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The Gradient OCP – Tonal Evidence from Swedish*

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1. Introduction

It is well known that languages have a tendency to avoid sequences of adjacent identical elements. This universally evidenced phenomenon, the so-called Obligatory Contour Principle (OCP), has generally been defined as shown in (1).

(1) Obligatory Contour Principle (Leben 1973, 1978, 1980; McCarthy 1979, 1986)
Adjacent identical elements are prohibited.

The OCP, which is exhibited at various levels of the phonological representation (e.g. featural, melodic, and tonal), has been extensively discussed in numerous studies (Leben 1973, 1978, 1980; McCarthy 1979, 1986; Archangeli 1986; Odden 1986, 1988, 1994; Archangeli & Pulleyblank 1987; Hyman 1987; Kenstowicz & Kidda 1987; Myers 1987, 1997ab; Yip 1988; Hewitt & Prince 1989; Myers & Carleton 1996, Alderete 1997; Itô & Mester 1996ab, 1998, and Keer 1999). These studies have introduced and analyzed patterns obeying the OCP in various languages, and also discussed the internal nature of the phenomenon, as well as offered tools for deriving the OCP effects in different theoretical frameworks.

This paper participates in the discussion on the nature of the OCP by demonstrating how both parameters of the OCP, adjacency and similarity, must be seen as gradient phenomena. I will provide evidence from tonal patterns encountered in the phonology-syntax interface in Swedish, in other words, from the interaction of lexical tones and sentence-level focus (Bruce 1977, 1990; Engstrand 1995; Riad 1996, 1998; Gussenhoven & Bruce, forthcoming). This paper demonstrates and explains patterns that arise when the sentence-level focus tone and a lexical tone are brought together into a context which contains not enough space for both of them to surface. I will demonstrate, through an Optimality Theoretic analysis (OT, Prince & Smolensky 1993, McCarthy & Prince 1993a), how the general definition of the OCP is not detailed enough,

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but how the restriction against adjacent identical elements, in fact, consists of a set of sub-constraints which concern both adjacency and similarity, and which together reflect the gradient nature of the OCP. Only by evaluating the OCP in a gradient manner, can an answer be offered for the question of why part of a lexical tone in Swedish disappears or changes the register in certain focal contexts.

The remainder of the paper is structured as follows. Section 2 briefly reviews the tonal background of Swedish, in other words, the types of lexical tones and the specific focus tone, and in section 3, I describe the data in detail. Section 4 motivates the location of the focus tone, while section 5 concentrates on finding an OT analysis for the OCP patterns found in the interaction of the focus tone and lexical tones. Finally, section 6 summarizes the results of the paper.

2. Tonal background

The focus of this paper is the dialect spoken in Stockholm area, often called the Central Swedish. Words in this dialect contain one of two lexical tones: either the so-called accent I or accent II, both of which have traditionally been characterized as a sequence of HL, the only difference being in timing (Bruce 1977, 1990; Riad 1996; Jones 1997; Gussenhoven & Bruce, forthcoming), as illustrated in (2)[1]. Thus, in accent I, the low tone occupies the pitch accent position preceded by the leading high tone, whereas in accent II, the pitch accent is the high tone followed by the low trailing tone[2].

(2)	Accent I	HL*
	Accent II	H*L

Another tonal pattern relevant to the discussion here is a special focus tone. When a word appears in the focus position in an utterance, an additional high tone, <u>H</u>, is attached to the word. In other languages, focus tones have been reduced to the group of boundary tones (Hayes & Lahiri (1991)); however, no evidence exists at this point that the same would hold true in Swedish. I therefore assume that the focus <u>H</u> is a special focus morpheme, a suffix. Furthermore, earlier studies have claimed that contrary to the lexical tones, the focus <u>H</u> would not be associated with a particular tone-bearing unit (TBU), due to the fact that the location of the tone varies phonetically (Bruce 1977, Riad 1996, Gussenhoven & Bruce, forthcoming)[3]. This paper,

[1] Some studies are of the opinion that the distribution of the lexical tones is, in fact, privative (Lorentz 1995, Bye 1996, Riad 1998). Consequently, only accent II words would be marked with a lexical tone, while accent I words appear as unmarked.
[2] The asterisk indicates the pitch accent (i.e. L*, H*), while the tone without the asterisk is either the leading tone (HL*) or the trailing tone (H*L). For the notation, see Pierrehumbert (1980), Pierrehumbert & Beckman (1988), and Pierrehumbert & Hirschberg (1990).
[3] See Lorentz (1995) and Riad (1998) for a different solution.

however, discusses the tonal configurations from a phonological point of view, thus assuming that slight phonetic differences are negligible, and that the focus tone is, in fact, linked to a TBU, a pattern which I will shown to be fully predictable.

