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Some Consequences of Word Faithfulness

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One of the interesting results of the Lexical Phonology program of Kiparsky 1985 was the account provided for the differential application of rules at the various levels of the phonology. The same rule, subject to different constraints such as Structure Preservation or the Strict Cycle Constraint, could have different outputs depending on where in the phonology it applied. Work in Optimality Theory has provided new explanations for some of these effects, in particular for those effects known as over -and underapplication (see for example McCarthy and Prince 1995, Benua 1995, 1997). The main focus of this paper is so-called "normal application" where the wellformedness constraint outranks or is equally ranked with faithfulness constraints. This situation is called "normal" because it describes the situation which is expected in a derivational model; where the rule applies if and only if its structural description is satisfied. The idea of relativised faithfulness as outlined in Benua 1997, or positional faithfulness Beckman 1998) allows for another possible situation: that is, a wellformedness constraint may outrank the faithfulness constraints but its satisfaction may result in different outputs due to the effects of the relativised.faithfulness constraints. This is a 'normal' application situation; the structural description of the rule (constraint) is met in all cases but the results of the rule application can be minimally different.

As shown in Selkirk 1982 and Borowsky 1986, 1993, and more recently in an OT interpretation in Benua 1998, WORDs and ROOTS have characteristically different phonological properties. Coming from a slightly different point of view Casali 1997 applies the ideas of positional faithfulness to the explanation of vowel elision showing that the vowel targeted for deletion is largely determined by positional faithfulness, and as I will claim below in particular by WORD-faithfulness. This paper considers other phonological phenomena which exhibit different results and suggests that they too can be explained as a consequence of by WORD-faithfulness.

Paul de Lacy and Anita Nowak (eds.). UMOP 24, 1-24

The bulk of the paper is concerned with the explanation of the pattern of progressive voicing assimilation. Lombardi 1995,1996 *et anni seq.* has shown that progressive voicing assimilation is rare and offers a solution in which other constraints are shown to override the usual regressive assimilation constraint ranking. Building on her idea I show that progressive voicing assimilation is associated systematically with WORD -level morphology and I go on to claim that this is due to WORD -faithfulness(or O-O_2 faithfulness (Benua 1998). We see that the explanation of the voicing assimilation patterns bears a strong resemblance to the explanation for the resolution of vowel sequences as discussed by Casali 1997 providing further evidence for the WORD/ROOT distinction and its associated differential faithfulness .

1. Casali's explanation of vowel elision

When sequences of vowels arise by morphological concatenation in languages which disallow both vowel sequences in syllables and onsetless syllables, it is commonly the case that the last vowel of the series survives while the others delete. Examples are given in (1).

(1)

Chichewa (examples from Mtenje 1992)

/si - u - pita/ --> [supita]	'you will not go'
Neg-2sg-go	
/zi - a - gona/ --> [zagona]	'they have slept
NCl-Perf- sleep	

For the moment let us use the shorthand constraint V_2WINS and *V_1 V_2 to explain the deletion in these forms. When V_2WINS outranks MAX it forces the deletion of the first vowel as shown in the tableaux below.[1]

(2)

si -u - pita	*V_1 V_2	V_2WINS	Max
->si-u-pita	*		*
si-u-pita	*	*	*

As shown by Casali 1997 the V_2WINS pattern may be overriden in certain circumstances - most notably when one of the vowels is in a lexical category (i.e. a WORD or a ROOT) and the other is in a nonlexical categories such as affixes or function words. In this situation the vowel of the lexical category is the survivor in preference to the vowel of the non lexical category. Casali identifies the following environments (among

[1] The V_2 pattern has not yet to my mind received a convincing explanation though see Rosenthall and Lamontagne ms. In the material presented here I rely on the observations and explanations of Casali 1997 with respect to most of the facts but continue to use the mystery constraint V_2WINS when no other explanation suffices.

others) in which faithfulness holds preferentially: word initial, in content words, in root words[2] When any of these constraints play a role the V_2WINS pattern breaks down. He provides special faithfulness constraints some of which are given below.

(3) MAXWI : Every word-initial segment in the input must have a corresponding segment in the output
MAXLEX: Every input segment in a lexical word[3] or morpheme must have a corresponding segment in the output
MAX: Every segment in the input must have a corresponding segment in the output

These constraints are universally ranked: MAXWI >>MAX; MAXLEX >>MAX. Notice the positional faithfulness constraints MAXWI and MAXLEX both refer specifically to the WORD and as such are WORD-faithfulness constraints in my view, or O-O_2 constraints in Benua's terms.

The system of constraints given in (3) accounts for the various patterns of vowel elision observed. Thus, modulo some special cases, V1 deletes when it occurs in a prefix or function word and is followed by a content word; V2 deletes when it occurs in a suffix or function word which follows a content word . Consider the following example from Etsako where the function word /Ona/ 'the' both precedes and follows a noun. Two sets of vowel sequences arise and are resolved differently but both in favor of the vowels of the lexical word. In the first sequence the first vowel (that of the function word) is deleted leaving the vowel of the real word whch happens to be V2. In the second sequence the first vowel of the function word goes and V1 (the vowel of the real word) wins. (The reader should assume the constraint *V_1 V_2 is at the top of the ranking forcing deletion of one of the vowels in all the examples below.)

(4)

/ɔna eɣi ɔna/ --> [ɔneɣina]
the tortoise the 'this tortoise'

/ɔna eɣi ɔna/	MAXLEX	MAXWI	MAX
->ɔna eɣi ɔna		*(?)	**
ɔna eɣi ɔna	!*	* and *(?)	**
ɔna eɣi ɔna	!**	*	**
ɔna eɣi ɔna	!*		**

[2] I do not include all Casali's positional faithfulness constraints here. I have restricted myself to those which illustrate the point I am making. Other cases he discusses are peceptual- long vowels srvive in preference to short vowels, or morphological - the beginnings of morphemes are more faithful than the ends. Some of these are covered by the interpretation given in this paper.

