Maximizing First Positions

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1. Introduction

In many languages, the first position of a syllable, the onset has phonological properties different from non-initial syllable positions such as the coda. Similarly, first syllables of words or roots often are subject to other types of restrictions than non-initial positions. More specifically, Beckman (1998) proposes that initial positions, being more prominent than non-initial positions, are special in that they tend to be more faithful to their underlying representations than non-initial syllables. Thus, initial positions often display a greater inventory of segments than non-initial syllables or trigger rather than undergo assimilation processes. A special case of "positional faithfulness", as she calls the phenomenon, is discussed by her under the term of "prominence maximization". She proposes that not only constraints of the IDENT type, requiring featural identity between corresponding segments in underlying and surface representation, can explicitly target initial positions, but that also constraints such as MAX can be specified for prominent positions in general and initial positions in particular. For instance, a positional MAX-P constraint for the first syllable is defined by her as follows:

(1) MAX-σ_1
If $\alpha \in S_1$, then there exists some $\beta \in S_2$ such that $\alpha R \beta$ and β appears in σ_1
"Every input segment has an output correspondent in the root initial syllable"

A positional MAX constraint of this type has the effect that every segment of the input will appear in the initial syllable of the root - in the limits of other constraints permitting it. The result is an increase of segmental material in initial positions. Beckman discusses several phenomena that show the effects of this constraint. Maybe the clearest case she discusses is the special behavior of initial syllables in Tamil. In Tamil complex codas are not permitted - except in the first syllable of the root.

(2) Tamil: complex codas only in the first syllable:

payt̪.t̪ɪ.yã	'madness'
maaɾt̪.t̪aan.dã	place name
ʋaaɭk.kɜ	'life'

Caroline Féry, Antony Dubach Green & Ruben van de Vijver (eds.),
Proceedings of HILP5, 1–19, University of Potsdam.

She interprets the unavailability of complex codas in general as the effect of *COMPLEX, a constraint militating against complex margins. However, initial syllables are protected by the positional faithfulness constraint MAX-σ_1, which outranks *COMPLEX and thus guarantees that input consonants will surface in the first syllable even if thus complex codas are created. As a result, initial syllables in Tamil may be "heavier" than non-initial syllables, more loaded with segmental material.

In this paper I want to discuss some possible extensions of Beckman's idea of prominence maximization. I will argue that prominence maximization can be the trigger for seemingly unrelated phenomena as certain types of metathesis, the existence of monosyllabic templates and certain types of vowel deletion. To illustrate the metathesis case, in the Sardinian dialect Sestu Campidanian, rhotic consonants migrate to the first syllable of the root in the presence of a determiner, increasing the number of segments in initial position:

(3) Metathesis in Sestu Campidanian (Bolognesi 1998):
a'ʒɾɔʁa 'farmyard'
s: ɾa'ʒɔʁa 'the farmyard'

The existence of monosyllabic templates in reduplication, truncation or as a restriction on the shape of morphemes can be interpreted as a case of prominence maximization as well. In reduplication, for instance, the reduplicant often takes the shape of a single, maximally filled syllable:

(4) Agta monosyllabic reduplication (Marantz 1982)
takki 'leg' taktakki 'legs'

I will analyze templates of this type as emerging under the pressure of a constraint requiring a morpheme to consist of an initial position and nothing else. Realizing a single syllable is the only way to make sure that all segments are in the first syllable.

The last case I will discuss is optional schwa-deletion in French, where a floating vowel is deleted in a phrase whenever syllable structure constraints allow it:

(5) Optional vowel deletion in French (Tranel 1999):
dans le panneau
[dɑ̃.lœ.pa.no] ~ [dɑ̃l.pa.no] 'in the panel'

Tranel (1999) analyzes schwa-deletion as being triggered by a constraint SYLLABLE ECONOMY, favoring the decrease of syllables in a phrase. The phenomenon can also be seen from a slightly different angle: since less segments are realized on the surface fewer of them are not in first position. The result is a structure where information, especially consonantal information, is condensed.

It is possible to extend the concept of prominence maximization to the phenomena mentioned above once we extend the constraint format that prominence maximization can take. I will propose that prominence maximization is not only triggered by the MAX constraints proposed by Beckman, but also by other types of constraints. Beckman's MAX-POSITION constraints are faithfulness constraints and as such they refer to the relation between input and output. They say: "every *input* segment has an *output* correspondent in some prominent position in the output". The prominence maximization constraints I use will be defined on the output only. In this form they are more similar to the family of COINCIDE constraints proposed by Zoll (1996, 1998) to account for "positional markedness". Zoll's constraints require certain marked output structure to appear in specified prominent positions in the output and thus account for cases where marked structure seems to be restricted to prominent positions. I will maintain Zoll's constraint format, but replace "marked output structure" with "every element":

(6) Output oriented prominence maximization:
COINCIDE-P: every element of the output is in P
(P = some prominent position).

