H%.



But notice that, the association of T to the onset's right boundary constitutes a violation of the principles of licensing at our disposal, since such a boundary does not inherit enough licensing potential to bear T (see (26) above).

In order to find a remedy to this situation, C-A invokes the *coda licensing principle* (Kaye 1990:331):

## (29) Coda licensing principle

Post-nuclear rhymal positions must be licensed by a following onset.

This is understood as follows: a dependent position can also be licensed by an immediately following head. In this situation the dependent position receives extra licensing potential. By (29) it is possible to identify another source of licensing power for the onset's right boundary to inherit extra licensing potential: the nucleus's left boundary. Thus, (30) below illustrates the well-formed version of (28):<sup>16</sup>



<sup>&</sup>lt;sup>16</sup>We have excluded L0 from this figure for the purposes of clarity.

Having presented a survey of how C-A's model works, and what its major components are, in the following section we briefly illustrate how downstep is treated within her framework.

#### 4 Downstep in Cabrera-Abreu (1996)

Recall from §3 that one of the goals of this paper is to introduce the reader to an elegant account of downstep. Ideally, we would like to see a model in which the trigger and target of such a phenomenon are clearly related. In addition, we would prefer that such an ideal is achieved without further elaboration of the tonal unit. In the previous section, we have already presented a model in which, not only is there a maximally simple unit (T), but also in which there is just one such unit. So, with these ingredients in hand, in this section we commit ourselves to fulfilling the remaining part of our ideal representation of downstep.

We have already observed in §2 that downstep is characterised by a sudden drop in the level of pitch. Also, we have already seen in (12) (d) that low pitch is accounted for by toneless boundaries. Given these two observations, we expect C-A's model to account for downstep in a way such as to involve toneless boundaries as the trigger for the sudden drop in pitch level. In fact, this is precisely what C-A proposes as illustrated in (2) above, and repeated below in (31):

The presence of toneless boundaries to the left of domains 2-3 and 4 trigger the effect of downstep in the interpretation of the tonal specifications associated to such domains. The toneless boundaries illustrated in (31) belong to domains which are empty. In these circumstances, there is no reason to associate tone to them in the first place. Hence, these boundaries remain toneless permanently.

An alternative proposal would have been to suggest that extra toneless boundaries around domains 2-3 and 4 are the trigger of downstep. However, as already discussed by C-A, this would have led to an arbitrary manipulation of the prosodic structure in order to introduce extra boundaries. In addition to this, it would have created an increased

number of potential TBUs, unless it was stipulated that they should remain toneless. At any rate, it would have led her on to the overgeneration of phonological representations. Obviously, these results are highly undesirable, and consequently C-A rejects such an option.

In order to integrate empty domains into constituent structure, C-A assumes that they are analysed as being licensed by empty nuclei, informally represented as N. This idea is based on the assumption in GP that specific Nuclei can remain empty.

With all this at our disposal, let us turn to an example which illustrates the phonological representation for a calling contour over An@na (this structure has already been introduced in (4), but here we have added boundary licensing for the purposes of illustrating the whole structure):



The position which licenses An- is licensed by the nucleus, and similarly, the position which licenses @ is licensed by the empty nucleus. The rightmost position licensing *-na* is not incorporated into a constituent. We shall discuss this point in the following section.

Tone is associated by following the principle of LI: the nucleus's left boundary acts as a licensor, and therefore, possesses sufficient licensing potential to bear tone. Although its right boundary acts a licensee, and in principle could not bear tone, notice that such a boundary is coda licensed by the licensor-boundary of the empty nucleus. This scenario of licensing relations ensures that the rightmost boundary of the nucleus inherits enough licensing potential to license T.

In this section we have illustrated how toneless boundaries belonging to empty nuclei in phonological representation act as the factor which triggers the downstep effect in phonetic interpretation. In this way we capture the natural relation between the source and the effect of the phenomenon.

However, as already mentioned in §2, the empty nucleus and the rightmost position cannot be integrated into the structure unless they participate in a licensing relation with another unit. This and other matters constitute the topic of the following section.

## **5** Edge-licensing in chanting contours

## **5.1 Introduction**

Let us remind ourselves of the points introduced in §2 and which we shall discuss to a greater length in the following subsections:

- (33) a. A strategy is needed whereby final empty nuclei and final skeletal positions can be integrated into phonological representation.
  - b. In the case of chanting contours over a single-syllable phrase, a satisfactory phonological representation remains to be defined.

