# Some Remarks on the Distribution and Representation of Glottalized Resonants in Salish[*]

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**Abstract:** This paper compiles information across the Salish language family regarding the distribution and representation of glottalized resonants (GRs). It includes information about the positions, timing, realizations, and processes related to GRs, as well as discussion of how the distribution and phonological patterns involving GRs compare to ejectives. Implications for how to represent GRs are explored, and areas for further research are outlined.

**Keywords:** glottalized resonants, reduplication, phonological representations, ejectives

## 1 Introduction

Glottalized resonants (GRs) are rare cross-linguistically, but found in almost every Salish language — a notable exception is the Upriver dialect of Halkomelem. The goals of this paper are to: (i) compile information on the distribution and patterning of GRs, describe and build on observations in the literature, (ii) identify ways ejectives and glottalized resonants differ, (iii) discuss implications of this cross-linguistic survey for the representation of GRs in Salish, and (iv) discuss predictions and areas for further investigation. The bulk of the paper discusses the distribution of GRs and how they behave (Section 2), starting with a discussion of the realization (and how this connects to the articulation of GRs), followed by a brief history of the early documentation regarding how this is reflected in choices about GRs in transcription and orthography, and further outlining some key evidence that supports identifying GRs as a class of segments. As part of the discussion of the distribution, we compile information regarding where GRs are found in each language and the range of processes relevant to GRs. Included in our discussion of processes are the glottalization and deglottalization of resonants,[1] including a detailed survey of how GRs pattern in reduplication. Also, as part of the discussion of phonological processes that affect GRs, we survey what has been documented about the timing of the perceived articulatory events (i.e., creakiness or production of a glottal stop relative to voicing) used in producing GRs. A final focus includes various ways we have found that GRs differ from ejectives. After outlining these patterns, we discuss what this implies for the phonological representation of GRs (Section 3). We note that this is quite an ambitious undertaking, and therefore a final section of the paper highlights some correlations, limitations, and gaps that warrant further study (Section 4).

## 2 Distribution and patterns

### 2.1 Articulation

Glottalized resonants are complex segments involving a supralaryngeal articulation (oral or nasal), plus constriction at the glottis. The usual vocal tract setting for resonants is open and

[*] We are grateful to members of the Salish Working Group for their helpful feedback on this project.

[1] We use the term "resonant" in this paper to stay consistent with the literature on Salish and neighbouring languages, but it would also be appropriate (and accurate) to use the term "sonorant".

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aerodynamically conducive to spontaneous voicing: the air pressure above the glottis is lower than below the glottis which creates a physical condition leading to vocal fold vibration. This vocal fold vibration impedes simultaneously constricting the glottis when producing resonants. Hence, a lot of variation can be found in how these largely incompatible articulatory settings are phonetically realized in the production of GRs. Quite often GRs are pronounced as a sequence of a glottal stop plus resonant, the order of which can vary within and between languages and speakers (Bird et al. 2008). Some ways that these have been written are presented in (1). Notice that Comox-Sliammon allows both orders, depending on the location of the GR in the word.[2] In (1a), the glottal stop is transcribed following the resonant, while it is transcribed before the resonant in (1b). The phonological input or underlying representation is given first, followed by a narrow surface transcription.

(1) *Comox-Sliammon*

| | | | | |
|---|---|---|---|---|
| a. | /pal̓/ | [pálʔ] | ‘heron’ | (Blake 2000:241) |
| b. | /tin̓iqʷ/ | [téʔnɛqʷ] | ‘salmonberry’ | (Blake 2000:240) |

Another way that GRs can be produced is by creaky voicing during the articulation of the resonant. For example, in Comox-Sliammon, GRs are realized as creaky voice in the coda of unstressed syllables, transcribed with an apostrophe above the resonant. Syllable boundaries are indicated with a period below to show the coda position.

(2) *Comox-Sliammon*

| | | | | |
|---|---|---|---|---|
| a. | /hiyum̓/ | [hé.yum̓] | ‘seagull’ | (Blake 2000:241) |
| b. | /səy-say̓ǰa/ | [sí.say̓.ǰɛ] | ‘leaves’ | (Blake 2000:241) |

## 2.2 Early documentation and evidence for GR as a class of segments

Much of the early documentation of Salish languages did not recognize GRs as a class of segments, but would instead transcribe them as a sequence of a resonant and a glottal stop (Efrat 1969; Mitchell 1968). We posit the underlying representations (URs) in (3), based on phonemicization of a sequence of a resonant and a glottal stop in the original sources.

(3) *Straits*

| | | | | | |
|---|---|---|---|---|---|
| a. | /q̓éŋ̓əy̓/ | [q̓æʔⁱŋi˃ʔ] | ‘young woman’ | *T’Sou-ke* | (Efrat 1969:19) |
| b. | /čəč̓ay̓əƛ̓/ | [ch’ʌch’áyʔʌtl’] | ‘short’ | *Ləkʷéŋən* | (Mitchell 1968:121) |

[2] We have chosen to use the more common English language names in this study, due to our goal of presenting a cross-Salish comparison and engaging with the existing literature and documentation. We respectfully acknowledge that communities have chosen to use names in their own language to identify their community’s language. However, general terms to refer to the entire language or dialect continuum are not known to us for every Salish language, as for example in referring to Halkomelem and Northern Straits. In some cases, where we want to refer to specific dialects, we use the community’s terms.

Subsequent to this early documentary work, a range of evidence has been compiled to establish that, what appeared to be a sequence of segments on the surface, is best analysed phonologically as a single segment in every Salish language. We outline the kind of evidence presented from reduplication and phonotactic patterns.

One of the most compelling types of evidence for a single segment analysis is found in examining what is copied in reduplication. Reduplication provides a diagnostic for segmenthood in circumstances where the surface form (or transcription choices) suggests that the glottalized resonant is treated as a sequence of resonant and glottal stop. If the resonant and a glottal stop occur in both the base and the reduplicant, this can be treated as a single segment in the input to the phonological grammar. Though Galloway (1984) treats GRs in Nooksack as sequences of resonant and glottal stop, this requires positing two types of reduplication: one that copies three consonants when a resonant and glottal stop sequence is present (4a–b), and one that just copies two consonants elsewhere (4c). It is more consistent to analyse each example in (4) as having a $C_1C_2$ reduplicant, where two consonants are copied. In (4a–b), the copied consonants are each a single GR (/ẏ/ and /l̇/, respectively) where the realization of glottalization is a post-resonant glottal closure ([yʔ] and [lʔ], respectively).

