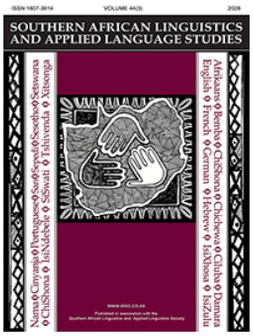

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# On the productivity of length-based alternations in Xhosa noun class prefixes

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**Abstract:** Noun classes in isiXhosa are each associated with specific prefixes on the noun stem. Some of these noun class prefixes exhibit length-based allomorphy: they take one form before multisyllabic stems and a different, longer form before stems that are monosyllabic. Specifically, classes 5 and 11 alternate between V- and VIV- shapes, and class 10 alternates between *iin-* and *izin-*. We use a wug test paradigm to test whether speakers apply these alternations productively in unfamiliar nonce words. We compare the results of several experiments, including both in-person and web-based tasks. Experiment results suggest that on the whole the prefix alternations are productive and therefore must be factored in to the synchronic (morpho)phonology of Xhosa. At the same time, not all speakers apply the alternations to wug items with 100% systematicity; rates of alternation vary by speaker, are different across online vs in-person tasks, are different for different noun class pairs and are sensitive to the 'direction' of the task (i.e. forming plurals vs forming singulars). This variability, in tandem with the existence of exceptional counter-examples, suggests that the pattern contains some inherent gradience or noise. Surprisingly, our experiments reveal an unexpected systematicity in the treatment of words that are inferred to be names. Altogether, these results contribute to growing our understanding of noun class systems in Bantu languages, including how they are represented in the mental grammar and how they are psycholinguistically processed.

## Introduction

Certain noun class prefixes in isiXhosa (Bantu, Nguni family, South Africa) are reported to alternate between different allomorphs based on the length of the root they attach to. The examples in (1) show the alternating classes and their respective forms, based on previous work (Jordan 1956; 1966; Claughton 1992; Gowlett and Dowling 2015; Dowling and Gowlett 2016).

(1) Xhosa noun class prefix length alternations

| | | | | | | |
|---|---|---|---|---|---|---|
| a. class 5: | *ilitye* | 'stone' | vs | *igama* | 'name, word' | (ili- ~ i-) |
| b. class 10: | *izinja* | 'dogs' | vs | *iinkomo* | 'cattle, cows' | (iziN- ~ iiN-) |
| c. class 11: | *ulusu* | 'skin' | vs | *ufinyelo* | 'shrinkage' | (ulu- ~ u-) |

To schematise the pattern, the alternating classes vary between two forms: a general form with a basically /V-/ shape, and an alternant of a /VCV-/ shape, which is used specifically with monosyllabic roots. The patterns we see in noun classes 5 and 11 are strikingly similar and suggest a phonological flavour to the pattern. These are the only two noun class prefixes in the language that ever have /l/, and both alternate in completely parallel ways. Other VCV noun class prefixes are not reported to drop their medial Cs in this way.

The question we take up in this article is whether these alternations are synchronically productive, or merely a fossilised vestige of some historical change. Some previous work has taken up closely related questions from a more lexical and historical perspective, particularly Dowling and Gowlett (2016). Our focus here is not so much on the consequences of the alternation for acquisition, or

restructuring of the noun class system of the language, but rather how it interfaces with the synchronic grammar – particularly the phonology. To that end, we conducted several experiments to ascertain whether L1 speakers of isiXhosa extend the prefix alternation pattern to novel words based on a word's prosodic shape.

## Background

### *Language background*

Xhosa (isiXhosa, [ìsíǁʰɔ̀sà]) is the southernmost Bantu language, endemic to the Eastern Cape (former Transkei and Ciskei homeland areas) of South Africa, with diaspora communities elsewhere in the more general region (see, for instance, Kunju 2017). Much of our data is presented using isiXhosa orthography, rather than IPA. The current standard orthography for isiXhosa is generally phonemic and highly similar to IPA and/or APA, but we provide some notes here to assist readers less familiar with isiXhosa to decode to phonetic values. Where the orthography deviates from IPA is in the representation of post-alveolars and pre-palatals, clicks, affricates and a handful of other segments. The palatal glide [j] is written as ⟨y⟩, and palatal stops as ⟨_y⟩ (i.e. ⟨ny⟩ = [ɲ], ⟨dy⟩ = [ɟ], ⟨ty⟩ = [cʼ], etc.); ⟨j⟩ represents the affricate [dʒ] (as in the APA convention). The consonants ⟨c x q⟩ represent, respectively, the clicks [ǀ ǁ ǃ]; these are preceded by ⟨g_⟩ to indicate (breathy) voicing and/or ⟨n_⟩ nasality, or followed by ⟨_h⟩ when aspirated. The digraph ⟨sh⟩ represents [ʃ] and ⟨tsh⟩ is used for both the affricates [tʃʼ] and [tʃʰ]. Voiced [b] is written ⟨bh⟩, but otherwise ⟨_h⟩ indicates aspiration (or breathiness on nasals, but these are quite rare in the standard variety). Unaspirated stops are ejective after a homorganic nasal, and may be variably realised as ejectives in other contexts. The voiceless lateral fricative [ɬ] is ⟨hl⟩, and voiced [ɮ] is ⟨dl⟩; the corresponding affricates are [tɬ] = ⟨tl⟩ and [dɮ] = ⟨dl⟩. Non-labial nasals are all represented as ⟨n⟩ (i.e. ⟨nk⟩ = [ŋkʼ], ⟨ndy⟩ = [ɲɟ], etc.). Orthographic ⟨rh⟩ (or, less commonly, ⟨r⟩) represents [x], while ⟨gr⟩ is [ɣ], and ⟨kr⟩ is [kxʼ]. For a full list of sounds and further details on the orthography, we refer the reader to more comprehensive sources and descriptions, such as the *Greater Dictionary of isiXhosa* (Tshabe et al. 2006). Tone is not marked in our examples for the most part, as is standard in isiXhosa orthography; for more details on the tone system of isiXhosa, we refer readers to previous work (Lanham 1958, Claughton 1992, Cassimjee 1998, Downing 1990, inter alia).

### *The isiXhosa noun class system*

The noun classes of isiXhosa are shown in (2), along with some of the agreement morphology that reflects the class distinctions. The traditional Meinhofian numbers 1–15 happen to roughly group classes into singular-plural pairs. That is, class 1 nouns normally have plurals in class 2, class 3 nouns normally pluralise into class 4, and so on. Not shown here are classes 16 and 17 (*pha-* and *ku-*, respectively), which are found only in vestigial locative forms.

| Class | Noun prefix | Example | | Subj. Agr. | Obj. Agr. | Adj. Agr. |
|---|---|---|---|---|---|---|
| 1 | *um-* | *um-ntu* | ‘person’ | *u-* | *-m-* | *om-* |
| 2 | *aba-* | *aba-ntu* | ‘people’ | *ba-* | *-ba-* | *aba-* |
| 1a | *u-* | *u-mama* | ‘mama’ | *u-* | *-m-* | *om-* |
| 2a | *oo-* | *oo-mama* | ‘mamas’ | *ba-* | *-ba-* | *aba-* |
| 3 | *um-* | *um-thi* | ‘tree’ | *u-* | *-wu-* | *om-* |
| 4 | *imi-* | *imi-thi* | ‘trees’ | *i-* | *-yi-* | *emi-* |
| 5 | *i(li)-* | *ili-tye* | ‘stone’ | *li-* | *-li-* | *eli-* |
| 6 | *ama-* | *ama-tye* | ‘stones’ | *a-* | *-wa-* | *ama-* |
| 7 | *isi-* | *isi-zwe* | ‘nation’ | *si-* | *-si-* | *esi-* |
| 8 | *izi-* | *izi-zwe* | ‘nations’ | *zi-* | *-zi-* | *ezi-* |
| 9 | *i(N)-* | *in-komo* | ‘cow’ | *i-* | *-yi-* | *eN-* |

| Class | Noun prefix | Example | | Subj. Agr. | Obj. Agr. | Adj. Agr. |
|---|---|---|---|---|---|---|
| 10 | *i(z)i(N)-* | *iin-komo* | ‘cows, cattle’ | *zi-* | *-zi-* | *eziN-* |
| 11 | *u(lu)-* | *ulu-su* | ‘skin’ | *lu-* | *-lu-* | *olu-* |
| 14 | *ubu-* | *ubu-so* | ‘face’ | *bu-* | *-bu-* | *obu-* |
| 15 | *uku-* | *uku-tya* | ‘food’ | *ku-* | *-ku-* | *oku-* |

(2) Standard isiXhosa noun class system

The pairings related to the noun classes of interest in this article are repeated in (3). There is some noteworthy variation on this point, however. First, some classes have substantial groups of nouns which deviate from the usual plural formation patterns. Often these are clusters of words in the same semantic neighbourhood and the most relevant of these sub-paradigms are listed in (4).

