Tetsót’iné prefix vowel length: Evidence for systematic underspecification

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Abstract
Tetsót’iné is a dialect of Dëne Sųhné (ISO: CHP) spoken in Canada’s Northwest Territories. The verb system of Tetsót’iné has only recently been described (Jaker and Cardinal 2020); this paper is the first to propose an analysis of the distribution of long and short vowels in Tetsót’iné prefixes. In Tetsót’iné, all long vowels in prefixes are derived from intervocalic consonant deletion, although not all cases of intervocalic consonant deletion result in a long vowel. Whether or not deletion of an intervocalic consonant results in a long or short vowel depends on a combination of two factors: the consonant that was deleted, and the morphological level to which the preceding prefix belongs. In this paper, I propose that the basic generalization about prefix vowel length can be stated in terms of SYSTEMATIC UNDERSPECIFICATION (Kiparsky 1993). I claim that prefix vowels, unlike stem vowels, have zero moras underlyingly, and only acquire a mora after passing through at least one level of the phonology. This analysis predicts that prefix vowel length ought to be subject to a Derived Environment Effect (DEE), for which there is indeed evidence. The pattern of mora insertion in Tetsót’iné prefix vowels is thus an example of the interleaving of phonology and morphology, and illustrates how phonological behaviour can be to some extent predicted based on morphological structure.

Keywords Dene · Athabaskan · Lexical phonology · Underspecification · Contrastivist hypothesis · Non-derived environment blocking

1 Introduction: Prefix vowels and consonant deletion

Tetsót’iné is a dialect of Dëne Sųhné (ISO: CHP), a Dene (Athabaskan) language, spoken in Canada’s Northwest Territories. In the Lexical Phonology literature, it has long been argued, based on phonological evidence, that the internal structure of the
Dene verb takes the form of a right-branching tree, with prefixes added in successive layers (called LEVELS or STRATA), from right to left (Rice 1982; Hargus 1988; Jaker 2012). In a recent paper, Jaker and Kiparsky (2020) found that phonological opacity in the Tetsôt’îné verb is closely tied to the morphological structure of the verb: phonological processes within a level always interact transparently, while opaque phonological interactions always involve processes belonging to different levels.

This paper is the first to propose an analysis of the distribution of long and short vowels in Tetsôt’îné prefixes. The main descriptive problem to be explained is this: all instances of prefix long vowels result from intervocalic consonant deletion, though not all cases of intervocalic consonant deletion result in a long vowel (Sect. 1.1). In my analysis, I find that Jaker and Kiparsky’s claim about the relationship between phonological opacity and morphological structure can be extended to account for prefix vowel length as well. I propose that, in prefixes, when /V1-C2V3/ sequences coalesce to a short [V 1, 3], this constitutes a transparent interaction of phonological processes, which happens when V1 enters the derivation at the same stratum at which C2 is deleted. On the other hand, long vowels in prefixes are always the result of phonological opacity, when V1 of a /V1-C2V3/ sequence is added at an earlier stratum, and C2 is deleted at a later stratum.

Why should transparent phonological interaction result in short vowels, while opaque interaction results in long vowels? I propose that this is because, in this language, all prefix vowels have zero moras underlingly, and only acquire a mora after passing through at least one cycle of the phonology (Sect. 1.2). Thus, when V1 enters the derivation at the same stratum at which C2 is deleted, V1 does not have a chance to acquire a mora prior to coalescence, and thus a short vowel results. On the other hand, when V1 is able to acquire a mora prior to C2 being deleted, when C2 deletes, both adjacent vowels V1 and V3 already have a mora, and a long vowel results. As we shall see in this paper, different prefixes are added at different levels, and different consonants are deleted at different levels. Whether a short vowel or a long vowel results cannot be predicted either by the consonant that was deleted or the level of the preceding prefix alone; rather, it is the combination of these factors—in particular, when consonant deletion occurs relative to affixation—that determines surface vowel length.

This type of phonological pattern has been termed SYSTEMATIC UNDERSPECIFICATION (Kiparsky 1993). Such an analysis predicts that prefix vowel length ought to be subject to a Derived Environment Effect (DEE), for which there is indeed evidence. The kind of morphophonemic patterns to be described in this paper can be characterized as an interleaving of phonology and morphology, a situation which is most easily described under the Lexical Phonology model (Kiparsky 1982b). From the perspective of Lexical Phonology, these patterns serve to illustrate the extent to which phonological behaviour can be determined by morphological structure.

1 Other internal structures have also been proposed for the Dene verb, including Rice’s (2000a) Scope Hypothesis, which adopts a largely left-branching structure, and McDonough (1990) Bipartite Model. See Jaker et al. (2020) for an overview of several different proposals.
1.1 Consonants and morphological levels

In this section, I will establish the general principle that all long vowels in prefixes in Tets’o’t’ine are the result of intervocalic consonant deletion. By “long vowel,” I mean a sequence of two adjacent, identical vocalic root nodes pronounced tautosyllabically. I will also provide an overview of the main empirical problem to be addressed in this paper, which is that, when a consonant deletes intervocally, it is not always the case that a long vowel results. In the data below, and throughout this paper, all examples will be taken from Jaker and Cardinal’s (2020) Tets’o’t’ine Verb Grammar (TVG), unless otherwise specified.

In some cases, morphophonemic alternations make it very clear that a long vowel is the result of intervocalic consonant deletion, in that the consonant which has deleted intervocally can be recovered by comparing a derived form with its base form. For example, in verbs which use the θe conjugation marker in the perfective (the conclusive and semelfactive conjugation patterns), the initial θ of the θe conjugation marker is retained word-initially, but is deleted when preceded by an object agreement prefix, as in (1).

(1) θe conjugation perfective forms with and without object agreement

| Without object agreement | With object agreement |
|--------------------------|-----------------------|
| **Surface form** | **English gloss** | **Surface form** | **English gloss** |
| a. θiká:r | ‘I slapped (O)’ | níká:r | ‘I slapped you’ |
| b. θíká:r | ‘you (sg) slapped (O)’ | súká:r | ‘you (sg) slapped me’ |
| c. θuhká:r | ‘you (pl) slapped (O)’ | súuhká:r | ‘you (pl) slapped me’ |
| d. θítθí:f | ‘I pinched (O)’ | nítθí:f | ‘I pinched you’ |
| e. θíθθí:f | ‘you (sg) pinched (O)’ | súθθí:f | ‘you (sg) pinched me’ |
| f. θuhtθí:f | ‘you (pl) pinched (O)’ | súuhtθí:f | ‘you (pl) pinched me’ |

TVG: 95, 115, 119, Jaker’s fieldnotes (08/31/20)

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2Nearly all of the data in this paper (~95%) are taken from Jaker and Cardinal (2020), published by Alaska Native Language Center Publications. Thus, any data taken from the grammar are publicly available to those who would purchase the book. A small number of examples in the article are taken from the author’s unpublished fieldnotes, which were re-checked for accuracy over the telephone, and are notated in the text as “Author’s fieldnotes (08/31/20)” or similar. In all cases these data serve merely to provide additional examples of patterns already demonstrated based on the published data; in no case do the empirical arguments in this paper depend exclusively on unpublished data.

I regret that sound files could not be included with this article; this is mainly due to a travel ban to the Northwest Territories due to Covid-19, currently in place, which precludes additional in-person fieldwork at the present time.

3Transcription in this paper follows IPA, with two exceptions. The first is the representation of laryngeal features in stops and affricates. Following Deneist convention, [t, tʰ, t’] are transcribed as <d, t, t'>, respectively. Secondly, long vowels in prefixes are written as a double vowel <aa> rather than using a length mark <aː>. See Sect. 2 for discussion. The segment [tθ'] is an interdental affricate ejective.

4Abbreviations used throughout the paper: caus = causative; con = conclusive; cont = continuative; da = disjoint anaphor; distr = distributive; du = dual; dur = durative; egr = egressive; H = High tone; impfv = imperfective; incep = inceptive; iter = iterative; mid = middle voice; mom = momentaneous; O =
Based on alternations such as in (1), I propose that the learner can construct a generalization that wherever there is a surface long vowel (in prefixes), an intervocalic consonant is present underlyingly (as part of the base). This generalization is supported by evidence that whenever two vowels come directly into contact in prefixes with no underlyingly consonant intervening, the resulting surface vowel is short without exception, as shown in (2).

(2) Adjacent vowels underlingly results in short vowel on the surface\(^5\)

| Underlying form | Surface form | English gloss |
|-----------------|--------------|--------------|
| a. /ná-uh=ðər/ | nóhər | ‘you (2) live’ | CONT-2plS=stand.SG/DU |
| b. /ná-uh=ðé/ | nóhé: | ‘you (pl) live’ | CONT-2plS=stand.PL |
| c. /jé-uh=d-üi/ | júhüi: | ‘you (2) eat’ | food-2plS=MID-eat.SG/DU |
| d. /jé-uh=l-ji/ | jútjii: | ‘you (pl) eat’ | food-2plS-CAUS.MID-eat.PL |

If we accept that all long vowels in prefixes are the result of intervocalic consonant deletion, we must then contend with the following problem: not all cases of intervocalic consonant deletion result in a long vowel. When a consonant is deleted between two vowels, in prefixes, sometimes a long vowel results, but in other cases a short vowel results. Whether intervocalic consonant deletion results in a short or long vowel seems to depend upon two factors: the consonant that was deleted (\(h, y, x, t, p, \theta\)),\(^7\) and the morphological level to which the preceding prefix belongs. I will illustrate each of these two factors below.

That the particular consonant which is deleted affects vowel length can be illustrated by the fact that, sometimes, the same set of prefixes, followed by a different consonant, will result in a different surface vowel length. In (3), this is illustrated with the object agreement prefixes \(se\) ‘1sgO,’ \(ne\) ‘2sgO,’ and \(je\) ‘3sgO.’ In (3a), we see that when \(se, ne\), and \(je\) are followed by \(h\), which deletes intervocically, a long...
vowel results. In (3b) on the other hand, when se, ne, and je are followed by $h$, which deletes intervocally, a short vowel results.

(3) $se$, ne, je followed by $y$ and $h$

(a) $se$, ne, je followed by $y$ results in long vowel

| Underlying form | Surface form | English gloss |
|-----------------|--------------|---------------|
| /ne-ye-s=l-t's=on/ | neests' on | ‘I kissed you (sg)’ |
| 2sgO-DUR-1sgS=CAUS.MID-kiss.PERF | | |
| /se-ye-je=l-t's=on/ | sîîls'ts on | ‘you (sg) kissed me’ |
| 1sgO-DUR-2sgS=CAUS.MID-kiss.PERF | | |
| /je-ye=l-t's=on/ | jeelts on | ‘he/she kissed him’ |
| 3sgDA-DUR=CAUS.MID-kiss.PERF | | |
| /se-ye-uh=l-t's=on/ | suuîls'ts on | ‘you (pl) kissed me’ |
| 1sgO-DUR-2plS=CAUS.MID-kiss.PERF | | |

(b) $se$, ne, je followed by $h$ results in short vowel

| Underlying form | Surface form | English gloss |
|-----------------|--------------|---------------|
| /ne-hí-s=?fːθ/ | nîs?fːθ | ‘I kick (sg)’ |
| 2sgO-SEM-1sgS=kick | | |
| /se-hí-ne=?fːθ/ | sî?fːθ | ‘you (sg) kick me’ |
| 1sgO-SEM-2sgS=kick | | |
| /je-hí=?fːθ/ | jî?fːθ | ‘he/she kicks him’ |
| 3sgDA-SEM=kick | | |
| /se-hí-uh=?fːθ/ | sûh?fːθ | ‘you (pl) kick me’ |
| 1sgO-SEM-2plS=kick | | |

TVG: 130

Although the $h$ (3b) is historically epenthetic (Leer 2000: 105), I assume that a learner will infer that it is underlying, based on the fact that it appears in word-initial position, as shown in (4a). See Sect. 5.1 for additional arguments regarding the underlying form of this prefix.

(4) /h/ and /y/ word-initially

(a) /h/ word-initially

| Underlying form | Surface form | English gloss |
|-----------------|--------------|---------------|
| /hí-s=?fːθ/ | hîs?fːθ | ‘I kick’ |
| SEM-1sgS=kick | | |
| /hí-ne=?fːθ/ | hî?fːθ | ‘you (sg) kick’ |
| SEM-2sgS=kick | | |
| /hí=?fːθ/ | hî?fːθ | ‘he/she kicks’ |
| SEM=kick | | |
| /hí-uh=?fːθ/ | hûh?fːθ | ‘you (pl) kick’ |
| SEM-2plS=kick | | |

Jaker’s fieldnotes (2/17/21)
In (4b), we can see that there is a recoverability issue in relation to the underlying /γ/ of the prefix γε, since this consonant surfaces as /h/ in word-initial position (although there are attested examples of the γε prefix surfacing faithfully in Tetsó’t’iné—see Sect. 4). Here I will briefly summarize my arguments for this underlying segment. By comparing examples such as (3a) and (3b), the learner can deduce that the underlying consonant in (3b) is different from that in (3a), since they exhibit different behaviour. Since the underlying segment in (3b) surfaces as [h] word-initially in (4b), the learner will posit a consonant which is featurally as similar as possible to /h/, but still different from /h/. In addition, the learner also has a bias towards positing the segment which is as featurally simple as possible, all other things being equal. The resulting segment is underlying /γ/. A more detailed discussion regarding the status of underlying /γ/ will be presented in Sect. 6.1.