[3] I take Casali's 'lexical word' to corresponds to my 'WORD' which refers to those forms which have exited the first level of the Lexical Phonology and thus it corresponds also with a form at Benua's O-O_2. I use the terms ROOT- and WORD-faithfulness instead of O-O_1 and O-O_2 because they are simpler to refer to.

The crucial factors in this example are the WORD-faithfulness constraints (MAXLEX and MAXWI) which determine which vowel deletes.

When elision takes place with two lexical words, as in a compound for example, elision universally targets V1 according to Casali. He puts this down to the MaxWI constraint. I claim however that this occurs because when there is a tie with respect to word-faithfulness the constraint hierarchy will be resolved in terms of the general pattern and word-faithfulness will not have any effect. Whatever is the explanation for V_2WINS between two affixes is also the explanation for the pattern with compounds because this is the one situation in which the word faithfulness constraints will be violated equally no matter which vowel is deleted. Consider the examples below:

(5)

egs. Emai:

/kɔ ema/ --> [kema]
plant yam

/kɛ ɔka/ --> [k ɔka]
share maize

Ogori:

ebi oboro --> [eboboro] 'good water
water good

ɔtele ɔkeka --> [ɔtelɔka] 'big pot'
pot big

ke oka	MAXLEX	MAXWI /V_2WINS
-> ke oka	*	
ke ɔka	*	!*

Both words in the compound are subject to the same Wordfaithfulness constraint (MAXLEX) and there is a tie. The decision falls to the lower ranked constraint and V2 wins.

Casali's explanation for vowel sequences which arise with two affixes involves some the additional constraints Max MI (Morpheme-Initial) and Max MS (Monosegmental morpheme[4]) . Consider for example the form given in (1) above repeated here with Casali's constraints.

(6)

si -u - pita	MAXMS	Max
->si-u-pita		*
si-u-pita	*	*

[4] This constraint is probably equivalent in some sense to the constraint Morphreal which ensures a morpheme gets some surface realization. If a morpheme consists only of one segment the morphreal will help ensure that it is not deleted- or not entirely deleted. MAXMS doesn't seem enough however. Consider a situation where there are three affixes such as /CV-V-V- .../ where the last vowel wins. MaxMS won't by itself pick out the correct vowel to save.

The compounded case in (5) above can be seen as a return to the unmarked pattern of deletion when the WORD-faithfulness constraints are knocked out by the tie. The second vowel wins. Similarly V_2 wins between two affixes where WORD-faithfulness constraints are irrelevant.

Many cases of suffixes following roots exist where V2 wins. Casali's analysis predicts that V_2 should delete in this circumstance and thus these cases raise a problem for , Casali and suggest that there is still something about V2 wins which we do not understand[5]. The problem can be accounted for if the constraint the constraint MAXLEX distinguished between ROOTs and WORDs. Casali rejects individual constraints because he considers the single constraint to encode the general preference for preserving material which "typically encode greater semantic content."(p500) As shown by Borowsky 1993 and Benua 1998 and as we shall see below, there is a difference between words and roots and their relationship to faithfulness constraints and two subsets of constraints are required: those which ensure faithfulness to WORDs (MAXWD, IDWD, DEPWD = O-O_2.) and those which ensure faithfulness to ROOTs (MAXRT, IDRT, DEPRT = O-O_1.) and the latter may be ranked differently from the former. Thus where Casali has a single constraint universally ranked high we now have two constraints and the MAXRT constraint is ranked below the crucial mystery constraint. Consider (7) from Siswati..

(7)

imbisi-ana	MAXWD	V_2WINS	MAXRT	Max
->imbisa:na			*	*
imbisina		*!		*

Thus the vowel deletion facts show a robust V_2 Wins effect which I propose we understand as the normal/unmarked case. Wherever WORD-faithfulness constraints do not have an effect the unmarked pattern is observed. Where WORD-faithfulness plays a role then the V2 Wins effect may be knocked out of the computation. The result is that the same process of vowel deletion has different outputs depending on the morphological construction.

In this paper I propose to consider other kinds of processes whose differential results can be described as a result of the effect of WORD-faithfulness. The paper is structured as follows: I begin with a discussion of voicing assimilation following on from the work of Lombardi (1995, 1996, 1998). I show that progressive voicing assimilation has two remarkable properties firstly it is characteristically found in the WORD-level

[5] It seems to me that the reason must be a perceptual one. Presumably vowel elision arises because the hearer does not hear both vowels in fast speech and ends up only hearing/listening to the last one maybe because it is 'nearest'. The positional faithfulness story is not incompatible with this view since as Casali points out the vowel in lexical material is easy to retrieve so if you don't actually hear it you can think you heard it because you know what it is.

phonology and secondly it seems always to be assimilation to voicelessness. Lastly I consider briefly whether the same kind of word-faithfulness effect can account for other assymetrical patterns observed with other phonological processes such as vowel harmony.

2. Voicing Assimilation in Dutch and English

Lombardi 1995, 1996, 1997 presents an analysis of voicing assimilation which accounts for the fact that voicing assimilation is generally regressive which is outlined below. According to her the few documented cases of progressive voicing assimilation can be explained as due to the interplay of the general voicing assimilation constraints with, in each case, other morphological or phonological constraints which have the effect of reversing the direction of assimilation. She provides a comprehensive discussion of each case of progressive assimilation and provides an account for each one providing in each case the appropriate additional constraint. I show in this paper that in fact only one additional assumption is necessary for the explanation of progressive assimilation patterns and that is WORD-faithfulness.

I adopt in its entirety Lombardi's (1996) analysis of voicing assimilation. (Lombardi's analysis builds on her own earlier work and makes assumptions justified in that work. I refer the reader to Lombardi 1991 et ann seq.) Regressive voicing assimilation is described as follows: Assimilation is due to satisfaction of the constraint AGREE which requires that sequences of obstruents have the same value for voicing.