(3) Key singular-plural pairings for classes with alternating prefixes

a. 5 → 6 *ili-* → *ama-*
b. 9 → 10 *i(N)-* → *izi(N)-*
c. 11 → 10 *ulu-* → *izi(N)-*

(4) Some common ‘irregular’ plural patterns

| Classes | Example | | Gloss (of sg.) | Semantic neighbourhood | |
|---|---|---|---|---|---|
| a. 1→6 | *um-Xhosa* | → | *ama-Xhosa* | ‘Xhosa person’ | ethnonyms |
| b. 11→6 | *u-sana* | → | *ama-sana* | ‘baby’ | humans, animals |
| c. 9→6 | *in-doda* | → | *ama-doda* | ‘man’ | humans |

Second, class 10 is the regular plural for class 11 as well as for class 9.[i] Many nouns of class 11, and nearly all nouns of classes 14 and higher, cannot form plurals; many of these are mass nouns referring to abstractions, collectives, or liquids (e.g. *ubu-si* (cl. 14) ‘honey’, *uku-nene* (cl. 15) ‘right-hand side’), though some are not so obviously semantically incompatible with plurality (e.g. *ubu-so* ‘face’, *ukw-indla* ‘green unripe produce; autumn’). There are also some mass nouns in class 6 which do not have singulars (e.g. *ama-nzi* ‘water’). Class 7 also has some nouns that are not acceptable to pluralise (e.g. *isi-Xhosa*, ‘Xhosa language’; **izi-Xhosa*).

The ‘N’ shown in classes 9 and 10 in our examples represents a nasal that has idiosyncratic properties, as in many other Bantu languages. In isiXhosa, the class 9 nasal is never syllabic, is homorganic to the following consonant and triggers a specific constellation of alternations generally labelled ‘hardening’; see Braver and Bennett (2016) for further details. These alternations distinguish an [m] in class 9/10 from /m/ in other noun classes like 1 and 3. The class 9/10 nasal is typically absent before root-initial nasals and surface [l h w j], and is not present in most class 9/10 loanwords (Jordan 1956; Doke 1954; Bennett 2014);[ii] it is, however, reported to be systematically present in the class 9 and 10 adjectival and relative clause agreement markers. We treat this ‘N’ as part of the prefix, rather than the start of the following stem, on the basis of alternations in some irregular nouns like cl. 9 *in-kosi* ‘chief’ ~ cl. 6 *ama-khosi* ‘chiefs’. However, we note that for many regular class 9/10 nouns, there is an ambiguity inherent in the data: the root in a noun like *inkomo* ‘cow’ ~ *iinkomo* ‘cows’ could plausibly be analysed by speakers as either /-komo/ or /-ŋkʼomo/, with the prefix [iŋ-]

[i] There may also be some class 14 nouns with class 10 plurals. For example, the *Greater Dictionary of isiXhosa* (Tshabe et al. 2006) notes that *ubu-hlanti* ‘cattle kraal’ takes the plural *iin-tlanti*, which is in class 10; further study of how widespread such words are in the lexicons of speakers and how common they are in spoken or written usage are questions we leave for future researchers.

[ii] There are also some class 9 nouns listed in the *Greater Dictionary of isiXhosa* (Tshabe et al. 2006) that do not have the nasal, but which do not appear to be loanwords (or, at least not recent loans). For example, *i-tunu* ‘the last drops of beer in a can, which only the oldest man at a beer-drink may drink’. There are also older loans from Khoekhoe that lack the nasal, e.g. *i-gusha* ‘merino sheep’.

or [i-], respectively. Given the variability between [i-] and [iN-] forms, either representation could be compatible with the rest of the system. There is known inter-speaker variation in at least some lexical items, e.g. *inkwenkwe* 'boy' has a variant *ikwekwe*, and Tshabe et al. (2006) list the plural as *ama-khwenkwe*.

Like many other Bantu languages, isiXhosa noun class prefixes have considerable regularity in their phonological structure. Most noun class prefixes are of a V-CV- shape (either presently or historically), and their tone patterns are generally non-contrastive.[iii] The *um-* prefixes in classes 1 and 3 are cognate with *umu-* elsewhere in the Nguni group and have reduced to a VC shape in isiXhosa because to loss of *u after m.[iv] Additionally, all of the VCV class prefixes have two identical vowels, which are always one of /i u a/. This is no accident: the initial V, which is sometimes taken as a separate morpheme (the 'augment' or 'pre-prefix'), is usually identical to the prefix's other vowel; its appearance also depends on syntactic context (for descriptive details and current analyses, see Doke 1927; Mzolo 1968; Poulos and Msimang 1998; Katamba 2003; Van der Spuy 2010; Halpert 2015; Carstens and Mletshe 2016). Leaving aside the augment, the other prefix segment(s) are, in most classes, also shared by the agreement marking they trigger. For example, the prefix on nouns of class 7 is normally *isi-*; the same two segments [si] also occur in the class 7 subject and object agreement markers, and the possessive and associative markers, as well as in various other agreement that is quasi-transparently related from the same /si-/ underlying form (see Van der Spuy 2010 for a discussion of the formal details of this relationship). These points of consistency mean that a learner would have ample evidence to associate /l/ with nouns of class 5, even if the prefix were systematically underlyingly *i-* (rather than *ili-*). Older descriptions also report that the /l/ of classes 5 and 11 and the /z/ of class 10 appear in vocatives and locatives (though see also Jordan 1956; Mzolo 1968; Gowlett and Dowling 2015; Dowling and Gowlett 2016 for some discussion of variation on this point).

For classes 5 and 11, most other Nguni languages have the same alternations (see Doke 1926; 1954; Mzolo 1968, Gowlett and Dowling 2015, and sources cited therein). For isiZulu, Mzolo (1968: 198) notes that VCV- forms of class 5 and class 11 prefixes are 'virtually obsolete' with disyllabic roots, but 'not as rare' with monosyllabic roots. Doke (1926; 1927) systematically transcribes the 'short' allomorphs of these classes in isiZulu as having long vowels, e.g. [úlú-tʰí] ~ [úː-tʰí] 'stick'. Most subsequent literature on isiZulu does not characterise these vowels as long, though (see, e.g., Poulos and Msimang 1998). For the isiZulu recordings and speakers that we have consulted, these vowels do not seem longer than others. Although Doke (1954) says that isiXhosa also has long u in class 11, other sources on isiXhosa do not (see, e.g., McLaren 1942; Jordan 1956; Claughton 1992). Anecdotally, we have not observed long vowels in classes 5 or 11 in the recorded or natural speech we have encountered for isiXhosa.

For class 10, isiXhosa's allomorphy differs from most other Nguni languages. The default form of the class 10 prefix is rendered orthographically as *ii(N)-*. By comparison, isiZulu, Siswati and Zimbabwean varieties of isiNdebele have *izi(N)-*, with no alternation (though some Southern Ndebele dialects do have *ii(N)-*; Wilkes 2001; Schulz and Laine 2016; Schulz personal correspondence). In isiXhosa, the *izi(N)-* allomorph is found only with monosyllabic roots (Jordan 1956; Oosthuysen 2016). The *ii(N)-* allomorph is standardly described as a long vowel [iː] (Jordan 1966), though there is some controversy on this point.[v] Some researchers report that there is little or no difference in

[iii] In VCV prefixes, the initial V (the augment) normally has an underlying high tone and the CV portion is toneless. High tones in isiXhosa typically spread to the right, which means the outcome of this spreading depends on the tone structure of the following root. As such, the surface tone pattern of a prefix depends on whether the augment is present, whether its high tone spreads and whether it is obscured by optional lowering processes – which is subject to dialect variation.