(4) *Nooksack*

| | | | |
|---|---|---|---|
| a. | sə́lʔsəlʔtən | ‘hand spinner’ | (Galloway 1984:84) |
| b. | síyʔsiẏʔ | ‘afraid’ | (Galloway 1984:84) |
| c. | ṗəčṗíčt | ‘lots of charcoal’ | (Galloway 1984:85) |

In terms of phonotactic patterns, Efrat (1978) provides evidence that a sequence transcribed as ʔR acts like a single segment in allomorph selection. A range of phonologically conditioned allomorphs are used to express the imperfective aspect in Straits.[3] The two allomorphs that are relevant to establishing that GRs are a single segment are (i) metathesis and (ii) a glottal stop infix.

Metathesis marks imperfective aspect with $C_1C_2$V́t- stems in (5), reordering the second consonant and vowel to have the stem shape $C_1$V́$C_2$t.

(5) *Straits*[4]

| | | | |
|---|---|---|---|
| a. | tqə́t sn cə sóɬ | ‘I closed the door.’ | (Efrat 1978:252) |
| | tə́qt sn cə sóɬ | ‘I am closing the door.’ | (Efrat 1978:252) |
| b. | x̣ʷčétŋ | ‘They were killed off.’ | (Efrat 1978:252) |
| | x̣ʷéčt | ‘Wipe them out!’ | (Efrat 1978:252) |

Efrat (1978:252) observes that the glottal stop is infixed (indicated in bold), “usually after the stressed vowel”, as illustrated by the examples in (6).

[3] Those familiar with the literature on Straits may be more familiar the label “actual”, but this is the same morpheme as the imperfective described here.

[4] The examples here are of the T’Sou-ke dialect of Straits and are represented in the same format as in Efrat (1978), noting that it is likely that predictable schwas were not written. Please see Efrat (1969:33–35) for discussion of the contexts in which schwa is predictable.

(6) *Straits*

| | | | |
|---|---|---|---|
| a. | ʔíɬn tóŋəɬ | ‘Let’s eat!’ | (Efrat 1978:252) |
| | ʔíʔɬnʔ sn | ‘I’m eating.’ | (Efrat 1978:252) |
| b. | kʷɬ čóxʷŋ | ‘It’s sour.’ | (Efrat 1978:252) |
| | hiʔ cóʔxʷŋ | ‘It’s getting sour.’ | (Efrat 1978:252) |

When the second consonant of the root is a sonorant, the glottal infix allomorph is used, and the post-stressed vowel is deleted, as illustrated in (7). The glottal stop is infixed adjacent to a resonant, and this creates a GR. These roots are $C_1$əR- shaped, and are combined with the control transitive suffix /-ət/.

(7) *Straits*

| | | | | |
|---|---|---|---|---|
| a. | čénət sn | | ‘I buried it.’ | (Efrat 1978:253) |
| | čənʔt sn | → čə́nt | ‘I’m burying it.’ | (Efrat 1978:253) |
| b. | q̓ʷéyət | | ‘Cook it!’ | (Efrat 1978:253) |
| | kʷɬ q̓ʷéyʔt sn | → q̓ʷéy̓t | ‘I’m cooking it.’ | (Efrat 1978:253) |

When the root shape is $C_1$ə$R$ə$C_3$-, the imperfective is formed the same way: a glottal stop infix is inserted and the following vowel is deleted (8).

(8) *Straits*

| | | | | |
|---|---|---|---|---|
| a. | čéyəx̣ | | ‘spear fish’ | (Efrat 1978:253) |
| | čéyʔx̣ | → čéy̓x̣ | ‘spearing fish’ | (Efrat 1978:253) |
| b. | ɬémex̣ʷt | | ‘put dirt on it!’ | (Efrat 1978:253) |
| | ɬémʔx̣ʷt sn | →ɬém̓x̣ʷt | ‘I’m putting dirt on it’ | (Efrat 1978:253) |

The crucial surface forms for the present discussion are those with the shape CəṘəC- in the non-actual. If the resonant and glottal stop are a single GR, this should pattern as a triconsonantal form, and Efrat (1978) analyses these as having a glottal stop infix (which is vacuous when infixed adjacent to a glottalized resonant) and deletion of the post stressed vowel in the imperfective form, which is illustrated in (9).

(9) *Straits*

| | | | |
|---|---|---|---|
| a. | séy̓əqʷt | ‘Dig them!’ | (Efrat 1978:254) |
| | séy̓qʷt | ‘digging them’ | (Efrat 1978:254) |
| b. | ɬəy̓əqʷt | ‘Smash it!’ | (Efrat 1978:255) |
| | ɬéy̓qʷt sn | ‘I’m smashing it’ | (Efrat 1978:255) |

A final set of forms in (10) illustrates that what appears to be a sequence of glottal stop and resonant, pattern with those stems that have metathesis, the $C_1C_2$V́t shaped words, as in (5) above.

Crucially, these stems do not pattern as triconsonantal roots, which would be expected if the glottal stop and resonant were two consonants. Instead, they pattern with the biconsonantal roots. In particular note the stress pattern is like those in (5), with non-initial stress. The initial schwa is required by syllabic constraints.

(10) *Straits*

| | | | |
|---|---|---|---|
| a. | qəm̓ét | 'cut it!' | (Efrat 1978:255) |
| | qém̓t | 'cutting it' | (Efrat 1978:255) |
| b. | tən̓ét | 'Line them up!' | (Efrat 1978:256) |
| | tén̓t sn | 'I'm lining them up.' | (Efrat 1978:256) |

Since reduplication and allomorph selection provide evidence that GRs pattern as a single segment, even when written as sequences of a glottal stop and a resonant, we treat GRs as single segments that are part of the phonemic inventories of Salish languages.

### 2.3 Distribution

Several factors have been found to account for the distribution and realization of GRs (Caldecott 1999; Caldecott & Mellesmoen 2018; Bird et al. 2008). This includes: position in the word, position in a syllable, location with respect to stress, and whether or not they are adjacent to another consonant or vowel.

In surveying the information available, we located sources that reflect impressionistic description pertaining to articulation, based on fieldwork decisions regarding the timing and realization of glottalization, such as if a glottal stop is heard before or after the resonant or if creak is heard throughout the duration of the resonant. We note that there has been no specific study on articulation of GRs, aside from Esling's laryngoscopic research (e.g., Carlson et al. 2004). All other information is either based on impressionistic transcriptions or assumptions about articulatory events, inferred from acoustic analysis. Other conditions we aimed to look for in the sources available include the location of stress, whether or not a range of positions (within syllable or relative to other segments) were listed, and if there was a narrow transcription of vowels.

Undertaking a thorough and complete examination of the distribution of GRs is a complex endeavor, as not all sources provide the kind of detailed information that we were seeking. Also, not all research identifies the class of GRs, even though now they are widely assumed to be present in every language. Another complication in compiling the information is that there is a great deal of variation. This variation is of two kinds: dialect variation and also speaker variation (see Bird 2008; Bird et al. 2008; Caldecott & Mellesmoen 2018 for discussion of this type of speaker variation in Lillooet, Thompson, and Comox-Sliammon). We set aside questions of variation in timing and realization at present and focus on the general distributional patterns described in the literature.