(8) AGREE: Obstruent Clusters agree in voicing

Voicing is privative and marked. This is encoded in the constraint *LAR which is viuolated by voiced consonants though not by voiceless consonants.

(9) *LAR: Don't have Laryngeal features

In addition there is IO correspondence ensuring that voicing does not change.

(10) Ident Laryngeal(IDLAR): Consonants should be faithful to underlying laryngeal specification

Voicing assimilation occurs when the constraints are ranked: AGREE >>IDLAR>>*LAR.

(11)

pik+ben	AGREE	IDLAR	*LAR
->pikpen		*	*
pigben		*	!**
pikben	*!		*

This kind of voicing assimilation is always toward the unmarked - that is, the result is always a sequence of voiceless consonants.

The crucial aspect of Lombardi's 1996 analysis is the introduction of a positional faithfulness constraint which takes into account the privileged status of onsets with regard to the voicing constrast[6]. This is encoded in the constraint: Ident Onset Laryngeal (IDONSLAR) which ensures the faithful parsing of onset voice. (This constraint is clearly perçeptually motivated in that the cues for voicing are often found in the release of obstruents.)

(12) Ident Onset Laryngeal (IDONSLAR): Onsets must be faithful to underlying laryngeal specification

This constraint outranks the other constraints governing the identity of voicing in consonants but is itself outranked by AGREE. The following tableaux illustrates. The successful candidate is the one in which the onset consonant is faithfully parsed. Assimilation is in favour of the marked voiced contrast.

(13)

pik+ben	AGREE	IDONSLAR	IDLAR	*LAR
pikpen		*!	*	*
->pigben			*	**
pikben	*!			*

The constraint AGREE says nothing about the direction in which assimilation should occur and thus progressive assimilation is equally possible as a means of satisfying this constraint. However the positional faithfulness constraint, in the normal ranking, always induces regressive assimilation. In Lombardi's account, progressive assimilation is only "possible when some other constraints come into play outranking the effects of the positional faithfulness constraint."p 39. I will show that this is indeed true and that the relevant factor inducing progressive assimilation is always word-faithfulness.

2.1. Dutch

Dutch has an interesting pattern of neutralization and voice assimilation which is discussed in detail in Lombardi's work. Regular voicing assimilation in Dutch is regressive except in obstruent+fricative sequences which always show progressive

[6] Voicing is not the only feature of onsets which is privileged- see Beckman for a full discussion of positional markedness and onset privilege.

assimilation always devoicing the fricative[7]. Dutch also has progressive voicing assimilation with nonfricatives. The regular or weak past in Dutch is formed by adding the sufix /-de/ to verbs. A voiced allomorph occurs following voiced segments: vowels, sonorants and voiced obstruents; a voiceless allomorph occurs after voiceless obstruents. The examples in (14) illustrate.

(14). (examples from Lombardi and v.d. Hulst and Kooij)

verb	past tense	gloss
brei en	breide	knit
rijmen	rijmde	run
leeven	leevde	live
krabben	krabde	scratch
stappen	stapte[8]	step
schrappen	schrapte	scrape
blaffen	blafte	bark

In (15) we see examples of regressive assimilation in compounds.

(15) (egs from Lombardi and Gussenhoven and Jacobs)

/kas + buk/	[kazbuk]	'cash book' cf.	[kas, kase]	cash sg.,pl.
/kaz+bot /	[kazbot]	'cheese boat'	[kas, kaze]	cheese, sg.,pl
/kaz+pers/	[kaspers]	'cheese press'		
/kas+post/	[kaspost]	'cashbook entry'		
/goud korts/	[xʌɯtkɔrts]	'gold fever'		
/lees bril/	[le:zbril]	'reading glasses'		
/laat bloeier/	[la:d blɔjər]	'late bloomer'		

Compounding and affixation of /-de/ are word-level morphological processes but the patterns of assimilation differ in exactly the same way as did the vowel deletion patterns discussed above. When the conflict is between a word and an affix faithfulness to to word is paramount; when the conflict is between two words the pattern reverts to the usual pattern - in this case regressive assimilation.

In the Dutch affix we might have expected that the assimilation trigger is the onset however in fact it is the target of assimilation instead. Word faithfulness as formalized in

[7] I shall omit this from the discussion. Lombardi 1995 proposes a fricative specific constraint which forbids voicing on fricatives which follow obstruents. This constraint outranks the rest and ensures the correct outcome - see Lombardi p11.

[8] I believe these forms can be pronounced in casual speech with voice throughout the cluster. This is not problematic - we assume that for these speakers the ranking of the relevant O-O_2 Identity constarint and the Id Ons constraint is not fixed and in the casual speech situation the IdOns constraint dominates.

the constraint IDWD[9] outranks IDONSLAR and thus sanctions the violation of IDONSLAR, with the result that the voicing of the affix changes rather than the voice of the base-final consonant- progressive voicing assimilation rather than regressive.

(16) IDWD: Don't change features of the WORD[10]

(17)

stap+de	AGREE	IDWD	IDONSLAR	IDLAR	*LAR
stapde	*!				*
-> stapte			*	*	
stabde		*!		*	**

Notice that once the effects of IDONSLAR are cancelled out by higher ranked IDWD, AGREE is satisfied by the unmarked sequence and the constraint making the final choice is *LAR.

In compounds each word should satisfy IDWD. However, satisfying AGREE means one of the consonants must change thus resulting in an IDWD violation no matter which way assimilation goes. The forms tie with respect to the IDWD constraint. The decision then falls, in what we have seen to be the 'usual' pattern, to IDONSLAR and the form with regressive voicing assimilation is the winner. In this way the pattern is exactly parallel to the vowel sequences pattern in compounds where the 'usual' second-vowel-wins situation is reverted to in the compound situation where the word faithfulness constraints are equally violated by deletion of either vowel .

