Reduplication and "Vowel Reduction" in Lushootseed[*]

Gloria Mellesmoen
University of British Columbia

Suzanne Urbanczyk
University of Victoria

Abstract: This paper reviews patterns of reduplication and vowel reduction in Lushootseed. Zimmermann (2021) provides a case study of Lushootseed vowel reduction in diminutive reduplication to motivate the Copying-Weakening-Implication (CWI). The CWI predicts that there are languages in which vowel reduction only occurs in reduplication. We outline the core features of the model and identify empirical issues with the CWI, presenting an analysis of the Lushootseed diminutive reduplication and "vowel reduction" that uses Gradient Symbolic Representations (Smolensky & Goldrick 2016). This analysis accounts for a wider range of data without the necessary assumptions of the CWI. We then discuss some problematic predictions of the CWI and conclude that treating reduplication as weakening is not necessary for analyzing Lushootseed reduplication, and further introduces additional complications from a cross-linguistic perspective.

Keywords: Lushootseed, reduplication, vowel reduction, Gradient Symbolic Representations

1 Introduction

Salish languages exhibit a wide and diverse array of reduplication patterns, with multiple meanings and shapes (including size, position, and segmental properties). These diverse properties make Salish languages ideal for case studies to test and confirm models of reduplication. A recent model of reduplication called the Copying-Weakening-Implication (CWI) has been developed by Zimmermann (2021). The CWI makes predictions about patterns of vowel reduction and reduplication. A central prediction of the CWI is that languages that may not have any general process of vowel reduction may permit vowel reduction in reduplication. She describes Lushootseed diminutive reduplication as an example of this, giving the patterns in (1). There are several diminutive reduplication patterns shown in (1): a copy of the first consonant and vowel of the root, with "reduction" to schwa in (1a), copying the first consonant and placing it after the stressed vowel in (1b), and a copy of the first consonant with a fixed vowel /i/ in (1c).

(1) Diminutive reduplication in Lushootseed (Bates et al. 1994; Urbanczyk 2001)[1]

a.	*yúbil*	'die, starve'	*yú-yəbil*	'small animal dies'	(p. 207)
	s-bádil	'mountain'	*s-bá-bədil*	'small mountain'	(p. 192)
	ʔágʷal-əb	'yawn'	*ʔa-ʔəgʷál-əb*	'yawn'[2]	(p. 191)
b.	*ʔúsil*	'dive'	*ʔú-ʔsil*	'shallow dive'	(p. 192)
	kúpi	'coffee'	*kú-kpi*	'a little coffee'	(p. 196)
	sáq̓ʷ	'fly'	*sá-sq̓ʷ*	'fly just a little bit'	(p. 201)

[*] We are grateful to each other for the opportunity to nerd out about Salish reduplication ☺. We are also grateful to Daniel Reisinger and Julia Schillo for their helpful comments and excellent editorial advice.
Contact info: Gloria Mellesmoen: gloria.mellesmoen@ubc.ca; Suzanne Urbanczyk: urbansu@uvic.ca
[1] Examples throughout the paper are presented in the North American Phonetic Alphabet (NAPA), in which the voiceless uvular fricative is represented as [x̌]. Unless stated otherwise, page numbers for the Lushootseed forms refer to the Appendix in Urbanczyk (2001).
[2] This example is a diminutive in form, though the translation given by Bates et al. (1994) is 'yawn'.

Papers for the International Conference on Salish and Neighbouring Languages 59.
D. K. E. Reisinger, Laura Griffin, Ella Hannon, Gloria Mellesmoen, Sander Nederveen, Bruce Oliver, Julia Schillo, Lauren Schneider, Bailey Trotter (eds.). Vancouver, BC: UBCWPL, 2024.

c.	*dú:kʷ*	‘knife’	*dí-du:kʷ*	‘small knife’	(p. 195)
	dáʔ(a)	‘name, call’	*dí-daʔa-t-əb*	‘name, calling’	(p. 194)
	č̓sáy	‘salmon spear’	*č̓i-č̓sày*	‘toy spear’[3]	(p. 194)

The patterns summarized in (1), which Zimmermann (2021) considers in her case study of Lushootseed, are all attested; however, we note that they represent only a subset of the reduplication patterns in Lushootseed. First, the pattern of "vowel reduction" associated with diminutive reduplication is a bit more complex, because there are many words which faithfully copy the root vowel, which is not predicted under the CWI. Second, Zimmermann does not consider the other reduplicative morphemes in Lushootseed, which should be equally susceptible to vowel reduction under the CWI.

In this paper, we consider Zimmermann's approach (Section 2) and illustrate how it is unable to account for the full range of diminutive forms in Lushootseed. We then present an analysis of diminutive reduplication, using Gradient Symbolic Representations (GSR; Smolensky & Goldrick 2016) in Section 3. This analysis does not require any extra assumptions about reduplication, other than what has already been proposed and accepted widely. We then discuss other predictions of the CWI that are typically odd or unattested (Section 4). We conclude that the CWI is not necessary for Lushootseed diminutive reduplication, and further that it makes some undesirable predictions with respect to reduplication more broadly.

2 CWI and Lushootseed reduplication

The CWI "predicts that copied elements are more likely to undergo phonological reduction and that reduction in a non-copying context implies reduction in a copying context, but not vice versa" (Zimmermann 2021:1). The model is based on two core assumptions: (i) reduplication is formalized as fission from a single segment in the input to multiple segments in the output, and (ii) each one of the fissioned segments in the output is weakened. The CWI assumes GSRs, in which every segment in the input will have an activity level. Zimmermann (2021) assumes that input segments have an activity level of 1 and this activity is split evenly among output segments in fission; when there is a single copy (1 input segment mapped to 2 output segments), each output segment has an activity level of 0.5. This section outlines the basic components of that model (Section 2.1), before providing a more complete picture of Lushootseed reduplication and vowel reduction (Section 2.2). We provide an analysis of the reduplication and reduction pattern in Section 3, showing that the extra complications introduced by the CWI model are not needed, and in fact make incorrect predictions for Lushootseed reduplication.

