

Consonant gradation

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1 Definitions

- (1) Consonant gradation, also known as “grade alternation”, is a subtype of consonant mutation occurring in the inflection and derivation of all parts of speech. It is a systematic morphophonological alternation of consonants on the border of two syllables, resulting in either weakening or strengthening of consonants. (Bakró-Nagy 2022: p. 859)

Some consonant grade alternation examples from Estonian (Trosterud & Uibo 2005).

» nouns:

- SG NOM (SG PART) – strong grade
- SG GEN – weak grade

» verbs:

- supine (primary form) – strong grade
- indicative mode present tense – weak grade

arg	:	ara	fearful	käskida	:	käsin	to order
tuba	:	toa	room	ehte	:	ehe	adornment
vedama	:	vean	to transport	mesi	:	mee	honey
uskuda	:	usun	to believe				

TABLE 1 Deletion of g, b, d, k, t, s

kk : k	pikk : pika	long	k : g	vilkuda : vilgub	twinkle
pp : p	sepp : sepa	smith	p : b	kubjas : kupja	taskmaster
tt : t	võtta : võtan	to take	t : d	kartma : kardan	to be afraid
ss : s	kirss : kirs	cherry			

TABLE 2 Estonian quantitative gradation

(Trosterud & Uibo 2005: pp. 139–140)

- » Consonant grade alternations are prominent in Finnic languages: Finnish, Estonian, Saami, Karelian, etc.
- » In the Estonian examples above, sometimes the change is positional: intervocalically, consonants undergo lenition (*pikk* : *pika*)
- » Sometimes, however, the alternation happens despite the consonants being in similar positions: *võtta* : *võtan*
 ⇒ consonant gradation can be morphologised

What is so special about consonant gradation?

- » It is not fully phonologically motivated on the synchronic level but sometimes productive (Nganasan)
- » How did it develop? Sometimes triggers of grade alternations disappear but the alternations themselves remain
- » Three-way distinctions may be a problem for autosegmental CVCV representations

So, what types of consonant gradation exist and how are they described?

1.1 Realisation of consonant grades

Grades can be realised via quality or quantity. Qualitative alternations include:

- » voicing : /k/ ↔ /g/

- (2) Finnish
alanko – *alango-n* ‘lowland.NOM’ – ‘lowland.GEN’

- » fricativisation : /t/ ↔ /ð/

- (3) Inari Saami (Valtonen, Ylikoski & Aikio 2022)
- a. *neeti* /nexti/ – *neðe* /neðe/ ‘marten.NOM’ – ‘marten.GEN’
- b. *tupe* /tupe/ – *tuve* /tuve/ ‘cabin.NOM’ – ‘cabin.GEN’

- » assimilation (cluster simplification) : /nd/ ↔ /nn/

- (4) Karelian (Kovedjaeva 1993)
kandua – *kannan* ‘to carry’ – ‘I carry’

- » approximation : /g/ ↔ /v/

- (5) Karelian (Kovedjaeva 1993)
ruga – *ruvan* ‘soft resin.NOM’ – ‘soft resin.GEN’

Quantitative alternations:

» (de)gemination : /kk/ ↔ /k/

(6) Finnish

pappi – papit

‘priest.NOM’ – ‘priest.PL’

» alternation between long and super-long geminates : /ppp/ ↔ /pp/

(7) Estonian

pikk /pikkk/ – pika /pikka/

‘long.NOM’ – ‘long.GEN’

» loss : /b/ ↔ ∅

(8) Estonian

tuba – toa

‘room.NOM’ – ‘room.GEN’

Within one paradigm, the set of alternating consonant grades is usually of size 2 but can be larger: Skolt Saami can have 3 or 4 grades alternating within the paradigm of one word (Koponen, Miestamo & Juutinen 2022). This is a problem for Strict CV representations

- Strong grade: long geminate
- Weak grade: short geminate
- Shortened grade: single consonant