#### 5.2 Empty nuclei and the final skeletal position

Let us direct our attention to (32) above. Notice that both the rightmost skeletal position which licenses *-na* and the empty nucleus fall outside the scope of any licensing relation. If they are not licensed, then they cannot be integrated into the representation. Of course, if this situation were permitted in the present model, it would constitute a serious violation of the principles of licensing, something which is highly undesirable. Therefore, we urgently need to identify a candidate to license each one of these units.

In relation to finding a unit which would act as a licensor for the skeletal position, a possible candidate could be a constituent, as shown by [?] in (34) below. However, before committing ourselves to this proposal, we must consider a few aspects which, eventually, will lead us to reject it altogether. For instance, we need to identify the status of such a constituent; whether it is an onset or a nucleus. If we chose the former option, then we would have to find another unit to license this onset, something which is not immediately obvious. If we chose the latter option, then we would predict that *-na* is prosodically prominent. In addition to this, given that *-na* would stand as the rightmost nuclear constituent, it would also count as the ultimate licensor. Clearly, neither of these suggestions is acceptable<sup>17</sup>.

<sup>&</sup>lt;sup>17</sup>In any case, the option to treat this as a constituent would not even be considered in C-A, since it would be extremely uncommon for *-na* to contribute to the distribution of focus information in the first place.

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Another difficulty with this proposal is that, by identifying [?] as a licensor, we are forced to admit an extra pair of boundaries at L1, and consequently, that such boundaries count as potential TBUs. This move would also have far reaching consequences, since it would allow the model to overgenerate. For example, consider the structure in (34):



Tone is associated to the leftmost boundary of [?]. Although the interpretation of this structure could be described straightforwardly as high level pitch over An- and downstepped falling pitch over -na, it is, nevertheless, rather unusual. Hence, we would prefer the grammar to disallow the possibility of generating such structures in the first place. This, together with what we have discussed so far, amounts to an argument convincing enough to discard this proposal.

In view of the failure to identify a licensor for the rightmost skeletal position, let us turn to the case of identifying a licensor for the rightmost empty nucleus<sup>18</sup> in the following paragraphs, since the suggestion presented by C-A for the latter may shed some light on this matter. After that, we shall return to the case of the skeletal position.

As can be seen in (32), the empty nucleus also falls outside the scope of any licensing relation. Both at L1 and L2 the directionality of licensing is from right to left. In order to propose a candidate for the empty nucleus's licensor, C-A suggests tentatively that it may be licensed by the right edge. However, she cannot commit herself to this idea since she has no evidence with which to support her argument. Thus, in this subsection we shall present some evidence which reinforces her suggestion.

Let us probe into C-A's proposal a while longer, and assume that the empty nucleus is indeed edge-licensed in chanting contours. This would account for the fact that, for example, in a sequence of (in O'Connor and Arnold's terms) a stepping head plus a nuclear fall over the phrase *John has a lamb*, it would be very uncommon to find a step

<sup>&</sup>lt;sup>18</sup>Observe that [?] could act as a candidate for licensing the empty nucleus. However, we shall not consider this option since, as we have already discussed, it leads us to further complications.

down within *John* (because it is away from the rightmost edge) and to treat the whole phrase as a single intonation domain, as illustrated below:

$$(35)^*$$
 Jo-ohn has a  $a_{m_b}$ 

We shall have more to add about this example shortly. Here, it suffices to say that the speaker receives the impression that there are two intonation domains (rather than just one domain): *John* (as if it were a vocative), and *has a lamb* (as if it were part of an unfinished message).

A more plausible rendition of the stepping head plus the nuclear fall would be to encode the step down between *John* and *has*<sup>19</sup>, and not within *John*:

This observation leads us to assume that, in order for a step down to occur within a single-syllable word, such a word must occur next to the right edge of the intonation phrase. In this situation, the empty nucleus would, indeed, be edge-licensed<sup>20</sup>.

However, it is still possible to find a contour which challenges this assumption. As an example, let us focus on (37) below, which illustrates the F0 contour for the phrase *The coach will be in the car park at one*, with a stepdown in *coach* (like in the case of *John* in (35)), between *car* and *park*, and in *one*. All levels in each step are sustained.