2.1 CWI

The central insight for the CWI comes from applying concepts from GSRs (Smolensky & Goldrick 2016) to the process of segmental fission. In the model of reduplication Zimmermann (2021) assumes, copying occurs via fission to fill an empty prosodic unit (also known as Generalized Nonlinear Affixation; Bermúdez-Otero 2012). While an input segment has full strength (activity level 1.0), fissioned segments divide up the strength equally, and thus only have half or one third the strength of an input segment (activity level 0.5 or 0.33, respectively), depending on the type of

[3] This form was only listed with secondary stress in the *Lushootseed Dictionary*, but one would expect the initial vowel to have primary stress in this case.

reduplication. The more copies of a single segment, the weaker the activity of all corresponding output segments. We start the discussion by first reviewing the central insights behind GSR, followed by an overview of Zimmermann's analysis.

In the framework of GSR, representations are non-discrete and may be made up of gradient symbols (Smolensky & Goldrick 2016). For example, segments in GSR may be partially active, which means they have an activity level greater than zero but less than 1.0. GSR is well-suited for analyzing exceptional patterns, such as vowel deletion in Palauan (Hsu 2022). As can be seen below some stem vowels undergo deletion in Palauan (2a), while others retain the vowel (2b).

(2) Palauan variable vowel deletion (Hsu 2022:4)

a.	*ðíŋəs*	'satisfaction'	*θŋəs-ɛ́l*	'his/her satisfaction'
	ðík	'wedge'	*θk-ɛ́l*	'his/her wedge'
b.	*ðíŋ*	'ear'	*ðiŋá-l*	'his/her ear' (/a/ is part of the stem)
	ðóko	'swim bladder'	*ðok-ɛ́l*	'his/her swim bladder'

In Hsu's analysis, the vowels that are retained have a higher activity level than the ones that delete (0.75 vs. 0.25). This use of GSR provides an elegant solution to the idiosyncratic pattern of vowel deletion in Palauan. GSR is also plausible due to psychological grounding, as it models the strength of phonological representations in the mental lexicon. In GSR, segments across different lexical items may have different activations, which provides a systematic way to derive exceptional patterns that are otherwise phonologically regular.

Zimmermann (2021) assumes a model of reduplication in which a reduplicative morpheme is a segmentally empty prosodic unit that needs to be filled in the output (e.g., Bye & Svenonius 2012). This is done via fission of an input segment to two output segments, in violation of a constraint demanding a faithful 1:1 mapping between input and output segments. The following figure illustrates the basic assumptions of the model, in which the input morpheme is a mora which is then filled in the output by fission.

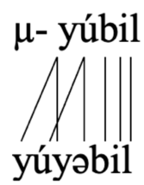

Figure 1: Reduplicated word with fission of input segments

Zimmermann (2021) applies the concept of activity levels from GSR to reduplication by proposing that whenever there is a copy, each fissioned segment in the output word bears a proportion of the activity level of the input segment, such that the activity levels of both output segments add up to 1.0. Crucially, she assumes that fission of an input is accompanied by the division, not fission, of its activity level. An activity level of 1.0 in the input corresponds to 0.5 for each output segment. If there are two copies of the same segment (triplication), each output segment would have an activity level of 0.33. The fissioned consonants in the output will add up to 1.0.

For the example in Figure 1 above, each segment in the input has a value of 1.0, but the segments in the output have the following values: [$y_{0.5}u_{0.5}y_{0.5}ə_{0.5}b_{1.0}i_{1.0}l_{1.0}$]. Set within Gradient

Harmonic Grammar (Smolensky et al. 2014), with numerically weighted constraints, the value of the segment is a multiplier. Markedness constraints penalize all segments equally, but the faithfulness constraints incur penalties relative to the segment's strength. With a markedness constraint that bans unstressed full vowels, the least costly way to satisfy that is to reduce a copied vowel, as it incurs half the penalties of the full-strength segments with an activity level of 1.0 under faithfulness constraints. Thus, the CWI predicts that copied segments are more likely to reduce than non-copied segments because they have a lower activity level. Violations involving partially active segments will be worth less than segments with an activity level of 1.0 (e.g., if IDENT-[PLACE] has a weight of 3, then a segment $S_{0.5} = -1.5$ and $S_{1.0} = -3$). The prediction that this model makes is all reduplicated words in Lushootseed should have vowel reduction. We turn next to a closer examination of reduplication and vowel reduction in Lushootseed.

2.2 Lushootseed reduplication and vowel reduction

Bates et al. (1994:xvii) identify seven ways to classify reduplication in the *Lushootseed Dictionary*. Among the diminutive forms with no fixed vowel, there are three main patterns, identified below: C_1V with faithful copying of the vowel (3a), C_1ə with schwa as the post-tonic vowel (3b), and C_1 with just a bare consonant (3c).

(3) a. C_1V- reduplication, retention of root vowel (= 56 forms) (Bates et al. 1994)

ƛ̓úb	'good, fine, alright'	*ʔəs-ƛ̓úƛ̓ubil*	'a little better'
č̓ít	'near'	*č̓ič̓it*[4]	'a bit nearer'
q̓íxʷ	'located upstream'	*q̓iq̓ixʷ*	'a little upstream'
s-tiqíw	'horse'	*s-títiqiw*	'pony, foal'
čáləs	'hand'	*čáčaləs*	'little hand'

b. C_1ə- reduplication, post-tonic vowel is schwa (= 23 forms)

táb	'thing, what'	*s-tátəb*	'a little while'
yíq̓	'weave a cedar root basket'	*yíyəq̓ʷus*	'small cedar root basket'
łágʷ	'mat, sleeping mat'	*łáʔłəgʷid*	'little mat'

c. C_1- reduplication (= 37 forms)

kúpi	'coffee'	*kúkpi*	'a little coffee'
łúp	'early morning dawn'	*łúʔłp*	'a little early'
k̓ʷátač	'climb a hill'	*s-k̓ʷák̓ʷtač*	'little mountain'
k̓ʷásəd	'stomach'	*k̓ʷak̓ʷsəd*	'little stomach'
k̓ʷát̓ad	'mouse'	*k̓ʷák̓ʷt̓ad*	'tiny mouse'
pús	'throw through the air'	*púps*	'toss pebbles'
sáq̓ʷ	'fly'	*sásq̓ʷ*	'fly just a little bit'
cáq̓	'spear (verb), jab'	*cácq̓*	'act of spearing big game on water'

[4] Not all the words in the *Lushootseed Dictionary* are consistently marked for stress. Rather than add any stress marks, we have decided to leave the words as they are represented in the dictionary. The only exception to this is that we have added primary stress marks to monosyllabic words, as the stress would clearly be there.