Table 12.7 Skolt Saami consonant gradation: Type 1

Strong grade	Weak grade	Shortened grade
<i>käll</i> forehead	<i>käll</i> forehead.GEN	<i>kälstan</i> forehead.LOC. POSS.1SG
<i>papp</i> priest	<i>paapp</i> priest.GEN	<i>papstan</i> priest.LOC. POSS.1SG
<i>vuä'b'b</i> sister	<i>vue'bb</i> sister.GEN	<i>vue'bstan</i> sister.LOC. POSS.1SG

- Lengthened grade: long geminate
- Strong grade: short geminate
- Weak grade: single consonant
- Shortened grade: single consonant

Table 12.11 Skolt Saami consonant gradation: Type 3b

Lengthened grade	Strong grade	Weak grade	Shortened grade
<i>ķiõ't'te</i> hand.ILL	<i>ķiõtt</i> hand	<i>ķiõđ</i> hand.GEN	<i>ķiõ'dstan</i> hand.LOC.POSS.1SG
<i>lāppa</i> permission.ILL	<i>lāā'pp</i> permission	<i>lāā'v</i> permission.GEN	<i>lā'vstan</i> permission.LOC.POSS.1SG
<i>põtt</i> buttocks		<i>põõđ</i> buttocks.GEN	<i>põđstan</i> buttocks.LOC.POSS.1SG

Grade alternations have triggers, targets and domains:

- » TRIGGER – a phonological entity that causes the alternation (e.g. suffix)
- » TARGET – the consonant whose grade is affected
- » DOMAIN – the phonological unit within which the alternation happens; the smallest relevant unit

The trigger and target of a consonant grade alternation do not have to be directly adjacent. Wrt. triggers, target and domains, these alternations are divided into two types:

- » RADICAL (SYLLABIC) GRADATION – occurs in the root, between the first (stressed) and the second (unstressed) syllable

(9) Finnish radical gradation (quantitative; semi-productive)

- a. *pappi* ‘priest’ : *papit* ‘priests’
- b. *lobbaan* : *lobata* ‘to lobby’

(10) Estonian radical gradation

- a. *arg* : *ara* ‘fearful’
- b. *sepp* : *sepa* ‘smith’ (Trosterud & Uiho 2005: pp. 139–140)

- » SUFFIXAL (RHYTHMIC) GRADATION – usually applies to suffix-initial consonants, conditioned by syllable count (odd stressed vs even unstressed)

(11) North Saami suffixes (Korhonen 1981: p. 149)

- a. *læžžap* ‘be.POT.1PL’
- b. *mânâžæp* ‘go.POT.1PL’

(12) Forest Nenets durative (Salminen 2007: p. 359)

- a. *kata-p’o-* ‘kill-DUR’
- b. *ta-m’p’o-* ‘bring-DUR’

- » What is the difference if both take into account foot structure and stress?

The trigger of syllabic gradation is often a consonant closing the syllable *after* the target of gradation (13). So, the trigger and the target are not adjacent because they are separated by a nucleus.

In Finnish, the gradation process has extended to occur after all syllables – stressed and unstressed.

(13) Finnish syllabic gradation

a. *sukka* ‘sock’ : GEN *suka-n*

b. *alanko* ‘lowland’: GEN *alango-n*

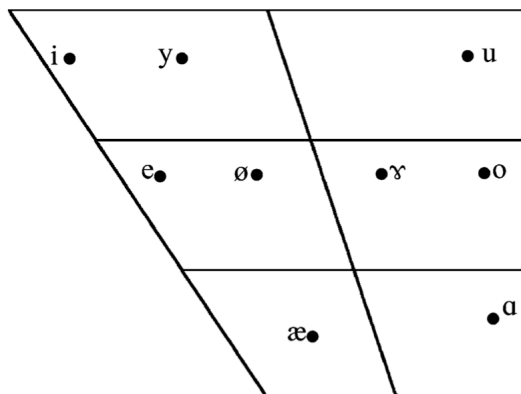
(Bakró-Nagy 2022: p. 862)

So, syllabic gradation extended to all syllables is no longer rhythmically motivated; its trigger is still working.