We compiled the information into a spreadsheet and have created a table to summarize what has been documented. The table includes at least one row for each Salish language, with dialect noted when relevant. For some languages, we delved into further details. We have put ✓ to indicate that the GR is found in that position, and ✗ to indicate that GR is not found; we use (RED) to indicate that it is only found in reduplication. A blank cell means that we have not found the relevant

information and therefore should not be interpreted as absence of GRs in that position. There are very few materials available on Pentlatch, primarily Boas's field notes. As this was one of the first languages Boas documented when he came to the Pacific Northwest in 1886, his ears were not yet tuned to these sounds. Kinkade (1952–2004) has noted that Boas did not reliably transcribe glottal stops or GRs in Pentlatch. While we are assuming that Pentlatch would have had GRs, because all the neighbouring languages do, we do not include that information in our charts. Additionally, it is unclear what the distribution of GRs is in Sechelt as Beaumont (1985; 2011) describes them as not consistently used and omits them from transcription.

**Table 1:** Summary of GRs by position

| Language | #_ | C_V | V_V | X_C | _# |
|---|---|---|---|---|---|
| Bella Coola | | | ✓ | | |
| Comox-Sliammon | ✗ | | ✓ | ✓ | ✓ |
| Sechelt | | | | | |
| Pentlatch | | | | | |
| Squamish | ✗ | | | | |
| Halkomelem (Hul'q'umi'num') | ✗ | | ✓ | ✓ | ✓ |
| Straits (Saanich/Sooke) | ✗ | ✗ | ✓ | ✓ | ✓ |
| Klallam | ✗ | | ✓ | | |
| Nooksack | ✗ | | | | |
| Lushootseed | ✗ | | | | |
| Twana | ✗ | | | | |
| Tsamosan (Quinault, Lower Chehalis, Upper Chehalis, and Cowlitz) | ✗ | | | | |
| Tillamook | | | | | |
| Lillooet | ✗(RED) | ✓ | ✓ | ✓ | ✓ |
| Shuswap | ✗ | | | | |
| Thompson | ✓ | ✓ | ✓ | ✓ | ✓ |
| Colville-Okanagan | ✓ | | | | |
| Columbian/Nxa'amxcin | ✓ | | ✓ | ✓ | ✓ |
| Spokane-Kalispel-Flathead (Montana) | ✓ | | ✓ | ✓ | |
| Couer d'Alene | ✓ | | | | |

Even though there are many cells in which no information has been checked, there are some gaps and patterns that can be described across Salish based on Table 1. First, word-initial or root-initial GRs are only found in Interior languages, such as Nxa'amxcin and Thompson (11).

(11) Word-initial GRs

| | | | | |
|---|---|---|---|---|
| a. | Nxa'amxcin | m̓əɬkʷ | 'blood' | (Bird & Czaykowska-Higgins 2016:167) |
| b. | Thompson | y̓é | 'good' | (Thompson & Thompson 1992:8) |

Second, GRs seem to be found in word-final position across all languages, as shown in (12) for Comox-Sliammon, Sooke, and Thompson.

(12) Word-final GRs

| | | | | |
|---|---|---|---|---|
| a. | Comox-Sliammon | čuẏ | 'child' | (Watanabe 2003:14) |
| b. | Sooke | [cənʔ] | 'your (NON-FEM)' | (Efrat 1969:19) |
| c. | Thompson | /ʔiṁnṁ/ → [ʔip͡ʔn̥nmʔə̥] | 'make a noise' | (Carlson et al. 2004:61) |

Some of these narrow transcriptions reflect the ordering of articulations, which we discuss below (Section 2.4.3). Another general trend that can be seen from the table regards intervocalic being a common position as well.

## 2.4 Processes

In investigating the processes, we have found several patterns and conditioning factors. There are a number of purely phonological processes: resonant glottalization by assimilation, deglottalization by position and dissimilation, coalescence, and reordering. There are some morphophonological processes as well, related to infixing a glottal stop or glottal feature and how they pattern in reduplication. We begin by discussing the purely phonological conditions.

### 2.4.1 Phonological processes

The phonological processes involve glottalization and deglottalization, based purely on the phonological context. Nater (1984:19) observes for Bella Coola "sonants are automatically glottalized in the surrounding T'_V when no shwa intervenes". Unfortunately, he doesn't provide any examples to illustrate this and a review of several recordings on the Nuxalk FirstVoices™ archive of words with that context do not have any impressionistic glottalization on the following resonant. To verify this claim, acoustic study of the words with the sequence ṪRV would be warranted.

Glottalized resonants can also arise by coalescence. As was illustrated above, for Straits, a glottal stop infix can coalesce with a resonant to create a GR (7–8). We consider this to be purely phonological, as it is simply a case of two segments that arise due to a morphological process, much like voicing assimilation in English plural affixation.

Resonant deglottalization can arise in a few different ways. Flemming et al. (2008) observe that in Montana Salish, when two GRs are adjacent, there is a process of deglottalization, that varies from speaker to speaker (13). We analyse this as a case of dissimilation.

(13) Montana Salish dissimilatory deglottalization

| | | |
|---|---|---|
| /ɬəṁṁoc/ | [ɬəˀmˀmóts] ~ [ɬəmˀmːóts] ~ [ɬəˀmːˀmóts] | 'soft' |

(Flemming et al. 2008:476)

Flemming et al. (2008:476) also cite the following: "Thompson and Thompson (1992) note a similar phenomenon in Thompson Salish (p.45), but state that the initial glottalized sonorant always

retains glottalization". It would be useful to know how glottalization is realized in these contexts as well.

There is also a process where GRs can deglottalize in certain positions, so would be cases of positional neutralization. Caldecott (2009:63) describes a process whereby underlying GRs are realized as plain in certain prosodic positions: "a resonant following a footed, unstressed vowel surfaces as glottalised and a non-glottalised resonant occurs elsewhere".

We have a summary table of the purely phonological patterns we are aware of, providing an example of a language with this process. This is not an exhaustive list and we note that there is much more research to be done to compile information on phonological processes affecting GRs.

**Table 2:** Processes found related to GRs

| Process | Language |
|---|---|
| Assimilation | e.g., in Nuxalk (according to Nater 1984) |
| Coalescence | e.g., in Straits |
| Dissimilation | e.g., in Spokane-Kalispel-Flathead (Montana Salish) |
| Deglottalization by Position | e.g., in Lillooet |

### 2.4.2 Morphophonological processes

We classify a resonant glottalization process as morphophonological when it is associated with meaning. This includes how imperfective is expressed in Hulq'umi'num', the Island dialect of Halkomelem. Resonant glottalization accompanies other stem modifications, regardless of whether it is reduplication, a glottal infix, sonorant devoicing, or vowel deletion, as indicated in (14).