Counting the diminutive forms in the *Lushootseed dictionary*, 23 are associated with "vowel reduction", and 37 with "deletion" of the vowel. However, 56 forms retain the root vowel, which is not predicted under the CWI, given that it predicts reduction of unstressed vowels in all reduplicative environments. Even though there are trends related to the distribution of C_1V, C_1ə, and C_1 forms, there is no robust pattern. For example, vowel quality (specifically sonority) is a significant factor in whether the vowel was retained (see Urbanczyk 2001:111 for details), but this is only a trend; there are exceptions.

The most common type of diminutive pattern has a fixed vowel /i/. These forms, given in (1c) at the onset of the paper, have a C_1í- reduplicant. This pattern is not explicitly analyzed by Zimmermann (2021): she treats it as a phonologically conditioned suppletive allomorph, to be accounted for by subcategorization (cf. Bates 1986 and Urbanczyk 2001, who treat the /i/ as a phonological repair). Table 1 summarizes where /i/ is found and associated counts; there are 77 words with the C_1í- form of the diminutive that are built on stems with a schwa (or with vowelless roots).

Table 1: Environments where /i/ occurs

Phonological context	Number of forms
C_1C_2-initial stem	13
Long vowel in base	4
$C_1VC_{[glottal]}$	8
Schwa or no vowel in base	77
Other (i.e. C_1VC_2- shaped roots)	10

We propose in the following section that the exceptional pattern of "vowel reduction" in (3b) and "vowel deletion" in (3c) above can be accounted for by assuming partially active segments in the input (lexical entries), rather than having reduplication create partially active segments from full strength representations in the input. The vowels that appear to delete in (3c) have lower strength, as with Palauan. However, we do not analyze this as deletion or reduction: instead, partially active vowels are not reduplicated. The schwa that occurs in (3b) is epenthesized; it is not a reduced copy of the root vowel. We further extend our analysis to account for the C_1í- forms, showing that the phonological grammar can derive these forms without need for subcategorization.

3 Analysis of Lushootseed using GSR

Our analysis of Lushootseed uses GSRs to account for the exceptional reduction patterns. This is the usual application of GSR (see, e.g., Hsu 2022). We assume a model of reduplication in which the input is a prosodic unit that must be filled by fission, as in Zimmermann (2021).[5] For diminutive reduplication, the input is a mora (μ).

We take the approach to schwa that is standard in Salish phonology: schwa is epenthetic (e.g., Blake 2000) and non-moraic (Shaw et al. 1999). We specifically assume that the schwas in the diminutive are epenthetic, rather than reduced vowels. Finally, we follow Urbanczyk (2001) in treating coda consonants as moraic in Lushootseed.

[5] The reasons for adopting this framework are twofold: (i) we find that it is well-suited to analysing reduplicative patterns, and (ii) it allows for a more direction comparison of our analysis with the predictions of the CWI.

Finally, we adopt a stratal model of phonology, which means that different processes of reduplication and epenthesis may occur at different strata. There is robust evidence that strata are needed for phenomena that are relevant to syllable structure in pre-OT phonology, and the process of resyllabification at each stage is referred to as continuous syllabification (Itô 1986). With some simple and well-supported assumptions about reduplication, syllable structure, and Salish phonology, we can account for the full range of diminutive reduplication patterns in Lushootseed. Notably, we do not require any constraint about the markedness of unstressed full vowels, which Zimmermann (2021) needs to motivate the reduction of copied vowels. This turns out to be particularly important when we discuss implications of the CWI in Section 4.

3.1 C_1(V)- reduplication

We begin by analyzing the pattern of C_1V- reduplication (given in 3a in Section 2.2), in which the full vowel is retained post-tonically. This is by far the most common pattern of reduplication for those that do not have the fixed segment.[6] Following the assumptions of Generalized Nonlinear Affixation (Bermúdez-Otero 2012) and Minimal Reduplication (Saba Kirchner 2010; 2013), reduplication involves the affixation of a segmentally empty prosodic unit. The prosodic unit is filled by fission of the input segment into two output segments, as was illustrated in Figure 1 in Section 2.1. There are several constraints needed to ensure that the prosodic unit is filled, including *FLOAT, REALIZEMORPHEME (RM), INTEGRITY, and DEP. The definitions are provided in (4) below, defined by when a violation mark is assigned (as per McCarthy 2008). We also use a markedness constraint against heavy (trimoraic) syllables, given in (5).

(4) Constraints that ensure an input prosodic unit is filled by fission of input segments in the output

*FLOAT	Assign a violation for every prosodic unit not filled in the output.
RM	Assign a violation for every morpheme not parsed in the output.
INTEGRITY	Assign a violation for every input segment that has two output correspondents.
DEP	Assign a violation for every segment in the output that is not in the input.

(5) Markedness constraint against heavy syllables

$*\sigma_{\mu\mu\mu}$	Assign a violation for every trimoraic syllable.

The tableau in (6) illustrates how the optimal form violates INTEGRITY twice (6a). It does so to avoid having a trimoraic syllables (6b), which violate the markedness constraint in (5). The model we use incorporates principles of constraint weighting from Gradient Harmonic Grammar (Smolensky et al. 2014), which we adopt too. In this approach, the linear position (ranking) of the constraints is not important. Constraints that would be higher ranked in classic OT are typically associated with higher weights. Violations of a constraint are first added together and then multiplied by the constraint. For example, in (6a), the violations −1 (fission of *q̓*) and −1 (fission of *a*) equal −2, which is then multiplied by weight of INTEGRITY (*w*=1) to yield −2. The totals for

[6] The fixed segment that occurs with Lushootseed diminutive reduplication is analyzed as a default epenthetic vowel /i/, not a segment in the input, as per Alderete et al. (1999).

each constraint are added up to yield an H score. We have indicated the weights below each constraint. INTEGRITY is the preferred way to fill a mora and, accordingly, it has the lowest weight.