3. Data description

The data discussed in this paper consist of two sets of examples (based on Bruce 1977 and 1990). The first set contains sequences of two accent I words, the first of which is in focus position (i.e. the most prominent word in the utterance), consequently including the special focus tone, H[4]. The length of the second word and the position of the pitch accent in that word are the variables, as illustrated in (3).

(3)

(a) längre nummer ‘longer numbers’

```
(H)  L*  H       L*
     |   |       |
     l ɛ  η.r e   num.mɛr
```

(b) längre lameller ‘longer disks’

```
(H)  L* H       !H  L*
     |   |        |   |
     l ɛ  η. r e   la.mɛl.lɛr
```

(c) längre lavemang ‘longer enemas’

```
(H)  L* H           H  L*
     |   |           |   |
     l ɛ  η. r e   la.ve.maηη
```

The examples (3a–c) differ tonally from each other with respect to the behavior of the leading H of the second word: in the example in (a), the high tone does not surface, whereas in (b), it appears as downstepped. Only in the case in (c) does the high tone surface without faithfulness violations. Furthermore, the leading H of the first word is never realized in this context, a fact indicated by parentheses.[5]

In the second set of the data, an accent I word is preceded by a focused accent II word, as shown in (4). Similar to the examples in (3), the behavior of the leading H of the second word varies. In addition, the focus H is upstepped when it appears in an accent II word, as in [lɔη.ηa] ‘long, pl.’, a pattern which is due to the property of the focus tone of being the highest F0 in a prosodic

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[4] I assume that the focus tone must always appear in the output and that forms violating this requirement do so with fatal consequences. This is a reflection of a universal constraint which requires morphemes to be realized in the output (MORPHREAL, Samek-Lodovici 1993, Gnanadesikan 1997, Rose 1997, Walker 1998).

[5] Were the first word not focused (i.e. without the focus H), the leading H of the second word would always appear on the syllable preceding the low pitch accent.

word. It follows that if another high tone occurs in the same word, such as the high pitch accent in accent II words, the focus H must be upstepped.

(4)

(a) långa nummer 'long numbers'

```
H*L  ↑H    L*
|  |   |     |
l ɔ  η.η a   num.mɛr
```

(b) långa lameller 'long disks'

```
H*L  ↑H        L*
|  |   |        |
l ɔ  η.η a    la.mɛl.lɛr
```

(c) långa lavemang 'long enemas'

```
H* L ↑H        H  L*
|  |   |        |   |
l ɔ  η.η a    la.ve.maηη
```

The examples in (4) illustrate how the leading H of the accent I word appears neither in the example (a) nor in (b); only in the case in (c) does the leading H surface. Having introduced the crucial data, let us now turn to the OT account. Before demonstrating the actual analysis, I will motivate the location of the focus H, which is dependent on other tones in the word.

4. The location of the focus tone

Various studies have claimed that the focus tone should not be associated with a particular tone-bearing unit (TBU), since the location of the tone varies phonetically (Bruce 1977, 1990, Riad 1996, Gussenhoven & Bruce, forthcoming). I assume, however, that the focus H is regularly linked to a TBU. Even though the location of the focus tone might contain phonetic variation, the position can be determined phonologically.

The location of the focus H is dependent on the type of lexical tone in the word, as illustrated by the examples *längre* 'longer' and *långa* 'long, pl.' in (5).

(5) (a) Accent I

längre [lɛηre] 'longer'

```
(H) L*H
     |  |
   l ɛ  η.r e
```

(b) Accent II

långa [lɔηηa] 'long, pl.'

```
H*L  ↑H
|  |   |
l ɔ  η.η a
```

In accent I words, the focus tone appears on the TBU following the pitch accent, while in words containing accent II, it is located further from the pitch accent. This is due to the fact that in accent II words the trailing L occupies the TBU in question, consequently forcing the focus H further to the right. Both patterns in (5) can be captured by a simple constraint interaction. The relevant constraints are given in (6); the TBU is crucially a mora.