The difference between prominence maximization as triggered by constraints in the guise of faithfulness constraints and prominence maximization as the result of output-oriented COINCIDE constraints is subtle and will be discussed in detail below. The difference is not crucial for my analysis of metathesis in Sestu Campidanian, but it will turn out to be important in the discussion of monosyllabic templates and vowel deletion.

The constraints proposed by Beckman (1998) and Zoll (1996, 1998) refer to prominent positions in general. They discuss the case of initial positions as well as cases of positions that are prominent because they are stressed or because they belong to a foot. I will limit myself here to initial positions, that is, to positions that are prominent because they are the first positions of a root (in Sestu Campidanian metathesis), of morphemes in general (in the cases of templates discussed below) or of a phrase (in French vowel deletion). I will argue that prominence maximization in initial positions has advantages in terms of processing of the segment string by the hearer and that thus prominence maximization in initial positions can receive a psycholinguistic grounding.

2. Metathesis to initial position in Sestu Campidanian

Bolognesi (1998) discusses a process of metathesis in the Sardinian dialect of Sestu Campidanian that shifts rhotics from word-internal position of vowel-initial roots to root initial position when the root is preceded by a determiner (the metathesizing rhotic is underlined):

(7) Metathesis to initial position in Sestu Campidanian

'o<u>r</u>ku	'ogre'	s: <u>r</u>ok:u	'the ogre'
'a<u>r</u>ku	'bow'	kust <u>r</u>ak:u	'this bow'
'ɛ<u>r</u>ba	'grass'	kus: <u>r</u>ɛβa	'that grass'
'a<u>r</u>dʒa	'tarantula'	s: <u>r</u>aʒa	'the tarantula'
'a<u>r</u>gu	'sour'	s: <u>r</u>aɣu	'the sour one'
'o<u>r</u>dʒu	'barley'	's: <u>r</u>oʒu	'the barley'

In the examples above the rhotic metathesizes from a coda position to the first onset of the root. However, Bolognesi (1998:420) also gives one example where metathesis moves a rhotic from the onset of a stressed syllable:

(8) metathesis from the onset of a non-initial stressed syllable:

a'ʒ<u>r</u>ɔʁa	'farmyard'	s: ra'ʒɔʁa	'the farmyard'

Since in this last example the rhotic does not originate in coda position, the trigger for metathesis cannot simply be the necessity to avoid a coda consonant. Neither can metathesis be caused by the necessity to move the rhotic to a stressed syllable since in this example the rhotic in fact *leaves* the syllable bearing main stress. Rather, I propose, metathesis is triggered by a constraint requiring segments to be in the very first position of the root, the onset of the first syllable:

(9) **COINCIDE-ONSETσ_1**:
every output-element must be in the onset of the first syllable of the root.

The first position is defined here as the onset of the first syllable of the *root,* not of the prosodic word, since metathesis does not result in structures such as **k<u>r</u>us: ɛβa* where the rhotic would appear in the first onset of the prosodic word.

In Sestu Campidanian, COINCIDE-ONSETσ_1 overrides the constraint LINEARITY prohibiting any change in the linear order of input segments:

(10) LINEARITY: "No Metathesis!"
The input is consistent with the precedence structure of the output, and vice versa (McCarthy & Prince 1995).

However, metathesis in Sestu is limited to rhotics. It is widely known that rhotics metathesize more easily than other segments, probably because of their longer phonetic cues (cf. Blevins & Garrett 1998). I therefore propose that the constraint LINEARITY be parametrized as to the types of segments it affects. Since rhotics metathesize more easily than non-rhotics, the LINEARITY constraint specified for rhotics will be universally lower ranked than LINEARITY constraints specified for other segments (here expressed as a set of constraints under the cover-term LINEARITY (¬ RHOTICS)). Thus, we can analyze the limitation of metathesis to rhotics in Sestu Campidanian with the help of a constraint ranking where the metathesis triggering constraint COINCIDE-ONSETσ_1 is ranked between LINEARITY (¬ RHOTICS) and LINEARITY (RHOTICS):

(11) Limitation of metathesis to rhotics:
LINEARITY (¬ RHOTICS) >> COINCIDE-ONSETσ_1 >> LINEARITY (RHOTICS)

(12) Metathesis to the onset of the first syllable[1]

/s:u orku/	LINEARITY (¬ RHOT.)	COINCIDE-ONSETσ_1	LINEARITY (RHOT.)
☞ a. s: [rok.ku]		o k u	*
b. s: [or.ku]		o r k u!	
c. s: [o.kru]		o k r u!	*
d. s:[krou]	*!	o u	*