(6) *q̓áq̓al* 'fooling someone'

	μ + q̓ál	*FLOAT *w*=7	RM *w*=7	DEP *w*=3	*$\sigma_{\mu\mu\mu}$ *w*=2	INTEGRITY *w*=1	H
a.	☞ q̓áq̓al					−2	−2
b.	q̓áq̓l				−1	−1	−3
c.	μ q̓ál	−1					−7
d.	q̓íq̓al			−1		−1	−4
e.	q̓ál		−1				−7
f.	μ q̓áq̓əl	−1		−1		−1	−11

As can be seen, candidate (6a) fills the mora by copying the consonant and vowel, incurring two INTEGRITY violations with an overall harmony (H) score of −2. Candidate (6b) fills the mora by copying the first consonant into a coda, resulting in a trimoraic syllable. The constraint penalizing trimoraic syllables has a higher weight than INTEGRITY, which means one violation incurs a score of −2. The resulting harmony score for (6b) is −3. Candidate (6c) is ruled out because it has an unfilled mora, incurring a violation of *FLOAT, which has the highest weighting of all the constraints (*w*=7). Candidate (6d) fills the mora by epenthesizing /i/, and fission occurs to supply an onset. DEP has a weight of 3, its overall harmony score is −4, ruling out (6d). Candidate (6e) fails to parse the input diminutive morpheme (μ), incurring a violation of RM, which also has a high weight (*w*=7). The final candidate (6f) fails to fill the mora. This candidate is of particular interest because it appears to have vowel reduction. However, in this analysis, we assume there is no vowel reduction (unlike Zimmermann 2021), and the schwa is inserted at this stratum, incurring a DEP violation as well as a *FLOAT violation.

The next most frequent pattern is when only a single consonant is copied, which was shown in (3c) in Section 2.2. We derive this pattern by proposing that the root vowel in the input for these forms has an activity level of 0.5, rather than having the typical activity level of 1.0. We mark only activity levels in the input that are less than 1.0. Certain lexical items have partially active vowels, which allows for the exceptional pattern to emerge in an analysis with GSR. In other words, the exceptionality of the pattern is encoded in the input vowel. A vowel with an activity level of less than one must be brought to an activity level of 1.0. Adding to the activity level of a segment is a violation of DEP, such that a segment with an activity level of 0.25 will incur a violation of −0.75 under DEP.[7] We need the faithfulness constraint MAX, defined in (7), to account for the single consonant diminutive pattern.

(7) MAX Assign a violation for every segment in the input that is not in the output.

We assume that fissioned segments in the output have the same activity level as the input segment, which diverges from Zimmermann's (2021) proposed weakening in reduplication. The

[7] We assume that the requirement for partially active segments to be brought to an activity level of 1.0 does not apply until the word stratum. Partially activated vowels at the stem may remain at an activity level below 1.0.

tableau in (8) shows how the diminutive with only a copied consonant is derived. The vowel in the input has an activity level of 0.5, indicated with a subscript. To reach an activity level of 1.0, candidates must add 0.5 for each copy, which explains the DEP violation of −0.5 for the attested candidate in (8a). The mora is filled by copying the root-initial consonant into the coda position, incurring a violation of both INTEGRITY and $*\sigma_{\mu\mu\mu}$. The harmony score is −4.5, which is the lowest among the candidates, making it optimal. Candidate (8b) copies the partially active vowel, incurring two violations of DEP ([−0.5 ∗ 2] ∗ *w* = −3) and INTEGRITY ([−1 ∗ 2] ∗ *w* = −2). The harmony score for (8b) is −5.[8] Candidates (8c−f) are like those in the previous tableau because they have a floating mora (8c), insert /i/ (8d), fail to parse the morpheme (8e), or epenthesize a schwa (8f). Candidate (8g) fills the mora by epenthesis but does so at the expense of deleting the input vowel. This incurs a violation of MAX. However, because the input vowel only has an activity level of 0.5, it does not get a full violation of MAX. Its harmony score is −5, making it non-optimal.

(8) *sásq̓ʷ* 'fly just a little bit'

μ + s $á_{0.5}$ q̓ʷ	*FLOAT *w*=7	RM *w*=7	DEP *w*=3	$*\sigma_{\mu\mu\mu}$ *w*=2	INTEGRITY *w*=1	MAX *w*=4	H
a. ☞ sásq̓ʷ			−0.5	−1	−1		−4.5
b. sásaq̓ʷ			−1		−2		−5
c. μ sáq̓ʷ	−1		−0.5				−8.5
d. sísaq̓ʷ			−1.5		−1		−5.5
e. sáq̓ʷ		−1	−0.5				−8.5
f. sásəq̓ʷ			−1.5		−1		−5.5
g. siq̓ʷ			−1			−0.5	−5

The patterns where the root vowel is not copied, such as in (8), and those with a faithful copy, such as in (6), are not explicitly analyzed in Zimmermann (2021). These two are more common than the pattern she analyzes (C_1ə- with schwa as the post-tonic vowel). They are predicted not to occur at all in the language, given the CWI. A potential way to derive these patterns with the CWI is to incorporate exceptionality in some way. There are several potential approaches to this, including having different co-phonologies or by incorporating some aspects of GSR and applying them to the exceptional forms (exceptional being either the retention of the full vowel or failure to copy it). Our analysis incorporates the assumption that the input vowel is only partially active, so it does not get copied in those stems. The CWI assumes that weakening via GSR is an inherent property of reduplication. The CWI in combination with Zimmermann's (2021) constraints,

[8] We assume that fission produces two output segments with identical activity levels to the input. An input segment with an activity level of 0.5 corresponds to two output segments that each have an activity level of 0.5. This means that an unreduplicated partially active segment incurs a violation of −0.5 under DEP, while reduplicating that vowel will incur a violation of −1 to bring both vowels to an activity level of 1.0.

including one against unstressed full vowels, only predicts the post-tonic schwa pattern. We turn to these forms next.

We assume that all forms that do not have a faithful copy of the root vowel are analyzed as single consonant reduplication in the coda to fill a mora, as in the tableau in (8) above. The first two consonants of the root are voiceless obstruents for most roots that only copy a single consonant to form the diminutive forms. The forms which have schwa do so via insertion of an epenthetic schwa to create well-formed syllables. The following forms illustrate the central patterns: schwa is inserted when at least one of the consonants is voiced. Most of these have the pattern where the first consonant is voiceless, as in (9a), while there are only a few where the first consonant is voiced, as in (9b).