(6) (a) NO CONTOUR
A TBU is maximally associated with one tone.

(b) ALIGN-R(H, PRWD^{Utt})
The right edge of focus H is aligned with the right edge of the most prominent word in an utterance.

(c) ALIGN-L(T, μ^{PrWd})[6]
The left edge of every tone is aligned with the left edge of the head mora of a prosodic word.

The employment of the three constraints is motivated as follows. First, the pattern in (5b), the fact that the trailing L of accent II forces the focus tone further to the right, suggests that contour tones are prohibited. This is adequately captured by NO CONTOUR, which has its basis in the group of autosegmental association constraints (Goldsmith 1976, Pulleyblank 1986). Second, since the focus tone is a suffixal element, it is located at the right edge of the most prominent word of the utterance by default, a pattern which is expressed by ALIGN-R(H, PRWD^{Utt}) (based on McCarthy & Prince 1993b, Myers 1997a). Third, if ALIGN-R(H, PRWD^{Utt}) were strictly obeyed, the focus H would surface at the right edge of the focused word, an assumption, which, however, does not always hold true, as illustrated by the example in (5a). It follows that ALIGN-R(H, PRWD^{Utt}) must be dominated by another constraint which forces the focus tone closer to the pitch accent (which occupies the head mora of the prosodic word). This is captured by the high-ranking ALIGN-L(T, μ^{PrWd}). In addition, a constraint is required which ensures that the pitch accent regularly appears on the head mora of a word. This constraint, which is undominated in the hierarchy, is given in (7)[7].

(7) ASSOC (T*, μ^{PrWd})
Every pitch accent is associated with the head mora of a prosodic word.

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[6] One might suggest that instead of an alignment constraint, an association constraint – which requires every tone to be associated with the most prominent mora of a prosodic word – could be employed. It is not, however, entirely clear whether an association constraint can be evaluated gradiently. This is crucial since the distance of the tone from the head mora is essential in this analysis, not only the whether a tone is associated with the head mora or not (i.e. categorical evaluation).

[7] Due to the undominated position of ASSOC (T*, μ^{PrWd}), I will not take into account candidates violating this constraint.

The tableaux in (8) and (9) illustrate the crucial ranking of the constraints given above and show how the location of the focus H is correctly predicted by the ranking in words containing accent I as well as in those with accent II. First, längre [lɛηre] 'longer' in (8) demonstrates the location of the focus tone in words with accent I.

(8) längre [lɛηre] 'longer'

NO CONTOUR >> ALIGN-L(T, μ^{PrWd}) >> ALIGN-R(H, $PrWd^{Utt}$)

H L* H | /l ɛ η r e/	NO CONTOUR	ALIGN-L (T, μ^{PrWd})	ALIGN-R (H, $PRWD^{Utt}$)
L* H | | ☞a. l ɛ η. r e		*	*
L* H | | b. l ɛ η. r e		*!*	
L* H | / c. l ɛ η. r e	*!		**

The evaluation in (8) demonstrates how in candidate (a), the focus tone appears on the TBU following the pitch accent, a pattern which violates both alignment constraints. Candidate (b) satisfies ALIGN-R(H, $PRWD^{UTT}$), but it incurs more violations of ALIGN-L(T, μ^{PRWD}) than the form in (a). Furthermore, candidate (c) associates the focus tone with the head mora of the word, consequently, creating a contour tone together with the low pitch accent[8]. Given the crucial constraint ranking, candidate (a), the one in which the focus tone immediately follows the pitch accent, is correctly selected as optimal.

Next, the tableau in (9) illustrates the predictions which the constraint ranking makes about the location of the focus H in a word containing lexical accent II.

[8] This candidate may also violate ALIGN-L(T, μ^{PRWD}). If only a single tonal tier is assumed, the focus H is not, in fact, aligned with the left edge of the most prominent mora, since the left edge is occupied by the low pitch accent. Whether this candidate violates ALIGN-L(T, μ^{PRWD}) or not, is, however, irrelevant here.

(9) långa [lɔɳɳa] 'long, pl.'