The preceding examples show that the deleted consonant itself is one factor in whether intervocalic consonant deletion results in a short or long vowel. Another factor, however, is what type of prefix precedes the deleted consonant. It is well established that Dene languages exhibit layered or level-ordered morphology (Rice 1982, 1989; Hargus 1988; Jaker 2012; Jaker and Kiparsky 2020). This assumes a model of the phonology-morphology interface in which prefixes are added, phonological rules apply, more prefixes are added, and more phonological rules apply, etc. (Kiparsky 1982b, 1985). Because different prefixes are added at different levels, and different rules apply at each level, this model allows for the possibility that different prefixes will participate in different phonological rules. We can see this in the case of the palatal nasal /ñ/. In (5a), /ñ/ is deleted, and results in a nasal vowel, after the prefix se ‘1sgO,’ which is a Level 4 prefix. On the other hand, in (5b), /ñ/ is retained (and pronounced as [n]) following the Level 5 prefix ná ‘continuative.’ Numerical subscripts refer to the level to which the prefix belongs.

(5) /ñ/ preceded by Level 4 and 5 prefixes

| Underlying form | Surface form | English gloss |
|-----------------|--------------|---------------|
| a. /se4-ñe2=ʔt:θ/ | sʔt:θ | ‘you (sg) kick me (repeatedly)’ |
| 1sgO-2sgS=kick | | |
| b. /se4-ñe2=11-ts’on/ | sǐlts’on | ‘you (sg) kiss me’ |
| 1sgO-2sgS=CAUS.MID-kiss.IMP/V/OPT | | |
c. /se₂-πε₂=t₁’t’uːs/  
1sgO-2sgS=CAUS-punch  
sīḥ’t’uːs ‘you (sg) punch me (repeatedly)’

d. /se₂-πε₂=ts’áːr/  
1sgO-2sgS-scratch.IMPFV/OPT  
sīts’áːr ‘you (sg) scratch me (repeatedly)’

TVG: 80, 130-131, Jaker’s fieldnotes (08/31/20)

(b) /p/ retained as [n] following the Level 5 prefix ná

| Underlying form | Surface form | English gloss |
|-----------------|--------------|---------------|
| /ná₅-πε₂=ðɔr/  | náneðɔr      | ‘you (sg) live’ |
| 2sgS=stand      |              |               |
| /ná₅-πε₂=₁-zęː/ | nánelzęː      | ‘you (sg) hunt’ |
| 2sgS=CAUS.MID-hunt |            |               |
| /ná₅-πε₂=leː/  | náneleː       | ‘you (sg) lend (pl. objects)’ |
| 2sgS=plural.objects.IMPF/OPT | | |
| /ná₅-πε₂=t₁’t’uːs/ | nānet’t’uːs  | ‘you (sg) punch (once)’ |
| 2sgS=CAUS-punch |              |               |

TVG: 127, 138, 140, Jaker’s fieldnotes (08/31/20)

An overview of all of the prefix positions and levels, and how they relate to the overall structure of the verb complex, will be given in Sect. 3. For present purposes, it is sufficient to note that whether intervocalic consonant deletion results in a long or short vowel cannot be predicted based entirely on the consonant itself, since deletion of the same consonant preceded by different prefixes can yield different results, as shown in (5). At the same time, as we saw earlier, vowel length can also not be predicted based entirely on the preceding prefix, since the same prefixes preceding different consonants which are deleted can also yield different results, as we saw in (3). Therefore, what is needed is a unified account of intervocalic consonant deletion, which takes into consideration both the consonant which is deleted as well as the preceding prefixes. I will propose such an account in Sect. 1.2.

1.2 The proposal: Systematic underspecification

I propose that a fairly simple generalization can account for nearly all cases of short and long prefix vowels in this language. Vowel length depends on when in the derivation an intervocalic consonant deletes, relative to the point in the derivation when a preceding prefix is added. If the consonant deletes at the same level, a short vowel results; if the consonant deletes at a later level, a long vowel results. This is stated in (6).

(6) Relationship between intervocalic consonant deletion and vowel length

a) When an intervocalic consonant C₂ is deleted at the same level that a preceding prefix is added, a short vowel results: /V₁-C₂V₃/ → [V₁V₃].

b) When V₁ is added first, and C₂ is deleted at a later level, a long vowel results: /V₁-C₂V₃/ → V₁C₂V₃ → [V₁V₃].

A pattern such as in (6) is predicted if prefix vowel moras are subject to SYSTEMATIC UNdERSPECIFICATION (Kiparsky 1993). Systematic underspecification was originally applied to segmental features: a feature which is unspecified in the UR has its value filled in contextually, after passing through at least one cycle of the phonology.
However, once the value for this feature has been filled in, the feature specification is retained for the rest of the derivation (Kiparsky 1993). In this paper, I apply the same logic to moras as well. In the case of (3b), C₂ has deleted prior to mora assignment, which causes V₁ and V₃ to coalesce to form a short vowel. On the other hand, in (3a), both V₁ and V₃ acquire a mora prior to C₂ being deleted, resulting in a long vowel in the output. The end result is that at each level of the phonology, vowel length is subject to a Derived Environment Effect (DEE): “new” /V-V/ sequences are shortened, while “old” /VV/ sequences are retained (cf. McCarthy 2003).

Just as this proposal predicts that the same underlying consonant can result in either short or long vowels when preceded by different prefixes, it also predicts that addition of the same prefix can result in either long or short vowels when followed by different consonants. For example, the prefix fé, which is part of the verb ‘eat,’ is a Level 5 prefix. The consonant γ, of the prefix ye (used in the perfective), deletes at Levels 2 and 6. The consonant w, on the other hand, which is part of the optative derivation, deletes at Level 5. This analysis is thus able to correctly predict a short vowel in the optative form jústi: ‘I will eat,’ while at the same time predicting a long vowel in the perfective form jésti: ‘I ate,’ as illustrated in (7).

(7) The Level 5 prefix fé followed by both w and γ

| Level | (a) Consonant deletes at same level, short vowel results | (b) Consonant deletes at later level, long vowel results |
|-------|--------------------------------------------------------|-------------------------------------------------------|
| Input to Level 5 | /fé- wústí:/ | /fé- yéstí:/ |
| Output of Level 5 (deletion of w) | jústí: | jéstí: |
| Output of Level 6 (deletion of y) | jústí: | jéstí: |

A summary of which prefixes are assigned to which levels will be given in Sect. 3.2, while a summary of which consonants delete at which levels will be given in Sect. 3.3. Given these two pieces of information, the proposal in (6) enables us to correctly predict whether a prefix vowel will turn out as short or long in Tetsóť’iné in nearly all cases.

1.3 Overview of the paper

The remainder of this paper is organized as follows. In Sect. 2 I provide background on the Tetsóť’iné dialect, including the phoneme inventory. In Sect. 3 I provide background on the morphological structure of the Dene verb, as it relates to the analysis. In Sect. 4 I examine the simplest case, that of word-medial /γ/ deletion. In Sect. 5 I examine a more complex case, involving a segmental chain shift. In Sect. 6, I consider a set of issues relating to abstractness and learnability, in particular the learnability of...
underlying /j/, and I consider an alternative analysis involving lexically listed allomorphy. I conclude in Sect. 7 with a discussion of the importance of representations in explaining morphophonemic behaviour.

Due to space constraints, and in order to better highlight the representational claims of this paper, my analysis will be presented in a relatively informal rule-based version of Lexical Phonology. However, the analysis is in most respects compatible with Stratal OT (Kiparsky 2000; Jaker and Kiparsky 2020). Some issues relating to a possible Stratal OT implementation of this proposal will be discussed in Sects. 5.2 and 7.

2 Background on Tets’ot’iné

*Tets’ot’iné Yatté* (literally ‘Copper People’s Language’), sometimes referred to as *Yellowknife*, is the most divergent dialect of Dëne Súłiné or Chipewyan, so much so that it might be regarded as a separate language. The traditional territory of the Tets’ot’iné people is primarily in Canada’s Northwest Territories, north and east of Great Slave Lake. The particular dialect represented in this paper is based on work with speakers from Yellowknife and Łútsël’ké, Northwest Territories. Tets’ot’iné differs from Dëne Súliné “proper” in consonant and vowel phonemic inventories, vocabulary, and verb morphology; many of these differences reflect contact effects between Tets’ot’iné and its neighbours, North Slavey (broken into Hare and Bearlake dialects on the map below) and Tłı̨ch’ǫ (Dogrib).

(8) Map of Dene languages (Kari 2020)
In this section I will present the phoneme inventory of Tetsót’íné, as well as the transcription system which will be used in this paper. The consonant inventory in (9) is similar to the Dëne Sųhné consonant inventory proposed by Li (1946: 398); the main difference is that Tetsót’íné does not seem to possess a labio-velar series (cf. Cook 2004: 22–23). My choice of symbols to represent the consonant inventory in (9) also differs from strict IPA in one key respect. Following convention in the Dene linguistics literature (e.g. Li 1946; Rice 1989; Cook 2004), the “plain” stops and affricates, which are phonetically weakly voiced or voiceless, are transcribed as voiced <d, dz, dl>, while the aspirate series is transcribed as voiceless <t, ts, tì>. In a more narrow transcription, these would be transcribed as [t, ts, tl] and [th, ts’h, tl’h], respectively.

(9) Tetsót’íné consonant inventory

|                      | Labial        | Interdental   | Alveolar       | Lateral        | Alveo-palatal  | Velar/Uvular   | Glottal |
|----------------------|---------------|---------------|----------------|----------------|----------------|----------------|---------|
| Stops and affricates | Plain /b/     | /dð/          | /d/, /dz/      | /dl/           | /dʒ/           | /g/            |         |
|                      | Aspirate /tð/ | /t/, /ts/     | /tɬ/          | /tʃ/           | /k/            |                |         |
|                      | Ejective /tɬ’/| /ɬ/, /ts’/    | /ɬɬ’/         | /ɬʃ’/         | /kʃ’/         | /ʃ/            |         |
| Fricatives           | Voiced /ð/    | /z/           | /l/            | /ʃ/            |                |                |         |
|                      | Voiceless /θ/ | /s/           | /ɬ/            | /ʃ/            | /x/            | /h/            |         |
| Sonorants            | Oral /w/      | /ɭ/           | /ɭ/            |                |                |                |         |
|                      | Nasal /m/     | /n/           | /n/            |                |                |                |         |

The consonant inventory in (9) also differs from previous proposed inventories for Dëne Sųhné, in that I distinguish two n’s underlingly: alveolar /n/ and alveo-palatal /ŋ/. A similar distinction between two different n’s has been previously proposed for North Slavey (Rice 1989: 61–62). However, just as in Slavey, underlying /ŋ/ surfaces as alveolar [n] when it is pronounced; in Tetsót’íné, the motivation for positing this segment rests on two pieces of evidence. First, there is the effect on neighbouring vowels: /ŋ/ causes raising from e to i, while /n/ does not. The second is patterns of deletion: whereas /ŋ/ deletes intervocically at several points in the derivation (Levels 2, 4, and 6), /n/ is not deleted. See Sect. 3.3.

The vowel inventory of Dëne Sųhné has been controversial. In the literature on Dëne Sųhné dialects, most sources report some type of surface vowel length contrast, for the dialects they examine (Li 1933, 1946: 399; Haas 1968; Cook 1983, 2004, 2004: 28–30, 41; Krauss 1983). The main point of controversy has been: is this vowel length contrast synchronically derived, or underlying? While Li (1946) in his grammatical sketch, and Krauss (1983) in his elicitation word list, both assume that at least some long vowels are synchronically non-derived, Cook (1983: 424) explicitly denies the existence of a vowel length contrast underlyingly.

The vowel inventory I assume for Tetsót’íné is given in (10). In stems, there are 5 full vowels /iː, eː, aː, oː, uː/ and 3 reduced vowels /a/ and /u/. This is similar to the Proto Dene system as reconstructed by Krauss (1964), and there may be some other dialects

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8The consonant /l/ is traditionally classified as a fricative in the Dene literature (e.g. Rice 1989), based on its phonological patterning.
of Dëne Súłìné which exhibit a similar system (Krauss 1983; Cook 2004: 28–30). In prefixes, this contrast is neutralized, yielding a five-vowel system. The vowels in (10) are given in broad phonemic transcription; for an experimental study investigating the precise quality of these vowels, see Jaker (2018).