Candidate a. is winning the competition because it has as many segments as possible in the onset of the first syllable of the root - in the limits permitted by the top-ranked constraint excluding non-rhotic elements from metathesizing. Candidate b. is faithful in its linear order to the precedence structure of the input, but has less segments in the onset of the first syllable than candidate a. The candidate under c. is interesting: it shows us that if we wanted to analyze metathesis as triggered by the necessity to avoid a consonantal coda in the first syllable, we would still have to explain why the rhotic migrates to the *left* and not to the *right*.[2] Candidate d. shows that a candidate where non-rhotics have metathesized has to fail because of high-ranked LINEARITY (¬ RHOTICS).

[1] To make the counting of COINCIDE-ONSETσ_1 violations easier for the reader I have indicated the segments that cause violations of this constraint, rather than giving the violation marks.

[2] Bolognesi (1998), who proposes an analysis in terms of coda-elimination, explains left-ward metathesis and hence exclusion of candidates such as c. with a constraint against rhotics forming complex onsets in the last syllable of the word. However, it remains unclear then why words such as *a'ʒr̠ɔʁa* 'farmyard' ~ *s: ra'ʒɔʁa* 'the farmyard' undergo metathesis at all since in this example the rhotic originates in a position that is neither a coda position nor the complex onset of the last syllable.

The constraint hierarchy constructed so far cannot account for the fact that in vowel-initial words without determiners no metathesis occurs. Why is the rhotic in underlying */orku/* not shifted to root initial position as well, generating the output *[roku]*? I will follow here Bolognesi's (1998: 422) explanation for the lack of metathesis in these cases. He argues convincingly that Sestu Campidanian has a ban on rhotics in word-initial position:

(13) $*[r...]_{PrWd}$: no rhotics at the beginning of a prosodic word[3]

The effects of this constraint are most clearly visible in the treatment of loanwords with word-initial rhotics which are "repaired" through an epenthetic vowel in Sestu Campidanian:

(14) Epenthesis in r-initial loan words:
ricco (Italian) > ar:ik:u (Sestu Campidanian) 'rich
radio (Italian) > ar:aðiu (Sestu Campidanian) 'radio'

The constraint $*[r...]_{PrWd}$ can block metathesis whenever there is no consonant (that is, no determiner) the rhotic can combine with. The conflict between metathesis blocking $*[r...]_{PrWd}$ and metathesis triggering COINCIDE-ONSETσ_1 is illustrated in the following tableau:

(15) No metathesis generating [r]-initial words

/orku/	$*[r...]_{PrWd}$	COINCIDE-ONSETσ_1	LINEARITY (RHOTIC)
a. $[_{PrWd}$ rok.ku]	*!	o k u	*
☞b. $[_{PrWd}$ or.ku]		o r k u	

The metathesizing candidate a. cannot succeed in this case since metathesis would create an illicit structure with a rhotic in initial position. As a consequence candidate b., which is faithful to input linearity, wins.

Summing up the discussion of Sestu Campdianian, I conclude that there are certain types of metathesis where segments consistently choose initial positions as their landing site. The reason, I want to propose, lies in the fact that there are constraints such as COINCIDE-ONSETσ_1 in the phonology of natural languages that favor maximization of initial positions.

3 Bolognesi observes that effects of a constraint of this type are attested also in other Southern Italian dialects, in Australian languages and in Basque. Korean seems to have a restriction against initial rhotics as well. Whatever the deeper explanation for $*[r...]_{PrWd}$, the constraint seems to have some cross-linguistic reality.

Note that in using COINCIDE-ONSETσ_1 instead of a Beckman-type MAX-P constraint we have to worry about a candidate not discussed so far. In fact, the best way to satisfy COINCIDE-ONSETσ_1 would be to simply delete all the segments from the output that are not located in the onset of the first syllable:

(16) *s: ro[4]

In order to prohibit this candidate from winning we will have to insert the anti-deletion constraint MAX on top of the ranking:

(17) MAX: for every segment in the input there has to be a corresponding segment in output (McCarthy & Prince 1995).