(14) *Hul'q'umi'num'*

| | | | | |
|---|---|---|---|---|
| a. | t̓íləm | 'sing' | t̓ít̓ələm̓ | 'singing' |
| b. | hésəm | 'sneeze' | hé?səm̓ | 'sneezing' |
| c. | ləc̓ət | 'fill it' | həl̓c̓t | 'filling it' |
| d. | łát̓əq̓ʷəm | 'snore' | łát̓q̓ʷəm̓ | 'snoring' |
| e. | t̓kʷəwəł | 'patch a canoe' | t̓əkʷəẇəł | 'patching a canoe' |

(Hukari & Peter 1995)

There are several meanings in which resonants are glottalized, such as diminutive, across the Salish language family. Undoubtedly, a thorough study of the conditions under which resonants get glottalized will lead to further understanding GRs as a class. Especially given what is known about the neutralization of glottalization in some languages, other aspects of their patterning could be learned by a thorough cross-linguistic study of the semantics associated with resonant glottalization. We leave that for future research, just noting that resonant glottalization can serve as an exponent of some meanings.

### 2.4.3 Timing

As noted by many researchers, the timing of the laryngeal and supralaryngeal articulations can vary with GRs. In addition to the conditions identified by previous researchers, we also include vowel quality, as we have found that the order of articulations is dependent on whether or not the vowel

is a schwa in some of the Central Salish languages we are familiar with. For example, in Hul'q'umi'num', the spelling reflects the order of articulatory events, where an apostrophe indicates the glottal stop portion. The usual order is for the glottal articulation to follow the resonant articulation. However, when the GR is in the onset, following a full vowel, it is pre-glottalized (15d). Note that for (15c), the same intervocalic context has the reverse order when the preceding vowel is schwa.

(15) *Hul'q'umi'num'*

a. word-finally
lelum' 'house'
meen' 'weak'

b. pre-consonantal
t'em'xw 'gooseberry'

c. intervocalic, after schwa
mun'u 'child'
sxun'u 'leg, foot'

d. intervocalic after full vowel
sta'lus 'spouse'
xwi'lum' 'rope'

(Hukari & Peter 1995; Hul'q'umi'num' Language Academy)

The table below summarizes what has been found. The languages are listed along the side, and the conditions are indicated in the columns. We indicate the order of perceived articulatory events as follows: if it has been transcribed with a glottal stop, we indicate it either as ʔR or Rʔ, depending on whether the glottal stop precedes or follows the resonant. If it has creaky voice or a mid-realization (as defined in Bird et al. 2008), we indicate the GR as Ṛ, with an apostrophe above. The top row outlines positions according to syllable and stress, as well as the end of word. The final column includes the context of a GR following a schwa. We do not include syllable position here. We re-interpret some of the information for comparative purposes, but note that this interpretation depends on knowing precise information regarding syllable position. The second row indicates Galloway's (1988) environments, to accurately convey his work, which did not include reference to syllable position. Once more, a blank does not indicate an absence in the language, but instead that we have not found relevant documentation that clearly indicates the order.

**Table 3:** Timing of laryngeal (ʔ) and supralaryngeal (R) articulations, and creak (Ṙ)

| Galloway (1988) | Post-stress: onset V'_V | Post-stress: coda V'__C, # | Unstress: coda V_# | Pre-stress: onset X_V'[5] | #_ | ə_ |
|---|---|---|---|---|---|---|
| Bella Coola | | | | | ✗ | |
| Comox-Sliammon | ʔR | Rʔ | Rʔ, Ṙ | Rʔ | ✗ | ʔR |
| Sechelt | Rʔ | Rʔ | R | R | ✗ | |
| Squamish | Rʔ | Rʔ | Rʔ | Rʔ | ✗ | |
| Halkomelem | ʔR | Rʔ | Rʔ | Rʔ | ✗ | Rʔ |
| Straits | Rʔ | Rʔ | Rʔ | Rʔ | ✗ | Rʔ |
| *Saanich, Songhees* | | | | | | |
| Straits | ʔR | Rʔ | Rʔ | Rʔ | ✗ | Rʔ |
| *Lummi, Samish, Sooke* | | | | | | |
| Klallam | ʔR | Rʔ | Rʔ | Rʔ | ✗ | |
| Nooksack | ʔS | R, Rʔ | R, Rʔ | R, Rʔ | ✗ | |
| Lushootseed | ʔR | Rʔ, R | Rʔ | Rʔ | ✗ | |
| Twana | ʔR | ʔR | R | R | ✗ | |
| Tsamosan Languages | | | | | ✗ | |
| Tillamook | | | | | ✗ | |
| Lillooet | Rʔ | Rʔ | Rʔ, ʔR, Ṙ: V_V | ʔR, Ṙ: V_V | ✗ | |
| Thompson | Rʔ | Rʔ | Rʔ | Rʔ | ✗ | |
| Shuswap | | | | | ✗ | |
| Spokane-Kalispel-Flathead | ʔR | ʔR | ʔR | ʔR | ʔR | ʔR |

**Sources:** Comox-Sliammon: Blake (2000)
Other Central Salish languages: Galloway (1988)
Thompson, Lillooet: Bird et al. (2008)
Montana Salish: Flemming et al. (2008)

While we have primarily drawn on others' research, in terms of identifying contexts related to prosodic structure, such as stress and syllable structure, we have also found that vowel quality can be a factor in the ordering of articulatory events. The order of articulations in some languages (mostly Central Salish) can be adjusted to avoid having a glottal stop in the coda following schwa (16a). In these languages, the constraint *əʔ]$_\sigma$ seems to also be obeyed by changing the vowel quality, by lowering as in (16b).[6]

[5] Galloway (1988) did not specify that this context include any segment preceding, but we have added an X to indicate that it cannot be considered word-initial, as GRs are not found word-initially in Central Salish, which was the focus of Galloway's work.

[6] Comox-Sliammon also lowers schwa before a glottal stop in the coda (Blake 2000).

(16) *Straits*

| | | | | | |
|---|---|---|---|---|---|
| a. | [c̓ə́ŋʔəɬ] | | *[c̓ə́ʔŋəɬ] | ‘chest’ | (Efrat 1969:19) |
| b. | /t̓éqəʔ/ | → | [t̓æqaʔ] | ‘salalberry’ | (Efrat 1969:19) |

This effect of vowel lowering suggests that GRs act as two segments, in terms of conditioning factors for allophonic alternations.

In terms of general findings, there are some languages which are quite flexible in the ordering of articulations, some languages which show a great deal of variability, even when controlling for certain contexts, such as pre-stress. There are also some languages with a fixed order. It is interesting to note that the languages that have a fixed order also seem to be those that allow GRs word-initially. We now turn to cases in which GRs pattern as single segments.