(10) Tetsót’íné vowel inventory⁹

|        | Stems | Prefixes |
|--------|-------|----------|
|        | Front | Central | Round  | Front | Central | Round |
| High   | /i/   | /æ/     | /u/    | /i/   | /æ/     | /u/   |
| Mid    | /e/   | /ʌ/     | /o/    | /e/   | /ʌ/     | /o/   |
| Low    | /ə/   | /æ/     | /a/    |       |          |       |

From a phonological perspective, I assume that the full ~ reduced vowel contrast is represented as a length contrast: full vowels in stems are bimoraic, while reduced vowels in stems are monomoraic. On the other hand, I claim that prefix vowels underlingely have zero moras (that is, they lack a moraic tier underlingely). These three different vowel representations are shown in (11).

(11) Vowel length in underlying representations

| (a) | (b) | (c) |
|-----|-----|-----|
| Full vowel in stems: two moras | Reduced vowel in stems: one mora | Prefix vowel: zero moras |
| /a/ | /æ/ | /a/ |

Non-moraic vowels have been proposed elsewhere in the literature. Hayes proposed using non-moraic vowels as the representation of glides /j, w/ (1989: 256). Blake (2001) presents the case of Sliammon (Salish), a language which has non-moraic vowels on the surface, which are realized phonetically as extra-short vowels. Michelson (1989) claims that the so-called “epenthetic” vowels in Mohawk, which cannot be assigned the accent, are not “epenthetic” but rather weightless, since the quality of these vowels cannot be predicted. In Tetsót’íné, I do not claim that non-moraic vowels exist on the surface. Rather, underlying non-moraic prefix vowels are repaired by the phonology, during the course of the derivation, by the insertion of a mora. Under the right set of conditions, as described in (6), the phonology can create long vowels in prefixes. However, due to their different derivational history, I assume that long vowels in prefixes have a different representation than full (long) vowels in stems. Since long prefix vowels derive from a sequence of two neighbouring vowels in the input, I assume that, in the output, they are represented as two adjacent, identical vowels, each associated with a mora. This is illustrated in (12).

⁹In stems, differences in vowel length are accompanied by differences in vowel quality, e.g. [ʌ] vs. [æ] (Jaker 2018). In prefixes, we lack phonetic data on the extent to which vowel length differences are accompanied by vowel quality differences; because of this, I transcribe prefix vowel length as though it were a pure durational difference.
This representational difference between stem and prefix vowels, which I assume, is reflected in my transcription throughout this paper: I represent long vowels in prefixes as a double vowel <aa>, whereas I represent long (i.e. “full”) vowels in stems with length marks <aː>. Apart from evidence from intervocalic consonant deletion, additional evidence for this representational distinction comes from the distribution of contour tones. Despite being bimoraic, full (long) vowels in stems may contrast only two tones, High or Low. However, long vowels in prefixes contrast four tones: High, Low, Rising, and Falling (TVG Sect. 2). This distribution is expected if the tone bearing unit in Dene languages is neither the syllable nor the mora but rather the Laryngeal node located beneath each segment (Rice 2000b). My transcription of contour tones in prefixes reflects the representation in (13). Thus, High, Low, Rising, and Falling tones in prefixes are transcribed as <áá>, <aa>, <aá>, and <áa>, respectively.

3 Dene verb morphology and level ordering

My thesis regarding prefix vowel length in Tetsóťiné, as stated in (6), requires crucial reference to LEVEL ORDERING. Level ordering is a particular kind of serialism which refers to morphological structure: the phonological derivation proceeds from the stem outwards, and prefixes are organized into groups, with certain groups of prefixes added before other prefixes. In this section, I will lay out my assumptions regarding Dene verb morphology and level ordering, as they relate to the thesis in (6). In Sect. 3.1 I will provide background on the Lexical Phonology model as it has been applied to the Dene verb, in Sect. 3.2 I will provide an overview of which prefixes are assigned to which levels, and in Sect. 3.3 I will provide an overview of which consonants delete at which levels. According to the thesis in (6), these latter two pieces of information—the level to which a prefix belongs, and the level at which a consonant deletes—are the two key pieces of information we need to know, in order to predict whether a prefix vowel will surface as long or short in Tetsóťiné.

3.1 Lexical Phonology and the Stem-Core model

Dene languages are templatic prefixing languages. The verb consists of a root near the right edge of the word, followed by a single suffix position, and preceded by a number of prefix positions. Jaker and Cardinal (2020) adopt the template shown in (13), with 13 prefix positions preceding the stem; it is identical to the template proposed for Slave by Rice (1989).
It was noted early in the history of Dene linguistics that the positions in (13) have internal phonological constituency. The distinction between CONJUNCT and DISJUNCT prefixes in the Dene linguistics literature (Li 1946) corresponds, loosely, to the STEM LEVEL~WORD LEVEL distinction in Lexical Phonology. This synthesis of the conjunct~disjunct distinction and Lexical Phonology has been called the STEM-CORE MODEL (Halpern 1992). However, researchers in Lexical Phonology have long recognized that at least four lexical levels are needed in order to account for the complex morphophonemics of Dene languages (Hargus 1988; Rice 1989; Jaker 2012), and in this paper, I will assume a total of six levels (five lexical levels, plus the Postlexical Level), as shown in (14); see also Randoja (1990) for a related proposal.

10In the original proposal of Hargus (1987, 1988), Levels 3 and 4 were reversed compared to Jaker and Kiparsky’s model in (14). That is, in Hargus’s model, the deictic prefixes ʔɑ, ʔsʔɑ, and ʔp were assigned to Level 4, after the object agreement prefixes, which were assigned to Level 3. This was because the deictic prefixes appear to pattern together with the disjunct (Level 5) prefixes, in that the floating tone of the s
3.2 Which prefixes are assigned to which levels?

One question which often arises regarding the levels of Lexical Phonology is: how do we know which affixes are assigned to which levels? There are two main types of evidence that are used to assign a given prefix to a level. The first is linear order. In a prefixing language, the phonological derivation proceeds outwards, from right to left. If prefix A is to the left of B, then A will have to be added at a later level than B, or at the same level, but not the reverse. In Dene languages, this means that prefix positions towards the left end of the template tend to belong to later levels, whereas prefix positions towards the right end of the template tend to belong to earlier levels. The second type of evidence is participation in phonological processes. Under normal circumstances, a Level 1 affix will participate in the phonological processes of all Levels 1–6, a Level 2 affix will participate in the phonological processes of Levels 2–6 but not Level 1, a Level 3 affix will participate in the phonological processes of Levels 3–6 but not Levels 1 and 2, etc.

If the levels to which different prefixes belong are already known based on independent evidence, then the same logic described above can be applied in reverse, to assign phonological processes to levels. If a phonological process applies to prefixes of all levels, then it is a Level 6 (postlexical) process. If a phonological process applies only to Level 1–5 prefixes, and does not apply across word boundaries, then it is a Level 5 (Word Level) process, etc.

Some examples of prefixes assigned to each of the levels are given in (15). The specific template position, for each prefix listed, is given as a subscript. The abbreviation QUAL stands for “qualifier” (cf. Kari 1989) and THM stands for “thematic” (cf. Kari 1979). The four conjugation markers, \( \theta e \), \( pe \), \( hi \), and \( ye \), I have glossed as CON (conclusive), MOM (momentaneous), SEM (semelfactive), and DUR (durative), respectively, following the traditional terms used in the Dene literature to describe conjugation patterns (e.g. Kari 1979; Rice 1989). The “H” before the prefixes \( \theta e \) and \( pe \) indicates that these prefixes are pre-accenting, in that the High tone precedes the prefix; the “H” following \( ta \) indicates that this prefix is post-accenting, in that the High tone follows the prefix. Within each level, I assume that the order of morphemes is determined by the template as in (13), although it may also be possible to derive morpheme order via selectional restrictions on pairs of prefixes (Fabb 1988). Note that subject agreement occurs in two different positions within the verb: position 7 and position 12 (Rice and Saxon 1994). For a detailed proposal that explains morpheme order, see Rice (2000a).

and n conjugation markers does not usually associate to these prefixes. In Jaker and Kiparsky’s model, the failure of conjugation High tone to map onto the cognate prefixes \( ?e \), \( ts’e \), and \( he \) in Tets’ot’imé is attributed to the deletion of High tone in the weak position of an iambic foot; this is based on independent evidence that Tets’ot’imé is an iambic language (Jaker and Kiparsky 2020; Jaker and Howson to appear).
(15) Examples of prefixes assigned to different levels

| Level | Template positions | Examples |
|-------|---------------------|----------|
| Level 6 | 000 – 0 | γá0 – for γí0 – into.air γá0 – out γí0 – speech γá0 – food |
| Level 5 | 1 – 4 | ná1 – CONT se0 – lsgO ná1 – dstr na3 – ITER ja4 – speech je0 – 3sgIO |
| Level 4 | 5 – 6 | ho5 – AREALO se0 – 1sgO je6 – 3sgO je6 – speech je6 – 3sgIO |
| Level 3 | 6 – 7 | ?e6 – IMPERS se6 – 2sgO je6 – 3sgO je6 – speech je6 – 3sgIO |
| Level 2 | 8 – 12 | ne8 – QUAL se8 – EGR te9 – INCERP |
| Level 1 | 13 | l13 – CAUS.MID d13 – MID |

In (15) I have described the momentaneous conjugation marker as /he/, with a palatal nasal, even though this prefix is reconstructed historically as having an alveolar nasal (Krauss and Leer 1981). The motivation for assigning this prefix the consonant /h/ underlyingly is that it patterns together with the 2nd person singular subject and perfective prefixes in that this initial consonant deletes intervocically in certain environments, in contrast with the alveolar /n/ of the ne qualifier, which is almost never deleted.

3.3 Which consonants delete at which levels?

According to the hypothesis in (6), the other main piece of data we need in order to predict prefix vowel length in Tets’ot’iné is the level at which different consonants are deleted intervocically. A summary chart is given in (16). When a consonant is listed in a given cell, this denotes that the consonant is deleted at that level. “- - - - -” means deletion does not occur for a consonant at a given level. In some cases, a consonant undergoes lenition rather than deletion, which is indicated as in e.g. γ → w.

(16) Summary of which consonants delete at which levels

| Consonants | h | γ | x | n | t | θ |
|------------|---|---|---|---|---|---|
| Level 2    | h → Ø | γ → Ø | - - - | n → Ø | t → Ø, t → x | θ → Ø |
| Level 3    | - - - | γ → w | x → w | - - - | - - - | - - - |
| Level 4    | h → Ø | - - - | - - - | n → Ø | - - - | θ → Ø |
| Level 5    | - - - | - - - | - - - | - - - | - - - | - - - |
| Level 6    | h → Ø | γ → Ø | x → h | n → Ø | - - - | t → Ø | - - - |

As shown in (16), consonant deletion occurs at every level of the phonology, with the exception of Level 3, which exhibits only lenition and not deletion (see Jaker 2020 for a discussion of Level 3 lenition of γ to w in Dëne Sulkné dialects). Regarding /x/, there is some evidence that different surface h’s exhibit different morphophonemic behaviours, suggesting that some h’s are actually /x/ underlyingly. This issue will be examined in (Sect. 5). While there are some natural classes of consonants that
delete—for example, /θ/ and /ʃ/, which are both [distributed]—there is no single set of features that can characterize the set of deleting consonants as a whole. The set of deleting consonants in this language is thus to some extent arbitrary.

One question which might arise at this stage is: what causes consonant deletion in this language? My opinion is that the deletion of intervocalic prefix consonants is prosodically conditioned, by iambic stress. There is independent evidence that Tsetsot’iné is an iambic language (Jaker and Kiparsky 2020; Jaker and Howson to appear). Indeed, in an OT analysis, prosodic constraints (such as RHTYPE=IAMB and ALIGN-L(FT, PRWD)) would be required in order to force consonants to delete; in the rule-based Lexical Phonology analysis of the present paper, however, such prosodic conditioning is not formally required in order make the analysis work, and therefore I have omitted it, for ease of exposition.

4 Deletion of /γ/ at Level 2 and Level 6

In this section, I will begin by presenting the simplest case, when the consonant γ deletes intervocically, and the resulting vowel length is not complicated by other factors. The analysis will focus mainly on the conjugation marker γe, but I will also include data on γu, the optative prefix, as well as the incorporated postposition γá, a Level 6 affix (i.e. a proclitic). The main descriptive claim in this section will be that /γ/ is deleted at Levels 2 and 6, based on the observed surface vowel length patterns.