(37) The co- oach will be in the car park at o- one

The arrows indicate the point at which the step down takes place. At first sight, it seems that the steps within *coach*, and between *car* and *park* are far away from the right edge. In the case of *coach*, the downstep effect occurs in a monosyllabic word, which is away from the edge. Thus, we would expect the empty nucleus to be encoded also away from

<sup>&</sup>lt;sup>19</sup>This contour is accounted for by C-A in terms of a sequence of onsets and nuclei.

<sup>&</sup>lt;sup>20</sup>It would be possible to find a step down within *lamb*, and hence, the empty nucleus would be edge-licensed.

the edge in phonological representation. As a consequence, its presence cannot be sanctioned by the edge. If this is the case, then it casts a serious doubt on C-A's proposal.

In (38) we illustrate such a phonological representation. As can be seen, the empty nucleus in co@oach is not licensed by the edge, but instead, is licensed by the ultimate licensor in the intonation domain.<sup>21</sup>

(38) \*



Note that, in this structure, all nuclei to the left of the rightmost 'filled' nucleus are licensed at L2. If this is the case, then this analysis does pose an even stronger threat to C-A's proposal, since it suggests that there is no need to identify the rightmost edge as the licensing source. Instead, the first and second empty nuclei are licensed by the ultimate licensor.

However, although this solution is viable, we can identify some aspects which remain unsolved, and which shall lead us to reject it. For instance, there are still unlicensed units at the rightmost edge of the phonological structure. In addition to this, the information encoded in the phonological representation does not account accurately for what is manifested in the phonetic interpretation. For example, this structure suggests that the constituent licensing *o* in *one* counts as the ultimate licensor. If this were indeed the case, then we would expect to see it reflected somehow in phonetic interpretation. To say the least, its interpretation would have to be different from that of the other constituents, since the latter are licensed at L2, whereas the former is licensed at L1<sup>22</sup>. But, in fact, perceptually, it sounds as if the tonal configurations of *The coach*, are copied onto *will be in the car park*, and *at one*. Moreover, observe that the F0 trace over these phrases is

<sup>&</sup>lt;sup>21</sup>For the sake of argument, let us assume that all skeletal positions to the left of the ultimate nucleus are licensed.

<sup>&</sup>lt;sup>22</sup>C-A claims that the pitch specifications of a unit which is nearer to the ultimate licensor are enhanced, whereas those which are further away from the ultimate licensor are attenuated.

extremely similar throughout. This suggests that they may be three equally weighted intonation domains.

We have already discussed and dismissed two possible counter examples to C-A's initial idea. In order to prove the validity of her proposal, let us study the phonological representation which we shall adopt to account for the contour in (37). We illustrate this in (39).

(39)

In this phonological structure there are three independent domains: *The co@oach, will be in the car@park*, and *at o@one*. Each one shows exactly the same internal configuration: a 'filled' nucleus followed by a final empty nucleus. This accounts elegantly for the repetition of the same F0 pattern over each intonation domain, and confirms our suspicion that they are indeed three equally weighted domains. Another benefit of the structure in (39) is that it allows us to generalise about the licensing of empty nuclei: they are all edge-licensed. Clearly, all this constitutes an advantage over the structure in (38), and therefore, we shall adopt the idea that an empty nucleus can be edge-licensed.

Having accepted edge-licensing, we are now in a position to return to the example in (35) above, and to suggest a phonological representation which captures the fact that Jo@ohn is an intonation phrase (a vocative, to be more precise), and therefore, that it constitutes an intonation domain independent from *has a lamb*. We do this by showing two independent intonation domains. The one on the left, Jo@ohn, shows an empty nucleus, which is edge-licensed, and a nucleus which is the ultimate licensor of the domain. The one on the right, *has a lamb*, shows a 'filled' nucleus which licenses an onset to its left.



Once we are satisfied with the idea that final empty nuclei are edge-licensed, let us now return to the issue about identifying a licensor for the rightmost skeletal position in (32) above. Recall that, there, we rejected the alternative of assigning such a task to a prosodic constituent. However, here, we are in a position to propose that the edge of the intonation domain can perform the task of being the licensor of the unit under discussion.

The main benefit of this proposal is that it allows us to make the following generalisation: units to the right of the ultimate licensor in the intonation domain can be edge-licensed.