### 2.4.4 Reduplication patterns

Observing how glottalized resonants are treated in reduplication provides insight into their underlying structure. Cross-Salish reduplication patterns are relatively uniform in the number of segments that are doubled in reduplication — all languages make use of a $C_1C_2$ reduplication process to mark some kind of plurality, for example. Given that most Salish languages lack initial GRs, we find that looking at $C_1C_2$ reduplication to be the most illustrative for learning more about GRs.

#### 2.4.4.1 Reduplication and glottalized resonants

Many Salish languages allow a faithful copy of a glottalized resonant in reduplication (glottalized-glottalized). This is true of every Interior Salish language except Shuswap (e.g., 17–18). The existing data for Tsamosan languages and Bella Coola also fit with this pattern (e.g., 19–20).[7]

(17) *Lillooet*

| | | | |
|---|---|---|---|
| a. | p’ən’p’an’án | ‘to fold something up’ | (van Eijk 2011:56) |
| b. | qʷəl’qʷal’əl’t | ‘to have a conversation’ | (van Eijk 2011:57) |

(18) *Thompson*

| | | | |
|---|---|---|---|
| a. | n-łəm’-łém’-tn | ‘containers’ | (Jimmie 1994:90) |
| b. | ƛ’ən’-ƛén’i | ‘ears’ | (Jimmie 1994:66) |

(19) *Lower Chehalis*

| | | | |
|---|---|---|---|
| | qʷím n-s-yíl̓-yil̓-iʔ | ‘I’m just walking around.’ | (Robertson 2014:123) |

(20) *Quinault*

| | | | |
|---|---|---|---|
| | kəlt ǰáy’ǰay’əm | ‘We told stories.’ | (Rowicka 2006:463) |

[7] The languages where this is more unclear at present are Upper Chehalis and Cowlitz. Newman (1971:37) gives *ʔin̓ʔin̓a-* as the continuative of ‘give food’, but this is not a full word and the corresponding word in Nater (1984:117) does not have glottalization marked on either resonant.

There appears to be a divide within Central Salish and the other branches of the family with respect to reduplication of glottalized resonants. This may be a result of the more tenuous status of glottalization on resonants in these languages: it has been lost completely in Upriver Halkomelem, for example, and is falling out of use in Sechelt (Beaumont 1985), and Comox-Sliammon (Watanabe 1994; Caldecott & Mellesmoen 2018).

Some languages follow the glottalized-glottalized pattern where glottalized resonants may be copied faithfully (Lushootseed, Nooksack, Klallam), but many show a plain resonant as the copy of a glottalized resonant (glottalized-plain). Languages with the glottalized-plain pattern include Twana, Comox-Sliammon, and Squamish. Within Straits and Halkomelem, there are differences between dialects of the languages. Though Samish and Saanich have a glottalized-glottalized pattern in reduplication, Songish is glottalized-plain. In Halkomelem, the Island dialect is glottalized-glottalized and the Upriver dialect has no resonant glottalization and therefore is (superficially) plain-plain. Musqueam shows a more complicated pattern with variation between speakers where both patterns are attested. It is not possible from available data to draw any conclusions about Pentlatch and Sechelt.[8]

(21) *Klallam*

| | | | |
|---|---|---|---|
| a. | c̓əm̓c̓əm̓úʔəŋ̓ | ‘getting all wet’ | (Montler 2014:313) |
| b. | čəm̓čəm̓əsnə́kʷi | ‘meeting’ (plural) | (Montler 2014:314) |

*Lushootseed*

| | | | |
|---|---|---|---|
| c. | dáy̓ay̓ | ‘alone’ | (Hess 1967:66) |

(22) *Comox-Sliammon*[9]

| | | | |
|---|---|---|---|
| a. | čəyčuy̓ | ‘children’ | (Watanabe 2003:327) |
| b. | ƛəm̓ƛəm | ‘wet’ | (Watanabe 2003:398) |

(23) *Dialects of Straits*

*Samish*

| | | | | | |
|---|---|---|---|---|---|
| a. | qénʔ | ‘to steal’ | qénʔqenʔ | ‘thief’ | (Galloway 1990:10) |

*Saanich*

| | | | | | |
|---|---|---|---|---|---|
| b. | qeṅ- | ‘steal’ | š-qéṅqəṅ | ‘They are a thief.’ | (Montler 1986:97) |

[8] This is due to the decline in use of glottalized resonants among younger speakers of Sechelt (Beaumont 1985), which makes the interpretation of dictionary data more difficult without knowing which speakers produced which forms.

[9] The difference in whether the first resonant or the second resonant is glottalized corresponds to a difference in function. The reduplication in (22a) is plural, while (22b) is characteristic.

*Songish*

c. qénʔ ‘to steal’ qénʔqən ‘thief’ (Raffo 1972:14)

(24) *Dialects of Halkomelem*

*Island Halkomelem*

| | | | |
|---|---|---|---|
| a. | qen’<br>‘steal’ | qun’qun’ ~ qen’qun’<br>‘thief’ | qelun’qun’<br>‘thieves’<br>(Hukari & Peter 1995:56) |

*Upriver Halkomelem*

b. qɛ́:l ‘steal’ qəlqəl ‘thief’ (Galloway 1977:69)

*Musqueam*

| | | | |
|---|---|---|---|
| c. | qéṉ<br>‘steal’ | qə́ṉqəṉ ~ (wə-)qə́nqən<br>‘thief’ | qélə̓ṉqəṉ ~ (nəxʷs-)qələ́nqəṉ<br>‘thieves’<br>(Suttles 2004:179,181) |

The other insight provided by examining reduplication patterns is that it gives information about a second type of resonant glottalization: resonant glottalization that arises from a morphological process. This is observed quite productively in Halkomelem. Musqueam has a glottalized-plain pattern, but there are some forms where glottalization occurs on both resonants. The source of glottalization (either lexically specified or assigned in conjunction with reduplication as part of a morphophonological process) is relevant.

(25) *Musqueam*

| | | | | | |
|---|---|---|---|---|---|
| a. | híləm | ‘fall, roll’ | b. | híl̓əm | PROG |
| c. | həlhíləm | PL PERF | d. | hilhíl̓əm | PL PROG (Suttles 2004:168) |

(26) *Musqueam*

| | | | | | |
|---|---|---|---|---|---|
| a. | nəẇ̓əx | ‘insert it’ | b. | həṉwəx | PROG |
| c. | nəẇ̓nəẇ̓əx | PL PERF | d. | hənhəṉwəx | PL PROG (Suttles 2004:170) |

Taken together, the glottalized-glottalized pattern in reduplication supports treating glottalized resonants as a single segment in those dialects and languages. This diagnostic is inconclusive in languages with a plain-glottalized pattern, as the non-faithful (plain) copy could arise as an emergence of the unmarked pattern or as the result of other phonological constraints. This is certainly the case in Shuswap: a Grassmann’s Law pattern is observed in words with ejectives and, therefore, deglottalization of a resonant could be motivated as a process independent of reduplication (Thompson & Thompson 1985).