(9) Schwa insertion with one segment being voiced

a.	*táb*	‘thing, what’	*s-tátəb*	‘a little while’
	łágʷ	‘mat, sleeping mat’	*łáʔłəgʷid*	‘little mat’
	łúb	‘soup’	*s-łú1ʔłəb*	‘a little soup’
	ʔádᶻq	‘meet’	*ʔaʔədᶻəq-bi-d*	‘meet someone dear’
	ʔágʷal-əb	‘yawn’	*ʔa-ʔəgʷál-əb*	‘yawn’
	k̓ʷíd	‘how much, how many’	*k̓ʷik̓ʷəd*	‘small amount’
	s-łádəyʔ	‘woman, lady’	*s-łáłədəyʔ*	‘girl, girlfriend’
	sídq̓	‘swing aside, turn s.t.’	*sísədq̓*	‘turn it just a bit’
b.	*yíq̓*	‘weave a cedar root basket’	*yíyəq̓ʷus*	‘small cedar root basket’
	s-bádil	‘mountain’	*s-bábədil*	‘small mountain’
	yúbil	‘die, starve’	*yú-yəbil*	‘small animal dies’

As part of our research, we checked the *Lushootseed dictionary* for phonotactic patterns and were not able to find any voiceless obstruents followed by a voiced consonant.[9] We therefore analyze schwa insertion as epenthesis related to having well-formed syllable structure, wherein voiceless–voiced consonant sequences are banned. The epenthesis seems to be a general pattern in the language, not linked directly to reduplication. We could only find the following examples of diminutive reduplication in which there was a schwa inserted between two voiceless obstruents, provided in (10). The second word is very likely epenthetic schwa to avoid a sequence of a glottal stop followed by four voiceless obstruents.

(10) Schwa with two voiceless obstruents

x̌ic	‘to lunch, snack, get a bite’	*x̌íx̌əc*	‘just lunches (verb)’
súp̓=qs	‘hair seal, harbour seal’	*súʔsəp̓=qs*	‘hair seal pup’

In all other diminutive words where schwa occurs between voiceless obstruents, schwa is present in the base form.

There are also a handful of examples with no epenthesis, when the first consonant is voiced. Examples are provided in (11). The generalization that we draw on to account for these cases is

[9] The only exceptions to this generalization are that there are some roots with /y/ following a voiceless obstruent, one set of related forms that begin with /pl/, and some interjections and animal vocalizations beginning with /šw/ in legends.

related to sonority. Voiced consonants are more sonorous, so the first syllable will end with a more sonorous consonant than the following, resulting in a well-formed sequence with respect to the Syllable Contact Law (SCL; Urbanczyk 2001). The SCL bans adjacent syllables that would result in having rising sonority between them (Murray & Vennemann 1983). As you can see below, with a more sonorous coda than the consonant in the following onset, these forms obey the SCL.

(11) No schwa insertion when first consonant is voiced

láq	'last, behind'	*láʔlqil*	'a little late'
dukʷ	'strange, transform'	*dúdkʷibəɬ*	'strange'

We assume that the unexpected lack of epenthesis in forms like (11) can also be accounted for with some aspect of GSR. Due to space limitations, and because epenthesis is a general property of the language, we do not present a formal OT analysis of this. Specifically, we assume that epenthesis of a schwa in forms like (9) above follows the stratum where reduplication occurs. At the point of reduplication, the copied segment fills the mora (C1V<C>.C…) and later epenthesis results in the copied consonant surfacing as an onset (C1V.C[ə]C…).

There were also some roots which have two forms: one with vowel reduction and one without. This is not predicted by GSR, because if the root vowel is partially active, we would not expect deletion with one word-formation process and retention of the vowel with another. However, the words that show this pattern are exceptional in other ways: they have two meanings associated with them. It could be the case that there are two lexical entries for these roots, or that the addition of different morphemes results in weighting of other constraints, that does not result in deletion. Some illustrative examples are presented in (12) below, with the diminutive form first.

(12) Roots with multiple patterns

a.	*pástəd*	'white person, Caucasian (from *Boston*)'
	pápstəd	'white child, white friend'
	pápastəd	'insulting way of referring to a white man'
b.	*sáxʷəb*	'jump, leap, scamper off'
	sáʔsxʷəb	'run a few quick steps'
	sáʔsaxʷəb	'they scampered all about, many run'

As you can see in (12), the vowel is retained with non-diminutive meanings. We turn next to the patterns of diminutive reduplication which have a fixed segment.

3.2 C_1í- reduplication

The fixed segment /i/ occurs with forms that would make it challenging to fill the mora as previously illustrated (i.e., with a copy of the root vowel or copying the first consonant of the root in coda position). These include those with a long vowel (13a), those with a schwa, which is non-moraic (13b), those that begin with a cluster (13c), and those with a glottal as the second consonant (13d).

(13) C_1í- reduplication

a. Long vowel

búus	'four'	*bíʔbuus*	'four little items'
*s-dúuk*ʷ	'knife'	*s-díduuk*ʷ	'small knife'

b. V = schwa

dᶻə́x̌	'move'	*dᶻídᶻəx̌*	'move a bit'
bə́lx̌	'go by, pass'	*bíʔbəlx̌*	'pass a little'
bə́č	'fall down, from standing'	*díbəč*	'drop in from time to time'
cə́q̓	'jab, spear'	*cícq*	'act of spearing game on water'

c. Cluster-initial roots

tx̌ʷúd	'pull, drag'	*títx̌ʷud*	'lightly pull on'
tq(a)	'close, block'	*títqad*	'close, but not tightly, …'
łč̓-íl	'arrive, get there'	*łíłč̓il*	'will arrive occasionally'
č̓ƛ̓áʔ	'rock, stone, boulder'	*č̓íč̓ƛ̓aʔ*	'little rock(s), stone(s)'

d. Glottal as second consonant

luh	'hear (Snohomish)'	*líʔluu-d*	'hear a little of something'
łáʔx̌	'platter, plate'	*łíłaʔx̌*	'little platter'
púʔ	'blow, wind'	*pípúʔ-təd*	'thin shirt'
qʷúʔ	'water, especially fresh water'	*qʷíʔqʷuʔ*	'little water, creek endearment'

We derive the C_1í- pattern as insertion of the least marked full vowel (/i/) to fill the mora. The consonant is copied to provide an onset. Long vowels cannot be copied faithfully, so the default vowel is provided. Because schwa is non-moraic, it does not fill the mora, and the cluster-initial stems lack a vowel to fill the mora. The stems with a glottal as the second consonant could be analyzed as a schwa that is affected by the preceding consonant: sequences like [əʔ] are typically avoided in Salish (Bessell & Czaykowska-Higgins 1993). We start by analyzing the forms with long vowels.