## 5.3 Chanting contours over a single-syllable phrase

The point to discuss in this section has to do with identifying the phonological representation which best accounts for a step down within a monosyllabic phrase such as Jo@ohn. Let us begin by assessing the structure in (7) above, which is also repeated below in (41) for the purposes of convenience:

As already indicated in \$2, (41) fails to achieve descriptive adequacy since it does not capture the fact that a step down occurs within Jo@ohn. Yet, in making a final effort to accept it, we could assume that the presence of L2's rightmost boundary is 'pushing in' the step down inside the toned-domain. But then we could also ask ourselves about the kind of principles of interpretation involved here — basically, about the specific meaning of

'pushing in'. For the time being, there is no answer to this question. Nevertheless, even if we seem to have reached a cul-de-sac temporarily, there is something to be learnt from the structures we have presented thus far: all the arguments we have pursued to account for downstep in calling contours have lead us inevitably to identify L2's rightmost boundary as one of the factors involved.

Bearing this in mind, it might be worthwhile looking into the matter from a different perspective, and to consider another structure introduced in C-A, which we have already illustrated in (8), and which we repeat below in (42).

$$(42) \qquad \begin{bmatrix} N & ] L2 \\ & | & ] \begin{bmatrix} N & ] L1 \\ & | & | & | \\ & | & X & | & | \\ & | & | & | \\ & J0 & | & @ ohn \\ & T & T \end{bmatrix}$$

The structure in (42) shows a skeletal position to the right of the position which is licensed by the empty nucleus. Such a position acts as the licensor of *-ohn*. As we argued above, one of the advantages of this representation is that it achieves descriptive adequacy by encoding the step down within Jo@ohn. Unfortunately, however, its acceptability is somehow dubious. This is due to two main reasons: first, the identification of a licensor for the rightmost skeletal position, and second, the origin of the position's melodic content.

The first point does not constitute a problem any longer, since, from the above discussion about the case of An@na, we have already identified the licensor of the skeletal position as the rightmost L2 boundary. Hence, the same can be applied to the case of Jo@ohn. The position licensing *-ohn* is edge-licensed.

This idea leads us to consider our second point: the identification of the melodic content of this position. The reader must have noticed that, throughout this paper, and specifically in one-syllable phrases, we have assumed that the segmental content of the second pitch level in a sequence of stepping levels arises from the lengthening of the nuclear vowel plus the consonants that may follow in the word. Now, we propose that this is, in fact, the case.

The assumption behind this proposal is the following: the representation of downstep is a template such as the one illustrated in (43) below.



Minimally there is one skeletal position to the right of the empty nucleus. Such a position is filled-in by the second syllable in a two-syllable phrase (in the case of An@na, by *-na*). In a one-syllable phrase, rather than this position remaining empty, it is filled-in by the nuclear vowel and any consonants that may follow.

One of the advantages of this idea is that it accounts for the characteristic lengthening of the segments in the second step. In addition, it establishes a generalisation about downstep, regardless of the number of syllables involved in the intonation domain.

#### **6** Conclusion

In this paper we have assumed that an empty nucleus and a skeletal position occurring at the rightmost edge of the intonation domain are edge-licensed. This manoeuvre has permitted us not only to integrate such units into phonological structure — something which was unreachable by C-A in her first attempt to do so — but also, to establish a generalisation about their common behaviour. That is, they are both edge-licensed. This approach has also led us to define a template-structure which accounts for downstep in chanting contours. In this way, downstep within a single-syllable phrase is not treated as an exceptional case of that phenomenon, but instead, it is shown that it can be analysed in exactly the same terms as other instances of downstep.

An advantage of the account presented here is that, unlike former models — in which we saw that a richer tonal structure was necessary to account for downstep — we analyse downstep as the interpretation of toneless boundaries which correspond to empty nuclei in phonological representation. In this way, we maintain maximal restrictiveness within the model, and in addition, we elegantly capture the natural connection between the trigger and target of downstep.

A point which remains undiscussed relates to whether edge-licensing is a feature particular to chanting contours in English or whether it is a characteristic shared by a range of languages. In other words, whether or not edge-licensing is controlled by a parameter. This is a major topic in itself, since it entails the examination of chanting contours in a wide variety of languages. For this reason, it is left for future research.

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