(18) No deletion to maximize the first position:[5]

/ s:u orku /	MAX	*[r ...]$_{PrWd}$	COINCIDE-ONSETσ_1	LINEARITY (RHOTIC)
☞ a. s: [rok.ku]			o k u	*
b. s: [or.ku]			o r k! u	
c. s: [o.kru]			o k r! u	*
d. s: [ro]	k u!		o	*

Candidate d. is the candidate that would best satisfy COINCIDE-ONSETσ_1 since all of the output consonants appear in the first syllable of the root. It loses against candidate a. because of its violations in terms of faithfulness. If instead of COINCIDE-ONSETσ_1 we had used a MAX-P constraint as defined by Beckman (1998) we would not have had any need to add MAX to the hierarchy. Beckman's MAX-P constraints have faithfulness already built into their definition: they require an input segment to appear in the output *and* to do so in a prominent position. For this reason both candidate a. and candidate d. rate equally well on the MAX-P constraint MAX-ONSETσ_1. In both cases the input segments /o/, /k/ and /u/ are not realized in the onset of the first syllable. Candidate d. will thus be excluded in any case for its numerous MAX violations, no matter where MAX is ranked in the hierarchy.

For the analysis of metathesis here, it is irrelevant whether we use a MAX-P constraint or a constraint of the COINCIDE type helped by a constraint against

[4] I am assuming here that some higher constraint against empty nuclei excludes deletion of the vowel.

[5] In this tableau I have ignored *s:u rokku*, the candidate where the vowel of the determiner has not been deleted. Bolognesi argues that this candidate is out because of a high ranked onset condition against sonorant onsets in Sestu Campidanian (cf. Bolognesi 1998: 424).

deletion. However, if we assume that COINCIDE constraints exist and play some role in prominence maximization, we have to ask what happens when MAX is dominated by them. The answer is that a ranking of this type will result in massive truncation down to the prominent position itself. This is what happens in the case of monosyllabic templates.

3. Monosyllabic templates as instances of maximization of first positions

Morphological categories that are restricted in their size or form by phonological conditions have been much discussed in the literature of the last years. Templates of this type are most conspicuous in partial reduplication, where the reduplicant does not copy the base completely, but often cannot exceed a certain number of syllables. This is the case in Diyari, where the reduplicant has invariably the size of a disyllabic foot (the reduplicative morpheme is underlined):

(19) Disyllabic reduplicants in Diyari (McCarthy & Prince 1994, 1999)

wil̪a	<u>wil̪a</u>-wil̪a	'woman'
kanku	<u>kanku</u>-kanku	'boy'
tʲilparku	<u>tʲilpa</u>- tʲilparku	'bird sp.'

McCarthy & Prince (1994, 1999) propose to analyze templates as the result of an "emergence-of-the-unmarked-ranking". The constraints responsible for the size restrictions imposed on the reduplicant are dominated by faithfulness constraints referring to input-output identity but dominate faithfulness constraints referring to the identity between the base of reduplication and the reduplicant. Since the reduplicant template is created through deletion of material from the base the relevant faithfulness constraints will be of the MAX type.

(20) Unmarked structure emerging in the template:
MAX$_{IO}$ >> "size restrictor constraints" >> MAX$_{BR}$

(21) MAX$_{IO}$: for every segment in the <u>input</u> there must be a corresponding segment in the <u>output</u> (McCarthy & Prince 1995)

MAX$_{BR}$: for every segment in the <u>base</u> there must be a corresponding segment in the <u>reduplicant</u> (McCarthy & Prince 1995)

In the case of disyllabic templates in Diyari, the size restrictor constraints proposed by McCarthy & Prince (1994) are PARSE-SYLL and ALIGN (FT, L, PRWD, L), two metrical constraints requiring all syllables to be parsed into feet and all feet to be aligned with the left edge of the prosodic word. The only way to satisfy these constraints is to have one, and not more than one, foot per prosodic word. The two size restrictor constraints can be satisfied in the reduplicant since they dominate the faithfulness constraint MAX_{BR} demanding all segments of the base to be copied to the reduplicant. Since PARSE-SYLL and ALL-FT-LEFT dominate MAX_{BR}, only as much material can be copied to the reduplicant as fits into a single foot. The ranking of MAX_{IO} over the size restrictor constraints, on the other hand, guarantees that input material surfaces in the base even when it exceeds a single foot: given the domination relation between input/output faithfulness and the size restrictor constraints, no input material can be deleted to satisfy PARSE-SYLL and ALL-FT-LEFT.