The rule which deletes intervocalic γ in prefixes is the result of a recent sound change, which is to some extent still in progress. In (22) we will see that, when γ belongs to a Level 6 prefix, the rule is still optional (that is, γ is variably retained). In addition, there are attested examples of the γe conjugation marker surfacing faithfully in Tsetsot’iné: Cardinal et al. (2021) Tsetsot’iné Dictionary lists the forms γHá: ‘send on errands,’ ?eyéna: ‘living,’ and nayeda: ‘move.’ These forms were collected in interviews with elders done in the mid 1980’s. When asked directly, speakers do understand and recognize forms with historical *γ in them, such as féγéṣij: ‘I ate’ or féγéṣij: ‘he/she ate.’ One speaker even responded, “I remember that.” Nevertheless, for subsequent generations who are no longer exposed to direct evidence for /γ/, the question arises as to how and to what extent underlying /γ/ might still be recoverable by learners—this issue will be discussed in Sect. 6.1.

4.1 Data

In Tsetsot’iné there are many alternations which, although they involve affixation of a CV shaped syllable in the UR, appear on the surface as vowel length alternations. In this section, we will compare and contrast forms where a given prefix is present underlyingly (γe, γu, γá), with forms where it is absent, and we will observe the difference in surface vowel length which does (or does not) result.

We will begin with cases where the prefixes γe and γu have no effect on vowel length. This happens when these prefixes (which are themselves Level 2 prefixes) are preceded by another Level 2 prefix. This is shown in (17) and (18).
(17) Conjugation marker ye following a Level 2 prefix has no effect on vowel length

(a) Imperfective forms: ye absent, short vowels

| Underlying form | Surface form | English gloss |
|-----------------|--------------|---------------|
| /ne₂-s₂=₁-ʔı:/ | nesʔıː | ‘I see’ |
| QUAL-1sgS=CAUS-see.IMPFV | | |

(b) Perfective forms: ye present, vowel still short

| Underlying form | Surface form | English gloss |
|-----------------|--------------|---------------|
| /ne₂-ye₂-i₂=₁-ʔıː/ | nıʔʔıː | ‘you (sg) saw’ |
| QUAL-DUR-1sgS.perf=CAUS-see.PERF | | |

Given that vowel lengthening is absent in (17b), the question could be asked: how do we know that ye is present underlyingly at all in these forms? Indeed, an analysis in which the ye conjugation marker has a /Ø/ allomorph when preceded by a Level 2 prefix would be formally possible. See Sect. 6.2 for a discussion of alternative analyses based on allomorphy. However, from a morphological perspective, the verb nělʔıː: ‘see’ in (17) belongs to a conjugation pattern called the DURATIVE (TVG: 123-136) which in Tets’ot’ine is usually marked by vowel lengthening in the perfective. For example, ŝěstʔıː: ‘I eat,’ ŝěestʔıː: ‘I ate.’ The fact that lengthening fails to occur following a Level 2 prefix is a fact which needs to be explained. Under my analysis, the explanation is that the consonant ye is deleted at Level 2. According to the hypothesis in (6), when a consonant is deleted at the same level a preceding prefix is added, a short vowel is the expected result. Thus, /ne-ye=iʔıː/ → nıʔʔıː, not *niiʔʔıː.

This same pattern can be found with the verb nedáː: ‘sit down.’ This verb contains the ne egressive prefix, which is a Level 2 prefix. Similar to what we saw before, the imperfective forms in (18a) have short vowels, and addition of the optative prefix ŝu in (18b) fails to add vowel length.

(18) Optative prefix ŝu following a Level 2 prefix has no effect on vowel length

(a) Imperfective forms: ŝu absent, short vowel

| Underlying form | Surface form | English gloss |
|-----------------|--------------|---------------|
| /ne₂-s₂=dáː/ | nesdá: | ‘I sit down’ |
| EGR-1sgS=sit.IMPFV/OPT | | |

| Underlying form | Surface form | English gloss |
|-----------------|--------------|---------------|
| /ne₂=voie₂=dáː/ | nıđáː | ‘you (sg) sit down’ |
| EGR-2sgS=sit.IMPFV/OPT | | |

| Underlying form | Surface form | English gloss |
|-----------------|--------------|---------------|
| /ne₂=dáː/ | nedá: | ‘he/she sits down’ |
| EGR=sit.IMPFV/OPT | | |
(b) Optative forms: γυ present, vowel still short

| Underlying form | Surface form | English gloss |
|-----------------|--------------|---------------|
| a. /ne2-γu2-s2=dá/ | nusdá: | ‘I will sit down’ |
| EGR-OPT-1sgS=sit.IMPFV/OPT | | |
| b. /ne2-γu2-ne2=dá/ | nuďá: | ‘you (sg) will sit down’ |
| EGR-OPT-2sgS=sit.IMPFV/OPT | | |
| c. /ne2-γu2=dá/ | nudá: | ‘he/she will sit down’ |
| EGR-OPT=sit.IMPFV/OPT | | |

TVG: 175–176

In (18b), there is evidence that γυ is present underlingly, in that it changes the quality of the output vowel from e or i to u. However, there is no difference in vowel length between (18a) and (18b). According to the hypothesis in (6), this is because γ is deleted at Level 2. Thus, /ne-γu=dá/ → nuđá:, not *nuuđá:.

Next we will consider cases where γ is preceded by a Level 3, 4, or 5 prefix. In these cases, intervocalic γ is not deleted until Level 6. As a result, the prefixes preceding γ will have passed through one, two, or even three levels of the phonology before γ is deleted. During this time, a mora will have been added to their vowels, as a repair strategy. As a result, when γ is finally deleted, a surface long vowel results.

In (19), we can see that affixation of γ results in vowel lengthening, if we compare the imperfective forms in (19a) with the perfective forms in (19b).

(19) Conjugation marker γε following a Level 3 prefix adds vowel length

(a) Imperfective forms: γε absent, short vowels

| Underlying form | Output of Level 3 | Surface form | English gloss |
|-----------------|-------------------|--------------|---------------|
| a. /se4-γe3=1l-ts’ón/ 1sgO-3plS=CAUS.MID-kiss.IMPFV/OPT | helts’ón | sehelts’ón | ‘they kiss me’ |
| b. /fę5-γe3=d1-ti/ food-3plS=MID-eat.SG/DU | heći: | féheći: | ‘they (2) eat’ |
| c. /fę5-γe3=l1-jiti/ food-3plS=CAUS.MID-eat.PL | helji: | féhelji: | ‘they (pl) eat’ |

(b) Perfective forms: γε present, long vowels

| Underlying form | Output of Level 3 | Surface form | English gloss |
|-----------------|-------------------|--------------|---------------|
| a. /se4-γe3-γe2=1l-ts’on/ 1sgO-3plS-DUR=CAUS.MID-kiss.PERF | heγels’ón | seheγels’ón | ‘they kissed me’ |
| b. /fę5-γe3-γe2=d1-titi/ food-3plS-DUR=MID-eat.SG/DU | heγeti: | féheγeti: | ‘they (2) ate’ |
| c. /fę5-γe3-γe2=l1-jiti/ food-3plS-DUR=CAUS.MID-eat.PL | heγelji: | féheγelji: | ‘they (pl) ate’ |

TVG: 128–130

The same pattern obtains following a Level 4 (object agreement) prefix, as shown in (20), as well as following a Level 5 (disjunct) prefix, as shown in (21).
(20) Conjugation marker ye following a Level 4 (object agreement) prefix adds vowel length

(a) Imperfective forms: ye absent, short vowels

| Underlying form | Output of Level 4 | Surface form | English gloss |
|-----------------|-------------------|--------------|---------------|
| a. /ne4-s2=l1-ts’ón/ | 2sgO-1sgS=CAUS.MID-kiss.IMP/ OPT | nest’s’ón | ‘I kiss you (sg)’ |
| b. /je4=1-ts’ón/ | 3sgDA=CAUS.MID-kiss.IMP/ OPT | jelts’ón | ‘he/she kisses him’ |
| c. /se4-uh2=1-ts’ón/ | 1sgO-2plS=CAUS.MID-kiss.IMP/ OPT | surts’ón | ‘you (pl) kiss me’ |

(b) Perfective forms: ye present, long vowels

| Underlying form | Output of Level 4 | Surface form | English gloss |
|-----------------|-------------------|--------------|---------------|
| a. /ne4-y2-s2=d1-ts’ı/: | 2sgO-DUR-1sgS=CAUS.MID-kiss.PERF | neyest’s’ı: | ‘I kissed you (sg)’ |
| b. /je4-y2=d1-ts’ı/: | 3sgDA-DUR=CAUS.MID-kiss.PERF | jeyelts’ı: | ‘he/she kissed him’ |
| c. /se4-y2-uh2=d1-ts’ı/: | 1sgO-DUR-2plS=CAUS.MID-kiss.PERF | seuylts’ı: | ‘you (pl) kissed me’ |

(21) Conjugation marker ye following a Level 5 (disjunct) prefix adds vowel length

(a) Imperfective forms: ye absent, short vowels

| Underlying form | Output of Level 5 | Surface form | English gloss |
|-----------------|-------------------|--------------|---------------|
| a. /fēs-d1-tı/: | food-1sgS=MID-eat.SG/DU | fēs’tı: | ‘I eat’ |
| b. /fēs=d1-tı/: | food=MID-eat.SG/DU | fēs’ı: | ‘he/she eats’ |
| c. /fēs-uh2=d1-tı/: | food-2plS=MID-eat.SG/DU | fūshı: | ‘you (2) eat’ |

(b) Perfective forms: ye present, long vowels

| Underlying form | Output of Level 5 | Surface form | English gloss |
|-----------------|-------------------|--------------|---------------|
| a. /fēs-y2-s2=d1-tı/: | food-DUR-1sgS=MID-eat.SG/DU | fēvestı: | ‘I ate’ |
| b. /fēs-y2=d1-tı/: | food-DUR=MID-eat.SG/DU | fēyetı: | ‘he/she ate’ |
| c. /fēs-uh2-y2=d1-tı/: | food-DUR-2plS=MID-eat.SG/DU | fēyuhtı: | ‘you (2) ate’ |

If the reason for vowel lengthening in (19–21) is that ye is not deleted until Level 6, this raises the question: what happens if ye is preceded by a Level 6 prefix? The hypothesis in (6) predicts that, in this case, a short vowel should result. This is indeed what we find, with some variation, with the incorporated postposition ýá ‘to.’

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11 Although ýá ‘to’ is technically a Level 6 prefix, it is at the same time also an incorporated stem. Thus it might be expected to exhibit somewhat different patterning than other prefixes—for example, by being subject to Positional Faithfulness effects. This might explain why ye shows variation in whether or not it is deleted.
we see examples of γá ‘to,’ preceded by various pronominal objects, e.g. seγá ‘to you (sg),’ neγá ‘to him/her,’ jeγá ‘to him/her,’ etc. What we find is that these prefix combinations have two variants: a disyllabic variant, in which γá is retained, and a monosyllabic variant, with a short vowel that is post-accenting, in which γá is deleted (i.e. sa, na, ba, ja, etc.).

(22) Variable γá deletion at Level 6

| Underlying Form | Output | English gloss |
|-----------------|--------|---------------|
| /neγá-ñe2-ntu/  | neγáastfu: naástfu: | ‘I feed you (sg)’ |
| 2sgO-for-MOM-1sgS=CAUS-feed | | |
| /seγá-ñe2-ntu/  | seγáṣtfu: satſfu: | ‘you (sg) feed me’ |
| 1sgO-for-MOM-2sgS=CAUS-feed | | |
| /jeγá-ñe2-ntu/  | jeγáatfu: jạatfu: | ‘he/she feeds him/her’ |
| 3sgDA-for-MOM-3sgS=CAUS-feed | | |
| /seγá-ñe3-ntu/  | seγáatfu: sáatſfu: | ‘they feed me’ |
| 1sgO-for-3plS-MOM=CAUS-feed | | |

In the examples in (22), the contrast between forms which retain γá and those that delete γá is best illustrated by (22d), where the disyllabic sequence seγá varies with sá, with a short vowel. In the remaining forms (22a–22c), the forms in which γá is deleted exhibit a long vowel or diphthong for independent reasons, namely deletion of intervocalic ŋ.

Deletion of γá in prefixes has been observed in other dialects of Dëne Sųhńé as well. For these dialects, some linguists have implied that γá deletion is best characterized as a lenition process in the phonetic component of the grammar, and thus outside the phonology proper. Thus for example, Holden states, “the voiced velar fricative gh- sound is so soft that some speakers do not even pronounce it between vowels” (Holden 2013: 466). Similarly, Cook states, referring to the long vowels which result from intervocalic consonant deletion in prefixes, “long vowels also occur sporadically in other dialects, but they occur only across a morpheme boundary, when an intervocalic consonant is deleted. Such derived long vowels (that are not tautomorphic) are not interpreted as phonemic” (Cook 2004: 29). However, a truly phonetic process would not be expected to be sensitive to morphological environment; as we have seen in this section, γá deletion yields different results when γá is preceded by prefixes belonging to different levels. This level of sensitivity to morphological structure suggests that γá deletion has been phonologized, at least in the Tetsó’tíne dialect.