(18)

kas+buk	AGREE	IDWD	IDONSLAR	IDLAR	*LAR
kasbuk	*!				
-> kazbuk		*		*	**
kaspuk		*	*!	*	

kaz-pers	AGREE	IDWD	IDONSLAR	IDLAR	*LAR
kazpers	*!				
-> kaspers		*		*	
kazbers		*	*!	*	**

[9] Notice that IDWD is a shorthand constraint , In these forms it refers to the identity of the laryngeal feature in the word and should more properly be: IDWD-LAR in contrast to IO-IdLar which corresponds to IdentLar above. I use the shorthand version to make the point that the **WORD** domain is the crucial thing - identity of words overall is a feature of the phonology. In the tableaux in the following sections IDWD will be used to stand for idenitity in the word domain to the value of the harmonizing feature/s and of place features as well.

[10] Specifically: Correspondents in a WORD-level output relation agree in voice.
The output relation referred to here corresponds exactly to Benua's $O\text{-}O_2$ (Benua 1997).

2.2. English

English has both regressive and progressive voicing assimilation. Voicing assimilation is observed generally as a static regularity in monomorphemic words, examples in (19)[11].

(19)

abdomen [bd]	observe
absurd ([ps] or [bz])	absent
subdue,	subject
fidget	absolve (?absolution [ps])
risky	adze
wispy	mist
elect	cocktail
lecture	rupture

Regressive assimilation, though very restricted, can also be observed under derivation. This assimilation is limited to a couple of idiosyncratic lexical items and occurs frequently with fricatives, which I will not attempt to account for here. I will confine my discussion to the voicing patterns. Notice that all the examples below show regressive assimilation with the change in voicing showing up in the base and never in the affix.

(20) a. /-th/

five	fifth	(also fifty, fifteen)
twelve	twelfth	
hundred	hundredth	
thousand	thousandth[12]	
broad	breadth [bretθ]	
wide	width [witθ]	

b. irregular inflection: /-t/

leave	left	
bereave	bereft	(cf. *bereaved* [vd]..derived with regular past tense)
cleave	cleft	
heave	heft	(adjective; verb has *heaved* as past tense)
lose	lost[13]	

[11] There are quite a lot of exceptions; many are old derived forms (some look like level 2 derivatives eg. *roadster*): *disgust disguise disgrace* (these may be pronounced [zg]). Some are from the Greek vocabulary : *obtuse, obsolete*, but once again these are often pronounced especially in casual speech with assimilated clusters; *o[pt]use*).

[12] Even though here the assimilation is not reflected in the spelling, [tθ] seems to me to be a better pronunciation than * hundre[dð] or ?hundre[dθ].

[13] We could add verbs ending in [d] which have [t] in the past: *bend–bent, lend lent,build built, spend spent,rend rent, send sent.* In derivational terms, the affix / -t/ attaches triggering assimilation and the resulting geminate degeminates: *spend+t --> spent-t --> spent.*

c. irregular inflection: /-z/

leaf	leaves
sheaf	sheaves
thief	thieves
calf	calves
wolf	wolves
wife	wives
knife	knives
etc	

d. words in *-scribe*:

describe	description, descriptive
scribe	scripture, script
scribble	

e. words in *-ceive*:

conceive	conception, conceptive
receive	reception

An interesting alternation, which according to Jespersen 1909/1961, is a remnant of Verner's law, shows that assimilation is regressive word-internally as well. Words with orthographic *x* are pronounced either [ks] or [gz] and in some cases the *k* ~*g* alternation is the result of voicing assimilation to the [z] which arose historically as a result of the voicing of an [*s*] in / _V (see Jespersen p203)[14]. This can be seen in the alternations below [15]:

(21)

[ks]	[gz]
exhibition	exhibit
exercise	exert, exertion
execute	executive
exhale	exhalation[16]

[14] This change can be seen in words like: *disease* (cf. ME *disese*), *design* (cf. MF *designer*) *disaster* (cf MF *desastre*, OI *disastro*), *desire* (cf. ME *desiren*), *resemble, resent dessert* etc. Compare: *disobey disagree disadvantage* all with [s], where in contrast the *s* is part of the prefix and the preceding vowel has secondary stress.

[15] It must be noted that some words do not participate in this alternation at all and others have optional variants whatever the stress; for example: *exit* may have a voiced cluster or a voiceless cluster: [egzit] or [eksit] even though the s voicing rule would not apply in this environment. Nevertheless, the crucial point here is that the cluster always agrees in voice. its never *[ekzit]. The alternation also occurs sometimes in non ks/gz clusters. For example, *absolve* ~ *absolution* may be pronounced [aebzolv~ aepsoluʃən]. Note that this is not the case for all speakers some of whom have non agreeing clusters [bs] in the second word.

[16] The last example may be pronounced as *[egzəleʃən] or [ekshəleʃən]* . Where the voiceless [h] is pronounced the preceding consonants are also voiceless. This can be observed also in forms like: *extort* ~ *extortion* (both [kst]) which do not show a voicing alternation because all segments in the cluster must

Consider now the account of the regressive assimilation pattern in English. Observe the interaction of Lombardi's constraints in tableaux (22) and (23) in which we see the selection of the regressively assimilated candidates for two English words. In (22) we see a voiced stop becoming voiceless when an affix which begins with a voiceless consonant is attached. In (23) we consider the case of regressive assimilation preceding a voiced stop.

(22)

describe +tion	AGREE	IDONSLAR	IDLAR	*LAR
descri [bz] ion		*!	*	**
->descri [ps] ion			*	*
descri [bs] on	*!			*

(23)

executive	AGREE	IDONSLAR	IDLAR	*LAR
->e[gz]ecutive				**
e[ks]ecutive		*!	*	
e[kz]ecutive	*!		*	*

The analysis must be augmented for the cases where a single word-final consonant induces an alternation. Since the affix laryngeal value remains faithful, I introduce a constraint asserting that the affix be faithfully parsed. We can assume this to be in the same family as Casali's constraint MAXMS. That is: IDMS, or IDMORPH.