Reduplicative morphemes are often restricted to consist of at most one syllable. For instance, in Agta the reduplicant contains as much and not more material of the base as can fit into a single syllable:

(22) Agta monosyllabic reduplication (Marantz 1982)

bari	'body'	barbari-k kik-in	'my whole body'
takki	'leg'	taktakki	'legs'
mag-saddu	'leak (verb)'	na-sadsaddu	'leak in many places'
na-wakay	'lost'	na-wakwakay	'many things lost'

Monosyllabic templates are also well-known from truncation. Thus, Swedish nouns can be truncated down to the size of a single syllable to which the morpheme *-is* is added (cf. also Lappe 2001 for monosyllabic templates in English short names):

(23) Swedish noun-truncation (Weeda 1992):

alkoholist	alk-is	'alcoholic'
da:ghem	da:g-is	'day-care center'
go:daaker	go:d-is	'candy'
kompanjon	komp-is	'friend'
lantbrukarer	lant-is	'farmer'

What could the size-restrictor-constraints look like that are responsible for monosyllabic templates? In the literature (cf. Mester 1990, Benua 1995) it has been claimed that monosyllabic templates are minimal feet. But the minimal foot is not a prosodic category of its own and cannot be derived in the same way as e.g. the disyllabic templates discussed above for Diyari. If the template has to take the shape of a foot (because the size-restrictor-constraints refer to metrical structure), this foot should always be *maximal*, since this allows for more material to be copied into the reduplicant (and hence to better satisfy MAX_{BR}).

My proposal is that monosyllabic templates are the result of a size-restrictor-constraint requiring all segments to be in the first syllable of some morpheme:[6]

(24) COINCIDE-σ_1: every segment of the output is in the first syllable of some morpheme.

Thus, monosyllabic templates in reduplication are the result of the following emergence-of-the-unmarked ranking:

(25) Constraint ranking for monosyllabic reduplication
MAX$_{IO}$ >> COINCIDE -σ_1 >> MAX$_{BR}$

When COINCIDE-σ_1 dominates the faithfulness constraint requiring maximal copying from the base to the reduplicant copying will be possible only up to at most one syllable. A single syllable guarantees that every segment appears in the first syllable of the reduplicative morpheme. Segments in a second syllable would violate COINCIDE-σ_1 since they are outside of the first, prominent position. The dynamics of Agta monosyllabic reduplication are given in the tableau below:

(26) Monosyllabic templates in Agta reduplication

RED+bari	MAX$_{IO}$	COINCIDE-σ_1	MAX$_{BR}$
☞ a. [bar.[ba.ri]]		r i	i
b. [ba.[ba.ri]]		r i	r i!
c. [ba.ri.[ba.ri]]		r i r! i	
d. [bar.[bar]]	i!		

Both candidate a. and candidate b. display a monosyllabic reduplicant. However, a. contains more segments from the base than b. and wins because it rates better on MAX$_{BR}$. Candidate c. exhibits full copying of the base. Although thus it optimally satisfies MAX$_{BR}$, this option is not allowed since too many segments

[6] Spaelti (1997) proposes ALIGN (σ, PRWD) as a size-restrictor constraint for monosyllabic templates. Since this constraint requires every syllable to be aligned with the (right or left) edge of the prosodic word it is best satisfied when only one syllable is realized. Another alignment constraint keeps the reduplicant from shrinking below syllable size, in these cases. As far as I can see, an alignment constraint referring to syllables and the proposed COINCIDE constraint do not make any different predictions for the cases discussed here (cf. however Zoll for differences between the two constraint types in her analysis of Guugu Yimidhirr). I chose the COINCIDE format here because it more clearly expresses the idea of maximization of prominent (here: initial) positions.

do not appear in the first syllable of some morpheme. Finally, candidate d. exemplifies the possibility of back-copying the template requirements to the base. Both COINCIDE-σ_1 and MAX$_{BR}$ would be fully satisfied in this case since every segment appears in the first syllable either of the reduplicative morpheme or of the base morpheme and every segment of the base surfaces in the reduplicant. In the tableau above back-copying is excluded by high-ranking MAX$_{IO}$ which prohibits deletion of input material in the base.

The back-copying candidate is a dangerous candidate (cf. discussion in McCarthy & Prince 1994). We do not know of any languages where words are shortened only if they are preceded by a reduplicant subject to size restrictions. This means that we have to exclude that a candidate such as d. will ever win, under any possible ranking. For instance, what will happen when we rank MAX$_{IO}$ under the COINCIDE constraint?

When COINCIDE-σ_1 dominates MAX$_{IO}$ a language will be generated where no morpheme is larger than a single syllable. Hence the back-copying problem does not arise: morphemes are monosyllabic in general, not just in reduplicating contexts.