Furthermore, γá deletion can give rise to surface minimal pairs, such as féstí: ‘I eat’ vs. féstí: ‘I ate,’ as we saw in (22). Finally, the rule which causes γá deletion, as we shall see in Sect. 5, actually participates in a chain shift (x → h → Ø), which gives rise to counterbleeding opacity. Thus in my opinion, γá deletion has all the characteristics of a phonological, rather than phonetic, process, and I will treat it as such in the remainder of this paper.

4.2 Lexical Phonology analysis

Here I will present an analysis of the data in Sect. 4.1, using a rule-based Lexical Phonology framework. My analysis will be relatively informal, in that I will ignore
some details which pertain exclusively to the segmental phonology (for example, voicing assimilation, and the consonant (Jaker 2015) and vowel (Casali 1998; Marinakis 2004) strength hierarchies), and instead I will focus on just two rules: intervocalic γ deletion, and mora insertion. These are defined in (23) and (24).

(23) Intervocalic γ deletion (Levels 2 and 6)
\[ \gamma \rightarrow \emptyset / V \_\_ V \]
“γ is deleted in between two vowels.”

(24) Mora insertion
\[ \mu V \rightarrow V \]
“A mora is inserted over a mora-less vowel.” (applies at every level)

The effect of these two rules is illustrated in (25), using the forms nedá: ‘he/she sits down’ and nudá: ‘he/she will sit down.’ The most important observation in (25) is that intervocalic γ deletion, along with the segmental rules which it feeds, precedes mora insertion. The two rules are in a transparent “bleeding” order: by deleting an intervocalic consonant, we remove an environment for mora insertion (by ultimately reducing the number of vowels). This bleeding order holds true at all levels of the phonology, wherever consonant deletion applies. However, since Lexical Phonology posits multiple levels, it is possible for an opaque, “counterbleeding” order to arise, i.e. where mora insertion precedes consonant deletion, when the derivation spans more than one level. This is illustrated later in (26), where we see long vowels arising when γ is preceded by a Level 3 prefix in the case of sehëels’ on ‘they kissed me’ a Level 4 prefix in the case of nees’ on ‘I kissed you,’ and a Level 5 prefix in the case of fëestj: ‘I ate.’

(25) No vowel lengthening when γ is preceded by a Level 2 prefix\(^{12}\)

| Underlying form | Input | Intervocalic γ deletion | Segmental rules\(^{12}\) | Mora insertion | Surface form | English gloss |
|-----------------|-------|-------------------------|--------------------------|----------------|--------------|--------------|
| (a) \[ \mu \mu \] \[/ne=dá:/\] | \[/ne=dá:/\] | ----- | ----- | \[ nédá:\] | \[ nédá:\] | ‘he/she sits down’ |
| (b) \[ \mu \mu \] \[/ne-yu=dá:/\] | \[/ne-yu=dá:/\] | ----- | ----- | \[ nubá:\] | \[ nédá:\] | ‘he/she will sit down’ |

\(^{12}\) See Jaker (2020) for a formalization of vowel coalescence rules in Dêne Suhné.
In the examples in (26) below, mora insertion seems to “overapply” on the surface: there are more moras in the output than we would expect to be inserted, based on the number of prefix vowels on the surface. This is because, in each of the forms in (26), mora insertion and γ deletion applied in reverse (“counterbleeding”) order, and vowel coalescence (one of the “segmental rules”) is formulated so that it cannot shorten a sequence of two vowels which already has two moras. This situation is exactly what Systematic Underspecification theory would predict: once a vowel has acquired a mora, its mora is retained.

(26) Vowel lengthening when γ is preceded by a Level 3, 4, or 5 prefix

| Underlying form | (a)        | (b)        | (c)        |
|-----------------|------------|------------|------------|
| Input           | /ye-lts’on/| /ye-s=l-ts’on/ | /ye-s=tl:/ |
| Intervocalic γ deletion | -----      | -----      | -----      |
| Segmental rules | -----      | -----      | -----      |
| Mora insertion  | ye-lts’on  | yests’on   | yestl:/    |
| Input           | /he- ye-lts’on/ | -----      | -----      |
| Mora insertion  | heye-lts’on | -----      | -----      |
| Input           | /se- heye-lts’on/ | /he- yests’on/ | -----      |
| Mora insertion  | seheye-lts’on | neye-lts’on | -----      |
| Input           | -----      | -----      | /feye-lts:/ |
| Mora insertion  | -----      | -----      | feye-lts:/ |
| Input           | /seheye-lts’on/ | /neye-lts’on/ | /feye-lts:/ |
| Intervocalic γ deletion | -----      | -----      | -----      |
| Segmental rules | -----      | -----      | -----      |
| Mora insertion  | seheye-lts’on | neye-lts’on | feye-lts: |

In the form neests’ on ‘I kissed you’ (26b), the underlying /l/ coalesces with the preceding consonant /s/, to yield [s]. This is in accordance with the consonant hierarchy of the language (Jaker 2015).

To summarize, we have seen that when a consonant is deleted at the same level a preceding prefix is added, mora insertion and γ deletion apply in transparent bleeding
order, and a short vowel results; on the other hand, when a consonant is deleted at a later level than a preceding prefix is added, mora insertion and γ deletion apply in opaque counterbleeding order, and a long vowel results. The fact that phonological opacity is correlated with morphological structure in this way is most straightforwardly accounted for in a theory such as Lexical Phonology, which assumes level ordering.

A reviewer suggests an alternative analysis of the facts presented in this section, based on Prosodic Phonology (Nespor and Vogel 1986; Selkirk 2011; Bennett and Elfner 2019). Under such an analysis, the morphological domains of Lexical Phonology could be re-interpreted as prosodic domains. At a certain level of representation, Level 2 prefixes belong to a single prosodic domain with the stem, so that they are syllabified together with the stem and its prefixes, thus: /ne-ye-i=l-ʔíː/ → [ni] [ʔíː]. On the other hand, Level 3, 4, and 5 prefixes form a separate prosodic domain, and, at a certain level of representation, are syllabified separately, e.g. /ne-ye-s=l-ts’ón/ → [ne] [es] [ts’ón]. This alignment of morphological boundaries with syllable boundaries could thus explain the extra surface vowel length in some forms. The reviewer further suggests that, under such an analysis, it is not necessary to posit underlying /γ/, rather an empty C slot (cf. Clements and Keyser 1983) would suffice.

The main problem I see with this proposal is that it cannot account for the behaviour of some of the other consonants listed in (16). For example, /ŋ/ deletes at Level 4, but not Level 3. Accordingly, deletion of /ŋ/ results in a long vowel when preceded by a Level 3 prefix, e.g. /ńí-he-je=le/ → nńíhele: ‘they put (pl obj) down,’ but a short vowel when preceded by a Level 4 prefix, e.g. /se-ye=l-ts’ón/ → síts’ón ‘kiss me.’ The only way to resolve this contradiction would be to treat most combinations of subject agreement, object agreement, and aspectual prefixes as unanalyzable portmanteau morphemes, as the reviewer also suggests (for example, /se-ye/ would be reanalyzed as /sí/ ‘1sgO.2sgS’).

5 A chain shift: x → h → Ø

In this section we will investigate a possible case of morphologically conditioned consonant deletion in Tets’ótné. In the prefix summary chart in (15), I assumed that the three prefixes hí ‘semelfactive’ (Level 2), híd ‘1st person dual/plural subject’ (Level 2), and he ‘3rd person plural subject’ (Level 3) all begin with the consonant /h/ underlingly—and indeed all three prefixes do surface with initial h in word-initial position. In the consonant deletion summary chart in (16), I also claimed that /h/ deletes at Levels 2, 4, and 6. However, when we combine these two assumptions, a problem emerges: while the h of hí and híd deletes following a Level 4 or 5 prefix, the h of he is retained. In this section, I will argue that what appears to be a case of morphologically conditioned phonology can actually be attributed to a representational difference between these prefixes. Specifically, I will propose that while hí and híd begin with /h/ underlingly, the underlying initial consonant of he is actually /x/. I further propose that these two consonants participate in a chain shift: x → h → Ø. This analysis is consistent with the fact that the initial consonants of these prefixes are believed to have different historical sources.
5.1 Data

There are two goals of this section (Sect. 5.1). The first goal is to provide evidence that the consonant $h$ is deleted at Levels 2, 4, and 6, as claimed in (16). The second goal is to show that $he$ ‘3rd person plural’ exhibits different morphophonemic behaviour than the other $h$-initial prefixes, $hí$ ‘semelfactive’ and $híd$ ‘1st person dual/plural subject.’ To do this, I will provide examples of $h$ preceded by different classes of prefixes, and we will observe whether or not $h$ deletes, and the vowel length which results (short or long). For morphotactic reasons, not all theoretically possible combinations are attested.

We will begin by examining the three prefixes $hí$, $híd$, and $he$, in word-initial position. In this position, the underlying $h$ surfaces faithfully as such, as shown in (27–29). For the moment, I will assume that all three of these prefixes begin with /h/ underlingly, although we will consider alternative representations as we go along.

(27) $hí$ ‘semelfactive’ in word-initial position

| Underlying form | Surface form | English gloss |
|-----------------|--------------|---------------|
| a. /hí2-s2=ká:r/ | hískár | ‘I slap’ |
| SEM-1sgS=slap | | |
| b. /hí2=ká:r/ | híkár | ‘he/she slaps’ |
| SEM=slap | | |
| c. /hí2-s2=t1-k’í:T/ | hísk’tí: | ‘I shoot’ |
| SEM-1sgS=CAUS-shoot.IMPFV/OPT | | |
| d. /hí2=t1-k’í:T/ | hílk’tí: | ‘he/she shoots’ |
| SEM=CAUS-shoot.IMPFV/OPT | | TVG: 115–116 |

(28) $híd$ ‘1st person dual/plural subject’ in word-initial position

| Underlying form | Surface form | English gloss |
|-----------------|--------------|---------------|
| a. /híd2=tsa:y/ | hítsa:y | ‘we (2) cry’ |
| 1plS=cry.IMPFV/OPT | | |
| b. /híd2=d1-jón/ | hídʒón | ‘we (2) sing’ |
| 1plS=MID-sing | | |
| c. /híd2=t1-tsi:/ | híltsi: | ‘we (2) make’ |
| 1plS=CAUS-make | | |
| d. /híd2=d1-dā:/ | hídā: | ‘we (2) drink’ |
| 1plS=MID-drink.IMPFV | | TVG: 76, 124–125, 136 |

(29) $he$ ‘3rd person plural subject’ in word-initial position

| Underlying form | Surface form | English gloss |
|-----------------|--------------|---------------|
| a. /he3=tsa:y/ | heetsa:y | ‘they (2) cry’ |
| 3plS=cry.IMPFV/OPT | | |
| b. /he3=d1-jón/ | heedʒón | ‘they (2) sing’ |
| 3plS=MID-sing | | |
In (29), the long vowel which occurs in the surface forms (e.g. *heedê* ‘they (2) sing’) is exceptional; this exceptionally long vowel occurs only in the 3rd person dual and plural imperfective forms of “bare verbs”—that is, verbs with no other conjunct or disjunct thematic prefixes (TVG: 74). One question which arises immediately regarding the examples in (27)-(29) is: could the initial *h* of these prefixes be epenthetic? It is well-documented that, in Dene Sûlûne, *h* is often epentthesized as a repair strategy for onset-less words (Li 1946: 413; Cook 2004: 14-15), and indeed the examples in (27–29) would be consistent with an epenthesis analysis. However, in subsequent examples we will see cases either where *h* is retained between vowels, or where we observe a long vowel where *h* would have been present earlier in the derivation—suggesting that the consonants in all three of these prefixes are underlying.

Next we will see what happens when *hí* and *híd* are preceded by another Level 2 prefix. As illustrated in (30) and (31) below, the initial *h* of these prefixes is deleted, and a short vowel results. The *e* vowels which occur in (30c) and (30d) are examples of a variable process of *i* to *e* lowering which occurs in some forms (see TVG: 194–204).