**Table 4:** Summary of GR patterns in reduplication

| | |
|---|---|
| Glottalized + Glottalized | Lillooet<br>Thompson<br>Coeur d'Alene<br>Okanagan<br>Spokane<br>Moses Columbia<br>Nooksack<br>Klallam<br>Samish/Saanich (Straits)<br>Lushootseed<br>Musqueam* |
| Plain + Glottalized | Shuswap<br>Comox-Sliammon<br>Island Halkomelem and Musqueam*<br>Songish (Straits)<br>Squamish<br>Twana |
| Plain + Plain<br>(*no GRs*) | Upriver Halkomelem |
| Unclear | Pentlatch<br>Sechelt<br>Upper Chehalis<br>Cowlitz<br>Bella Coola |

* both patterns occur

Notice that the most common pattern is: Ṙ-Ṙ, then R-Ṙ, with some cases of Ṙ-R. In the latter case, second (plain) resonant is part of a reduplicative affix (as in Comox-Sliammon, for example). We now turn our attention to whether or not there are asymmetries with reduplication in ejectives. We find a similar asymmetry, where the most common pattern is identity, and some languages can neutralize the contrast in the copy/affix, but not the base/stem.

#### 2.4.4.2 Reduplication and ejectives

We begin by making a few observations about how ejectives differ from GRs and how GRs fit into the larger consonant inventory; this will help to understand which phonological features may be present, and how GRs behave in phonological patterns. Van Eijk (2011) notes that (phonetically) ejectives are different than glottalized resonants because the oral closure and release are simultaneous for ejectives. This is different from glottalized resonants which show variation across and within a language with respect to the timing of the acoustic correlates of glottalization (see Bird et al. 2008).

In the Upriver dialect of Halkomelem, glottalization of resonants and glottal stops have been lost, but ejectives remain. There are two observations to make: (i) post-vocalic glottal stops and the

glottalization on resonants have been lost in tandem, which may suggest a resonant-glottal stop sequence at some point in history and the loss of a single element (the glottal stop following any resonant or vowel) which resulted in the loss of GRs, or possibly, (ii) that ejectives have a different structure.

(27) a. *Upriver Halkomelem*

| | | |
|---|---|---|
| q̓áw | 'howl' | (Galloway 1977:514) |

b. *Musqueam*

| | | |
|---|---|---|
| q̓éẇəm ~ q̓éẇəm̓ | 'be howling' | (Suttles 2004:528) |

In the previous section, it was established that reduplication of GRs in Shuswap fits into the plain-glottalized category. This is the same pattern found with ejectives in the language: there is maximally one ejective segment in a word following the Grassmann's Law that Thompson and Thompson (1985) propose, which means reduplication of an obstruent results in one plain and one ejective consonant (plain-ejective), as indicated in (28a). However, Urbanczyk (1992) observes that words in Shuswap may have both a single ejective and a glottalized resonant (28b). This suggests that while a similar mechanism (barring multiple GRs or multiple ejectives) might be at play, the two classes of sounds are still distinct at some level.[10]

(28) *Shuswap*

| | Root | Reduplicated Word | Reduplicated Word Meaning |
|---|---|---|---|
| a. | k̓il̓- | skik̓l̓ | 'Rocky mountain pica' |
| b. | k̓eẏ- | skek̓ẏ | 'spider' |

(Urbanczyk 1992, from Kuipers 1974)

Most languages do not show as striking parallel dissimilatory behaviour between ejectives and glottalized resonants as what is found in Shuswap. For example, Comox-Sliammon has a plain-glottalized pattern for resonants in reduplication as well (29b), but reduplicated ejectives remain ejective in reduplication (29a). Other languages show deglottalization in reduplication, similar to Shuswap, but in a much more restricted manner. In Okanagan, /ƛ̓/ may be reduplicated as a plain obstruent when it is not root-initial (30a), though it remains glottalized when reduplicated and root-initial (30d). In contrast, any other root-initial ejective is reduplicated as a plain obstruent (30b–c).

(29) *Comox-Sliammon*

| | | | |
|---|---|---|---|
| a. | gəq̓gəq̓ | 'all of them opened' | |
| b. | čəyčuẏ | 'children' | (Watanabe 2003:327,373) |

[10] The glottal stop is also not part of the restriction on ejectives.

(30) *Okanagan*

a. skʷtkʷƛ̓ús
s-kʷƛ̓-kʷƛ̓-(ú)s
'They are eyes.'

b. tənt̓ína?
t̓n-t̓ína?
'They are ears.'

c. pənp̓ína?
p̓n-p̓ína?
'They are baskets.'

d. ƛ̓ə?ƛ̓a?kʷílx
ƛ̓?-ƛ̓a?kʷílx
'They are medicine men.' (Mattina 1973:24)

In contrast, Bella Coola shows a particular pattern when obstruents undergo reduplication: an ejective may be reduplicated as a glottal stop (note that initial glottal stops are not written in the orthography).

(31) *Bella Coola*

| | | | | |
|---|---|---|---|---|
| a. | p'wi | 'halibut' | up'wii | 'halibut, DIM.' |
| b. | p'c | 'crabapple' | icp'iclhp | 'crabapple tree' |

(Nater 1990:89–90)

Having pointed out some differences between ejectives and GRs in reduplication, we now turn our attention to those differences in general.

### 2.5 Differences between GRs and ejectives

In addition to patterning differently in reduplication, GRs differ from ejectives in a number of ways. This is likely due to the articulatory compatibility found for ejectives, of constricting the glottis, while there is an oral closure with stops and affricates (as in articulatory binding, for example, in which the glottal articulation is "bound" to the stop release, see Kingston 1985).

#### 2.5.1 Consonant inventories

One of the most striking differences between how glottalization patterns in obstruents and sonorants is that there are many more symmetrical patterns in GRs than with ejectives. With obstruents there can be gaps in the plain-ejective pairs, as well as differences in place and manner. However, with GRs there is more symmetry: if a language has a GR, it also has a plain counterpart. The following charts represent the glottal contrasts on obstruents that are unexpected, or not symmetrical. We have omitted uvulars in all languages, noting that uvular ejectives are the least marked, both in

terms of distribution and articulation, and these are found in every language. Second, all languages except Tillamook have /p/, /ṗ/, /kʷ/, /k̓ʷ/, /qʷ/, /q̓ʷ/ because Tillamook has lost all labial consonants, and these are also omitted from Table 5 and Table 6. Table 5 does not include /t/ and /t̓/, as these are found across the Central Salish languages, and Table 6 does not include /c/ and /c̓/ (found across the languages included in the table) or /tᶿ/ and /t̓ᶿ/, which are only found in Central Salish languages. Retracted and voiced consonants are also omitted.