[iv] This change is also evident from correspondences like isiZulu *phefumula* ~ isiXhosa *phefumla* 'breathe', where the same vowel deletion has occurred within a root. isiZulu and Siswati may also have a similar alternation in classes 1 and 3, between *um-* with polysyllabic roots and *umu-* with monosyllabic ones (Taraldsen 2010).

duration between class 9 (singular) *i(N)-* and class 10 (plural) *ii(N)-* (Lanham 1958; 1963; Claughton 1992; Eva-Marie Bloom-Ström personal correspondence). This would suggest that the distinction is primarily tonal and that the vowel is perhaps not underlyingly long. Since standard isiXhosa orthography does not include tone, the characterisation of the class 10 prefix *ii(N)-* as 'long' is also prominent in instructional materials and a common prescriptivist trope – which might influence some speakers' intuitions. We adopt the standard long vowel characterisation here, on advice from isiXhosa speakers we have consulted.

We also note that all of these specifics are subject to a vastly under-researched wealth of dialect variation, of which precious little is documented. For example, Nyamende (1994) notes that Hlubi has lost class 11 entirely, while Ntlangwini retains as its class 10 prefix *iti(N)-*. This is to be expected: the umbrella of 'Xhosa' as a label covers many different varieties with different lexicons and different grammars and the scope of our study is limited to just the idealised standardised form.

***Prosodic minimality effects in isiXhosa and related languages***

Bantu languages in general, and Nguni languages in particular, tend to show a preference for words or stems to contain at least two syllables or moras; this points to a phonological minimality constraint. Evidence for this kind of minimality constraint emerges from several sources, including the distribution of word and stem lengths in the lexicon and insertion of 'dummy' morphemes or other material in certain morphological contexts. These effects offer a ready motivation for the prefix alternations: a longer prefix allows a sub-minimal root to fill out a two-syllable prosodic template.

Disyllabic minimality is also evident in the isiXhosa lexicon. Monosyllabic noun roots are uncommon in general. While there are some unambiguously monosyllabic words in the language, as in (5), the ones we know of are all interjections, conjunctions, discourse particles, or ideophones (which typically can have expressively lengthened vowels, as in (5f). These are all somewhat peripheral lexical categories, and they share the characteristic of being generally incompatible with affixes.

(5) Monosyllabic words in isiXhosa (Tshabe et al. 2006)
- a. *qhâ* 'only (quantificational)' (particle)
- b. *njé* 'only, just; like so' (particle)
- c. *xá* 'if, when' (complementiser)
- d. *yhó* 'expression of distress, fear' (exclamation)
- e. *ké* 'and so, just, then' (discourse particle)
- f. *wû*(ː) 'empty liquid in one go' (onomatopoeic, as in *ukuthi wu* 'to say *wu*')

There are no nouns, verbs, or adjectives that yield genuinely monosyllabic words. Most monosyllabic nominal roots belong to classes with VCV- prefixes, which means they typically surface as trisyllabic words in citation form (e.g. *ili-tye* 'stone'), or as disyllabic (*Ø-li-tye*) in syntactic contexts where the augment is omitted. McLaren (1942) observes that the nasal of class 9 is deleted in native words before certain consonants, but all examples he gives (and all others known to us) are nouns with polysyllabic roots. This distribution neatly parallels the analysis proposed by Coetzee (2001) for class 9 minimality-driven nasal-only syllables in Setswana.

Further evidence for minimality – both in isiXhosa, and elsewhere in Nguni – can be seen in imperative verbs. Imperatives in these languages normally appear with tense or subject prefixes. Ergo, we might expect monosyllabic verb roots to yield monosyllabic words when used as imperatives – but that is not what happens. Instead, the generalisation is that a 'dummy' syllable [yi] appears before the verb (e.g. *yi-za* 'come!') to achieve disyllabicity. This has been documented, discussed and analysed

[v] Lanham (1958; 1963) reports that some class 9 nouns are homophonous with their class 10 plurals, which entails that the *ii(N)-* prefix does not always have a long vowel. Lanham's analysis is that length in this prefix is not underlying, but rather a byproduct of a falling tone sequence. As such, if a noun stem has a tonal pattern that induces a high tone on the prefix instead of a fall, then its class 9 and class 10 forms would be homophonous. See also Claughton (1992) for discussion.

in considerable detail in other Nguni languages like isiNdebele and isiZulu (Downing 2001; Hyman et al. 2009; Cook 2011; 2013). Similar 'dummy' syllables are also reported in future verb forms in isiZulu (Downing 2001; Cook 2013) and reduplication patterns (Downing 1998; Hyman et al. 2009).

At the same time, one facet of the prefix length pattern does *not* seem to fit with this intuitive interpretation: the alternation in class 10 is between *ii(N)-* and *izi(N)-*. On the face of it, this is quite odd: both allomorphs would seem to have two vocalic moras. Why should the insertion of an onset consonant in a prefix have anything to do with minimality in the stem? We discuss the mechanism for this further later in this article; for now, it is enough to note that minimality is a much more transparent motivation for classes 5 and 11 than it is for class 10.

***Hypotheses and motivation for the experiments***

We see two possible mental representations for the length-based alternations found in isiXhosa noun classes. It could be that (a) the allomorphy is a remnant of a historical change, represented only in the lexicon and learned for each word, or (b) the pattern is the result of a generative process in the (synchronic) grammar, such as a long underlying prefix that undergoes deletion. If the 'historical change' analysis is correct, speakers should not generally apply the length-based alternations to nonce words, since they would not have a lexical entry for these items to record their idiosyncratic behaviour. Conversely, under the 'synchronic phonology' view, speakers should apply the length-based alternations to novel words since they reflect a productive process.

Some previous work on isiXhosa – and on related Nguni languages with some of the same alternations – presumes the historical change analysis axiomatically. For instance, Meinhof's (1932) description of isiZulu identifies the alternations in class 5 and class 11 prefixes, but Meinhof makes no distinction between these synchronic alternations and major diachronic changes like Proto-Bantu *k > isiXhosa /s/. Doke (1954) likewise conflates synchronic and diachronic sound changes. Poulos and Msimang (1998) specifically identify *ili-* and *ulu-* as historical forms that have largely fallen out of use except with short stems. There is some independent support for this from older texts: Claughton (1992) notes that an isiXhosa word list from the 1780s gives 'horse' as *ili-hashe*, with the full prefix on a disyllabic root, in contrast to the modern form *i-hashe*. Oosthuysen (2016) follows the tradition of analysing *iin-* as a contraction of underlying *izin-*, but notes that short prefixes are common in some phrasal contexts – which suggests that there must be synchronic reality to the alternation.

We also have good reasons to take the historical change view seriously, even if it were not explicitly argued for in previous work. One of these is language contact: isiXhosa has been in long-term contact with English and Afrikaans – two languages with vast numbers of monosyllabic nouns, some of which may have been forcibly donated into isiXhosa. A second reason is that representing the alternations in the grammar might not lead to a stable phonological system, since they do not occur in all noun classes. The basis for the alternations seems to be phonological minimality, as noted above. But, there are counter-examples to the pattern in the form of nouns in other classes that do not meet the two-syllable stem minimality requirement. A few of these are given in (6). They include native words in classes 3 and 9 (6a-c), nominalised verbs (6d) and loanwords (6e-h).[vi] There are also longer class prefixes which never shorten, like class 7 *isi-*, class 6 *ama-*, and class 8 *izi-* (which, unlike its class 10 cousin, is never reported to surface as *ii-*).

[vi] There is also the possibility of additional words like these emerging as loans or through neologisms. Loanwords into isiXhosa typically go in class 9 by default, or class 1a if they denote humans. As such, we might expect these classes to contain more recent, non-nativised borrowings than what is apparent from available sources (like the *Greater Dictionary of isiXhosa*, Tshabe et al. 2006). For instance, personal names are systematically treated as class 1a (e.g. *u-Meri, u-Adam*; compare *u-Ham* & *u-Shem*, sons of *u-Nowa* in the bible). If monosyllabic names are treated in the same way, then we would expect that there are other words like *u-Joe*, with a monosyllabic root and monosyllabic prefix. There might also be meta-linguistic nouns on par with *u-thu* 'numeral 2' derived from native isiXhosa words, which could potentially be monosyllabic – e.g. *i-qha* 'a token of the word *qha*' ('only'). Words like these are not likely to appear in dictionaries or grammars though.