(30)  

**‘semelfactive’ preceded by a Level 2 prefix**

| Underlying form | Surface form | English gloss |
|-----------------|--------------|---------------|
| a. /nì5-ne2- hí2-s2=jú/ | níníjú: | ‘I bring dogs’ |
| TERM-QUAL-SEM-1sgS=bring.dogs |
| b. /nì5-ne2- hí2=jú/ | nínjú: | ‘he/she brings dogs’ |
| TERM-QUAL-SEM=bring.dogs |
| c. /nì5-ne2- hí2-s2=ýa/ | nínésa: | ‘I get stuck’ |
| TERM-QUAL-SEM-1sgS=go.SG |
| d. /nì5-ne2- hí2=ýa/ | nínẹ́xa: | ‘he/she gets stuck’ |
| TERM-QUAL-SEM=go.SG |

TVG: 194, 196

(31)  

**‘1st person dual/plural subject’ preceded by a Level 2 prefix**

| Underlying form | Surface form | English gloss |
|-----------------|--------------|---------------|
| a. /ne2- híd2=í1-?i/ | níí?i: | ‘we see’ |
| QUAL-1plS=CAUS-see.IMPFV |
| b. /na5-ne2- híd2=d1-?i/ | narí?i: | ‘we check again’ |
| ITER-QUAL-1plS=MID-see.IMPFV |
| c. /ne2- híd2=té:s/ | níte:s: | ‘we go to bed’ |
| EGR-1plS=sleep.IMPFV/OPT.PL |
| d. /ne2- híd2=je:/ | nídže: | ‘we (2) grow’ |
| QUAL-1plS=grow |

TVG: 133–134, 141, 177
Assuming that \( h \) is underlying, the fact that a short vowel results when \( h \) is preceded by a Level 2 prefix would lead us to deduce, in accordance with our hypothesis in (6), that \( h \) is deleted intervocally at Level 2 (as shown in (16)). Next, we will examine what happens when \( h \) is preceded by a Level 3 prefix. This seems to happen only when the \( hí \) conjugation marker is preceded by either \( he \) or \( ts‘e \); thus, the sequences \( he–hí \) and \( ts‘e–hí \) are realized as \( hii’i \) and \( ts‘ií \), respectively. This is illustrated in (32). These examples also include the distributive prefix \( dá- \), which indicates that the number of the subject is plural rather than dual (the author’s informant judges that the \( dá- \) prefix is required with the impersonal forms of these verbs, in (32b)).

(32) \( hí \) ‘semelfactive’ preceded by a Level 3 prefix

(a) \( he–hí \) pronounced \( hii’i \)

Underlying form | Surface form | English gloss
--- | --- | ---
\( /dáš he3-\hí2=\lú/ \) | dáhlílú: | ‘they snare’
| DISTR-3plS-SEM=snare | | |
\( /dáš he3-\hí2=\lú / \) | dáhlíltj’é: | ‘they get angry’
| DISTR-3plS-SEM=CAUS.MID-angry.PERF/OPT | | |
\( /dáš he3-\hí2=\lú / \) | dáhlílk’iθ | ‘they shoot’
| DISTR-3plS-SEM=CAUS-shoot.IMPFV/OPT | | |
\( /dáš he3-\hí2=\lú / \) | dáhlíkár: | ‘they slap’
| DISTR-3plS-SEM=slap | | |

(b) \( ts‘e–hí \) pronounced \( ts‘ií \)

Underlying form | Surface form | English gloss
--- | --- | ---
\( /dáš ts‘e3-\hí2=\lú/ \) | dáš’tiílú: | ‘one snares’
| DISTR-impS-SEM=snare | | |
\( /dáš ts‘e3-\hí2=\lú / \) | dáš’tiíltj’é: | ‘one gets angry’
| DISTR-impS-SEM=CAUS.MID-angry.PERF/OPT | | |
\( /dáš ts‘e3-\hí2=\lú / \) | dáš’tiílk’iθ | ‘one shoots’
| DISTR-impS-SEM=CAUS-shoot.IMPFV/OPT | | |
\( /dáš ts‘e3-\hí2=\lú / \) | dáš’tiíkár: | ‘one slaps’
| DISTR-impS-SEM=slap | | |

TVG: 97–98, 115–116, Jaker’s fieldnotes (2/17/21)

Previously in Sect. 1 we established the generalization that the only source of long vowels in Tetsó’tíñe prefixes is intervocalic consonant deletion. Therefore, consistent with this generalization, the surface long vowels observed in (32) can be taken as evidence that a consonant was present underlyingly, and has been deleted. More specifically, our hypothesis in (6) would lead us to deduce that the underlying /\( h/\) in these forms is not deleted at Level 3, given that these longs voweles follow a Level 3 prefix; rather, it must be deleted at some later level, either 4, 5, or 6. Indeed, consistent with this hypothesis, we do observe that when the prefixes \( hí \) or \( híd \) are preceded by a Level 4 prefix, a short vowel results, as shown in (33–34).

(33) \( hí \) ‘semelfactive’ preceded by a Level 4 prefix

Underlying form | Surface form | English gloss
--- | --- | ---
\( /n\e4-hí2-s2=\lú/ \) | nís\iθ | ‘I kick you’
| 2sgO-SEM-1sgS=kick.IMPFV/OPT | | |
Tets'o'téni prefix vowel length: Evidence for systematic underspecification 637

(34)  híd ‘1st person dual/plural subject’ preceded by a Level 4 prefix

| Underlying form | Surface form | English gloss |
|-----------------|--------------|---------------|
| a. /ne₄-híd₂=₁-ts’ón/ | nílt’s’ón | ‘we kiss you (sg)’ |
| 2sgO-1plS=CAUS.MID-kick.IMPFV/OPT | | |
| b. /ne₄-híd₂=káːr/ | níkáːr | ‘we slap you (sg)’ |
| 2sgO-1plS=slap | | |
| c. /ne₄-híd₂=₁-t’uːs/ | nílt’uːs | ‘we punch you (sg)’ |
| 2sgO-1plS=CAUS-punch | | |
| d. /ne₄-híd₂=ʔiːθ/ | níʔiːθ or níʔʃiːθ | ‘we kick you (sg)’ |
| 2plO-1plS=kick.IMPFV/OPT | | |

TVG: 119, 130–131, Jaker’s fieldnotes (08/31/20)

There is a problem, however. When the h of the 3rd person plural subject prefix he is preceded by a Level 4 prefix, the h is retained on the surface. This is illustrated in (35).

(35)  he ‘3rd person plural subject’ preceded by a Level 4 prefix

| Underlying form | Surface form | English gloss |
|-----------------|--------------|---------------|
| a. /se₄-he₃-híd₁=ʔiːθ/ | sehíʔiːθ | ‘they (2) kick me’ |
| 1sgO-3plS-SEM=kick.IMPFV/OPT | | |
| b. /se₄-he₃-ʔe₂=ʔéːθ/ | sehēʔéːθ | ‘they (2) kicked me’ |
| 1sgO-3plS-CONCL=kick.PERF | | |
| c. /se₄-he₃=₁-ts’ón/ | sehelt’s’ón | ‘they (2) kiss me’ |
| 1sgO-3plS=CAUS.MID-kiss.IMPFV/OPT | | |
| d. /se₄-he₃-¥e₂=₁-ts’ún/ | sehelt’s’un | ‘they (2) kissed me’ |
| 1sgO-3plS-DUR=CAUS.MID-kiss.PERF | | |

TVG: 119, 130

A similar problem is found with Level 5 prefixes. Following a Level 5 prefix, the h of híd is deleted, resulting in either a long vowel or diphthong as shown in (36–37), while the h of he is retained, as shown in (38). Regarding the underlying status of h, the surface long vowels and diphthongs in (36–37) can also be taken as evidence that the initial h of híd is underlying, in accordance with our hypothesis in (6): if h were not present underlyingly, all of these forms would be predicted to surface with short monophthongs.

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Our hypothesis in (6) can easily explain why deletion of \( h \) results in short vowels in (33–34), and long vowels or diphthongs in (36–37): we may simply deduce, based on these examples, that \( h \) is deleted intervocally at Levels 4 and 6, but not Level 5. What our hypothesis cannot explain, however, is why \( h \) fails to delete in (35) and (38). In these cases, it would seem that the prefix \( he \) is exhibiting exceptional behaviour: it behaves differently than \( hí \) and \( híd \), even though it appears to begin with the same consonant, and is preceded by the very same set of prefixes. In the next section, I will
propose that the initial consonant of *he* is actually /x/ underlyingly, and that *x* and *h* participate in a chain shift: *x → h → Ø*.\(^{13}\)

### 5.2 Lexical Phonology analysis

In this section, I will propose that the failure of *h* to delete in 3rd person plural forms is actually a manifestation of a CHAIN SHIFT. A chain shift is when “certain sounds are promoted (or demoted) stepwise along some phonetic scale in some context” (Kirchner 1996). In the present case, I suggest that the initial *h* of the 3rd person plural prefix *he* is actually /x/ underlyingly—thus, the actual UR of this prefix is /xe/. At Level 6, what happens is that /x/ lenites to [h], while /h/ is deleted. Thus, there is a stepwise chain shift: *x → h → Ø*. Alternatively, one could say that the underlying contrast between /x/ and /h/ is realized on the surface as a contrast between [h] and [Ø]—where Ø is actually expressed as a long vowel, as we saw in (36–37).

To formalize this chain shift, in the present rule-based Lexical Phonology framework, we must first consider the representation of the segments /x/ and /h/. In accordance with the Contrastivist Hypothesis (Dresher 2009), I assume that the relative featural complexity of segments within a language can differ on a language-particular basis. For Tets’ot’íné in particular, the evidence suggests that laryngeal is the least marked place of articulation (in that it is actually placeless), velar is more marked, and coronal is still more marked, as shown in (39). That velar consonants are less marked than coronals is demonstrated by the so-called “t > k shift” exhibited by some Tets’ot’íné speakers, whereby *t* is pronounced as *k* (Haas 1968, TVG: 9; see also Cook 2004: 23).

(39) Relative markedness of Place features in Tets’ot’íné

\[
\begin{array}{cccc}
\text{h} & \text{x, Y} & \text{s, z} \\
\text{Lar} & \text{[supralaryngeal]} & \text{[supralaryngeal]} \\
\text{[spr. gl.]} & \text{[supr. gl.]} & \text{CPlace} & \text{[spr. gl.]} & \text{CPlace} & \text{[coronal]}
\end{array}
\]

I further assume that voiced segments are simpler than voiceless or aspirate segments, in that voiced segments lack the feature [spread glottis] (i.e. I assume the “Aspiration

\(^{13}\)A reviewer suggests an alternative analysis of these facts, whereby the prefix *he* is underlyingly *h*-initial, while the prefixes *hi* and *hid* are underlyingly vowel-initial. Under this analysis, whether or not a sequence of two adjacent vowels results in a short or a long vowel is determined by vowel quality. However, there are numerous examples where the same sequence of input vowels yields different results in different contexts. For example, both */e-uh=dl-ti:/ → *fúuhj: ‘you (2) eat’ and */e-ye-uh=dl-ti:/ → *fúuuhtj: ‘you (2) ate’ contain an /e-u/ sequence underlyingly, but only the latter has a long vowel, due to an intervening consonant, /l/. Similarly, both */e-hid=dl-ti:/ → *fúihj: ‘we (2) eat’ and */e-hi̱d=ke:/ → *θi̱ke: ‘we (2) sit’ contain an /e-il/ sequence underlyingly (with intervocalic /h/); the difference is that *fj* is a Level 5 prefix while *θe* is a Level 2 prefix. Conversely, I am not aware of a case in which two words have identical underlying consonants, and preceding prefixes belonging to the same level, where a different vowel length results, due to differences in vowel quality.
Hypothesis,” cf. Rice 1994). Under this set of assumptions, debuccalization of \(x\) to \(h\) can be modeled as deletion of the [supralaryngeal] node, as in (40), while deletion of \(h\) can be modeled as deletion of a segment which lacks a [supralaryngeal] node. The rule of Debuccalization in (40) is actually none other than the rule of “Intervocalic \(h\) deletion” seen previously. When debuccalization applies to /\(x\)/, the feature [spread glottis] is left behind, resulting in \(h\); on the other hand, when debuccalization applies to /\(\gamma\)/, there are no laryngeal or place features left, resulting in deletion of the entire segment.\(^{14}\) This is illustrated in (42), using the forms \(\text{fi\'iti}:\, \text{we (2) eat},\) \(\text{fe\'heti}:\, \text{they (2) eat},\) and \(\text{fe\'heeti}:\, \text{they (2) ate}.

(40) Debuccalization

\[
\text{[supralaryngeal]} \rightarrow \emptyset
\]

“The [supralaryngeal] class node is deleted.”

(41) Intervocalic \(h\) deletion

\[
h \rightarrow \emptyset / V _ _ / V
\]

“A segment which lacks a supralaryngeal node is deleted in between two vowels.”