**Table 5:** Central Salish languages

| | c | c̓ | tᶿ | t̓ᶿ | ƛ | ƛ́ | č | č̓ | k | k̓ |
|---|---|---|---|---|---|---|---|---|---|---|
| Comox-Sliammon (Watanabe 2003) | | | ~ | ✓ | ~ | ✓ | ✓ | ✓ | ~ | ~ |
| Sechelt (Beaumont 1985) | ✓ | ✓ | | | | ✓ | ✓ | ✓ | ✓ | ✓ |
| Pentlatch (Kinkade archival material)^ | | ✓ | | | | ✓ | ✓ | ✓ | ~ | ~ |
| Upriver Halkomelem (Galloway 1977) | ✓ | ✓ | | ✓ | | ✓ | | | ~ | ~ |
| Musqueam (Suttles 2004) | ✓ | ✓ | ~ | ✓ | | ✓ | ~ | | ~ | ~ |
| Lushootseed (Hess 1967) | ✓ | ✓ | | | | ✓ | ✓ | ✓ | ✓ | ✓ |
| Twana (Drachman 1969) | ✓ | ✓ | | | | ✓ | ✓ | ✓ | ✓ | ✓ |
| Nooksack (Galloway 1984) | ✓ | ✓ | | | | ✓ | ✓ | ✓ | ~ | |
| Straits – Saanich (Montler 1986) | | | | ✓ | | ✓ | ✓ | ✓ | ~ | |
| Klallam (Montler 2015) | ✓ | ✓ | | | | ✓ | ✓ | ✓ | ~ | |
| Squamish (Dyck 2004) | ✓ | ✓ | | | | ✓ | ✓ | ✓ | ~ | ~ |

**Table 6:** Interior and Tsamosan languages, plus Tillamook and Bella Coola

| | t | t̓ | ƛ | ƛ́ | č | č̓ | k | k̓ |
|---|---|---|---|---|---|---|---|---|
| Tillamook (Edel 1939) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Upper Chehalis (Kinkade 1963) | ✓ | ✓ | | ✓ | ✓ | ✓ | ~ | ~ |
| Lower Chehalis (Robertson 2014)^ | ✓ | ✓ | | ✓ | ✓ | ✓ | ~/✓? | ~/✓? |
| Cowlitz (Kinkade 2004) | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ |
| Quinault (Rowicka 2006)^ | ✓ | ✓ | | ✓ | ✓ | ? | ~ | ? |
| Spokane (Carlson 1972) | ✓ | ✓ | | ✓ | ✓ | ✓ | | |
| Okanagan (Mattina 1973) | ✓ | ✓ | | ✓ | | | ✓ | ✓ |
| Moses Columbia (Willett 2003) | ✓ | ✓ | | ✓ | | | ✓ | ✓ |
| Coeur d'Alene (Reichard 1938) | ✓ | ✓ | | | ✓ | ✓ | | |
| Thompson (Jimmie 1994) | ✓ | ~ | | ✓ | | | ✓ | ✓ |
| Shuswap (Kuipers 1974) | ✓ | ✓ | | ✓ | | | ✓ | ✓ |
| Lillooet (van Eijk 2011) | ✓* | | | ✓* | | | ✓ | ✓ |
| Bella Coola (Nater 1984) | ✓ | ✓ | | ✓ | | | ✓ | ✓ |

**Key**: ✓ author gives as a phoneme
~ noted by author as marginal or rare
* these ejectives may be considered as a pair
^ from data
? unclear from source

**Notes:** Galloway notes some consultants that use [t̓ᶿ] for /c̓/ in Nooksack

A second general difference related to inventories is that GRs seem more additive. Because there are numerous morphological processes to create GRs, the addition of glottalization to a resonant seems to be consistently adding just glottalization, with no effect on place or manner. This is likely due to the relatively independent articulations involved in each (Bird 2011).

### 2.5.2 Processes

Having established the asymmetries in phonemic inventories that exist for ejectives in comparison to GRs, it is also important to examine if there are differences between the how the ejectives and GRs behave in phonological processes. While a detailed and thorough examination of each Salish language is beyond the scope of this preliminary study, we note that glottalization on obstruents seems much more stable (such that it is rarely lost from, or added to a segment), and so is not affected the same as with resonants. On the other hand, GRs can arise through various sources in addition to being lexically specified. The following description about Thompson is illustrative:

> [GRs] are only superficially parallel to glottalized (ejective) stops. The stops are integral, with just a very few cases of apparent derivation from combination of a plain stop with a following [ʔ]. Glottalized resonants, on the other hand, are commonly derived, there being a fair number of morphological processes calling for glottalization of underlying plain resonants.
>
> (Thompson & Thompson 1992:5)

In reviewing the differences between GRs and ejectives, we have found two striking differences. First, there is more symmetry between plain and glottalized resonants in the phonemic inventory than there is between plain and ejective obstruent pairs. For example, there are gaps in the obstruent contrasts. Also, in some languages, like Lillooet, the contrast in glottalization is accompanied by a difference in manner: an alveolar stop contrasts with an ejective lateral affricate. No such asymmetries for place or manner have been found for resonants. The second difference relates to articulatory stability, whereby ejectives are much less likely to alternate than GRs, as noted above for Thompson. The neutralization patterns found for ejectives are limited to a few cases of reduplication in some Interior Salish languages, such as Shuswap.

## 3 Implications for representing GRs

Having outlined some of the general patterns, we now discuss some of the implications these patterns have for the phonological representation of GRs. We propose that many of the enigmatic qualities of GRs follow from looking at how to reconcile incompatibility at different levels, as related to the phonology-phonetics interface and the phonology-morphology interface. GRs provide a window into the architecture of the grammar. The central enigmatic property of GRs is that they seem to pattern as two segments for the phonological component, but one segment for the morphological component.

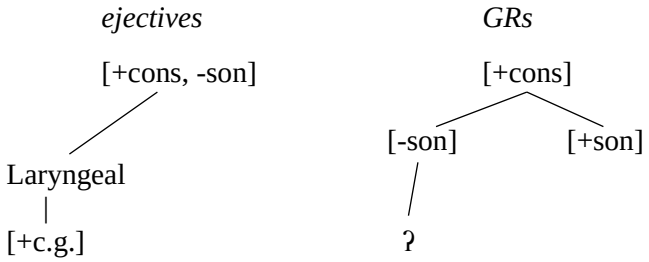
Regarding patterning as two segments in the phonological component, there are several converging findings. The first relates to phonetic realization and variation. Parametric variation in glottal timing has been argued to be subject to language specific grammar, or the phonological component (Howe & Pulleyblank 2001; Bird et al. 2008). Phonetic or functional goals of maximizing perceptual differences have not been able to account for the language particular variation in timing. Second, evidence for GRs patterning as two segments in the phonology comes from looking at the role of vowel quality in the timing of laryngeal and supralaryngeal articulations. GRs seem to pattern as two segments. The phonological constraint *əʔ]$_{\sigma}$, which bans having a

glottal stop in the coda following a schwa, is obeyed in two different ways: by ordering the articulations to have the resonant first, or by changing the vowel.