H* L H | / l ɔ ɳ ɳ a /	NO CONTOUR	ALIGN-L (T, μ^{PrWd})	ALIGN-R (H, PRWD^{Utt})
H*L ↑H | | | ☞ a. l ɔ ɳ. ɳ a		**	
H* L ↑H | |/ b. l ɔ ɳ. ɳ a	*!	*	*

The evaluation in (9) shows how candidate (a) aligns the focus tone with the right edge of the word, whereas in the form in (b), the focus H is located closer to the pitch accent, consequently creating a contour tone, a pattern which leads to the fatal violation of NO CONTOUR. The evaluation therefore correctly expresses the fact that in accent II words, the focus H cannot surface immediately after the pitch accent, due to existence of the trailing L of the lexical tone.

The constraint ranking NO CONTOUR >> ALIGN-L(T, μ^{PRWD}) >> ALIGN-R(H, PRWD^{UTT}) thus correctly captures the fact that in accent I words, the focus H appears on the TBU following the pitch accent, whereas in words containing accent II, the focus H occurs after the trailing L. In the following sections, I will not consider outputs in which these patterns are not followed; any candidates violating these requirements do so with fatal consequences.

5. The behavior of the leading H

This section introduces the analysis of the interaction of the focus H and the leading H of accent I. I will demonstrate how the sometimes arbitrary-looking behavior of the leading H is adequately captured by a simple constraint interaction, which crucially relies on the idea that the OCP, in fact, consists of a set constraints reflecting the gradient adjacency as well as similarity. I will first discuss the cases with two accent I words (the examples in (3)).

5.1. Two accent I words

The first example, *längre nummer* 'longer numbers', illustrates the situation in which the leading H of the lexical tone of the second word fails to surface in the output. In OT terms, this clearly violates an input-output faithfulness, which is captured by the constraint given in (10).

(10) MAX-IO(T) (McCarthy & Prince 1995, Myers 1997)
Every tone in the input must have a correspondent in the output.

Since the deletion of the leading H occurs in the first place, a constraint must exist which motivates the deletion and which therefore dominates MAX-IO(T). This crucial constraint is the one which militates against sequences of two adjacent high tones, in other words, a constraint which is based on the general idea of the OCP (Leben 1973, 1978, 1980; McCarthy 1979, 1986). The constraint is defined in (11), and the tableau in (12) demonstrates the evaluation of *längre nummer* 'longer numbers', based on the crucial ranking of MAX-IO(T) and OCP.

(11) OCP (Myers 1997)

*H H
| |
μ μ

(12) längre nummer [lɛηre nummɛr] 'longer numbers'

OCP >> MAX-IO(T)

H[9] L* H H L* | | /l ɛ η r e nummɛr/	OCP	MAX-IO (T)
L* H L* | | | ☞a. l ɛ η. r e num.mɛr		*
L* H H L* | | | | b. l ɛ η. r e num.mɛr	*!	

The evaluation in (12) demonstrates how the candidate without the leading H, candidate (a), appears as the optimal output, due to the fact that the surface realization of the leading tone in the form in (b) leads to the violation of the higher-ranked OCP. In addition, a candidate which avoids the violation of the OCP by moving the focus H further to the left, violates NO CONTOUR, which suggests that also NO CONTOUR dominates MAX-IO(T). Similarly, if the leading H were moved to the right, a contour tone would result. Thus, the surface realization of the leading H is clearly impossible in this environment. However, the interaction of the focus tone and accent I leads to another type of tonal configuration when more TBUs intervene between the two pitch accents, implying that more space is available for the focus H and the leading H. This is illustrated by *längre lameller* 'longer disks' in the tableau in (13)

[9] The leading H of the first word never surfaces in this context. Since all candidates incur this same violation, it remains irrelevant in the evaluation, and I thus do not indicate this violation in the tableaux (Prince & Smolensky 1993).

(13) längre lameller [lɛŋre lamɛllɛr] 'longer disks'

H L* <u>H</u> H L* | | /l ɛ ŋ r e lamɛllɛr /	OCP	MAX-IO (T)
L* <u>H</u> !H L* | | | | ☞ a. l ɛ ŋ. r e la.mɛl.lɛr		
L* <u>H</u> H L* | | | | ☞ b. l ɛ ŋ. r e la.mɛl.lɛr		
L* <u>H</u> L* | | | c. l ɛ ŋ. r e la.mɛl.lɛr		*!
L* <u>H</u> H L* | | | | d. l ɛ ŋ. r e la.mɛl.lɛr	*!	