(6) Some sub-minimal words (Tshabe et al. 2006)

| | | | | |
|---|---|---|---|---|
| a. | *ín-tó* | (9/10) | ‘thing’ | |
| b. | *ín-dɮù* | (9/10) | ‘building, house, hut’ | |
| c. | *úm̀-qá* | (3/4) | ‘stiff porridge of maize meal’ | |
| d. | *úm-phí* | (1/2) | ‘generous person, giver’ | (see *-pha* ‘give’) |
| e. | *um̀-qhà* | (3/4) | ‘tree dassie’ | (<Khoekhoe ǂʰa) |
| f. | *í-tí* | (9/10) | ‘tea’ | (<Eng. *tea*) |
| g. | *í-thá* | (9/10) | ‘tarred road’ | (<Eng. *tar*) |
| h. | *ú-thú* | (1a) | ‘2’ (digit two) | (<Eng. *two*) |

Since there are isiXhosa nouns that do not meet the two-syllable minimality requirement, it makes sense that the system of prefix length alternations might be an unstable pattern. If so, it is plausible that it could have levelled out during the time between descriptions in the early 1900s and the present day. Such levelling might involve lexically storing short roots as ones that take irregular versions of the prefixes, and/or re-analysing where the prefix-root boundary falls (e.g. *ili-tye* → *i-litye*). There is ample precedent for this too, from nouns that have had their prefixes mangled by regular phonological alternations. For instance, isiXhosa has a productive pattern of labial palatalisation, where /ɓ/ changes to [c’] before [w]. As a result, the very few class 14 nouns that come from historically vowel-initial roots do not have the usual class 14 prefix /uɓu-/; instead, they have palatal stops: PB **ubu-ala* > [uc’wala] *utywala* ‘booze*’*. So, a child learning isiXhosa already must learn some amount of irregular ‘noise’ in the system of noun class prefixes. There is the potential, then, for the length-based alternations to fall into this category and to be internalised as individual lexical oddities rather than as a systematic phonological alternation.

There is, however, previous work that does characterise the minimality-based prefix alternations as synchronically active. This is implicit in work that treats the prefixes as ‘shortened’ from a longer form (e.g. Oosthuysen 2016). It is also crucial for Claughton’s (1992) analysis of Xhosa tonology. The examples in (7) illustrate the relevant generalisations.

(7) Tonal evidence for synchronic prefix length change (examples from Claughton 1992)

| | | | | | |
|---|---|---|---|---|---|
| a. | /áma-tikiti/ | → | *ámá-tíkiti* | ‘tickets’ | (pre-prefix H tone spreads right) |
| b. | /í-langa/ | → | *í-langa* | ‘sun’ | (*í-lánga; prefix H fails to spread) |

High tones in isiXhosa typically spread rightward, unless followed by another high tone; this means that prefixal H normally spreads onto a toneless noun root that follows (7a). But, for nouns in class 5, the H fails to spread (7b). Claughton’s analysis explains these cases by positing that the prefix tone spreads *before* the prefix syllable deletes: /í-li-langa/ → *í-lí-langa* → [í-langa]. This analysis is elegant, but requires the class 5 prefix to be underlyingly VCV in shape – which entails that the alternation is being implemented in the synchronic (morpho)phonology. A similar line of analysis for isiZulu is taken by Laughren (1984) and Khumalo (1987). Some other generative analyses of noun class morphology also require the class 5 prefix to be underlyingly long even where it surfaces as short (Taraldsen 2010; Van der Spuy 2010).

In short: both the synchronic and diachronic analyses of the prefix alternations have been argued for and both have credible evidence supporting them. To further distinguish between them, we conducted the two experiments described below.

**Experiment 1**

In order to test whether speakers apply the length-based allomorphy pattern to novel forms – and thus whether the ‘historical process’ or ‘synchronic rule’ hypothesis is more likely – we conducted a wug test (à la Berko 1958). In this type of task, the synchronic hypothesis predicts that the alternation will be applied to nonce words, since nonce words by definition do not exist in the lexicon where such idiosyncratic information might be stored; by the same logic, the historical hypothesis predicts that the alternation will apply only to existing forms and will not apply to nonce words.

The basic design of the experiment is the production of singular-plural pairs; this task involves changing nouns of one class to another. We presented speakers with the singular or plural counterpart of the classes that have alternating prefixes and prompted them to produce the other form – i.e. cl. 9 (sg.) → 10 (pl.) and cl. 6 (pl.) → 5 (sg.). In doing so, they must combine the potentially alternating prefixes with our nonce roots – which are designed to be compatible with one allomorph or the other: monosyllabic roots with long prefixes and disyllabic roots with short prefixes.

### *Stimuli*

Experiment 1 was divided into two blocks to test alternations in two different classes. In block A, speakers were presented with singular nouns of class 9; these are expected to have class 10 plurals, which would have either *ii(N)-* or *izi(N)-* prefixes. In block B, speakers were presented with class 6 plurals; the intent was for them to back-form class 5 singular forms from these words to see how they choose between *i-* and *ili-*.

For block A, we created 20 nonce roots – 10 monosyllabic and 10 disyllabic. The class 9 singular prefix *i(N)-* was then added to these nonce roots to create stimuli. 20 distractor items, which were part of another experiment, were included and consisted of 10 monosyllabic and 10 disyllabic roots.

For block B, we created 20 additional nonce roots, again evenly divided into 10 monosyllabic and 10 disyllabic roots. The class 6 plural prefix *ama-* was then added to these nonce roots. 20 new distractor items were included, again evenly divided by root length.

Here and throughout we refer to 'root length' to distinguish monosyllabic root stimuli (e.g. *in-dlu* 'building, house') from disyllabic root stimuli (e.g. *in-dlela* 'road'), and 'prefix length' to distinguish between the short prefix form (*ii(N)-* in block A; *i-* in Block B) and the long prefix form (*izi(N)-* in Block A; *ili-* in Block B).

### *Method*

Both experiments described in this article received ethics approval from the Texas Tech University Human Research Protection Program's Institutional Review board under study #504581. Participants were informed of the experimental procedures before they consented to participate in the study. The following procedure was implemented in the SuperLab software application (Cedrus Corporation 2010).

On each trial in block A, participants were shown a screen with a singular nonce noun or filler item (randomised) with the class 9 prefix *i(N)-*. They were then asked to produce aloud the plural form of that nonce noun with the expectation that they would apply one of the two class 10 allomorphs – *izi(N)-* or *ii(N)-*. Table 1 shows representative examples of stimuli from Block A and the expected possible responses. Bold responses represent nouns which conform to the length-based allomorphy pattern. A full list of stimuli is provided in Appendix A.

Block B proceeded in a similar fashion, using nonce stimuli with the class 6 plural prefix. Participants were shown the class 6 nonce items (randomised with fillers) and were asked to produce the singular form of that nonce noun, with the expectation that they would apply one of the two class 5 allomorphs – *i-* or *ili-*. Table 2 shows representative examples of stimuli from Block B and the possible expected responses. Bold responses represent nouns which conform to the length-based allomorphy pattern. A full list of stimuli is provided in Appendix A.

At the start of each block, participants saw three real noun singular/plural example pairs, then did several real word practice items to ensure task familiarity. Audio of responses was recorded and later coded for which class prefix had been used. Across both blocks, item order was randomised and participants were allowed to determine the pace at which trials advanced.

