cf. Gəttk'a[31]	/Gatdk'-a/	'is cold'
pipəkca?a:k	/DIST-pikca-'a:k'/	'little picture' (distr.)
cf. pikca	/pikca/	'picture'
hoscənwa	/hVs-conw-a/[32]	'makes vomit'
cf.conwa	/conw-a/	'vomits'

c. Vowel Deletion

soltq'a	/sV-lt'oq'-a/[33]	'thumps oneself with finger and thumb'
cf. lt'oq'a	/lt'oq'-a/	'thumps'
solp'o:k'a	/sV-lo-p'o:k'-a/	'puts warpaint on oneself'
cf. lop'o:k'a	/lo-p'o:k'-a/	'puts warpaint on someone'
coqpq'a	/coq-p'eq'-a/	'puts the buttocks in someone's face'
cf. wp'eq'a	/w-p'eq'-a/	'hits in the face with a long instrument'
popli:k'a	/DIST-poli:-k'a/	'little policemen' (distr.)
cf. poli:s	/poli:-s/	'police'

As has been observed, the three processes that affect short vowels have common property: they affect the short first vowel of a prefix or root in input in case it is preceded by at least one syllable. Particularly, the vowel to be affected by vowel reduction and vowel deletion occupies the same position in a word, the only difference being the right environment. As a rough approximation, the constraints in charge of the three processes may be stated as in the following:

(69) a. Initial Vowel Truncation (VT): $*VC_o$ [[V, -long]$_i$

b. Vowel Reduction (VR): $*VC_1$ [V, -long]$_j$ C{C,#}

c. Vowel Deletion (VD): $*VC_1$[V, -long]$_i$ CV

And the faithfulness constraints dominated by these constraints are as follows:

(70) MAX_{IO} ([V, -long]$_i$), MAX_{IO}-[V, -long]$_j$ (F)[34]

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[31] The vowel *a* in closed syllable is reduced to schwa

[32] The vowel V of the causative / transitive prefix /hVs/ reduplicates the first vowel of the base.

[33] The vowel V of the reflexive / reciprocal prefix /sV/ reduplicates the first vowel of the base.

[34] It is assumed that schwa has only root node without any feature; hence, the violation of MAX_{IO}-[V, -long]$_j$ (F) results in schwa, deleting every feature in input. Of course, this constraint is formulated on the basis of featural correspondence.

However, the data that will be given in (77b) make it necessary to refine the environment to the right of V_i of the constraint VD: another right environment should be G (= glide). The reason is that to provide the environment for the vocalization of the underlying glide the preceding short vowel must be deleted. For example, in the derivation of *pnipno:pc'a* from /DIST-pniw-abc'-a/, the deletion of the short vowel *i* preceding the glide *w* provides the environment for vocalization of the latter. Hence, VD is revised as $*VC_1[V, -long]_i\{CV,G\}$. To reiterate, the deletion of the vowel before G by the revised VD provides the environment for the satisfaction of the constraint responsible for vocalization (i.e., G sandwiched in between two C's or in between C and #). Moreover, the identical left environment $V\{C_o, C_1\}$ of the constraints given in (69) can be removed by positing a process-specific constraint to constrain these three constraints contextually.[35] Consequently, these three constraints which may be dubbed Vowel Gradation (VG) as a whole are restated in (71) and the contextual constraint on VG is stated in (72), which dominates the latter.

(71) Vowel Gradation (VG)
a. VT: $*[[V, -long]_i$
b. VR: $*C_1[V, -long]_j\ C\{C, \#\}$
c. VD: $*C_1[V, -long]_i\ \{CV,G\}$

(72) Constraint on VG (C-on-VG)
The target in the satisfied domain of the constraint VG must be preceded by at least one vowel in another morpheme.