The tableau in (13) shows how the constraint ranking correctly rules out candidates (c) and (d); however, based on this hierarchy, the decision cannot be made between candidates (a), in which the leading H surfaces as downstepped, and the output in (b), which is the most faithful form. Since the form in (a) is, in fact, the attested output, a solution must be found which both makes the decision between the two candidates as well as ensures that the tonally less faithful form will be selected as optimal[10]. In the following paragraphs, I will show how the solution lies in the re-evaluation of the OCP constraint, with respect to both adjacency and similarity.

Let us begin with the issue of adjacency. The tonal pattern of the unattested candidate (b) in the tableau in (13) implies that a sequence of two high tones is prohibited – not only when the high tones are linked to adjacent TBUs – but even in cases in which these TBUs are intervened by an additional TBU. This pattern is adequately expressed by a hierarchy of the OCP constraints, given in (14).

(14)
```
*H  H        *H         H            *H          H
 |  |    >>   |         |      >>     |          |
 μ  μ         μ    μ    μ             μ   μ   μ  μ
```

In addition to the now familiar prohibition of two high tones associated with adjacent TBUs, the hierarchy in (14) also implies that the sequence of two high tones might be banned even if they are not linked to adjacent TBUs. The adjacency parameter of the OCP is therefore broken up into

[10] Clearly, a faithfulness constraint which penalizes downstep must be low-ranked; consequently, I will not consider it more detail here.

a set of sub-constraints, which together express the *degree* of adjacency. Based on the hierarchy given in (14), I propose another OCP constraint. This constraint, which I call OCP_2 at this point, is defined in (15).

(15) OCP_2

$$\begin{array}{ccc} {*}H & & H \\ | & & | \\ \mu & \mu & \mu \end{array}$$

The postulation of OCP_2 leads towards the correct prediction, since it correctly rules out candidate (b) of the tableau in (13). However, the constraint has undesirable effects as well, since it is also violated by the attested output, candidate (a), thus clearly being too powerful. This problematic situation leads to the question of the gradiency of the second parameter of the OCP, namely similarity. The two candidates, (a) and (b), in the tableau in (13) differ from each other with respect to the register of the leading H: candidate (a) exhibits downstepping, while candidate (b) retains the tonal register of the input. It follows that a formal distinction must be established between the two tonal sequences, HH and H!H. In order to capture this difference, let us introduce the constraint hierarchy in (16).

(16)

$$\begin{array}{cc} {*}H_\alpha & H_\alpha \\ | & | \\ \mu & \mu \end{array} \quad >> \quad \begin{array}{cc} {*}H_\alpha & H_\beta \\ | & | \\ \mu & \mu \end{array}$$

The ranking in (16) implies that two high tones with the same register is a less optimal combination than two high tones with different registers. This similarity hierarchy can be further combined with the adjacency hierarchy given above, resulting in the more comprehensive OCP ranking, as shown in (17), which thus adequately expresses the gradiency of both parameters of the OCP.

(17)

$$\begin{array}{cc} {*}H_\alpha & H_\alpha \\ | & | \\ \mu & \mu \end{array} \quad >> \quad \begin{array}{cc} {*}H_\alpha & H_\beta \\ | & | \\ \mu & \mu \end{array} \quad >> \quad \begin{array}{ccc} {*}H_\alpha & & H_\alpha \\ | & & | \\ \mu & \mu & \mu \end{array} \quad >>$$

$$\begin{array}{ccc} {*}H_\alpha & & H_\beta \\ | & & | \\ \mu & \mu & \mu \end{array} \quad >> \quad \begin{array}{cccc} {*}H_\alpha & & & H_\alpha \\ | & & & | \\ \mu & \mu & \mu & \mu \end{array} \quad >> \quad \begin{array}{cccc} {*}H_\alpha & & & H_\beta \\ | & & & | \\ \mu & \mu & \mu & \mu \end{array}$$

Let us next illustrate how the OCP ranking illustrated in (17) is able to capture the tonal patterns of Swedish. The relevant part of the hierarchy with respect to the evaluation of the case in question, *längre lameller* 'longer disks', is the one given in (18).