This experiment targeted only class 5 (*i-* ~ *ili-*; singular) and class 10 (*ii(N)-* ~ *izi(N)-*; plural). We did not attempt to collect data to show alternations in the class 11 prefix (*u-* ~ *ulu-*; singular), for reasons of feasibility. Class 11 nouns typically have plurals in class 10 (the normal case), or in class 6 (a sizeable group of atypical nouns). Each of these plural classes also contains the canonical plurals of other singular classes (class 9 and class 5 respectively). There are also fewer nouns in class 11 than in class 5 or class 9 and they seem less common. This makes it difficult to elicit class 11 nouns using the same task: when presented with a plural in class 6 or class 10, speakers are unlikely to presume that it has a class 11 singular. Additionally, the short allomorph of class 11 is just *u-*, which

**Table 1:** Sample stimuli and expected responses (bold) for Block A.

| Nonce word (cl. 9) | Root length | | Long prefix | (cl. 10) | Short prefix |
|---|---|---|---|---|---|
| *in-da* | monosyllabic | → | ***izin-da*** | or | *iin-da* |
| *i-vu* | monosyllabic | → | ***izi-vu*** | or | *ii-vu* |
| *in-tila* | disyllabic | → | *izin-tila* | or | ***iin-tila*** |
| *i-labu* | disyllabic | → | *izi-labu* | or | ***ii-labu*** |

**Table 2:** Sample stimuli and expected responses for Block B

| Nonce word (cl. 6) | Root length | | Long prefix | (cl. 5) | Short prefix |
|---|---|---|---|---|---|
| *ama-tu* | monosyllabic | → | ***ili-tu*** | or | *i-tu* |
| *ama-xi* | monosyllabic | → | ***ili-xi*** | or | *i-xi* |
| *ama-sola* | disyllabic | → | *ili-sola* | or | ***i-sola*** |
| *ama-lufa* | disyllabic | → | *ili-lufa* | or | ***i-lufa*** |

is homophonous with the prefix for class 1a, making the class identification uncertain. While some participants did produce nouns which bear the unambiguous class 11 prefix *ulu-* in some trials, these were far less common than other classes.

### *Participants*

18 native speakers of isiXhosa were recruited for this experiment. All speakers participated in both blocks A and B (order balanced across speakers). Speakers ranged in age from 17–42 years old (mean: 23.4). All were bilingual isiXhosa/English speakers, with two participants also speaking Afrikaans, seven participants also speaking isiZulu and four participants also speaking Sesotho. 14 participants grew up in the Eastern Cape province, two in the Western Cape and one in Gauteng.

### *Results*

In both block A and block B, speakers in general appeared to extend the length-based allomorphy pattern to novel nonce words. In block A, speakers were presented with nonce nouns with class 9 (singular) morphology and were expected to respond with one of two allomorphs of the class 10 (plural) prefix, either *ii(N)-* (expected for disyllabic roots) or *izi(N)-* (expected for monosyllabic roots).

As shown in Figure 1 (left panel), in addition to the two expected class 10 allomorphs, speakers also produced nonce nouns with unexpected prefixes – across both monosyllabic (*σ*) and disyllabic (*σσ*) roots, 52% of responses were an unexpected prefix (most frequently *ama-*, the class 6 [plural] prefix, accounting for 97% of these unexpected prefixes).[vii] We discuss this 'other' category further below. The two expected prefixes, *ii(N)-* (short) and *izi(N)-* (long) were provided in 31% and 17% of all trials respectively.

In cases where speakers responded with one of the two expected allomorphs, monosyllabic roots received long prefixes 51% of the time and short prefixes the remaining 49%; however, the expected pattern was much more strongly attested among the disyllabic roots, which received short prefixes 82% of the time and long prefixes the remaining 18% of the time.

Figure 2 (left panel) visualises this finding: the y axis represents the proportion of trials for each speaker in which they provided the long prefix *ii(n)-*, with each point representing one speaker. The figure shows that for disyllabic roots (purple), most speakers provided the long prefix near 0% of the time (i.e. the points at the bottom of the graph), whereas with monosyllabic roots (blue),

[vii] No participant provided 100% 'other' responses; expected responses accounted for 341 trials.

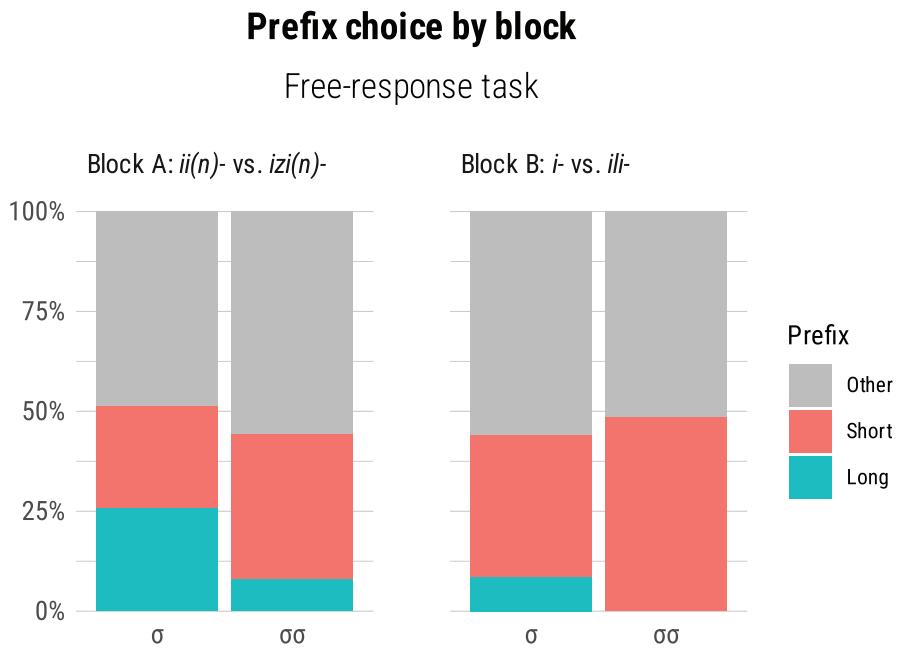



**Figure 1:** Prefix choice by block in the free-response task. Bars show the percentages of long prefixes (block A: izi(N)-; block B: ili-), short prefixes (block A: ii(N)-; block B: i-) and other responses

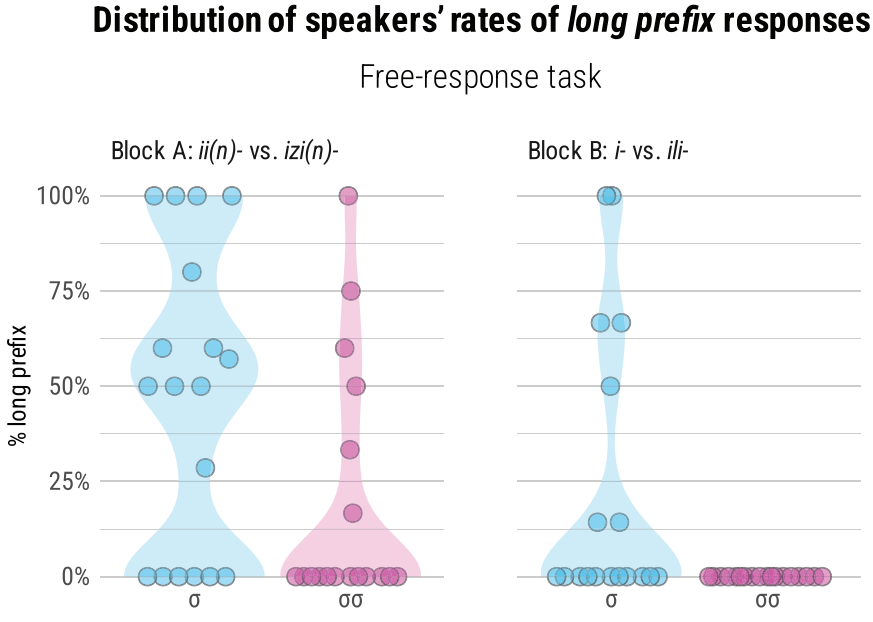



**Figure 2:** Percentage of trials in the free response task (with one of the expected prefixes) for each participant in which they chose the long prefix. Across both blocks, participants were more likely to choose the long prefix for monosyllabic roots (σ), than for disyllabic roots (σσ). See text and Figure 1 for trials with unexpected prefixes.

speakers provided the long prefix ranging anywhere from 0% to 100% of the time. In other words, in accordance with our expectations, speakers were fairly uniform in rejecting the long prefix when presented with a disyllabic root. When given a monosyllabic root, some speakers always rejected the long prefix (0% in the figure), some always provided the long prefix (100% in the figure), or were somewhere in between (remaining points).