To prevent VG from affecting the second vowel (underlying or vocalized) of a morpheme, it is necessary to invoke an instantiation of the general schema FAITH-to-INPUT to constrain it. For the second vowel of the first morpheme of a word must not undergo VG. And the underlying second vowel of the second morpheme in a word may become its first vowel eligible for the potential target of VG as a consequence of the deletion of its underlying first vowel by the satisfaction of VD. The latter case is a self-feeding one; namely, VG interacts with itself. Thus, the necessity of a specific instantiation of the schema FAITH-to-INPUT to constrain VG is certified by the following data:

(73) sninklilk'a (*sninkləlk'a)	/sni-nkililk'-a/	'makes dusty'
cf. nkililk'a (*nkiləlk'a)	/nkililk'-a/	'is dusty'
sm'osmq'itk (*sm'osmq'ətk)	/DIST-sm'oq'y-dk/	'having a mouthful' (distr.)

[35] Alternatively, we might think of the constraint $FAITH_{IO}$ ($V\text{-}\sigma_1$) (Beckman 1995), which militates against the vowel gradation of the vowel in the first syllable of a word

cf. sm'oq'ya	/sm'oq'y-a/	'has a mouthful'
mbompditk (*mbompdətk)	/DIST-mbody'-dk/	'wrinkled up'
snəcw'iga (*snəcwga) (*snəco:ga)	/sna-c'aw'ig-a/	'drives someone crazy'
cf. c'aw'iga (*c'aw'əga)	/c'aw'ig-a/	'is crazy'

Now, the constraint in question is stated below:

(74) FAITH-to-INPUT (VG)

The vowel V_i or V_j in the satisfied domain of the constraint VG has a correspondent in the first vowel of a prefix or root in input.

Eventually, the constraints C-on-VG and FAITH-to-INPUT (VG) allow us to have the following summary tableau. There is no ranking between the two constraints, but they dominate VG.

(75) Summary Tableau for Vowel Gradation in Klamath

		C-on-VG	FAITH-to-INPUT (VG)	VG
/sni-nkililk'-a/	☞ sninklilk'a			***
	sninkləlk'a		*!	
	sninkililk'a			****!
/nkililk'-a/	☞ nkililk'a			***
	nkiləlk'a		*!	**
/DIST-mbody'-dk/	☞ mbompditk			**
	mbompdətk		*!	*
/sna-c'aw'$_1$i$_2$g$_3$-a/	☞ snəcw'$_1$i$_2$g$_3$a	*		**
	snəcw$_1$g$_3$a	*	*!	*
	snəco:$_1$g$_3$a	*	*!	*
/c'aw'ig-a/	☞ c'aw'iga			***
	c'aw'əga		*!	**
	cw'iga	*!		**

We might conceive of an alternative to FAITH-to-INPUT (VG); it might be to impose the level condition INPUT on the constraint VG. But it fails because the hypothetical VG_{INPUT}

could not delete, for example, the root-initial vowel in the underlying representation /DIST-mbody'-dk/ until the underlying glide /y'/ is vocalized.[36]

Next, I will turn to the problem of vowel shortening. The constraint SHORTENING demands that a long vowel be shortened in the environments V:C_o ____ and CC ____ {CC, C_o #}. But the puzzling problem is that not all the long vowels are shortened in these environments and that the surface long vowels *i:* and *o:* have three sources. They originate from underlying long vowels (e.g., *ʔowi:cn'a* from /ʔo-owi:-cn'-a/ '(long objects) go along in a row'), from glides preceded by a vowel in the underlying representations (e.g., *saʔi:si* from /sa-ʔaysi/ 'keeps something to oneself') and from underlying postconsonantal glides (e.g., *delo:ga* from /delwg-a/ 'attacks'). I will sidestep the knotty problem of formulating explicitly the process pair responsible for vocalizing glides *y* and *w* (plain or glottalized) as long vowels *i:* and *o:* in the environment C ___{C,#} respectively.