(42) Chain shift (\(x \rightarrow h \rightarrow \emptyset\)) illustrated in forms of the verb \(\text{fe\'iti}: \text{eat}’

| Underlying form | Input to Level 6 | Intervocalic \(h\) deletion | Debuccalization | Mora insertion | Surface form | English gloss |
|-----------------|------------------|-----------------------------|-----------------|---------------|--------------|--------------|
| (a) /fe\text{-}\text{h}\text{\text{-}i}d=d-ti/ | f\text{\text{-}}h\text{\text{-}i}t\text{\text{-}i} | ----- | ----- | f\text{\text{-}}.he\text{\text{-}i}t\text{\text{-}i} | ‘we (2) eat’ |
| (b) /fe\text{-}\text{x}\text{\text{-}e}=d-ti/ | f\text{\text{-}}x\text{\text{-}e}t\text{\text{-}i} | ----- | ----- | f\text{\text{-}}.he\text{\text{-}e}c\text{\text{-}i}t\text{\text{-}i} | ‘they (2) eat’ |
| (c) /fe\text{-}\text{x}\text{\text{-}e}=d-ti/ | f\text{\text{-}}x\text{\text{-}e}t\text{\text{-}i} | ----- | ----- | f\text{\text{-}}.he\text{\text{-}e}c\text{\text{-}i}t\text{\text{-}i} | ‘they (2) ate’ |

The end result of this ordering of the rules is that /\(\gamma\)/ and /\(h\)/ are deleted (though leaving behind long vowels), while /\(x\)/ surfaces as [\(h\)]. In order to achieve this result, it is necessary that the rules of Intervocalic \(h\) deletion and Debuccalization apply in counter-feeding order: \(h\) deletes first, before \(x\) has lenited to \(h\); otherwise, all three segments (/\(x\)/, /\(\gamma\)/, /\(h\)/) would be deleted. This example serves to illustrate that chain shifts, which are a form of counter-feeding opacity, are contrast-preserving (Łubowicz 2003). It should be noted also that, under standard assumptions, the analysis presented in this section is compatible only with rule-based Lexical Phonology, and not Stratal OT, since the rules operating in counterfeeding order constitute a case of opacity within a stratum.\(^{15}\)

\(^{14}\)Strictly speaking, this rule leaves behind a root node with no features below it; I assume that this remaining root node is subsequently deleted by Stray Erasure (Steriade 1982).

\(^{15}\)Paul Kiparsky (p.c.) suggests that chain shifts may be the one type of opacity that does arise within strata, and suggests the use of “Super Optimality,” a version of bidirectional OT, to account for such cases.
Is there any independent evidence which would support the prefix *he having a different initial consonant than *hí and *hid? In the neighbouring Tłı̨ch’o language, the cognates of *he, *hí, and *hid are ge, i, and wid, respectively (Ackroyd 1982). In Proto Dene, the 3rd person plural prefix *q@ was consonant-initial, containing a uvular stop (Leer 2000: 107). On the other hand, the modern Tets’ot’íné forms *hí and *hid likely derive from the vowel-initial Proto-Dene forms *i and *i D, respectively (Leer 2000: 105). The initial h in *hid may possibly derive from a reflex of the Proto Dene *s conjugation (modern Tets’ot’íné *be conjugation), which became re-analyzed as part of the 1st person plural subject agreement prefix at some point historically—this is also the source of the initial w in Tłı̨ch’o wid (Story 1989: 501). Alternatively, it is possible that the initial h of both *hí and *hid derives from the epenthetic h which is inserted to repair vowel-initial words (Rice 1989: 130–131; Cook 2004: 14–15), which was re-interpreted as part of the underlying form of these prefixes. In any case, it is clear that the initial consonants of the three prefixes *he, *hí, and *hid have different historical sources, and they have different reflexes in related Dene languages. Therefore, it is not entirely unexpected that, in Tets’ot’íné, they have different underlying representations, and exhibit different morphophonemic behaviour.

6 Abstractness, learnability and allomorphy

In this paper so far, I have presented an analysis of Tets’ot’íné prefix vowel length in which I have claimed that all long vowels in prefixes are the result of intervocalic consonant deletion, under certain conditions. This claim, however, does involve a certain degree of phonological abstractness—particularly in relation to underlying /ɣ/. In this section, I will consider a set of issues relating to the abstractness of this underlying segment. In Sect. 6.1, I will present arguments for the learnability of /ɣ/, while in Sect. 6.2, I will consider an alternative analysis, in which underlying /ɣ/ and /ŋ/ are instead replaced with lexically listed allomorphy. I will conclude that while an allomorphy analysis involves less abstractness in the phonological component of the grammar, it involves greater abstractness in the morphological component of the grammar.

6.1 Arguments for underlying /ɣ/

In this section we will examine the status of underlying /ɣ/, in particular in relation to the *ge conjugation marker, although the same set of arguments will also apply to the optative prefix /ɣu/, seen previously in (18b). It is important first of all to emphasize that the rule which deletes /ɣ/ in prefixes does not constitute an absolute neutralization rule, for several reasons. The first is that the surface phone [ɣ] does exist in the language, and [ɣ] surfaces faithfully in stem-initial position, e.g. in the form niɣa: ‘he/she arrives.’ The second is that the γ-deletion rule in (23) can be learned transparently from surface variants both with and without [ɣ], such as seɣáheeta: ~ saheeta: ‘they feed me,’ as shown in (22). Finally, there are attested examples of the *ge conjugation marker itself surfacing faithfully, in forms such as nayeda: ‘move.’
As discussed previously in Sect. 4, speakers understand and recognize similar forms with historical *\( \gamma \) in them, suggesting that they had some exposure to such forms during language acquisition.

Nevertheless, there is a learnability issue relating to the initial /\( \gamma \)/ of the ye conjugation marker. The question is: for subsequent generations, in whose L1 input the initial /\( \gamma \)/ of ye is always deleted, based on what evidence can they assign this prefix an underlying initial /\( \gamma \)/ (rather than initial /h/, or analyzing this prefix as vowel-initial)? Here I will briefly present a set of arguments that, even if the initial /\( \gamma \)/ of ye is deleted in all contexts, learners can still arrive at /\( \gamma e \)/ as the underlying form of this prefix, given certain assumptions about learning and the featural representation of segments.

First, learners can deduce that the prefix /\( \gamma e \)/ is consonant-initial, based on two types of evidence. The first is that this prefix surfaces as consonant-initial (as he) in word-initial position, for example hests’ on ‘I kissed,’ as shown in (4b), from underlying /\( \gamma e \text{-s} \text{-l-ts’on} \)/. Since most consonants surface faithfully in word-initial position, the learner will posit an initial consonant /h/ in these forms, in the absence of evidence for the contrary. The second piece of evidence concerns the behaviour of this prefix word-medially. When a prefix is added before /\( \gamma e \)/, a long vowel results, as in the form neests’ on ‘I kissed you’ in (3a), from underlying /ne-\( \gamma e \text{-s} \text{-l-ts’on} \)/. Given surface alternations such as in (1), where deletion of an intervocalic consonant results in a long vowel, the learner can deduce that forms such as neests’ on have an intervocalic underlying consonant as well.

Second, the learner can deduce that the initial consonant is not /h/, by comparing forms such as neests’ on ‘I kissed you’ in (3a) with forms such as nís?’t\( \theta \) ‘I kick you’ in (3b). This is because the underlying consonant in neests’ on exhibits different morphophonemic behaviour (specifically, results in a different surface vowel length) than a true underlying intervocalic /h/, in words such as nís?’t\( \theta \).

If the prefix ye begins with a consonant which is not /h/, which consonant is it? Here I assume that the learner will be guided by two criteria. Following Dresher (2001), I assume that, all other things being equal, the learner will posit the simplest possible underlying segment—that is, with the fewest possible features. In addition, I also assume that the learner will posit the underlying segment which is similar to the surface form, to the greatest extent possible.\(^{\text{16}}\) Given certain assumptions about the featural representation of segments, these two criteria yield convergent results (since \( h \) is one of the simplest segments). The contrastive hierarchy I assume for place features in Tetsót’i né is given in (43). For clarity of exposition, only stops (or affricates) and fricatives are shown.

\(^{\text{16}}\)In OT, such an underlying form would be preferred because it would incur the fewest faithfulness violations.
The hierarchy in (43) employs privative features; thus, the laryngeal segments /h/ and /ʔ/ are the simplest segments in that they lack place features entirely. However, we may exclude /ʔ/ as the initial consonant of ye, because /ʔ/ surfaces faithfully in word-initial position, in forms such as ʔeэk’ээθ ‘he/she shot unspecified object’ and ʔeэhkáэx ‘he slapped himself.’ Unlike in other Dene languages, the initial consonant of ye in Tetsótiné (as in all Dëne Súłíné dialects) does not have any effect on neighbouring vowels (Jaker 2020). Therefore, the identity of this segment can be decided solely based on the criteria of formal simplicity, and similarity to /h/. Other than laryngeal, the place of articulation which is specified for the least number of place features is velar. Thus, we may narrow down the identity of this segment to one of the five consonants k, g, k’, x, y.

Next we will consider manner features. The contrastive hierarchy I assume for manner features in Tetsótiné is given in (44). For ease of exposition, I will illustrate using alveolar consonants, since this is where the full set of manner contrasts is found.
In the case of velar consonants, not all possible manners of articulation are attested in the language, as shown in the chart in (9): there are no velar sonorants, or velar affricates. A velar consonant therefore must be either a stop (\(k, g, k'\)), or a fricative (\(x, y\)). There is no direct evidence with which to decide if the initial segment of \(\gamma e\) is a fricative or a stop; however, as shown in (44), fricatives are featurally simpler than stops, in that they lack the feature \([\text{stop}]\). Also, \(/h/\) also lacks the feature \([\text{stop}]\). Thus, based on criteria of formal simplicity as well as similarity to \(/h/\), the learner may deduce that the consonant is a velar fricative.

The remaining possible consonants are \(/x/\) and \(/\gamma/\). I assume that \(/x/\) bears the laryngeal feature \([\text{spread glottis}]\), while \(/\gamma/\) does not. Here, our two criteria come into conflict: \(/x/\) is more similar to \(/h/\) in that both segments are \([\text{spread glottis}]\), while \(/\gamma/\) is featurally simpler in that it lacks \([\text{spread glottis}]\). However, in Sect. 5 I presented arguments that underlying \(/x/\) surfaces as \([h]\) word-medially. In other words, \(/x/\) is actually too similar to \(/h/\), in that it actually surfaces as \([h]\). \(/\gamma/\), on the other hand, exhibits the desired morphophonemic behaviour, in that it deletes intervocally—and there is direct evidence for this, from variable \(\gamma\)-deletion, as we saw in (22). Therefore, the underlying initial consonant of the \(\gamma e\) conjugation marker must be \(/\gamma/\).

To summarize, I have argued that, in the examples presented, the learner can infer that (1) there is a consonant present underlyingly, and (2) it is the simplest consonant which is neither \(/h/\) nor \(/x/\). According to the representations I assume as shown in (43) and (44), this consonant must be \(/\gamma/\). Whether this chain of reasoning can be learned computationally I leave as a question for future work.

6.2 A possible alternative: Lexically listed allomorphy

In this section, I will consider a possible alternative analysis, which, for the prefixes discussed previously, does not posit underlying \(/h/\) and \(/\gamma/\), but rather attributes the different surface variants of these prefixes to lexically listed allomorphy. By allomorphy, I mean that the same morpheme—that is, the same bundle of morphosyntactic features—has more than one phonological underlying form. Allomorphy approaches in general have the advantage of not requiring abstract phonological representations: each allomorph is the same (or nearly the same) as its surface form. Allomorphy has been used previously to describe the morphophonemics of some Dene languages, for example Witsuwit’en (Hargus 2007).

If the 2nd person singular subject prefix were to be represented by means of two allomorphs, it is clear that these allomorphs would be \(/ne/\) and \(/\tilde{n}/\) (cf. Li 1946). For the \(\gamma e\) conjugation marker, on the other hand, there are several possible analyses, depending on which other analytic assumptions are adopted. In the related languages Tłı̨c̱ẖ’ (Ackroyd 1982) and Witsuwit’en (Hargus 2007), the cognate of this prefix has been represented as a vowel, \(e\) or \(i\). Thus, under one possible analysis, the \(\gamma e\) conjugation marker would have two allomorphs: \(/e^{\mu}/\) and \(/e/\)—that is, \(/e/\) both with and without a mora. Under such an analysis, \(/e/\) occurs word-initially and after a Level 2 prefix, whereas \(/e^{\mu}/\) occurs after a Level 3, 4, or 5 prefix. This is illustrated in (45).
The correct allomorph of the 2nd person singular subject prefix can be selected in much the same way: /ne/ occurs word-initially and after a Level 5 prefix; /i/ occurs after a Level 2 or 4 prefix (examples with a Level 3 prefix are not attested for morphotactic reasons). This is illustrated in (46).

(46)  Illustration of morphological selection of /ne/ ~ /i/.

| Morphological Position | Input to the Morphology (before selection) | Output of the Morphology (after selection) | Surface Form |
|------------------------|-------------------------------------------|------------------------------------------|--------------|
| a. Word-initial        | /{ne ∼ i}-l-t’s:í/                        | /ne-l-t’si:/                             | ne’tsi: ‘you (sg) make’ |
| b. After a Level 2 prefix | /0e-{ne ∼ i}-l-t’si:/                     | /0e-i-l-t’si:/                           | òihtsi: ‘you (sg) made’ |
| c. After a Level 4 prefix | /se-{ne ∼ i}-l-t’u:s/                    | /se-i-l-t’u:s/                         | sìlt’us: ‘you (sg) punch me repeatedly’ |
| d. After a Level 5 prefix | /ná-{ne ∼ i}-l-t’u:s/                 | /ná-ne-i-l-t’u:s/                      | náne’t:us: ‘you (sg) punch’ |

The same analysis also works when both the ye conjugation marker {e ∼ eµ} and the 2nd person singular subject prefix {ne ∼ i} occur as part of the same linear string. In this situation, the /i/ allomorph of the 2nd person singular is selected by the /e/ allomorph of the ye conjugation marker. This is illustrated in (47).