(24) IDMS: don't change a morpheme which consists of only one segment

(Notice that a constraint like this is essentially the same as : AFFIXFAITH (refs. Alderete 1997, McCarthy and Prince 1993). Whatever we call it it is only required here where the single consonant *is* the morpheme[17].)

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agree in voicing with the last consonant, the [t] which is voiceless. So this example shows regressive assimilation as well.

[17] The AFFIXFAITH constraint is probably unnecessary. If we had a different explanation for the voicing assimilation effects in words like *leaves, houses* the observed patterns would fall out without AFFIXFAITH merely as a response to*Lar. This can be seen clearly in the tableau for *fifth*.

Mohanan 1993 observes that all voicng assimilation in English is to voicelessness. This could be true if another analysis for the fricative cases and the execute~executive alternation were available. This is not inconcievable. Then the explanation in terms of IdOnsLar would fall away and the account for English would be, as suggested by Mohanan, entirely in terms of markedness. However notice that this will not in itself explain andything more than the direction of assimilation and as we shall see below the peculiar laryngeal status of the two levels of affixes also requires explanation.

However AFFIXFAITH may not be wholly unjustified. Level 1 affixes consistently cause changes in the base that they attach to while remaining themselves faithful (the strict cycle condition forbids a changl affix alone; such a change would have to change the base too). While in most cases it seems clear that satisfaction of markedness by changing the base is less costly than an alternative which changes the affix (*ser[ɛ]nity* is better than *ser[i:]nty* say), it is not always so obvious (though certainly not inconceivable) that a markedness argument could be reached: consider *syllabicity* , which has spirantized

Below I show two tableau illustrating the interaction of this constraint with the rest of Lombardi's system.

(25).

five+th	AGREE	IDMS/AFFAITH	IDLAR	*LAR
fivθ	*!			*
fivθ		*!	*	**
->fifθ			*	

(26)

leaf+z	AGREE	IDMS/AFFAITH	IDLAR	*LAR
leafz	*!			*
leafs		*!	*	
->leavz			*	**

So, Lombardi's system accounts for all the regressive assimilations of English. We must note also that all the cases of regressive assimilation are associated with level 1 or Root-level morphology hence IDWD is irrelevant. (The parallel constraint IDRT, which we have not considered here, would be relevant. However it would be outranked by the constraint ensuring faithfulness to the affix .)

Progressive voicing assimilation in English is associated with all the regular inflections. In these cases it is always the affix which shows the voice change. Progressive voicing assimilation is highly productive and is found also after vowel deletion in casual speech variants of certain auxiliaries. All the affixes concerned are the level 2/WORD-level variety so in these cases we should see the effects of faithfulness to WORDs.

(27) a. *regular inflection plural*:
rope~rope[s] robe~ robe[z],
reef~reefs, five~fives,
cat~ cats dog~dogs...
pipe~pipes scribe~scribes
b. *past*:
kick~kick[t] hug~hug[d],
leaf~leafed heave~heaved
loose~loosed hose~hosed

---

and changed the place of the final *k* (at least two feature changes) and is nevertheless better than an alternative which changes the backness of the vowel say, *syllabi[k]uty* (only one feature change).

bereave~bereaved

c. *3ps sg.*

the cat walk[s]...	the train speed[z]
he leafs through...	the man heaves ..

d. *possessive*:

Pete'[s] ball	Jed'[z] cat etc
the reef's ecology	the hive's honey
Jack's ball	the scribe's pen

e. *contracted is:*

Pete'[s] going...	Jed'[z] leaving ...
Leif's singing	Genevieve's running

etc.

As noted by Lombardi, progressive voice assimilation is very rare. It is thus very interesting for us that it occurs productively in English while regressive assimilation which is supposed to be the normal pattern is observed in the irregularities of the language. Notice that if regressive voicing assimilation is the normal pattern we would expect it to be observed in the irregular historical detritus. The difficulty comes when we ask ourselves why it does not occur in the regular phonology as well. Why is the productive pattern the progressive assimilation one? The answer must also account for the fact that it is observed with word-level or post word-level morphology.

Notice that the usual ranking of markedness above faithfulness at the first level and faithfulness above markedness at the second level will not provide an explanation of the English facts. AGREE is satisfied at both levels. There is assimilation at the second level, it is just not regressive. The phonology selects the progressively assimilated forms which are faithful to the base word, rather than the regressively assimilated forms which have changes in the base word. We see from this that IDWD is ranked equal to or above[18] all the other constraints involved in the account of voicing alternations.

(28)

cat+z[19]	IDWD	AGREE	IDMS/AFFAITH	IDLAR
catz		*!		
-> cats			*	*
cadz	*!			*

[18] Actually IDWD probably outranks AGREE in English. The fact that there is no regular Voicing Assimiliation between compounds as in Dutch shows that AGREE does not dominate IDWD. IDWD comes into effect only in compounds then and blocks assimilation. Between a word and an affix it ensures that the laryngeal quality of the word is always faithful.

IDWD rules the regressively assimilated form out. Because IDWD outranks IDMS/AFFAITH, a voicing change in the affix is permitted and the progressively assimilated form is the successful candidate. (Even without IDMS/AFFAITH, the correct output will emerge because of IDWD.)

With the addition of IDWD the account of progressive assimilation in English is straightforward. Word-level identity forces faithfulness to the base and the assimilation constraint is satisfied by altering the affix instead. Since the only assimilating affixes are these productive word-level suffixes it follows that all productive voicing assimilation is progressive. Notice the analysis predicts that a word-level prefix should assimilate regressively for the same reasons. No such prefix exists in English to use as a test case however.