(18) OCP(REGISTER)[11]

```
*Hα         Hα
 |           |
 μ     μ     μ
```

The constraint OCP(REGISTER) thus prohibits a sequence of two high tones with the same register when one TBU intervenes between the TBUs with which the tones are associated. Furthermore, since the optimal tool of satisfying OCP(REGISTER) is a change in the register of one of the tones, not the deletion of an entire tone, it becomes clear that the faithfulness constraint MAX-IO(T) must dominate OCP(REGISTER). A change in the register, however, violates a type of input-output faithfulness, which is captured by the constraint given in (19). As a result of this constraint, both downstep and upstep are prohibited.

(19) IDENT-IO(REGISTER) (based on McCarthy & Prince 1995)
Output correspondents of an input [γregister] tone are also [γregister].

I demonstrate the re-evaluation of *längre lameller* 'longer disks' based on the idea of the gradient OCP in the tableau in (20).

(20) längre lameller [lɛηre lamɛllɛr] 'longer disks'

OCP >> MAX-IO (T) >> OCP(REGISTER) >> IDENT-IO (REGISTER)

H L* H̲ H L* | | /l ɛ η r e lamɛllɛr /	OCP	MAX-IO (T)	OCP (REGISTER)	IDENT-IO (REGISTER)
L* H̲ !H L* | | | | ☞ a. l ɛ η. r e la.mɛl.lɛr				*
L* H̲ H L* | | | | b. l ɛ η. r e la.mɛl.lɛr			*!	
L* H̲ L* | | | c. l ɛ η. r e la.mɛl.lɛr		*!		
L* H̲ H L* | | | | d. l ɛ η. r e la.mɛl.lɛr	*!			

[11] I call it simply OCP(REGISTER), since no other register constraints are relevant to the analysis here.

The evaluation in (20) illustrates how candidate (a), the one with the downstepped high tone, incurs only a violation of the lowest-ranked IDENT-IO (REGISTER), while candidate (b) fails to satisfy OCP(REGISTER), due to the identical register of the two high tones. Given the crucial ranking of OCP(REGISTER) over IDENT-IO (REGISTER), the optimal output is the one with the downstepped tone, candidate (a).

To summarize the analysis so far, I provide the relevant OCP hierarchy together with the faithfulness constraints in (21).[12]

(21) *H H[13] >> MAX-IO(T) >> *H_α H_α >> IDENT-IO(REGISTER)
| | | |
μ μ μ μ μ

The ranking (21) has three implications. First, when two high tones are associated with adjacent TBUs, the register of the tones remains irrelevant; the tones necessarily appear as too close to each other, a problematic situation which is resolved by the deletion of one of the tones. Second, the violation of the constraint OCP(REGISTER) cannot be avoided by the deletion of a tone, given the crucial ranking of MAX-IO(T) over OCP(REGISTER), but the undesirable situation must always be solved by the change of the register (i.e. downstep, due to the dominant position of OCP(REGISTER) over IDENT-IO(REGISTER)). Third, when the two high tones with different registers are associated with TBUs which are intervened by one TBU, no changes are required. Finally, when more than one TBU intervenes, no changes take place. Naturally, the register of the tones is irrelevant in the last case.

Let us now turn to the final example of the sequence of two accent I words, *längre lavemang* 'longer enemas', and the predictions which the proposed constraint hierarchy makes about this example. I illustrate the evaluation in the tableau in (22). Crucially, one more TBU is available between the two pitch accents than in the previous case, consequently leaving more space for the focus tone and the leading H.

[12] The hierarchy has certain typological implications, given the assumption that all constraint are re-rankable. It suggests that a language should exist in which IDENT-IO(REGISTER) dominates MAX-IO(T). This ranking is highly unlikely, since it would require a situation in which the register of one of the high tones is changed when they are linked to adjacent TBUs, but when the tones are further apart, one of them is deleted. This is clearly a problem for the analysis. The situation might be captured by assuming a crucial connection between the degree of violation and the degree of reconciliation. In other words, a more serious violation (i.e. the closer the tones are to each other, or the more similar they are) requires a stronger mechanism (i.e. the deletion of a tone is a more serious change than the change in the register). This would explain why MAX-IO(T) is always higher-ranked than IDENT-IO(REGISTER) in the OCP hierarchy. Clearly, the connection between the degree of violation and the degree of reconciliation must be formalized. This is, however, outside the scope this paper.