(47)  Comparison of 2nd person singular allomorph with and without the ye prefix.

| Morphological Position | Input to the Morphology (before selection) | Output of the Morphology (after selection) | Surface Form |
|------------------------|-------------------------------------------|------------------------------------------|--------------|
| a. ye conjugation marker is absent | /{ne ∼ i}-d-d:á/                       | /ne-d-dá:/                              | neda: ‘you (sg) drink’ |
| b. ye conjugation marker is present | /{e ∼ eµ} -{ne ∼ i}-d-d:á/           | /Ø-i-d-dá:/                             | hída: ‘you (sg) drank’ |
The analysis illustrated above is only one of several possible allomorphy-based analyses. While this type of analysis can indeed account for the facts, and has the advantage of limiting phonological abstractness, it also comes at the price of complicating the morphology and lexicon. Thus not only ye, but also any prefix that participates in length alternations, including the conjugation markers te ‘conclusive,’ pe ‘momentaneous,’ and hi ‘semelfactive’ would also require the listing of moraic and mora-less allomorphs, thus increasing the complexity of lexical representations. At the same time, certain other generalizations are missed—the fact that that surface vowel length can be predicted if we know which consonants delete at which levels.

A more radical solution, also suggested by a reviewer, would be to treat the entire domain of subject agreement, object agreement, and aspectual prefixes (Levels 2, 3, and 4) as synchronically unanalyzable portmanteau morphemes. For example, the conclusive perfective paradigm would consist of the set of prefixes thi ‘1sg,’ thi ‘2sg,’ the ‘3sg,’ thi ‘1pl,’ thuh ‘2pl,’ hee ‘3pl.’ While such an analysis is formally possible, and would involve minimal abstractness, at the same time nearly all generalizations about the morphophonemic behaviour of nasality, vowel length, and tone in this language would not be statable in the synchronic phonology. Furthermore, Dene verb morphology, already one of the most complex morphological systems in the world (Rice 2000a: 1), would be rendered even more complex due to the proliferation of lexically listed prefix combinations. In evaluating such alternatives, I agree with Bonet and Harbour that “to assign such variation to the lexicon, when phonology is perfectly equipped to handle it, seems a significant loss of insight, and so we restrict allomorphy to cases that cannot be derived by regular phonology” (Bonet and Harbour 2012: 201).

The issue of abstractness has been debated throughout the history of generative phonology. In SPE (Chomsky and Halle 1968), the Evaluation Metric generally favored abstract phonological representations, which simplified the lexicon. This practice was challenged in the 1970s: Kiparsky (1982a) proposed the Alternation Condition, which banned absolute neutralization, and similarly Hooper (1976) presented a model which largely replaced abstract underlying forms with lexically listed allomorphy. More recently, some authors have argued that learners may actually prefer to posit abstract underlying forms in some contexts. McCarthy (2005) proposed the Free Ride Principle, whereby a learner that infers the mapping /A/ → [B] based on alternations will try to derive every surface [B] from underlying /A/ (McCarthy 2005). Rasin and Katzir (2017) reach a similar conclusion based on the principle of Minimum Description Length (MDL). According to Rasin and Katzir, MDL “balances two competing factors: (a) the simplicity of the grammar, |G|; and (b) the tightness of fit of the grammar to the data, |D: G|.” They find that abstract underlying representations often make it possible to eliminate certain features from underlying representations. This simplifies the grammar |G|, without complicating the description of the data |D: G|. I believe that a similar argument could be made in this case: in Tetsôt’įné, abstract underlying consonants simplify the grammar to the extent that they enable us to avoid positing lexically listed allomorphs both with and without moras (indeed, they eliminate moras entirely from the underlying forms of prefixes). Thus it may be that an abstract analysis such as I have proposed is preferred by the MDL metric over more concrete, allomorphy-based analyses (though I leave an implementation of this question for future work).
7 Conclusion

To conclude, in Sect. 7.1 I will briefly consider a possible Stratal OT implementation of the current proposal, while in Sect. 7.2 I will consider more generally the role of representations in explaining morphophonemic behaviour.

7.1 Stratal OT

Stratal OT (Kiparsky 2000; Jaker and Kiparsky 2020) is an OT version of Lexical Phonology. In Stratal OT, each phonological level (or stratum) is a parallel OT system, with an input, output, and constraint evaluation; the difference is that, in Stratal OT, the levels interface serially: the output of Level $n$ forms the input to Level $n+1$. Thus the Stem-Core model in (16) could be re-formulated in Stratal OT as 6 OT grammars, serially ordered.

With regards to the present proposal of systematic underspecification of moras, the basic mechanism can be modeled straightforwardly in Stratal OT. The Derived Environment Effect involving prefix vowel length can be derived using just three constraints, which are defined in (48).

(48) Constraints which refer to moras

- $V\mu$: Every vowel must be associated to at least one mora (no mora-less vowels).
- DEP($\mu$): Don’t add moras.
- MAX($\mu$): Don’t delete moras.

If $V\mu$ is ranked above DEP($\mu$), then the analysis predicts that all vowels which were mora-less in the input (which, under my hypothesis, is all prefix vowels) will be repaired by insertion of a mora. This is illustrated in (49), using the form $nudâ$: ‘he/she will sit down.’

(49) Mora inserted to repair mora-less vowels (Level 2)

| Form   | MAX($\mu$) | $V\mu$ | DEP($\mu$) |
|--------|------------|--------|------------|
| /ne-\u0158u=dâ:/ |            | $!*$   |            |
| a. nu.dâ:  |            |        |            |
| b.nu.dâ:  |            |        | $!*$       |
| c. nu.dâ:  |            |        | $!!*$      |

The constraint MAX($\mu$), which is undominated, ensures that all moras which were added at earlier levels of the phonology are retained at later levels—this is the Derived Environment Effect. Added to these constraints are a set of prosodic constraints which force intervocalic consonant deletion (such as ALIGN-L(FT, PRWD), and a set of
segmental faithfulness constraints, specified for particular segmental features, which determine which consonants are deleted or retained at each level of the phonology. The Stratal OT analysis described above predicts the correct result in Tetsōt’íné, given one key assumption: that all prefix vowels have zero moras underlyingly. However, this raises the formal question: what specific formal device ensures that prefix vowels will have zero moras in the UR? From the point of view of OT, which assumes Richness of the Base (Prince and Smolensky 2004), a phonological grammar should be able to yield the correct output given any input; on the other hand, the analysis presented in Sects. 4 and 5 would, in many cases, yield the wrong surface form, if prefix vowels with underlying moras were allowed.

A reviewer notes that this is perhaps not a problem: given the relatively small inventory of prefixes in Tetsōt’íné, it is possible that all of them are simply lexically specified as mora-less. Thus, perhaps the lack of underlying moras in prefix vowels is not something which the grammar needs to capture directly. Along a similar line of reasoning, it has also been suggested that, in OT, underspecified underlying forms are preferred wherever there are predictable surface alternants (Inkelas 1995). Again, in this case, the lack of underlying moras in prefix vowels would not need to be stated by the grammar directly.

However, it is not clear to me that there is sufficient morphophonemic evidence for the learner to learn that every Tetsōt’íné prefix is underlyingly mora-less; for some prefixes, the necessary length alternations may not be attested. In such cases, the only way for a prefix to be stored as mora-less is due to a generalization at the level of the whole grammar—that is, a Morpheme Structure Constraint (MSC), as shown in (50).

\[(50) \text{Morpheme Structure Constraint (MSC) banning moras from prefix vowels} \]
\[*/V_{/}^\mu_/\text{Prefix} \]
\[“\text{Moras are banned from the underlying representation of prefix vowels.”} \]

While the use of MSCs has been historically disallowed in OT, it is worthwhile to ask why this should be the case. MSCs go against Richness of the Base (ROTB) and Lexicon Optimization (LO); however, ROTB and LO, although motivated by considerations of theoretical elegance and simplicity, are ultimately stipulations, and do not follow from the OT architecture (Vaux 2005). Ultimately, an MSC is really just a generalization about the lexicon: “...humans can and do extract generalizations from the structure of their lexicon—even, as Dell et al. (2000) have shown, in the absence of alternations. This move resonates with what we know about human and primate cognition... and is grounded in the fundamental linguistic tenet that extracting generalizations is the heart of grammar construction” (Vaux 2005: 10).

In my estimation, although there are potential alternatives to the use of an MSC for the data presented in these paper, all of these require some modification to the OT architecture. For example, it could be possible to introduce a “Level 0” prior to the beginning of the phonological derivation proper, at which no phonological processes take place, but phoneme inventories are established. In the end, it seems that there are a number of cases which are problematic for Lexicon Optimization and Richness of the Base (see Vaux 2005 for a survey); it appears that Tetsōt’íné prefix vowel length must now be added to the list of such cases. Given that other core tents of OT have also been questioned by phonologists in recent years, including strict constraint
domination and/or parallelism (McCarthy and Pater 2016), it is worth reconsidering what role Lexicon Optimization and Richness of the Base ought to play in a theory of grammar, especially in light of problematic cases such as I have presented here.17

Another issue concerns opacity within strata. In previous literature on Stratal OT, it has been claimed that the only source of opacity is constraint re-ranking across levels (Kiparsky 2000) and that the lack of opacity within strata can help predict morphophonemic behaviour: processes interacting across levels may interact opaquely, while processes within a level interact transparently (Jaker and Kiparsky 2020). In this context, the analysis presented in Sect. 5.2 is problematic for Stratal OT, since the chain shift \( x \rightarrow h \rightarrow \Theta \) constitutes a case of counterfeeding opacity within a stratum. As mentioned earlier, Paul Kiparsky (p.c.) has suggested that the one type of opacity that does arise within strata is chain shift effects, which can be modeled using Super Optimality, a version of bi-directional OT (Jäger 2000). Nevertheless, if opacity of this type were to be allowed within strata, it would be a significant departure from earlier claims regarding the status of opacity in Stratal OT. I therefore leave the proper treatment of this type of opacity within Stratal OT as a question for future work.

7.2 Explaining morphophonemic behaviour

In this paper, I have described a pattern of prefix vowel length in Tetsó‘t’íne which could be characterized as a Derived Environment Effect (DEE): at any given level of the phonology, new \(/V_1-V_2/\) sequences are coalesced and simplified to \([V_{1,2}]\), while \(/V_1V_2/\) sequences already present in the input are retained \([V_1V_2]\). I have offered an explanation as to how this pattern may be derived. Using Systematic Underspecification, I proposed that the reason why \(/V_1-V_2/\) sequences coalesce to \([V_{1,2}]\) at a morpheme boundary is that all prefix vowels have zero moras underlyingly. However, after passing through at least one cycle of the phonology, prefix vowels acquire a mora, and are thus “inoculated” against any further changes.

The bigger question is: why should such a pattern of Systematic Underspecification exist in this language? To answer this question, I have proposed two general lines of explanation. One line of explanation involves the morphological structure of the verb. As discussed in Sect. 3, I assume a model of Dene verb structure where the verb has the shape of a right-branching tree, and the phonological derivation proceeds inside-out, from right to left. This morphological structure can explain why prefixes belonging to different levels exhibit different phonological behaviour. The other line of explanation involves underspecification: all prefix vowels in Tetsó‘t’íne have zero moras underlyingly. It is thus the combination of level ordering and underspecification that gives rise to the morphophonemic effects we have observed in this paper.

The broader point is that both lines of explanation are representational. They are not about processes or targets, but rather about the substrate upon which processes and targets are defined. Furthermore, the representations in question are not universal, but system-dependent and language-specific. Since both morphological structure

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17Rasin and Katzir remark that, in order for the MDL metric to yield the correct result, it is necessary to assume that S, the alphabet with which underlying forms are written, may vary between languages: “we believe that allowing S to vary between languages is generally required for an MDL learner to successfully acquire the phonological knowledge that speakers have” (Rasin and Katzir 2017: 286). See also Rasin and Katzir (2016: 236).
and contrastive relations vary from language to language, the model assumed here makes different predictions for different languages. In my opinion, this is a desirable result: by investigating the representational basis of phonological systems, we may find that morphophonemic behaviour is much more regular and predictable than has been generally assumed.

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I regret that sound files could not be included with this article; this is mainly due to a travel ban to the Northwest Territories due to Covid-19, currently in place, which precludes additional in-person fieldwork at the present time.

Code Availability Not applicable

Declarations

Conflict of Interest None to declare.

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