Let us now consider the following data in an effort toward settling the problem of vowel shortening. The underlined short vowels of the forms in (c) are derived from the long vowels originating from underlying postconsonantal glides:

(76) i. a.	mboty'a	/mbody'-a/	'wrinkles'
b.	mbodi:tk	/mbody'-dk/	'wrinkled up'
c.	mbompdi̲tk	/DIST-mbody'-dk/[37]	'wrinkled up' (distr.)
ii. a.	sm'oq'ya	/ sm'oq'y-a/	'has a mouthful'
b.	sm'oq'i:tk	/sm'oq'y-dk/	'having a mouthful'
c.	sm'osmq'i̲tk	/DIST-sm'oq'y-dk/	'having a mouthful' (distr.)
iii. a.	lək'wa	/la-ak'w-a/	'puts a round object across'
b.	ʔak'o:c'a	/ʔa-ak'w-c'n-a/	'just put a long object across and went on'
c.	sasəlk'o̲bli	/DIST-sa-la-ak'w-ebli/	'puts round objects back across oneself' (distr.)
iv. a.	giwk	/gi-wk/	'because of being, doing'
b.	woNo:k	/woN-wk/	'because of finishing'
c.	sʔawi:go̲k	/sʔawi:g-wk/	'because of being angry'
	loyk'o̲k	/loyk'-wk/	'because of picking berries'
v. a.	keys	/ken-y-s/[38]	'snow'

[36] If VT were viewed apart from the conflated VG, the level condition INPUT placed upon it would perhaps suffice.

[37] This form and those in (iic, iiic) observe I-R faithfulness (McCarthy & Prince 1995 359-360).

b. sGoc'i:s	/sGoc'-y-s/	'breastbone'
c. ce:lis	/ce:l-y-s/	'porcupine'
soyn'is	/soyn'-y-s/	'race'
vi. a. tawyi:ya	/tawy-i:y-a/	'curses for someone'
b. tawi:	/tawy/	'curses'
c. tatwi	/DIST-tawy/	'curse' (distr.)

In contrast, the long vowels in the following forms are not shortened in the aforementioned environments. The reason is that they arise from other sources, namely, from underlying long vowels (a) and from the glides preceded by a short vowel in underlying representations (b):

(77) a. yəydi:s	/DIST-yadi:-s/	'spirit stones' (distr.)
bonwo:ts	/bonw-o:t-s/	'something to drink with
sc'iwa:go:la	/sc'iwa:g-o:l-a/	'takes off a skirt'
sʔawi:kWi:ya	/sʔawi:g-Wi:y-a/	'almost became angry'
pecl'əqWi:s	/pec-el'G-Wi:y-s/	'footprint'
solwo:lgi	/so-lo-o:lgi/	'gathers a round object'
b. sdəsdi:nk'a	/DIST-sdayn-k'a/	'little heart' (distr.)
pnipno:pc'a	/DIST-pniw-abc'-a/	'blow out' (distr.)
njonji:lga	/DIST-njoy-el'g-a/	'are numb' (distr.)
snikso:lGa	/sni-ksiw-elG-a/	'makes someone dance'

At the outset, we must devise some means to spare the forms in (a) which contain non-derived potential target from being subject to the constraint SHORTENING. Fortunately, there is a means ready to serve our purpose: we may rely on an instantiation of the process-specific constraint schema NONFAITH proposed in Lee (1997):

(78) NONFAITH (SHORTENING)
The target in the satisfied domain of the constraint SHORTENING is not faithful to the correspondent in input.

[38] Roughly, *n* is deleted in the environment __-y-s#.