[13] This constraint is, in fact, a combination of two sub-constraints, * H_α H_α and *H_α H_β
| | | |
μ μ μ μ

(22) längre lavemang [lɛηre lavemaηη] ‘longer enemas’

H L* H H L* | | /l ɛ η r e lavemaηη/	OCP	MAX-IO (T)	OCP (REGISTER)	IDENT-IO (REGISTER)
L* H H L* | | | | ☞ a. l ɛ η. r e la.ve.maηη				
L* H !H L* | | | | b. l ɛ η. r e la.ve.maηη				*!
L* H H L* | | | | c. l ɛ η. r e la.ve.maηη			*!	
L* H L* | | | d. l ɛ η. r e la.ve.maηη		*!		
L* H H L* | | | | e. l ɛ η. r e la.ve.maηη	*!			

The tableau in (22) demonstrates the optimality of the most faithful input–output mapping, illustrated by the attested candidate (a). All other outputs in (22) correctly lose the competition under the constraint hierarchy: candidate (b) incurs a violation of IDENT-IO(REGISTER), given the appearance of the downstepped H, while the output in (c) fails to satisfy OCP(REGISTER). Furthermore, candidate (d) fatally violates MAX-IO(T), while the form in (e) locates the leading H closer to the focus tone, consequently violating the OCP. The evaluation result in (22) is due to the fact that the two high tones are now *far enough* from each other, thus causing problematic configurations neither with respect to adjacency nor similarity, a pattern which is a direct result of the more detailed OCP hierarchy[14].

In conclusion, this section has shown how the behavior of the leading H in a sequence of two accent I words (the first of which is focused) is captured, if one assumes that the OCP is not only a general restriction against adjacent identical elements, but that it consists of a set of sub-constraints which adequately express the gradient nature of the OCP when necessary, both with respect to adjacency and similarity.

[14] Candidates (b–d) incur a violation of ALIGN-L(T, μ^{PrWd}) as well, the constraint which requires all tones to surface as close to the head mora of a prosodic word as possible. These violations, however, remain irrelevant here.

5.2. The sequence of accent II and accent I

Let us finally turn to the second set of data in which an accent I word is preceded by a focused accent II word and demonstrate the predictions which the proposed analysis makes about these cases. First, the evaluation of *långa nummer* 'long numbers' in (23) illustrates the situation in which the focus <u>H</u> and the following leading H would surface on adjacent TBUs.

(23) långa nummer [lɔŋŋa nummɛr] 'long numbers'

<table>
<tr><th>H* L <u>H</u> H L*
| |
/ l ɔ ŋ ŋ a nummɛr /</th><th>NO CONTOUR</th><th>OCP</th><th>MAX-IO (T)</th><th>OCP (REGISTER)</th><th>IDENT-IO (REGISTER)</th></tr>
<tr><td>H* L ↑<u>H</u> L*
| | | |
☞ a. l ɔ ŋ. ŋ a num.mɛr</td><td></td><td></td><td>*</td><td></td><td>*</td></tr>
<tr><td>H* L ↑<u>H</u> H L*
| | | \|
b. l ɔ ŋ . ŋ a num.mɛr</td><td>*</td><td>*!</td><td></td><td></td><td>*</td></tr>
</table>

The evaluation in (23) clearly shows how the constraint ranking correctly predicts the disappearance of the leading H, given the high-ranking position of NO CONTOUR and the OCP. Similarly, the hierarchy continues to make adequate prediction also when one more TBU intervenes between the two pitch accents, thus leaving more space available for the two high tones, as in the case of *långa lameller* 'long disks' shown in (24),.

(24) långa lameller [lɔŋŋa lamɛllɛr] 'long disks'

<table>
<tr><th>H* L <u>H</u> H L*
| |
/ l ɔ ŋ ŋ a lamɛllɛr /</th><th>NO CONTOUR</th><th>OCP</th><th>MAX-IO (T)</th><th>OCP (REGISTER)</th><th>IDENT-IO (REGISTER)</th></tr>
<tr><td>H* L ↑<u>H</u> L*
| | | |
☞ a. l ɔ ŋ. ŋ a la.mɛl.lɛr</td><td></td><td></td><td>*</td><td></td><td>*</td></tr>
<tr><td>H* L ↑<u>H</u> H L*
| | | | |
b. l ɔ ŋ. ŋ a la.mɛl.lɛr</td><td></td><td>*!</td><td></td><td></td><td>*</td></tr>
<tr><td>H* L ↑<u>H</u> H L*
| | | \|
c. l ɔ ŋ . ŋ a la.mɛl.lɛr</td><td>*!</td><td></td><td></td><td></td><td>*</td></tr>
</table>