A language that comes very close to such a grammar is German. Thus, the typical German root is usually monosyllabic. Golston & Wiese (1998), basing themselves on an extensive root database by Ortmann (1993), note that 79% of all native German roots consist of a single (heavy) syllable. The typical German root therefore is exemplified by words as the following ones:

(27) Monosyllabic roots

hu:t	CV:C	'hat'
o:pst	V:CCC	'fruits'
praxt	CCVCC	'splendor'

An additional 19% of all native roots exceed a single syllable only minimally: they are disyllabic and end in schwa plus a sonorant (or, optionally, a syllabic sonorant):

(28) Disyllabic roots ending in schwa+sonorant:

be:zən	'broom'
a:təm	'breath'
laɪtər[7]	'ladder'
ze:gəl	'sail'

It is striking that this second class of roots resembles very much regular monosyllabic roots plus inflectional suffixes. In fact, inflectional suffixes invariably

[7] Pronounced as [laɪtɐ] by a process of vocalization of coda /r/s.

consist either of schwa plus a sonorant, the coronal obstruents [s] and [t], or of a single schwa (cf. Wiese 2001). The following are typical *root+inflectional suffix* structures mirroring the roots above:

(29)	dɛnk-ən	'think, 3rd p. pl.'
	ro:t-əm	'red, masc./neuter dat.sg.'
	kɪnd-ər	'children, pl.'

Although devoid of any semantic content, with respect to their structure the examples in (28) could be analyzed as consisting of a *root* and a 'pseudosuffix' *ən/əm/ər/əl*. Under this hypothesis we could explain the fact that the "root" that precedes the schwa-sonorant sequence has always to be syllabifiable on its own. Words such as **a:tpəm* are unattested, because a root such as **a:tp* is not a possible syllable of German and hence not a possible root. If we follow this interpretation, the number of native roots characterized by monosyllabicity increases to 89%. In any case it seems clear that the core of German roots is subject to a size restriction of some sort leading to a monosyllabic shape.

The same is true for the core of native German affixes (cf. Wiese 2001). In sum, the majority of all German morphemes can be considered to consist of a single syllable.

I will analyze this size restriction as being the result of the same constraint as the one we found active in shaping the monosyllabic template in reduplication. The main difference with respect to reduplication is that in this case the COINCIDE constraint responsible for template shaping dominates MAX_{IO} and thus affects the input-output relations of segments: no segment can surface in the output that does not belong to the first syllable of some morpheme. Since every second syllable in a morpheme will violate this restriction the result is monosyllabicity. MAX_{IO}, in turn, dominates constraints militating against coda consonants (NOCODA) and complex margins (*COMPLEX). Therefore the faithfulness constraint can still show its force, even in dominated position. As much material as possible will surface in the single root syllable, even if this syllable contains coda consonants and complex margins.[8] The result is a root that is maximally packed in the restricted space of a single syllable. Consider what happens to a hypothetical disyllabic input *hɛlmur* when it is evaluated by the following constraint ranking:

(30) COINCIDE -σ_1 >> MAX_{IO} >> NOCODA, *COMPLEX

[8] However, the restrictions on complex margins are tighter in affixes than in lexical roots (cf. Wiese 2001).

(31) Generation of monosyllabic roots:

input: [$_{Root}$ hɛlmur]	COINCIDE -σ_1	MAX$_{IO}$	NOCODA	*COMPLEX
☞ a. hɛlm		ur	*	*
b. hɛl.mur	m u r!		**	
c. hɛ.lə.mu.rə	l ə m u! r ə			
d. hɛ		l m u! r		

In candidate a. all output segments surface in the first syllable of the root. Candidate b., though rating best in terms of faithfulness, has three segments outside of the first syllable and therefore fails. Candidate c. has an unmarked syllable structure, but again fails on the COINCIDE -σ_1 constraint. The last candidate in the tableau has an unmarked syllable structure as well, but in this case MAX$_{IO}$ makes sure that as many segments as possible make it into the first syllable of the root.

We have now seen two cases where a constraint requiring the maximization of first syllables leads to the creation of monosyllabic templates. In the case of reduplication, the template is the result of a COINCIDE constraint dominating the faithfulness constraint targeting the correspondence relation between the base of reduplication and the reduplicant. In the case of template restrictions on specific morphemes it is the correspondence relation between input and output that is subject to the pressures of prominence maximization. The last case, template restrictions in truncation, receives an explanation along the same lines. In Swedish, nouns such as *alkoholist* 'alcoholic' are shortened to the truncation morpheme *alk-* because COINCIDE-σ_1 dominates the faithfulness constraint MAX$_{BT}$ that requires maximal copying from the base to the truncation morpheme. Hence the truncation process copies just as much material from the base as can fit into a single (the first) syllable.

Summarizing the discussion of this section, monosyllabic templates are instances of prominence maximization because they satisfy the constraint COINCIDE-σ_1, albeit in a rather radical fashion, by deleting all segments that do not fit into the first syllable. What remains is, so to speak, pure prominence - the initial syllable and nothing else.

4. Vowel deletion leading to information condensation

In the last section we have seen cases where COINCIDE-σ_1 is satisfied through massive deletion of segments in the output. I will now turn to phonological processes where deletion is again employed to concentrate segmental information at the beginning of a prosodic or morphological category but where it is more limited in its scope by other constraints.