To account for the fact that a long vowel is never copied, we adopt the constraints in (14): one banning extremely heavy syllables (those with four moras), and two faithfulness constraints related to length. INTEGRITY-Vː is violated when a long vowel undergoes fission; IDENT-LENGTH is violated when the length of a vowel in the input does not match the length of a corresponding vowel in the output.

(14)	$*\sigma_{\mu\mu\mu\mu}$	Assign a violation for every syllable that is four moras.
	INTEGRITY-Vː	Assign a violation for every input Vː with multiple output correspondents.
	IDENT-LENGTH	Assign a violation for every vowel that changes its length.

The tableau in (15) shows how incorporating these constraints with the correct weight predicts the attested form (15a). Candidate (15a) has the lowest harmony score, even though it has an inserted vowel, a trimoraic syllable, and has fission of the initial consonant. Other candidates that aim to fill the mora differently fare worse. Candidate (15b) copies the base vowel as short, incurring an extra INTEGRITY violation and a constraint against changing the length of the vowel. Candidate (15c) fails to fill the mora. Candidate (15d) copies the long vowel faithfully, adding an extra mora. Candidate (15e) does not parse the morpheme. And candidate (15f) copies the consonant into the coda, resulting in an extremely heavy syllable.

(15) *dí-du:k*^{w} ‘small knife’

μ + dú:k^{w}	*FLOAT *w*=7	RM *w*=7	DEP *w*=3	$*\sigma_{\mu\mu\mu}$ *w*=2	INTEGRITY *w*=1	$*\sigma_{\mu\mu\mu\mu}$ *w*=4	INT-V: *w*=3	MAX *w*=4	IDENT-LENGTH *w*=3	H
a. ☞ dídu:k^{w}			−1	−1	−1					−6
b. dudu:k^{w}				−1	−2				−1	−7
c. μ dú:k^{w}	−1			−1						−9
d. du:du:k^{w}				−1	−2		−1			−7
e. dú:k^{w}		−1		−1						−9
f. dú:dk^{w}				−1	−1	−1				−7

Moving on to stems with schwa, we assume that the diminutive applies to a phonological stem, rather than a root. We also add a constraint *ə́ in (16), which is violated whenever a schwa bears primary stress.

(16) *ə́ Assign a violation for every stressed schwa.

A schwa must be added to the root *bč*- in (17) to yield a well-formed phonological stem. As we assume a stratal model of phonology, this means that the diminutive applies at a later stratum than the phonological stem (i.e., at the level of the phonological word); the diminutive applies to the stem with a stressed schwa. Accordingly, we include schwa in the input in (17), which illustrates a range of candidates. The attested candidate (17a) inserts /i/ and copies the first consonant of the root to provide an onset. Candidates (17b) and (17c) fail to fill the mora, violating *FLOAT (recall that schwa is non-moraic). Candidate (17d) fills the mora by copying the initial consonant into the coda but incurs a violation of a constraint against stressing schwa. Candidate (17f) fails to parse the underlying schwa, and candidate (17g) has a syllable with three moras.

(17) *bíbəč* ‘drop in from time to time’

μ + (bə́č)	*FLOAT *w*=7	RM *w*=7	DEP *w*=3	$*\sigma_{\mu\mu\mu}$ *w*=2	INTEGRITY *w*=1	$*\sigma_{\mu\mu\mu\mu}$ *w*=4	INT-V: *w*=3	*ə́ *w*=5	MAX *w*=4	IDENT-LENGTH *w*=3	H
a. ☞ bíbəč			−1		−1						−4
b. μ bə́bəč	−1				−2			−1			−14
c. μ bə́č	−1							−1			−12
d. bə́bč					−1			−1			−6
e. bə́č		−1						−1			−12
f. bíč			−1						−1		−7
g. bíbč			−1	−1	−1						−6

Our analysis raises the question of what would happen with stems with a stressed schwa that do not have diminutive reduplication: would they epenthesize /i/ to avoid stressing schwa as well? We do not find empirical evidence of stressed schwa being replaced outside of reduplication, which is consistent with what our analysis predicts. Deleting a schwa is more costly than allowing it to remain stressed. This is presented in the following tableau. We include the constraint GRWD=PRWD, which is violated if the output is not a well-formed prosodic word, to rule out candidate (18c), which keeps the schwa but does not assign primary stress.

(18) No reduplication, stress stays on ə

bə́č	*FLOAT *w*=7	RM *w*=7	GRWD=PRWD *w*=6	DEP *w*=3	$*\sigma_{\mu\mu\mu}$ *w*=2	INTEGRITY *w*=1	$*\sigma_{\mu\mu\mu\mu}$ *w*=4	INT-V: *w*=3	*ə́ *w*=5	MAX *w*=4	IDENT-LENGTH *w*=3	H
a. ☞ bə́č									−1			−5
b. bíč				−1						−1		−7
c. bəč			−1									−6

The analysis that we propose in this paper accounts for a wide range of patterns seen in Lushootseed diminutive formation. We are able to account for this breadth of patterns using GSR and Harmonic Grammar. Our analysis shares some of the same basic assumptions as those in Zimmermann (2021), but without adopting the predictions of the CWI. We find no evidence that reduplication in Lushootseed is inherently weakening, and further find that the patterns can be accounted for by partial activation of vowels in certain lexical items and an analysis that assumes the input activity level is identical to the output activity level for all fissioned consonants. Having shown that the assumptions of the CWI are not necessary for Lushootseed, and extending our analysis to a set of examples that were not discussed with respect to the CWI, we turn to a consideration of the predictions made by the CWI, more generally.

4 Other typological predictions of the CWI

As noted by many, reduplicants can often undergo reduction processes (Becker & Potts 2011; McCarthy & Prince 1994). The range of reduction processes have been termed “the emergence of the unmarked” (TETU) and frequently extend beyond reduplication, showing up in many morphophonological contexts such as root-affix asymmetries and other types of positional effects (Beckman 1999). A widely cited pattern is found in Sanskrit in which voiced aspirates are copied as unaspirated. Examples are given in (19).