The tableau in (24) illustrates the success of the constraint ranking by demonstrating how the optimal reconciliation of the tonally undesirable situation is the deletion of the leading H, as in candidate (a). Interestingly, this is example together with *längre lameller* ‘longer disks’ (two accent I words) implies the crucial dependence of the leading H on the location of the focus tone (which is dependent on the type of the lexical tone): due to the fact that the focus <u>H</u> surfaces closer to the right edge in accent II words, the leading H must be deleted also in cases in which more TBUs intervene between the two pitch accents. This holds true also with respect to *långa lameller* ‘long disks’. Even though this example contains the same number of TBUs between the pitch accents as *längre lameller* ‘longer disks’, the deletion of the leading H is the only viable solution. Recall that in *längre lameller* ‘longer disks’ the change in the register was able to satisfy the crucial requirements.

Finally, the example *långa lavemang* ‘long enemas’ illustrates the situation in which the leading H surfaces without violating faithfulness, as shown in the tableau in (25). This is due to the fact that one more TBU intervenes between the two pitch accents when compared to the previous example, *långa lameller* ‘long disks’.

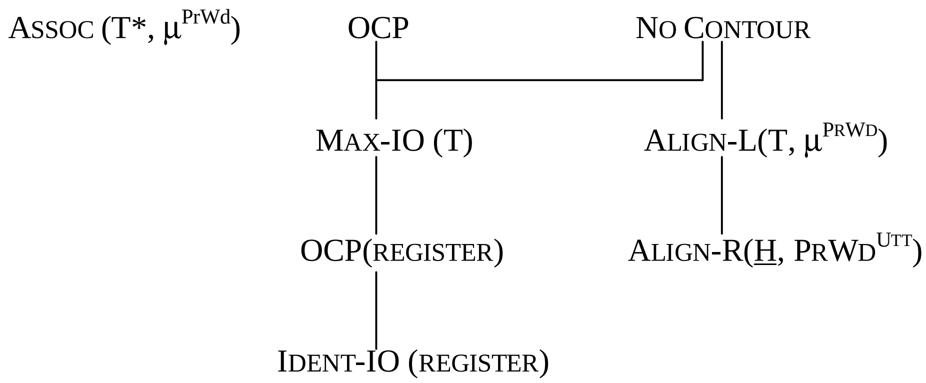
(25) långa lavemang [lɔηηa lavemaηη] ‘long enemas’

H* L <u>H</u> H L* | | / l ɔ η η a lavemaηη /	OCP	MAX-IO (T)	OCP (REGISTER)	IDENT-IO (REGISTER)
H* L ↑<u>H</u> H L* | | | | | ☞ a. l ɔ η. η a la.ve.maηη				*
H* L ↑<u>H</u> L* | | | | b. l ɔ η . η a la.ve.maηη		*!		*
H* L ↑<u>H</u> H L* | | | | | c. l ɔ η. η a la.ve.maηη	*!			*

The evaluation in (25) shows how the form with the leading H associated with the TBU preceding the second pitch accent, candidate (a), is the optimal output. This form incurs only a violation of IDENT-IO(REGISTER), due to the upstepped focus tone; the upstep also ensures that no condition for the downstepped leading H is met.

In conclusion, this section has demonstrated how the proposed constraint ranking makes correct predictions also in the cases which contain a focused accent II word. The diagram in (26) summarizes the constraint hierarchy. The higher-ranked constraints are located at the top.

(26)



6. Summary

This paper has demonstrated the need for the re-evaluation of the nature of the OCP. The evidence provided by tonal patterns encountered in the phonology-syntax interface in Swedish has clearly shown how the OCP can no longer be expressed only as a general, categorical restriction against adjacent identical elements. Conversely, the OCP must be seen a result of the interaction of sub-constraints, which are separately concerned with the two parameters involved, namely adjacency and similarity. Only by constructing the OCP effects from the set of sub-constraints, the gradient nature of the OCP exhibited by the interaction of focus and lexical tones in Swedish is adequately explained.

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