In block B, speakers were shown a nonce noun with class 6 (plural) morphology and were asked to produce the singular form. Speakers were expected to respond with one of the two possible allomorphs of the class 5 (singular) prefix: *i-* (expected for disyllabic roots) and *ili-* (for monosyllabic roots). As can be seen in Figure 2 (right panel), of responses conforming to the expected class 5 morphology, speakers did appear to apply their knowledge of the length-based allomorphy pattern: monosyllabic roots were more likely to receive the long *ili-* prefix – 81% of the time; the short prefix *i-* occurred in monosyllabic roots only 19% of the time. Among trials with responses consisting of the expected class 5 morphology, disyllabic roots received *only* short prefixes – no participant provided a long prefix in response to a disyllabic root in such trials.

As with block A, speakers produced many forms with morphology other than a class 5 singular prefix (see Figure 1, right panel). Most of these responses (73%) were *um-*, which is ambiguous between class 1 and class 3 singular prefixes.

We ran a mixed effects logistic regression for prefix choice (monosyllabic vs disyllabic; 'other' prefixes were excluded and are discussed below) against root length, block and the interaction of root length and block, with participant and item as random intercepts. In line with our expectations, root length showed a significant effect on prefix choice ($t$ = 4.422, $p$ < 0.001). Block ($t$ = -0.190, $p$ = 0.849) and the interaction of block and root length ($t$ = 0.173, $p$ = 0.862) were not significant, showing no evidence of a difference in the effect of root length based on block. The full regression table is provided in Appendix B.

*The 'other' category*

The majority of responses in Experiment 1 were unexpected, 'other' noun class prefixes. By and large, these consist of: *u-* (class 1a or class 11), *um-* (class 1), *i-* (class 5 or class 9) and *ulu-* (class 11; only produced by participant 8). The 'other' category excludes trials where the participant simply repeated the stimulus word with the same prefix. The total set of responses by participants to trials, distractor items and practice items also included a single token each of *oo-* (class 2a), *isi-* (class 7), *ubu-* (class 14) and *uku-* (class 15). In this section, we explore possible reasons for why the unexpected responses were so common.

In block A, many speakers gave the class 6 plural prefix *ama-* instead of one of the expected class 10 allomorphs. There are two likely reasons for this result. First, the nonce forms were provided with the class 9 singular prefix *i(N)-*, but it should be noted that the class 5 singular prefix *i(li)-* may also have the surface realisation *i-*. If any speakers interpreted the nonce nouns as being class 5 rather than class 9, then it makes sense for them to respond with class 6, as this is the regular plural counterpart of singular class 5 nouns. A second contributing factor to the preponderance of *ama-* responses in block A is that class 9 does include some irregular nouns which have class 6 plurals: for example, singular *in-doda* (cl. 9, 'man') becomes plural *ama-doda* (cl. 6, 'men'). So, even if participants interpreted the nonce stimuli items as class 9, they could still be identifying them as being in the sub-class that make plurals in class 6.

In block B, speakers responded largely with the class 1 singular prefix *um-* instead of either expected option (those being class 5 singular *i-* (for disyllabic roots) or *ili-* (for monosyllabic roots)). Also very common were responses with class 1a, *u-*, which does not alternate for length. This was not what we expected and was strikingly common across participants. One explanation for this result comes from the fact that clan names and other ethnonyms follow an irregular pattern in which they show class 1 singular morphology (*um-*) in the singular and class 6 plural morphology (*ama-*) in the plural. If participants interpreted the nonce nouns prefixed with *ama-* like clan names, then providing a class 1(a) singular response is the natural extension of that sub-paradigm. We believe that participants, when faced with a phonotactically licit string of unknown meaning, may have treated it like a proper noun. In other words: names are phonotactically licit, yet do not have a definition like

other nouns; so, participants may have naturally interpreted some stimuli as names and accordingly applied the morphology appropriate to ethnonyms. Additionally, the distractor items were nouns with the class 2 prefix *aba-*, for which *um-* (class 1) is the regular singular counterpart. It is possible that these distractors might have primed participants to be more likely to respond with class 1 *um-*. Finally, we note that short roots with the class 6 prefix *ama-* might be construed as having an anomalous prefix *a-*, with a (bisyllabic) stem commencing from the [m] (e.g. *a-matu* instead of *ama-tu*).

Appendix D shows the prefix choices made by each speaker, broken down by block, root length and prefix choice. To save readers some scrolling and page-turning, we summarise here: there is considerable cross-participant variation. For block B, three participants (3, 5, 7) gave responses in the 'other' category in every single trial; three other participants (16, 17, 18) used no 'other' responses to any test items in this block. Other participants fell between these extremes. An impressionistic tendency across the whole speaker pool is that long prefixes were provided more often than short prefixes, but not every speaker obeyed that trend. Conceivably there are extrinsic information-related factors that might skew the group as a whole in this direction: because the long allomorphs of the prefixes disambiguate class 5 from class 9, overgeneralisation of the long forms might in some instances be construed as pedantic rather than incorrect.

Since speakers varied considerably, especially with prefix choice among monosyllabic roots in block A and with responses containing unexpected prefixes in both blocks, we conducted a follow-up experiment. It is tempting to speculate that the responses of the 'other' category might be further mined for evidence that participants might be exhibiting the length-based alternations in unconventional ways. For example, it is conceivable that speakers might alternate between using *u-* with long roots and *um-* with short roots, or that the duration of prefixal *i-* or *u-* responses differ based on the syllable count in the item. While a handful of responses were impressionistically flagged as potentially containing long vowels, they are too scarce in the data set for further analysis to be insightful. In Experiment 2, we aimed to preclude the possibility of the 'other' responses to more clearly assess the productivity of the length-based allomorphy pattern.

## Experiment 2

Because many participants in Experiment 1 provided responses with unexpected noun class prefixes, we conducted a follow-up forced-choice experiment. In a forced-choice task, participants must choose from a set of preselected options and thus are not able to provide responses with noun classes other than those specifically being probed. This allows us to test judgments between the alternating prefixes directly.

### *Stimuli*

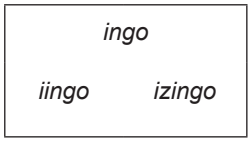
The 30 stimuli used in Experiment 2 were similar in form to those from block A of Experiment 1: half had monosyllabic roots and half had disyllabic roots; each nonce root was preceded by the singular noun class prefix *i(N)-* (cl. 9) which takes the class 10 plural prefix of either *ii(N)-* or *izi(N)-*. A full list of stimuli is provided in Appendix C.

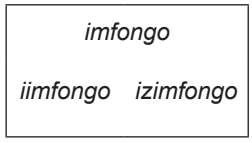
### *Methods*

Experiment 2 was conducted in two modalities: some speakers participated in-person via Superlab (Cedrus Corporation 2010), while others completed an online survey via Moodle. The online and in-person methods were approximately identical, modulo modality; differences between the two are discussed later. Both sets of participants were informed of the study procedures and agreed to participate in the study.

On each trial, participants were presented with a singular nonce noun above two possible choices of plural form. For example, as shown in (8), on a given trial participants may have been presented with singular *ingo* and the choices *iingo* and *izingo*; or the singular *imfongo* and the choices *iimfongo* and *izimfongo*. Participants then either pressed a key (in-person) or clicked on a button (online) to indicate their preferred plural form. In both modalities, trials were presented in random order and participants were not under time pressure.

(8) Example trials




***Participants***

Eight speakers participated in person via Superlab; three of these were thrown out due to interference during testing. 34 participants began the online survey, but only nine completed the entire survey. All participants were recruited on the basis of being L1 speakers of isiXhosa, with pre-screening in the form of biographic pre-task questions being presented solely in isiXhosa.

***Results***

Both online and in-person participants showed knowledge of the length-based alternation pattern; however, the results were more pronounced among the online participants. Taking first the in-person results, participants were slightly more likely to select the long prefix (53%) than the short one (47%) among monosyllabic roots and were considerably more likely to select the short prefix (75%) than the long prefix (25%) in disyllabic roots. This result for in-person participants is shown in Figure 3 (left panel).

Participants in the web-based survey showed a similar pattern, more often applying the short prefix (72%) than the long prefix (28%) to disyllabic roots and the long prefix (73%) than the short prefix (27%) to monosyllabic roots. The pattern among online participants is more pronounced than for the in-person participants as can be seen in Figure 3 (right panel).