2 Estonian puzzle

Consonant and vowel inventories (Asu & Teras 2009)

	Bilabial	Labio-dental	Alveolar	Post-alveolar	Palat-alized	Palatal	Velar	Glottal
Plosive	p		t		tʲ		k	
Nasal	m		n		nʲ			
Trill			r					
Fricative		f v	s	ʃ	sʲ			h
Lateral			l		lʲ			
Approximant						j		



3 Consonant gradation data

Several verbs in 5 different forms (Belikov, Muravenko & Alekseev 2006).

Infinitive I	Infinitive II	Present tense	Past tense	Participle	Translation
hakkama	hakata	hakkan	hakkasin	hakatud	begin
hüppama	hüpata	hüppan	hüppasin	hüpatud	jump
näitama	näidata	näitan	näitasin	näidatud	show
kompima	kompida	kombin	kompisin	kombitud	feel, touch
lõikama	lõigata	lõikan	lõikasin	lõigatud	cut
õppima	õppida	õpin	õppisin	õpitud	study, learn
põdema	põdeda	põen	põdesin	põetud	be sick
pumpama	pumbata	pumpan	pumpasin	pumbatud	pump
sulgema	sulgeda	sulen	sulgesin	suletud	close
rääkima	rääkida	räägin	rääkisin	räägitud	speak
tõlkima	tõlkida	tõlgin	tõlkisin	tõlgitud	translate

- $g \rightarrow /k/$
- $k \rightarrow /kk/$
- $kk \rightarrow /kkk/$

3.1 Questions and answers

» How many consonant grades does Estonian have?

There are 4 grades:

1	2	3	4
pp	p	b	ø
tt	t	d	ø
kk	k	g	ø

» Which of the forms is the most “basic” one, from which all the other are produced?

The basic form should be Infinitive II – other forms are produced from it. In Infinitive II, the ending *ta/da* tells us whether the present tense should have a weak or a strong grade.

- *-da* \Rightarrow weak grade in the present tense
- *-ta* \Rightarrow strong grade in the present tense

» What are the rules that produce each form?

Take Infinitive II, strip the ending (*da/ta*), then apply the gradation rule to the base. Strong grade is the same as in Infinitive II, weak grade is one grade weaker.

For the *da* class:

- Infinitive I – strong grade + *ma*
- Present tense – weak grade + *n*
- Past tense – strong grade + *sin*
- Participle – weak grade + *tud*

For the *ta* class:

- Infinitive I – strong grade + *ama/ima*
- Present tense – strong grade + *n*
- Past tense – strong grade + *sin*
- Participle – weak grade + *tud*

4 Grades in Substance-Free Phonology

There has been proposed phonetic motivation for radical gradation.

- (14) Radical gradation has always been caused by the need for greater articulatory energy in the closed syllable after the syllable with the main stress than in the open syllable. This brought about a corresponding drop in intensity at the preceding syllable juncture and a weakening of the [onset] consonant. (Korhonen 1988: p. 275)

However:

- » The alternations are not always synchronically linked to the strength of the position (Finnish)
- » In some cases, the strong grade of some segments actually takes less energy to produce (Guovdajohtolat Northern Saami)

In the Guovdajohtolat dialect of Northern Saami, there are weak and strong consonant grades (15). /pp tt kk/ in the strong grade correspond to their voiced counterparts /bb dd gg/. What we observe in other languages with consonant gradation is voiced consonants occurring in weaker positions, which is more expected from the point of view of articulation: voiced stops are more difficult to hold than the unvoiced ones.

- (15) Northern Saami consonant gradation (Bals Baal, Odden & Rice 2007: p. 19)

strong grade	weak grade
...hp...	...p...
...ʔm...	...m...
...ss...	...s...
...bb...	...pp...