It has been pointed out by Mohanan 1993 that in English the voiced segment always assimilates to the voiceless one- i.e. the change is always in favor of the unmarked form[20] This alone might be considered explanation enough for English voicing assimilation, especially the productive progressive assimilation pattern. But such an explanantion fails to explain why it is the WORD-level suffixes that behave this way. Why are there no voiceless suffixes at the WORD-level which cause regressive assimilation? Why are the level 1/ ROOT-level affixes voiceless and the level 2 /WORD-level affixes voiced? The analysis I propose allows for the possibility that the affixes at either level could be either voiced or voiceless - the correct patterns will come out whatever they are underlyingly but more importantly the analysis suggest a reason for why the affixes are distributed this way.

The existence of only voiceless consonantal suffixes [20]can be explained at the ROOT-level as a markedness >> faithfulness effect as is characteristic of I-O faithfulness. Bound root level morphemes tend to be unmarked in general; they are coronals they are voiceless; they exhibit restricted sets of vowels etc. because the effects of dominant markedness constraints would preserve the unmarked formsw which will anyway be more frequent. Voiceless suffixes are unmarked - regressive voicing assimilation resolves everything in favor of the unmarked value for voicing. It is less clear why there are only voiced suffixes at the word-level. If only voiced suffixes occur and voicing assimilation is always resolved to the unmarked then the affixes will be affected by the change, as indeed they are. However if there were voiceless suffixes as well, and if the voicing assimilation situation is always resolved toward the unmarked then violations of word-faithfulness would be forced by such affixes. So the distribution of voiced and voiceless suffixes could be construed to be itself a consequence of word-faithfulness.

Richness of the Base allows the possibility that the WORD-level suffixes might just as well be voiceless. The same constraint ranking will pick out the correct output in

[20] Assuming there is some other explanation for the /z/ of *wolf wolves* etc. (see fn 17)

this situation. No matter what the voicing status of the suffix, word-faithfulness will ensure progressive voicing assimilation[21].

(29)

cat+s	IDWD	AGREE	IDMS/AFFAITH	IDLAR
catz		*!		*
-> cats			*	
cadz	*!			*

The word-faithfulness explanation allows for a unified analysis of both regressive and progressive voicing assimilation in English which parallels in many respects assimilation in Dutch and vowel deletion cross-linguistically.

3. Harmony Mismatches

Clements 1977 observed that vowel harmony systems generally have what he called 'root control'. That is, it is the property of the vowels of the root which determine the quality of the vowels in the affixes and not the other way around. The property of root control has also been described as an instance of positional faithfulness. Beckman 1997 and 1998 proposes that roots are privileged positions requiring faithfulness. In this section I consider how the privileged status of WORDs will affect harmonic processes with a discussion of so-called mismatches (Selkirk 1980; Nespor and Vogel 1982).

Mismatches are found in compound constructions. While they are single morphological domains they often have more than one phonological domain. Thus a compound in a harmonizing language may be made of of two words with distict harmonic properties and no harmonic process will change that. Further, if an affix is attached to the compound as a whole that affix will harmonize with the vowels of the adjacent word. The result is that it appears to be attached to that word directly instead of to the compound as a whole. So, a suffix attached to a compound made of two words with different harmonic patterns behaves like a suffix attached to a disharmonic root which harmonises with the vowel in the preceding syllable. This pattern is called a 'mismatch' by Nespor and Vogel) because the structure of the phonological word is not isomorphic with that of the morphosyntactic word. Mismatches like these have been more recently discussed in the Pre OT literature in such works as Cohn 1989 and Zsiga 1992 who argue for a cyclic analysis. In OT they have been described in terms of alignment (Cohn and McCarthy 1994) as well as receiving faithfulness accounts (Kenstowicz (1996)).

[21] Lombardi's account of these facts utilizes Harms' generalization (1973) which asserts that a voiced segment cannot follow a voiceless one at the end of a syllable because it violates sonority. As Lombardi has noted however, Harms' generalization cannot account for the facts if the affixes are underlyingly voiceless.

WORD -faithfulness makes a very clear prediction about compounds made of words which differ in their harmony. Any word compound[22] automatically has as many prosodic domains as there are words in that compound since each of the words must itself satisfy the prosodic constraints governing words. Given WORD-faithfulness the harmony-inducing constraint/s could not effect any change in the words of the compound.

Let us consider Hungarian which has backness harmony: suffix vowels share the backness value of the root. Examples (Taken from Nespor and Vogel 1986) are given in (30), The harmonic domains are shown in b.

(30)a. öleles 'embracement'
ölelesnek 'embracement Dat sg.'
hajonak 'ship Dat sg' hajo 'ship'

b.
$[_{-B}$ öleles -nek $_{-B}]$
$[_{+B}$ hajo + nak $_{+B}]$

The patterns of hamony in compounds depends on the harmonic domains of the words which make up the compound. Harmony does not change the backness value of either of the two words. They may be the same or they may be different as shown below:

(31) $[_{+B}$ Buda $_{+B}][_{-B}$ Pest$_{-B}]$ 'Budapest' *Budapast
$[_{-B}$ konyv$_{-B}]$ $[_{+B}$ tar$_{+B}]$ 'library' ('book+collection') *konyvter
$[_{+B}$ alul jaro$_{+B}]$ 'tunnel' ('under +path')
$[_{+B}$ Buda $_{+B}][_{-B}$ Pest$_{-B}]$ $[_{+B}$ alul jaro$_{+B}]$ 'Budapest tunnel'

Any compound whose constituents are disharmonic remains disharmonic and if affixed the compound behaves exactly as it would if it were a disharmonic root- the affix harmonizes with the adjacent vowel. The harmonic domains of an affixed compound are shown below.