(19) Sanskrit intensive reduplication (Steriade 1988:108)

Root	Full grade	Zero grade	Gloss
b^{h}*ranɕ* / *b*^{h}*rnɕ*	*ban-i-b*^{h}*ranɕ*	*b*^{h}*an-i-bnrnɕ*	‘fall’
d^{h}*vans* / *d*^{h}*vns*	*dan-i-d*^{h}*vans*	*dan-i-d*^{h}*vas*	‘sound’

Only the reduplicative prefix eliminates the marked structure in (19). This is not predicted by the CWI: the strength of both fissioned segments is half the strength of the input segment, which means that they have an equal activity level in the output. If there is pressure to eliminate marked structure and fission yields a weakened activity level, both segments should eliminate the marked structure. The CWI does not predict patterns where only one of the segments undergoes change, without something to protect one of the segments from reduction. The rest of this section delves into this issue further, starting with the analysis of Lushootseed vowel reduction that Zimmermann (2021) presents.

The CWI analysis of Lushootseed relies on having a markedness constraint with a context encoded in it. This constraint is given in (20) and comes directly from Zimmermann (2021:22). The context of a vowel being in a non-prominent position (i.e., an unstressed position) is built into this constraint, making it a context-sensitive markedness constraint.

(20) *UNSTRV Assign −1 violation for every unstressed full vowel (= a vowel with place features).

In diminutive words in Lushootseed, one of the copied vowels is always stressed (usually the first), so one of the fissioned and weakened vowels (which bears stress) would not be subject to this constraint. That leaves the other vowel subject to it. The context-sensitive constraint protects one of the vowels from being reduced. That is why we do not see reduction in both vowels in reduplication. There is thus a confound in the analysis: the location of stress coincides with the location of the diminutive morpheme.

The CWI approach also makes the wrong predictions for other types of reduplication, including distributive C_1VC_2 reduplication, as in (21a), and out-of-control VC_2 reduplication, as in (21b). We would expect that all reduplicative morphemes would have vowel reduction, under pressure from the constraint in (20). However, while there are a handful of words which have vowel reduction, the vast majority do not show any vowel reduction. Notice that in each of these patterns, the input vowel is copied faithfully, without reduction.

(21) Lushootseed reduplication

a.	Distributive		C_1VC_2	
	šáx̌	'scrape'	*bə-šax̌šax̌ad*	'scrape and scrape some more'
	s-táləɬ	'nephew, niece'	*s-tál'taləɬ*	'nephews, nieces'
	p̓ál-il	'come to, revive'	*p̓álp̓al-il*	'many revived'
	s-ɬádəyʔ	'woman'	*s-ɬadɬadəyʔ*	'women'
b.	Out-of-control		VC_2	
	sáxʷ-əb	'jump, leap,…'	*sáxʷaxʷ-əb*	'scurrying about (inefficiently)'
	ʔaɬ	'fast, quickly'	*ʔáɬaɬ*	'hurry'
	ʔíbəš	'walk, travel,…'	*ʔíbibəš*	'pace back and forth'
	ƛ̓iq	'emerge, …'	*ƛ̓íqiq*	'emerge partially'
	saq̓ʷ	'fly (verb)'	*sáq̓ʷaq̓ʷ*	'fly around, wheeling in the sky'

A non-schwa vowel may be copied faithfully in the type of reduplication shown in (21) above. This shows a place where the CWI does not make the correct predictions as all reduplication should involve weakening and, therefore, vowel reduction should apply to any unstressed vowel in reduplication. The forms in (21) are not predicted to be possible in the same language that reduces the vowel with diminutive reduplication. Of particular interest is the last form in (21b). Recall that we have proposed a partially active vowel in the input for this root, and that only the first consonant copies with diminutive reduplication. In this pattern of VC_2 reduplication, there is a faithful copy. We draw on observations in Urbanczyk (2001) that geminates are not permitted in Lushootseed, so would rule out (**sáq̓ʷq̓ʷ*).

Moving beyond Lushootseed, where reducing both vowels with the diminutive is avoided by having a context-sensitive constraint, it is also relevant to examine how the CWI model works with context-free markedness constraints. The prediction the CWI makes is that all reduplicated segments should be weakened. The only context-free markedness constraint we could find in the case studies provided for the CWI was used in an analysis of Tagalog glottal deletion. Zimmermann (2021) proposes that *GLOTTAL emerges in the context of reduplication to result in the elimination of glottal consonants in reduplication. The patterns are presented in (22). In (22b), intervocalic glottal consonants are present in the base, but lost in reduplicated forms.

(22) Tagalog reduplication (Blust 2007:7, cited in Zimmermann 2021:5)

	Base		Reduplicated	
a.	*ma-basag*	'get broken'	*ma-basag-basag*	'get thoroughly broken'
	mag-sugat	'have sores'	*magka-sugat-sugat*	'thoroughly covered with sores'
b.	*laʔás*	'cracked'	*las-lás*	'ripped'
	láhad	'opening of the hand'	*lad-lád*	'opened'
	súhol	'bribe'	*sul-sól*	'instigation to do evil'
	suʔóŋ	'advance against odds'	*suŋ-sóŋ*	'go against wind'

We do not find the Tagalog forms to be convincing as evidence for the CWI because glottal insertion is a result of a historical process reliant on having disyllabic bases (Blust 1976, 2007), and the meanings of the reduplication pattern are not consistent with other productive reduplicative meanings in Tagalog. When one looks at the meanings associated with reduplication above, it is challenging to find a consistent meaning. Furthermore, reduplication in Tagalog is quite productive, occurring with over 80 different prefixes (Schachter & Otanes 1972). Of relevance here, there is a regular process that epenthesizes glottal consonants to provide onsets either at the beginning of words or in a liaison context between morphemes (French 1988), as shown in (23).

(23) Tagalog glottal insertions & vowel elision (French 1988)

/bilí/	'to buy'	+ /-in/	→ [bilhín]	'to buy X'	(p. 12)
/dalá/	'to carry'	+ /-an/	→ [dalhán]	'to carry to X'	(p. 12)

It is therefore unexpected to have such a heavily weighted constraint active in the language. To get glottals as the default epenthetic consonant, *GLOTTAL would have to be weighted lower than other places, like *CORONAL, to ensure that inserted consonants like /ʔ, h/ have a lower H score than /t, s/. There is then a puzzle as to why consonants with a coronal place are preserved in the reduplicated forms in (22b), while glottals are not.