Consider the following optional process of vowel deletion in French:

(32) Optional vowel deletion in French (Tranel 1999):

a. *ce panneau:*
[sœ.pan.o] ~ [spano] 'this panel'

b. *dans le panneau*
[dɑ̃.lœ.pa.no] ~ [dɑ̃l.pa.no] 'in the panel'

c. *sûr de personne*
[syr.dœ.pɛr.sɔn] ~ [syrd.pɛr.sɔn] 'sure of no one'

Tranel (1999) analyzes [œ] in these contexts as an underlyingly floating vowel, and uses the term "schwa" to distinguish it from "stable" /œ/. He observes that schwa-deletion takes place freely inside a phrase, as long as deletion does not create illicit onset or coda clusters.[9] The trigger for schwa-deletion in Tranel's analysis is a constraint SYLLABLE ECONOMY. I will replace this constraint here with COINCIDE-σ_1, but otherwise follow the spirit and details of Tranel's analysis. COINCIDE-σ_1 must dominate a constraint MAX (SCHWA) requiring faithful parsing of schwa-vowels and it will be dominated by MAX constraints referring to consonants and full vowels (MAX-C and MAX-FULLV, respectively).[10] This ranking guarantees that schwa and only schwa can be deleted.

(33) Optional schwa-deletion in French

/ sœ pano /	MAX-C	MAX-FULLV	COINCIDE-σ_1	MAX (SCHWA)
☞a. spa.no			n o	
b. sœ.pan.o			p a n! o	*
c. span		o!		*
d. sœp	n!			

The means to optimize COINCIDE-σ_1 is again deletion, as in the cases discussed in the previous section. However, deletion is more limited in this case. Full satisfaction of COINCIDE-σ_1 would be obtained in the candidates c. and d., which both much resemble monosyllabic templates. These candidates must lose since in c. a full input vowel is deleted and in d. an input consonant is missing in the output. The overall effect of this case of prominence maximization thus is that segmental information in the phrase is condensed - at the cost of losing some of it.

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9 Tranel (1999) mentions that in Canadian French also full vowels are affected by vowel deletion. See Kenstowicz & Kisseberth (1979) for a (similar, but more complicated) process of vowel deletion in Tonkawa.

10 COINCIDE-σ_1 has to be dominated also by syllable structure constraints that ban certain types of complex margins (cf.Tranel 1999 for a detailed discussion).

In all the examples given by Tranel deletion affects the first or second vowel of the phrase thus making the first syllable heavier. However, his description of the phenomenon implies that deletion is not limited to these contexts but affects schwa-vowels throughout the phrase. In fact, we can observe the same optional deletion in examples such as *parfais le texte* 'improve the text', which is pronounced either as *[par.fɛ.lœ̱.tɛkst]* or as *[par.fɛl.tɛkst]*.[11] Thus, the target output of schwa-deletion is not so much a structure with an initial heavy syllable, but contraction of the word such that all remaining segments are closer to the left edge.

Tranel mentions briefly that articulatory economy, instead of syllable economy, could be the trigger of interconsonantal vowel deletion of this type. The deletion of a vowel spares the speaker the effort of going through full vocalic aperture between two reduced consonantal apertures. This is of course a possibility, though the fact that "alternating deletion" processes of this type typically affect vowels can also be explained differently under the present approach of information condensation. On average, the phoneme inventory of a language has twice as many consonants as vowels (Crystal 1993: 165). This means that vowels carry less information than consonants, therefore less information is lost when they are deleted. To illustrate more clearly the disparity in informational content between consonants and vowels consider a hypothetical situation where a language has only two vowels, /a/ and /i/, and four consonants, /p/, /t/, /k/, /s/. Let us assume that all segments have the same probability of occurring in a string (because, for instance, the language allows only for CV syllables and has no particular co-occurrence restrictions on segments). Now assume that we are parsing a word segment by segment and we reach at some point the vowel /a/. In determining which word we are parsing we will now be able to exclude all those words that are identical to what we have parsed so far but contain an /i/ instead of /a/ at that point. When reaching a consonant like /p/, on the other hand, we will be able to exclude all the words that instead of /p/ contain /t/, /k/ and /s/ at the same point. Thus, a consonant will help us to exclude many more words than a vowel and lead to faster word recognition.