(32) { {{ }{ }} } *morphological structure*
$[_{+B}$ lat $_{+B}]$ $[_{-B}$ kep+ ünk$_{-B}]$ *phonological structure*
'our view' (latkep 'view' ünk 'our')
*latkepunk

[22] Note there are also root compounds which will not be subject to $O\text{-}O_2$ identity. Eg. compare the word *shepherd* with *sheepskin* and *goatherd*. The first is a root compound while the latter are both word compounds. We know this because *shepherd* has one stressed syllable and the vowel of *sheep* is shortened by the level 1 process which shortens vowels when they are followed by two consonants. *Sheep* in *sheepskin* has a long vowel even though there are three consonants following it; and there are two stresses. While English does not have a great many root compounds, many languages have regular processes of root compounding as well as word compounding.

Without going into details about the description of the harmony process (see for example Cole and Kisseberth 1995, Beckman 1997, Reddel 1996 for analyses of harmony within OT) we can see how our system will account for this pattern. In the tableaux below we see that the optimal form is the one which satisfies WORD-faithfulness (IDWD) at the expense of a violation of harmony because there are two harmonic domains. The last form has two violations of harmony because the affix has not harmonized. The first and third forms each have fatal violations of IDWD because the backness value of the the words making up the bases have been altered.

(33)

lat+kep+unk	IDWD	Harmony
{{[$_{+B}$ lat + kap}unk$_{+B}$] }	*!	
->{{ [$_{+B}$ lat$_{+B}$] [$_{-B}$ kep} ü nk$_{B}$]		*
{{[$_{-B}$ let kep} ünk$_{B}$]}	*!	
{{[$_{+B}$ lat] [$_{-B}$ kep$_{-B}$]}unk$_{+B}$]}		**

From this point of view the mismatch pattern is unsurprising and parallels the root controlled pattern discussed in Beckman. What would happen however in an affix controlled harmony?

Imagine a hypothetical situation in a dominant/recessive language in which the harmonic value spreads from the affix onto its host? In a compound in this language the affix could in principle trigger a change in the adjacent word so that that word harmonised with the affix but not with the word on its other side.
word

(34) {{[let $_{-B}$] [kop $_{+}$ }unk $_{+B}$]}

This is a logically possible mismatch pattern yet, to my knowledge, such a case is unattested[23]. WORD-faithfulness predicts that this situation would be highly marked.

The prediction is that harmony can, in root level constructions, be either ROOT or affix controlled but in WORD-level constructions Harmony should only be WORD-controlled. that is, there can be no harmony into WORD compounds which changes the

[23] Note the pattern in (34) must be distinguished from a similar one which at first looks like it may be this pattern is in fact a construction in which the affix attaches to the second word or root prior to compounding and not one in which the affix is attached to the whole compound: {{ root $_{-B}$ } { root aff$_{+B}$ }}
An example like this occurs in Warlpiri which has a regressive dominant harmony occuring in verbs. Regressive harmony *kiji-rni* 'throw NonPast' ; *kuju-rnu* 'throw- Past'. In the form *miyi-kupu-rnu* 'food winnower' which is a Nominal Nomic Agentive compound, we can see that the second member of the compound has harmonized with the suffix . The morphological analysis given by Nash for forms like these is: {{miyi}{kupurnu}}
{food}+{winnow-Past}
and hence the example is in fact not a counter example.

vowels of the word adjacent to the affix . Only the affixes should change. This prediction seems to be born out. It is not inconceivable for a dominant affix to trigger changes in the host word so why is the pattern in (34) so rare? A dominant WORD -faithfulness constraint makes changes in the host word impossible without massive word-faithfulness violations. If however the constraint motivating harmony outranks the word-faithfulness constraints then violations will be permitted equally in **both** of the words forming the compound so the mismatch pattern would not occur. The mismatch pattern requires some kind of dominant word-faithfulness to ensure that the word boundaries are recognized.

While there are no reported examples of this mismatch pattern with regressive affix dominant harmony there are some interestingtcases where minimal word -level violations seem to occur in contrast to the usual long distance harmony patterns in the language. would like to propose that these examples could be seen as minimal word-faithfulness violations. The point is that while it is unlikely that a harmony rule could affect a whole word because that would result in massive violations of WORD-faithfulness, it is possible that the grammar might choose to satisfy harmony minimally governed by the number of WORD-faithfulness violations. One such violation would be better than three - and so on.

In his discussion of harmony in Nez Perce, which has dominant affix regressive harmony, Aoki 1966 observes:

> "In terms of word classes, morphological words and harmonic sequences are always coterminous in verbs, eg./wu:lelikepese/ *'I am riding into bushes'*, /wo:lalikapasaqa/ *'I rode into bushes recently'*. On the other hand there is considerable discrepancy in substantives: for example, the word for the *Red River* in Idaho has three freely varying forms: /tukpe:nwąwą:m/, /tukpą:nwąwą:m/, /tǫkpą:nwąwą:m/ ..." p 761

The difference in the patterns in verbs and nouns could be attributed to the ROOT/WORD distinction. Complex verbs like these, made of bound root plus affixes are frequently ROOT-level structures. They are, as a result, single hamonic domains.

(35) [wu:lelikepese$_{,F}$]
[wo:lalikapasaqa$_{,F}$]

The harmony constraint in Nez Perce dominates ROOT-faithfulness (O-O$_I$) constraints with the result that all the vowels of the form harmonize.

(36)

/wU:lElIkEpEsE+ qa/	Harmony	IDRT
->{wo:lalikapasaqa$_{,H}$}		*
{wu:lelikepeseqa$_{,H}$}	*	

WORD-faithfulness ($O\text{-}O_2$) comes into the picture with the nouns (which are free forms). If IDWD is not crucially ranked above the harmony constraint variation occurs. It may block harmony completely however the phonology will always be able to choose between a series of possibilities going from the least unfaithful with one harmonized vowel to a completely unfaithful possibility, where all the vowels are unfaithful. So harmony is gradient in this circumstance because of the conflict between the requirement of faithfulness to word and the markedness constraint: harmony. I do not know how the system accounts for why all the different variants occur but it seems to me these gradient patterns indicate that when violating a constraint like this the grammar prefers less violation to more violation.