In terms of the phonological representation of the class of segments, we observed several differences between GRs and ejectives, as well as some interesting cooccurrence restrictions. Recall that in Shuswap there is a cooccurrence restriction that no glottalized segments — from the same class — can occur in the same form. So, there are no cases of T̓T̓ or R̓R̓. However, we did find T̓R̓. This type of OCP restriction does not hold when glottalization is on different classes, so implies that ejectives and GRs are representationally different. Differences in phonological activity between GRs and ejectives also implies a representational difference between the two classes of segments. We explore some possible ways to capture these differences, classified into two broad approaches: (i) they are the same phonologically at the UR: perhaps both are specified with the feature [+c.g.], but the expression of [+c.g.] is realized differently at the surface, due to language-specific phonetic implementation; and (ii) GRs and ejectives could be different phonologically at the UR, which accounts for the patterns. We explore several scenarios below.

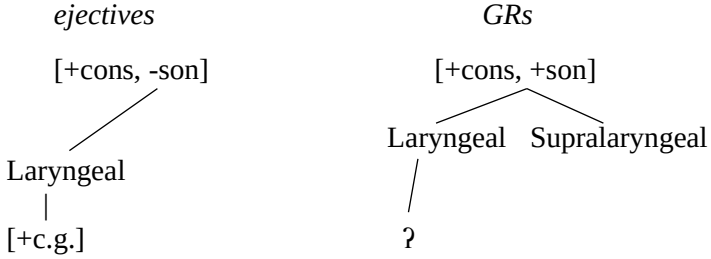
In one situation, ejectives could be specified with [+c.g.], but GRs could be represented as a contour segment consisting of two articulatory components: a glottal stop plus resonant (as in Urbanczyk 1992).

(32)




This proposal that GRs are contour segments can account for some of their enigmatic properties, such as acting like two segments articulatorily, but one for morphological purposes, like reduplication. It also accounts for how GRs pattern with glottal stops: they are literally composed of them. It would also account for differences between ejectives and GRs in terms of the coalescence of glottal stop and sonorants, as a type of economy of effort/representation effect. However, it crucially assumes that glottal stops are not sonorant — a not uncontroversial assumption in Salish. This doesn't mean that this general approach is incorrect. It just involves possibly adjusting the featural specification of the glottal stop. If glottal stops are sonorant, then the following structures could represent their differences. The representation on the right could arise from a sequence of glottal stop + resonant, especially if sonorants are underspecified for laryngeal features. One way for them to acquire a Laryngeal feature would be to fuse with a glottal stop.

(33)



Another way to represent resonants and obstruents differently could be to have different features, so adopting [SV] (Sonorant Voice) for resonants (Rice 1993) which is lacking for obstruents. It could be that both have the laryngeal feature [+c.g.], but that they are realized differently depending on what the major class feature is that distinguishes obstruents from resonants. The phonological grammar could thus treat these classes differently because they do not have the same feature associated with the glottalized resonants. In order to account for voiced obstruents that developed from Proto-Salish resonants and still pattern as resonants with respect to their phonological behaviour, Mellesmoen (2018) argues that [SV] feature is more appropriate. A feature like [c.g.] that sits beneath [SV] could account for these differences.

Another approach to accounting for the activity of GRs is that different patterns could reflect different strata (Bermúdez-Otero 2012), as can be identified by different phonological patterns. For example, the differences in Halkomelem glottalization patterns that arise in multiple reduplication (see example 25 and 26 in Section 2.4.4.1) could be related to where and how GRs are formed at various points in the phonological derivation. Whether or not the glottalization is copied could follow from whether or not it is an underlying or lexical GR or whether glottalization arises due to a morphophonological process, in which case it is not copied. A GR could be one segment in input, and available to be copied, but a GR later in the phonological derivation could be treated as two segments.

Finally, we note that the reduplication patterns found fit in with a general pattern of phonological alternations, referred to as "the emergence of the unmarked" in reduplication (TETU, McCarthy & Prince 1999). It is frequently the case that the copied portion of a word eliminates marked structures that are permitted in the base. We found this for glottalization on both ejectives and GRs. Most languages maintain identity in the copied portion. However, there are some languages in which the copied portion is plain (Comox-Sliammon for GRs, and Okanagan for ejectives). The processes of glottalization and deglottalization are more common on resonants, which likely relates to why this TETU pattern is more common on resonants than obstruents.

## 4 Discussion

Finally, we summarize our findings and point out gaps and potential directions for future research as well as some limitations. How glottalization ([+c.g.]) is realized phonetically is dependent on position, including whether it is in a stressed or unstressed syllable. Examining the morpho-phonological patterns and phonetic realization of GRs allows us to examine the interfaces between morphology and phonology, and between phonology and phonetics. At the morphological level, GRs are a single segment, but later in the phonological derivation and phonetic implementation, they may act like two segments. As intriguing as these findings are, there are limitations to this preliminary study. For example, in undertaking this research, we have not been able to check for every possible position and pattern for every Salish language. Moving forward, the blanks in the charts can serve as a guide for further research to identify relevant patterns and types of variation.

A key limitation is also the scope and depth of what has been documented and recorded in the literature on Salish languages. We are indebted to all those previous researchers, but are also keenly aware that it would be helpful to learn more about other aspects of the realization of GRs, such as carefully controlling for stress, syllable structure, and vowel quality. Also, documenting creak and pitch changes, including how these vary between and within speakers, would be helpful as well in terms of understanding the pathway of language change. Additional, future work should explore how GRs and voiced obstruents compare with respect to the phonetics and phonology of

glottalization and voicing, particularly as both voiced obstruents and resonants in Salish can be analysed as having a [SV] feature.

A key area for future research is understanding the extent to which correlations in the distribution and acoustic realization of GRs follow from some underlying linguistic principles. For example, the Southern Salish languages are the only ones to have GRs in word-initial position and they are also the only languages to have a relatively fixed timing of articulatory events. Is this correlation due to some deeper principle, or is it simply that the two parameters coincide in these languages because they come from a common source? Another related question is to what extent GRs across the languages interact with a *ə?]$_\sigma$ constraint. For example, do the Southern Interior Salish languages, which have the order ʔR, also change the vowel quality of schwa?

Finally, we note that this research on GRs also has the potential to shed light onto the general debate in phonological theory about whether or not features have phonological substance or not, and if so, what is the nature of that substance? Vowel quality, aerodynamics and abstract combinations are all components of understanding the patterns and realization of GRs and therefore this is an area that deserves more systematic research across Salish, as well as cross-linguistically, in order to further develop phonological theory and typological predictions.

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