As noted by Chabot (2021: p. 141), “there is no phonetic explanation for how phonological lengthening could produce voicing of voiceless geminates”, which is an argument for the Substance-Free phonology view that phonological rules do not have to be phonetically grounded (Hale & Reiss 2008).

4.1 Russian iotation

A sharp pivot to Russian palatalisation and iotation, which Daniar Kasenov and I have proposed a grade-like treatment for (Shikunova & Kasenov 2023). The idea is parallel to

In Russian, there is a small class of suffixes which produce *iotation*, one of them is the 1sg ending *-Ju*. Iotation is productive and affects recent loanwords.

- (16) pobudka – bužu (d/ž alternation)
kosa – košu (s/š alternation)
uklon – klon^ju (n/n^j alternation)
- (17) l^jubov^j – lyubl^ju (b/bl^j alternation)
spat^j – spl^ju (p/pl^j alternation)
stavka – stav^ju (v/vl^j alternation)

The /b/–/bl^j/ alternation has been analysed as a feature mismatch between a labial segment and a palatal iotising segment that results in the epenthesis of /l^j/ (see Morén (2006) for Serbian and Magomedova & Slioussar (2017) for Russian). The catch is that *palatalisation* is another common alternation that makes segments more palatal, distinct from iotation.

- (18) pobudka – bud^jit (d/d^j alternation)
kosa – kos^jit (s/s^j alternation)
uklon – klon^jit (n/n^j alternation)
- (19) l^jubov^j – lyub^jit (b/b^j alternation)
spat^j – sp^jit (p/p^j alternation)
stavka – stav^jit (v/v^j alternation)

The OT analysis:

- » J is a floating segment
- » Palatalisation cannot expone J
- » Palatalising instead of iotising violates MAXFLT and base-final palatalised labials are banned in the output
- » *MAP(lab, pal) ⇒ no b/ž-like alternations
- » Epenthesis of /l^j/ results

(20) OT table for a *b*-final stem

/l ^j ub/ + /Ju/	MAXFLT	*MAP(lab,pal)	DEP	IDENT(place)
l ^j ub ^j u	*!			
☞ l ^j ubl ^j u			*	
l ^j užu		*!		*
l ^j ubžu		*!	*	

(21) Putative OT table for a *n*-final stem – the correct form is ruled out by MAXFLT

/klon/ + /Ju/	MAXFLT	*MAP(lab,pal)	DEP	IDENT(place)
klon ^j u	*!			
☞ klonl ^j u			*	
kložu		*!		*
klonžu		*!	*	

Below is the summary of the two alternations, conveniently captioned as “grades” by Brown (1998).

(22) Three forms of consonants, Brown (1998, Table 5)

Zero Grade	Soft Grade	Jotated Grade
/p/	/pʲ/	/pʲlʲ/
/b/	/bʲ/	/bʲlʲ/
/m/	/mʲ/	/mʲlʲ/
/f/	/fʲ/	/fʲlʲ/
/v/	/vʲ/	/vʲlʲ/
/t/	/tʲ/	/tʲç/
/d/	/dʲ/	/dʲž/
/s/	/sʲ/	/sʲš/
/z/	/zʲ/	/zʲž/
/l/	/lʲ/	/lʲ/
/n/	/nʲ/	/nʲ/
/r/	/rʲ/	/rʲ/
/k/	/č/	/č/
/g/	/ž/	/ž/
/x/	/š/	/š/

» /p b m f v/ – soft grade is palatalised and the jotated grade gets /lʲ/ epentheticum

» /t d s z/ – all three grades different

» /l n r/ – both the soft and the jotated grade are palatalised

» /k g x/ – palatal segments in soft and jotated grades

The OT analysis proposed by Magomedova & Slioussar (2017) has to prohibit palatalisation as an exponent of J in order to account for the labials and the palatals, where the jotated grade needs to be something other than just palatalised. However, it has to keep it as an exponent for J + /n r l/. The jotated grade is so diverse in its phonetic exponence that we propose to store it in the phonology-phonetics lexicon and not to introduce rules that would produce it every time from the merger of J.

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