Furthermore, it is very easy to find forms that copy glottals, that have more clearly compositional translations, and result from productive processes of reduplication. Some examples are given in (24) below. The question arising from the examples in (24) is: why are these glottal stops treated differently in reduplication? The CWI and context-free constraint would predict that they would be sensitive to it, as in (22b).

(24) Tagalog reduplication with glottal stops (from French 1988)

ʔisdáʔ	'fish'	*naŋ-ʔi-ʔisdáʔ*	'X is fishing'	(p. 23)
ʔupóʔ	'to sit'	*p-in-a-ʔu-ʔupóʔ*	'is causing X to sit'	(p. 25)
ʔupóʔ	'to sit'	*pa-ʔu-ʔupoʔ-ín*	'will cause X to sit'	(p. 25)
ʔíbig	'to love'	*ʔi-ʔibíg-in*	'will love X'	(p. 33)

We close this section by concluding that any grammar with context-free markedness constraints is prone to face problems under the assumptions of the CWI. Specifically, the CWI predicts rampant reduction of contrasts in both reduplicant and base as they will have equal activity levels and this model of reduplication does not distinguish between a base and reduplicant. This kind of widespread weakening through both a base and reduplicant is not well-attested in language. In light of this, the CWI is likely to over-generate with respect to TETU and reduction processes.

5 Summary

To summarize, the variation and conditions on "vowel reduction" in Lushootseed are the kind of pattern that GSRs predict: there are lexical exceptions that can be accounted for by positing that some lexical items have partially active segments. GSR is needed to account for the variation in the system in general. A model in which segments are weakened further by reduplication, such as the CWI, is not required. By Occam's Razor, the simpler model of reduplication we use in our analysis can account for the facts more parsimoniously.

References

Alderete, John, Jill Beckman, Laura Benua, Amalia Gnanadesikan, John McCarthy, & Suzanne Urbanczyk. (1999). Reduplication and segmental markedness. *Linguistic Inquiry* 30:327–364.

Bates, Dawn. (1986). An analysis of Lushootseed diminutive reduplication. In V. Nikiforidou, M. Van Clay, & M. Niepokuj (eds.), *Proceedings of the Twelfth Annual Meeting of the Berkeley Linguistics Society*. Berkeley, CA: Berkeley Linguistics Society Publications, 1–12.

Bates, Dawn, Thom Hess, & Vi Hilbert. (1994). *Lushootseed dictionary*. Seattle, WA: University of Washington Press.

Becker, Michael, & Kathryn Flack Potts. (2011). The emergence of the unmarked. In Marc van Oostendorp, Colin J. Ewen, Elizabeth Hume, & Keren Rice (eds.), *The Blackwell Companion to Phonology*. London, UK: Wiley Blackwell, 1363–1379.

Beckman, Jill. (1999). *Positional faithfulness: An Optimality Theoretic treatment of phonological asymmetries*. New York, NY: Garland.

Bermúdez-Otero, Ricardo. (2012). The architecture of the grammar and division of labor in exponence. In Jochen Trommer (ed.), *The morphology and phonology of exponence*. Oxford, UK: University Press, 8–83.

Bessell, Nicola, & Ewa Czaykowska-Higgins. (1993). The phonetics and phonology of postvelar consonant in Moses-Columbia Salish (Nxaʔamxcin). Toronote, ON: *Toronto Working Papers in Linguistics, CLA Proceedings*, 35–48.

Blake, Susan, J. (2000). *On the distribution and representation of schwa in Sliammon (Salish): Descriptive and theoretical perspectives*. Doctoral dissertation, University of British Columbia, Vancouver, BC.

Blust, Robert. (1976). Dempwolff's reduplicated monosyllables. *Oceanic linguistics* 15(1):107–130.

Blust, Robert. (2007). Disyllabic attractors and anti-antigemination in Austronesian sound change. *Phonology* 24:1–36.

Bye, Patrick, & Peter Svenonius. (2012). Non-concatenative morphology as epiphenomenon. In Jochen Trommer (ed.), *The morphology and phonology of exponence*. Oxford, UK: University Press, 426–495.

French, Koleen M. (1988). *Insights into Tagalog reduplication, infixation and stress from nonlinear phonology*. SIL.

Hsu, Brian. (2022). Gradient symbolic representations in Harmonic Grammar. *Language and Linguistics Compass* 16(9):1−21.

Itô, Junko. (1986). *Syllable theory in prosodic phonology*. Doctoral dissertation, University of Massachusetts, Amherst, MA.

McCarthy, John, J. (2008). *Doing Optimality Theory: Applying theory to data*. Hoboken, NJ: Wiley.

McCarthy, John J., & Alan Prince. (1994). The emergence of the unmarked: Optimality in prosodic morphology. *Proceedings of NELS* 24:333–379.

Murray, Robert, & Theo Vennemann. (1983). Sound change and syllable structure in Germanic phonology. *Language* 59:514–528.

Saba Kirchner, Jesse. (2010). *Minimal reduplication*. Doctoral dissertation, University of California, Santa Cruz, CA.

Saba Kirchner, Jesse. (2013). Minimal reduplication and reduplicative exponence. *Morphology* 23:227–243.

Schachter, Paul, & Fe T. Otanes. (1983). *Tagalog reference grammar*. Los Angeles, CA: University of California Press.

Shaw, Patricia A., Susan J. Blake, Jill Campbell, & Cody Shepard. (1999). Stress in hən̓q̓əmin̓əm̓. *Proceedings of WSCLA* 4:131–163.

Smolensky, Paul, & Matthew Goldrick. (2016). Gradient symbolic representations in grammar: The case of French liaison. Ms. Johns Hopkins University and Northwestern University. ROA 1286.

Smolensky, Paul, Matthew Goldrick, & Donald Mathis, D. (2014). Optimization and quantization in gradient symbol systems: A framework for integrating the continuous and the discrete in cognition. *Cognitive Science* 38(6):1102–1138.

Steriade, Donca. (1988). Reduplication and syllable transfer in Sanskrit and elsewhere. *Phonology*, 5(1):73–155.

Urbanczyk, Suzanne. (2001). *Patterns of reduplication in Lushootseed*. New York, NY: Garland.

Zimmermann, Ewa. (2021). Faded copies: Reduplication as distribution of activity. *Glossa: a journal of general linguistics* 6 (1):58.1–38.