A mixed-effects logistic regression model was run in which prefix choice was regressed against root length, modality (in-person vs online) and the interaction of root length and modality; random intercepts were included for item and participant. In line with our expectations and following the same pattern as in Experiment 1, root length was a significant factor in prefix choice ($t$ = 1.48, $p < 0.001$). The main effect of modality was not significant in the model, ($t$ = 0.15, $p$ = 0.82); however, the interaction of modality and root length ($t$ = 1.78, $p$ = 0.08) approached significance, in line with our general impression that the root-length effect was stronger among online participants. The full regression table is provided in Appendix B.

As shown in Figure 4, there was variation among speakers in both the in-person and online cohorts. In the in-person cohort, participants selected long prefixes for monosyllabic roots at rates ranging from 33% to 93% (mean 53%) and for disyllabic roots from 13% to 60% (mean 25%). In the online cohort, participants selected long prefixes for monosyllabic roots at rates ranging from 0% to 93% (mean 51%) and for disyllabic roots at rates ranging from 13% to 73% (mean 28%). In spite of this variability, the pattern is clear: matching our expectations, more speakers selected long prefixes in monosyllabic roots than in disyllabic ones.

Because of this variability, a figure is provided in Appendix D to show the prefix choices made by each speaker, broken down by modality, root length and prefix choice.

**Limitations and lessons for future experiments**

This section acknowledges some limitations of the study and offers some suggestions for further research. Lesson 1: there is significant disparity between the in-person and web-based versions of the experiment. As discussed in the previous section, online participants showed a stronger effect of root length on prefix choice than in-person participants. One reason for this may have to do with the fact that many web participants began the experiment, but did not complete it. We venture that many of the web participants who stopped part way through the experiment did so because they lacked clear intuitions. As such, the only complete results from the online survey came from participants who had reasonably clear intuitions about the length-based allomorphy pattern. In the in-person experiment, on the other hand, no participants asked to stop part-way through – it is easier to quit

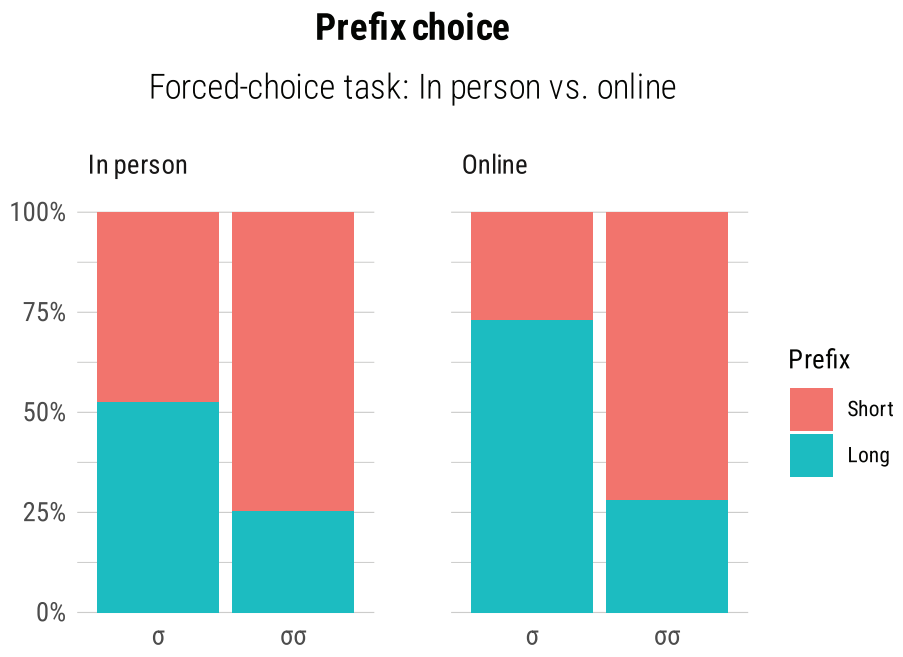



**Figure 3:** Prefix choice by modality in the forced-choice task by root type: monosyllabic (σ) vs disyllabic (σσ). Bars show the percent of long prefixes (block A: izi(N)-; block B: ili-), short prefixes (block A: ii(N)-; block B: i-)

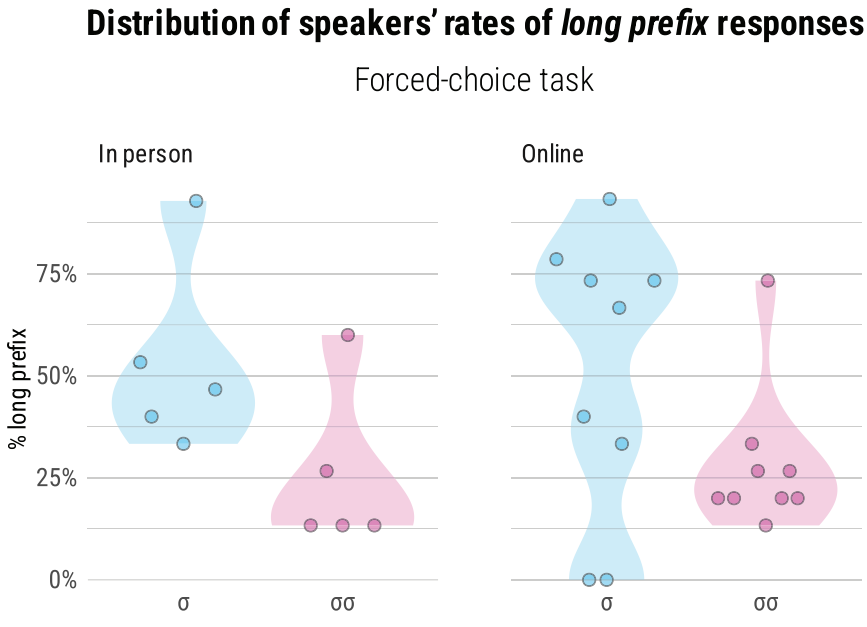



**Figure 4:** Percent of trials in the forced-choice task where speakers selected the long prefix rather than the short one. Across both modalities, participants were more likely to choose the long prefix for monosyllabic roots (σ), than for disyllabic roots (σσ). See text for discussion of trials with unexpected prefixes.

an experiment online without breaking social norms or experiencing 'peer pressure' by opting out. This could be remedied by incentivising completion of the experiment, for example with a payoff to participants at the end of the task.

Lesson 2: singular-plural pair creation is perhaps not the best task to assess participants' judgments about noun class membership. While classes 9/10 and 5/6 are strongly conventionalised pairings, there are also irregular bunches of nouns that follow other paradigms like 1/6 or 9/6. We chose singular-plural pairings for two reasons. First, it is simple to explain this task to participants. Second, we designed the experiment task in tandem with another experiment, such that some of the distractor items in Experiment 1 were test items analysed in another study (Braver and Bennett 2016). An anonymous SALALS reviewer helpfully pointed out that adjectival agreement morphology offers ways to disambiguate stimuli of class 5 from class 9, which might afford future experiments finer control over the noun classification cues available in stimuli. We note that demonstrative agreement also offers a paradigm where there are noun class ambiguities, albeit between different pairs of noun classes.

Lesson 3: participant recruitment could be further optimised. We recruited participants opportunistically and based partly on word of mouth – which naturally follows some lines of existing social networks. The rigour of the study could be increased by using a statistical power analysis to set the target sample size in advance. Since this experiment was done in tandem with two other tasks, we limited the number of test items to limit the total time commitment needed from participants.

Lesson 4: the study is limited by the medium of stimulus presentation. We opted to present stimuli items in writing, since this is fast and easy to implement. However, an auditory presentation of stimulus items would allow participants access to additional parsing clues like loudness, duration, pitch and tone patterns.

## Discussion

Our findings show that on the whole, speakers productively applied the length-based allomorphy to nonce words. Rule and pattern generalisation has been a topic of substantial interest to phonologists since at least Berko's (1958) wug test, whose logic suggests that most of our participants have internalised the generalisation as a rule – at least to some extent – in their individual idiolectal grammars. A number of different models of the generalisation of patterns to nonce words have been proposed and a systematic overview of the literature is too much to fit in the available space. Nonetheless, we review some of this work here, to highlight that this study connects not merely to work by Jean Berko Gleason, but also to the significant body of work that extends outward from her pioneering research.