In this section I have discussed one more case where prominence maximization is achieved through deletion. Differently from its template-shaping effect, in the case of schwa-deletion in French COINCIDE-σ_1 cannot reduce the output to a single syllable. Rather, its activity results in information concentration, more specifically, in concentration of segments through deletion of informationally weaker elements such as vowels. In this sense, phenomena such as schwa-deletion in French go beyond what was promised in the title of this paper. Not only can first positions be maximized, but strings of segments can be compressed in a way that will bring consonants closer to the left edge of the word. In

[11] Thanks to Stéphanie Lescure for providing this example.

the following section I will discuss the advantages of crowding material at the beginning of words or phrases and thus try to give a psycholinguistic grounding to the COINCIDE constraint that I have proposed.

5. Why it is good to have lots of information right at the beginning

Psycholinguistic research has long since recognized the importance of word beginnings, especially for word recognition. To quote some studies (but cf. Nooteboom 1981 and Nooteboom & Vermeulen 1998 for detailed references), Brown & McNeill's (1966) experiments regarding the "Tip of the Tongue" phenomenon show that in trying to recall words, the probability to recall word beginnings correctly is higher than that of recalling non-initial sequences; Fay & Cutler (1977) demonstrate that in certain types of speech errors the target word and the error word share the beginning, but not non-initial strings; Nooteboom (1981) shows that word recognition is much more difficult when subjects are presented with final fragments of a spoken word than when they are presented with initial fragments. The reason for the importance of word beginnings for word recognition, as Nooteboom & Vermeulen (1998: 2) put it, "seems to be that lexical activation is organized in such a way that mental representations of lexical forms can only be accessed efficiently from beginning to end, in accordance with the normal time order in speech."

If word recognition is indeed "an online-process, using stimulus information as it comes" (Nooteboom & Vermeulen 1998: 14) it is not surprising that word beginnings are important and it can also be expected that having information concentration in initial positions is of some advantage to hearers when trying to recognize the word they hear. To see this more clearly, consider the following *Gedankenexperiment.* Take a relatively "light" CV syllable and compare it with a relatively "heavy" CCCVCCC syllable. The former string obviously carries less information than the latter in the time span a syllable occupies.[12]

(34) Heavy syllables carry more information than light syllables

a.	$[_\sigma$ C V] 1 2	less information in a one syllable span
b.	$[_\sigma$ C C C V C C C] 1 2 3 4 5 6 7	more information in a one syllable span

Now assume a language with an average number of seven segments per word. If the first syllable of the word in such a language consists of a CV syllable, we

[12] To assume that a two-segment syllable and a seven-segment syllable occupy the same time span is of course an idealization. But it is clear that the "light" syllable will not take three times less to be pronounced than the "heavy"syllable.

have not made much progress in recognizing the average seven-segment word, after hearing the first syllable. If, however, the first syllable is of the CCCVCCC type consisting of seven segments, we have good chances of having recognized the whole word. Heavier initial syllables thus lead to earlier recognition.

(35) Heavier beginnings lead to earlier recognition

a.	# [$_\sigma$ C V] ... 1 2	later recognition
b.	# [$_\sigma$ C C C V C C C] ... 1 2 3 4 5 6 7	earlier recognition

As Nooteboom (1981: 422) observes, " ... one may expect that languages will have adjusted to this situation, in the sense that lexical items will generally carry more information early in the word than late in the word." Beckman (1998) has shown that indeed initial syllables often represent underlying phonological structure more faithfully than non-initial syllables and that, in the case of prominence maximization, underlying segments may be required to appear in the first syllable of the word. I hope to have shown in this paper that there also exist constraints favoring the realization of output segments in or close to first positions and that their effects can be detected in phenomena such as metathesis, template-shaping and vowel deletion.

6. Conclusions

In this paper I have proposed two constraints, COINCIDE-ONSETσ_1 and COINCIDE-σ_1, which require all output segments in a specified domain to be realized in the onset of the first syllable and in the first syllable, respectively. I have argued that the reason why constraints of this type exist in the languages of the world lies in the fact that having many segments right at the beginning of domains has clear advantages for word recognition. The two constraints are instances of the phenomenon described as "prominence maximization" by Beckman (1998). Although the proposed COINCIDE constraints state that all segments must surface in initial position, their effect is not necessarily that of e.g. making first syllables particularly heavy. Rather, the structure of the output that is generated depends largely on the interaction of COINCIDE constraints with other universal well-formedness constraints. Since the COINCIDE constraints are defined on the output alone (differently from Beckman's 1998 constraints) deletion is a means to satisfy them: the fewer segments are realized in the output, the less segments may find themselves outside of the initial syllable. However, the effects can be seen as a maximization of prominence also in these cases. Thus, monosyllabic templates maximize prominence through realizing only the prominent position and nothing else and vowel deletion can lead to an overall condensation of (especially consonantal) information. These results are very typical for an analysis in the framework of Optimality Theory. Single constraints may receive a functional explanation, but output structures arise through constraint interaction and conflict and therefore are optimal, not perfect.

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