(37)

/tUkpE:nwAwa:m	IDWD	Harmony
->tukpe:n{wa̲wa̲:m$_{+H}$}	*	**
tuk{pa̲:nwa̲wa̲:m$_{+H}$}	**	*
{to̲kpa̲:nwa̲wa̲:m$_{+H}$}	***	

(38)

/tUkpE:nwAwa:m	Harmony	IDWD
tukpe:n{wa̲wa̲:m$_{+H}$}	**	*
tuk{pa̲:nwa̲wa̲:m$_{+H}$}	*	**
-> {to̲kpa̲:nwa̲wa̲:m$_{+H}$}		***

In rapid speech in Nez Perce harmony often occurs across word boundaries by one syllable. Compare the normal speech and rapid speech variants in the following phrase:

(39) normal speech /ʔitamya:tas ʔewsi:x/ 'they are for sale'
rapid speech /ʔitamya:te̲s ʔewsi:x/

These examples suggest that while WORD faithfulness is dominant in careful speech, in rapid speech minimal violations occur. The point is that they are minimal- on syllable rather than the whole phrase and they seem to indicate that while the fully hamonized forms may occur (like one of the options for Red River), the preferred pattern is the one with the minimal violation: that is, only one vowel harmonizes. A similar explanation might be offered for other cases where the harmonizing feature is known to spread to only one adjacent vowel: see for example the discussion of local harmony in Chamorro and Lango[24] in Poser 1982.

[24] In Chamorro the first vowel of a word harmonises when the word is preceded by a high vowels particle. In Lango certain suffixes cause the last vowel of the preceding form to harmonize. In Somali which has ATR harmony which is root controlled, certain determiners which attach to nouns as suffixes cause the final vowel of the noun to harmonize with the determiner.

In these cases the morphemes concerned are certainly consistent with the assumption that they are word-level morphemes however at the moment this remains speculation.

4. Nasal Place Assimilation

In the last section of this paper I turn to another set of facts which seem to support the ideas in this paper. Nasal Place Assimilation. like voicing assimilation, is a process which characteristically spreads place features regressively from a segment to a preceding nasal. Padgett 1997, following Lombardi, explains this with a positional faithfulness constraint requiring faithfulness to place in onsets: IdentOns-Pl. I will not give detainsl of his analysis here. It need only be noted that once again the analysis predicts regressive assimilation and thus any progressive assimilations that occur require special explanation.

Such an explanantion is therefore required for the pattaren of progressive nasal assimilation observed in Dutch. Vd. Hulst and Kooij observe that in diminutives in Dutch nasal assimilation is unusually progressive. The diminutive is marked with the word-level suffix *-tje*. It has various allomorphs as shown in (37). We will be concerned only with last the three forms showing assimilation.

(40)			
	bal + tje	balle[c]e	'little ball'
	stoel	stoel[c]e	'little chair'
	lap	lapje	'little rag'
	mes	me[ʃ]je	'little knife'
	mand	ma[nc]je	'little basket'
	koning [N]	koni[ŋk]je	'little king'
	besem	bese[mp]je	'little broom'

In all forms like the last three above where the word ends in a nasal consonant the obstruent of the suffix assimilates in place to the place of the nasal rather than the other way round. Thus these forms cannot be pronounced **koni[nc]e* or **bese[nc]e*. The words remain faithful and the affix undergoes the rule in exactly the same way as we saw above in section 2. The tableaux in (41) illustrate:

(41)

duim +tje	NAS-AGREE	IDWD	IDOnsPL
->duimpje			*
dui[nc]e		*!	
dui[mc]e	*!		
koni ŋ +tje	NAS-AGREE	IDWD	IDOnsPL
->koni[ŋk]je			*
koni[nc]e		*!	
koni [ŋc]e	*!		

The nasal assimilation constraint dominates the others so assimilation is obligatory. IDWD dominates the positional faithfulness constraint and hence
the form in which the affix assimilates rather than the word final consonant is selected by the constraint heirarchy. Thus we see another case in which WORD-faithfulness results in a constraint being satisfied in a different way.

There is another analysis for this case which relies instead on the markedness heirarchy. The Dutch diminutives can be analysed as a case in which the direction of assimilation is determined by the place hierarchy: the coronal consonant is always the undergoer of harmony and since it is the affix here which is coronal it will always be the affix which undergoes the assimilation.[25]. Mohanan 1993 has observed of Enlgish that nasal assimilation only takes place from obstruents onto preceding coronal nasals. The same seems to be true in general of Dutch. Thus there are words like *komkommer* 'cucumber' or *hemd* 'shirt' which show that all nasals do not assimilate to a following stop. Across word boundaries coronal nasals may assimilate in place to following stops however notice that word-initial coronals do not assimilate to preceding nasals as in examples (38) and (39). So the regressive pattern is still required by the phonological system. The fact that the assimilation direction is determined by markedness with the diminutives is not enough to explain the facts. Instead, as we saw with vowel sequence elisions and voicing assimilations, the explanation requires use of positional faithfulness constraints in particular : WORD-faithfulness.

In this paper I have attempted to show that faithfulness of words is a robust phenomenon in grammar. I have discussed various processes which apply to different kinds of morphological inputs and shown that faithfulness to the WORD has the effect of causing different kinds of outputs in satisfaction of the same constraints.

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[25] An analysis like this is supported by facts such as those given below from Afrikaans in which the affix begins with a dorsal consonant instead : *-ki* and the assimilation seems to go always in the direction of the lesser marked consonant following the hierarchy: Id labial>>Ident dorsal>>Ident coronal. Thus assimilation is regressive when the word-final consonant is coronal and progressive when the word-final segment is labial. This pattern is discussed in detail in Borowsky in progress.

duim+kie	dui[mpi]
konin	koni{ŋki}
soen	soi{ŋki}

In fact we see a little of the same effect in fast speech in Dutch where the word-final coronal nasal is pronounced as a palatal nasal : ma[=c]je .

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