In this constraint, "A is not faithful to B" denotes that F_{IO} is not observed between A and B. For example, the target *o:* in *bonwo:ts* from /bonw-o:t-s/ in (77a) is *faithful* to its input correspondent, because in every respect F_{IO} is strictly observed between the target *o:* and the correspondent /o:/ in input. On the other hand, the shortened *i* in *mbompditk* from /DIST-mbody'-dk/ in (76ic) is *not faithful* to its input correspondent /y'/ since F_{IO} in the feature [+voc] is not observed between the target *i* and the correspondent /y'/ in input. Note, however, that this constraint is incapable of preventing the forms in (77b) from obeying the constraint SHORTENING. For *o:* in *pnipno:pc'a* from /DIST-pniw-abc'-a/, for example, is *not faithful* to its input correspondent *w*.

Following Kisseberth's (1973) suggestion that the alternations in vowel length could not be described without recourse to a global condition, Clements & Keyser state the following global rule of vowel shortening simply for the sake of argument, which they reject as extremely powerful:

(79) A long vowel is shortened in the following environments, provided it is derived from an underlying postconsonantal glide:

a. $V{:}C_0$ ____
b. CC ____CC
c. CC ____ C_0#

Utilizing the insight underlying this global rule within the framework of OT, we may invoke another process-specific constraint FAITH-to-INPUT (SHORTENING), an instantiation of the schema FAITH-to-INPUT:

(80) FAITH-to-INPUT (SHORTENING)
The sequence CV in the satisfied domain of the constraint SHORTENING has a correspondent in input.[39]

In view of forms like *spospni* from /DIST-spon-oy/ 'give a person' (distr.) and *wa:miki'na* from /wa:m-oyki:n-a/ 'extends out of water in a line' in which the respective sequences *ni* and *mi* have no correspondents in input, the phrase "the sequence CV" in this constraint must be further qualified by the term "intramorphemic" as stated in the following:

[39] It is assumed that the structural elements in correspondence may include sequences of segments like CV (see footnote 16)

(81) FAITH-to-INPUT (SHORTENING)

The intramorphemic sequence CV in the satisfied domain of the constraint SHORTENING has a correspondent in input.

For example, the intramorphemic sequence CV, i.e., the sequence $n_1o:_3$ in *pnipn$_1$o:$_3$pc'a* from /DIST-pn$_1$i$_2$w$_3$-abc'-a/ has no correspondent sequence in input, while the intramorphemic sequence CV, i.e., the sequence d_1i_2 in *mbompd$_1$i$_2$tk* from /DIST-mbod$_1$y'$_2$-dk/ has the correspondent sequence /d$_1$y'$_2$/ in input. Here again, we might think of an alternative to the process-specific constraint given above. It might also be to impose the level condition INPUT on the constraint SHORTENING. But it fails, too, merely because it affects the long vowels vocalized from underlying glides.

Armed with the two process-specific constraints NONFAITH (SHORTENING) and FAITH-to-INPUT (SHORTENING), which must dominate SHORTENING, we may clear up the intricate problem of vowel shortening in Klamath, as is demonstrated in the following summary tableau. (In this tableau, the satisfaction of the constraint in charge of vocalization and VG is assumed.)

(82) Summary Tableau for Vowel Shortening in Klamath

		NONFAITH (SHORTEN-ING)	FAITH-to-INPUT (SHORTENING)	SHORTEN-ING
a. /DIST-mbod$_1$y'$_2$-dk/	☞ mbompd$_1$i$_2$tk			
	mbompd$_1$i:$_2$tk			*!
b. /DIST-spon$_1$-o$_2$y$_3$/	☞ spospn$_1$i$_3$			
	spospn$_1$i:$_3$			*!
c. /bonw$_1$-o:$_2$t-s/	☞ bonw$_1$o:$_2$ts			*
	bonw$_1$o$_2$ts	*!		
d. /DIST-sd$_1$a$_2$y$_3$n-k'a/	☞ sdasd$_1$i:$_3$nk'a			*
	sdasd$_1$i$_3$nk'a		*!	

Even though the wrong candidates **bonw$_1$o$_2$ts* in (c) and **sdasd$_1$i$_3$nk'a* in (d) obey SHORTENING perfectly, they are in violation of the higher-ranking NONFAITH (SHORTENING) and FAITH-to-INPUT (SHORTENING) respectively.

There is something unsatisfactory about the treatment of the constraint SHORTENING. Thus, an alternative is suggested to SHORTENING that has been taken as a matter of course. Recall that its environments are those given in (79a-c). The constraint in charge of

shortening can be split into two parts: the part responsible for shortening after a long vowel and that responsible for shortening after CC:

(83) Constraints for Shortening

*Vμμ (SHORTENING$_1$), *[μμ{μ]$_\sigma$,#} (SHORTENING$_2$)

The second constraint is founded on the assumption that coda consonant is moraic. Now, we are in need of a constraint to constrain these constraints contextually:

(84) Constraint on SHORTENINGs (C-on-SHORTENINGs)

The targets of the constraints SHORTENING$_1$ and SHORTENING$_2$ are immediately preceded by [...Vμμ...]$_\sigma$ and [... Vμ Cμ]$_\sigma$ respectively.

It is to be noted that the two SHORTENING constraints must occupy the same position in the ranking, since they are constrained by the same instantiations of the schemata NONFAITH and FAITH-to-INPUT, which are assumed to be revised in accordance with the alternative constraints. In brief, how matters stand in the alternative proposed here may be epitomized in the following summary tableau:

(85) Summary Tableau for Vowel Shortening in Klamath

		C-on-SHORTEN-INGs	NONFAITH (SHORTEN-INGs)	FAITH-to-INPUT (SHORTEN-INGs)	SHORTEN-INGs
/wa:m$_1$-o$_2$y$_3$ki: n-a/	☞ wa:m$_1$i$_3$ki: na				
	wa:m$_1$i:$_3$ki: na				*!
/sc'iwa:g$_1$-o:$_2$l-a/	☞ sc'iwa:g$_1$o:$_2$la				*
	sc'iwa:g$_1$o$_2$la		*!		
/DIST-mbod$_1$y'$_2$-dk/	☞ mbompd$_1$i$_2$tk				
	mbompd$_1$i:$_2$tk				*!
/bonw$_1$-o:$_2$t-s/	☞ bonw$_1$o:$_2$ts				*
	bonw$_1$o$_2$ts		*!		
/DIST-sd$_1$a$_2$y$_3$n-k'a/	☞ sdasd$_1$i:$_3$nk'a				*
	sdasd$_1$i$_3$nk'a			*!	

To sum up, it has been demonstrated that we must rely on two instantiations of the schema FAITH-to-INPUT, one instantiation of the schema NONFAITH and a process-specific constraint to restrict markedness constraints contextually for a satisfactory account of the processes of vowel gradation and vowel shortening in Klamath. Moreover, it has been shown that three process-specific constraints are involved in constraining the two constraints responsible for shortening which are suggested to take the place of SHORTENING established before.

7. Conclusion

In this paper, I have attempted to give an account of the cases in which at first sight it would seem plausible to have recourse to the imposition of the level condition INPUT upon markedness constraints as a whole to settle the problem of phonological opacity. In reality, the investigation of the cases cited from various languages has shown that the complex and intricate data, which incur a species of phonological opacity, can be accounted for by the crucial role of the instantiations of the general schema FAITH-to-INPUT as presented at the outset. To recap, the level condition INPUT may be imposed upon some markedness constraints at large to take care of a certain species of phonological opacity. It has been argued that, apart from this, the process-specific constraints are absolutely necessary that make reference to input to cope with the problem of another species of phonological opacity. Conclusively, it is thus claimed that every process-specific constraint of this property can be subsumed under the general schema FAITH-to-INPUT.

I have this to say in addition: in the course of discussion I have been driven to depend upon novel devices other than the instantiations of the schema FAITH-to-INPUT, namely, the level conditions placed upon markedness constraints, a specific instantiation of the general schema NONFAITH, NRC and the pair theory.

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