Models of regularity and rule extension to nonce items can be divided broadly into two camps: analogy-based and rule/constraint-based. Analogy-based models (e.g. Rumelhart and McClelland 1986; Skousen 1989) propose that pattern application in novel forms is computed by similarity to existing forms or exemplars or through neural networks. These connectionist-style models are not without problems, however (Pinker and Prince 1988). The analogy-based models may be contrasted with rule/constraint-based approaches, which model generalisation by application of productive rules or constraints, sometimes with stochastic application (e.g. Albright and Hayes 2003). Still others occupy a more nuanced position: for example, Pinker (1999) posits a double dissociation between regular rules that apply by default and connectionist-style associative memory that allows for analogical extension of patterns from irregular forms without any rules involved. More recently, Becker et al. (2012) argue that while statistical generalisations clearly play a role in the production of novel forms, so too does knowledge of typologically common phonological patterns or universal constraints. As described below, the speakers in our studies demonstrate a range of patterns – some who adhere completely or not at all to the generalisation, and those who show a preference – a non-exclusive preference – for generalising the pattern. On the whole, we think a doubly dissociated model is probably the best way to accommodate the sort of variation in regularity that we see when comparing across participants in our experiments.

### *Only some speakers are all-in*

Some speakers, like speaker 16 in Experiment 2 (see Appendix D), show near-categorical performance. This speaker never once selected the short prefix for a disyllabic root and almost never

selected the long prefix for a monosyllabic root. This is the kind of performance we would naturally expect from a speaker who has internalised the pattern as a synchronically active rule.

Many other speakers, however, showed a more nuanced pattern: they *preferred* the expected prefix, but did not pick it *categorically*. For example, speaker 5 in Experiment 2 (again see Appendix D) provided long prefixes to monosyllabic roots slightly more often than not (53%) and provided short prefixes for disyllabic roots in a significant majority of trials (87%). If this speaker had a fully productive synchronic rule governing prefix choice, we might expect that *all* of their responses would match the expected pattern. Similarly, if speaker 5 lacked such a rule and relied on lexically stored idiosyncratic properties of individual words, we might expect that they would show a preference for only the long or only the short prefix (see, e.g., speaker 18 in Experiment 1, Appendix D, who never provided a short prefix), or might randomly choose between the two.

What do we make, then, of speakers who show less than absolute adherence to the pattern in nonce words? One explanation may be that such speakers are exposed to the pattern in real words due to fossilisation of historical forms (and may store prefix forms idiosyncratically for some lexical items), but that when presented with nonce words and forced to choose a prefix, rely on analogy to the fossilised pattern. In such speakers, we might expect the analogy to point them in the expected direction some of the time, but to fail to do so categorically, explaining the intermediate rates of length-matched prefix choice.

***Class 10's [z] and the left edge of the minimality domain***

The clear productivity of the class 9/10 alternation, *iiN- ~ iziN-*, is somewhat surprising from a theoretical perspective. We now turn to the details of this case. The length-conditioned alternations in isiXhosa – especially the class 5/6 alternation – look like minimality effects of the standard sort. For example, *ili-* is disyllabic, while *i-* is monosyllabic: it makes intuitive sense to prefer the former option any time the extra syllable would help complete a desired prosodic template. In the case of isiXhosa, the template might be V-CVCV: an initial vowel, then a (minimally) disyllabic stem. Setting this as the intended target shape favours using *i-* generally and *ili-* only if the stem is smaller than two syllables. This accords with various other patterns that point to disyllabic minimality for certain domains in the language more broadly.

On the other hand, the *iiN- ~ iziN-* allomorphy is the one facet of the pattern that *does not* comport neatly with minimality as the driving factor. For this pair alone, the one segmental difference is the presence or absence of a [z] syllabified as an onset; but onsets usually have no direct effect on metrical size. Thus, both allomorphs would seem to have the same number of moras, which means they ought to have the same weight in terms of minimality.

In order to capture this wrinkle in the pattern, we adopt the following analysis. We assume that the domain of 'stem' minimality commences from the leftmost consonant and not from the left edge of the morphological stem. Let us call this the Pstem, following Downing (1998). Given this definition, the various alternating prefixes have the Pstem parses shown below, demarcated with {braces}. The forms in (9a-d) are grammatical and neatly fit into the expected pattern: the prefixes fluctuate such that the Pstem is minimally disyllabic. By contrast, the forms in (9e-g) deviate from the established pattern. These either surface with a sub-minimal Pstem (9e-f); or, they make unnecessary use of the long prefix, leading to misalignment of the Pstem with the morphological stem (9g).

(9) Pstem domain structures, phonetically

| | | | |
|---|---|---|---|
| a. i {l i - c e} | 'stone' | long-short | c5 |
| b. u {l u - n t' u} | 'humankind' | long-short | c11 |
| c. i i {ŋ - k' o m o} | 'cows' | short-long | c10 |
| d. i {z i - n dʒ a} | 'dogs' | long-short | c10 |
| e. * i – {c e} | 'stone' | (short pfx + short root: sub-minimal stem) | |
| f. * i i {n - dʒ a} | 'dogs' | | |
| g. *ʔ i {z i ŋ - k' o m o} | 'cows' | (non-canonical in isiXhosa, normal in isiZulu) | |

This allows a straightforward characterisation of the alternation while assuming that minimality requirements count in terms of moras. For the V(CV)- alternating cases (classes 11 and 5), the long form of the prefix has two moras. In the case of class 10, including the [z] serves to shift the

onset of the Pstem leftwards, functionally expanding it to include one of the moras carried by the prefix. Thus, while the long and short forms of class 10 are both putatively bimoraic, 'long' *izi(N)-* contributes a mora to the Pstem, while 'short' *ii(N)-* does not. Conveniently, this analysis sidesteps the pre-existing debate over whether the class 10 short form *ii(N)-* has a (putative) long vowel because it has a falling tone (Claughton 1992), or whether it has a falling tone because the vowel is long (Lanham 1958; 1963).

***A note on exceptions and the right edge of the minimality domain***

As mentioned above, Oosthuysen (2016) notes a curious point of variation: although short noun roots *usually* take the long form of the class 10 prefix, his impression is that the short form is typically used when there is a following quantifier or modifier. He illustrates with the examples in (10).

(10) Exceptional acceptability of short + short combinations for class 10 (Oosthuysen 2016)
  a. *iinto zonke* 'all things'
  b. *iimvo zabaNtsundu* 'the opinions of black people'

Our interpretation of this case is that the post-nominal modifiers effectively serve to make the short nouns behave like long nouns. One plausible mechanism for this interaction is if the right edge of the minimality domain is aligned not with the noun itself, but rather with some higher-level unit such as the NP or the prosodic phrase. If this is the case, the short prefixes in (10) are not really exceptions and instead are just cases where the minimality domain runs past the end of the noun root, e.g. *ii{nto = zonke}*. Further study of the details of these edge cases is needed to understand how this works. One speculative possibility is that the minimality domain is defined in a way that can straddle word edges, such as a metrical foot or prosodic phrase, and not the Pstem. Alternatively, it could be that the prefixes attach at the phrasal level, such that the domain of the minimality effect includes not only the noun, but also other words in the NP.

## Conclusion

The aim of this article has been to present new experimental data that speaks to the productivity of noun class prefix length alterations in isiXhosa. The historical development of isiXhosa, and of the Nguni language cluster more broadly, clearly points toward historical deletion as the origin of the length-triggered prefix variation seen in noun classes 5, 9 and 11. However, our experiment shows that speakers frequently extend the pattern productively – for some speakers and in some conditions, at rates nearing 100%. This indicates that it should be understood as an active part of the synchronic phonology or morphology of modern isiXhosa. Whether speakers tend to analyse and internalise the pattern as a phonological one or a morphological one awaits future study. We hope these results will spur further study of the prosodic structures of isiXhosa and will contribute to a deeper understanding of the psycholinguistic and syntactic characteristics of nominals across related languages.

## Declaration of interest

The authors have no conflicts of interest in the publication of this article.

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## Appendix A: Stimuli from experiment 1

### *Block A (Class 9 singular)*

| Monosyllabic roots | Disyllabic roots |
|---|---|
| *in-da* | *in-dela* |
| *im-pa* | *in-tila* |
| *i-vu* | *i-fongo* |
| *i-hlu* | *i-labu* |
| *i-tsa* | *i-nebe* |
| *i-gce* | *i-peko* |
| *i-nxu* | *i-qata* |
| *i-qhe* | *i-baqu* |
| *i-chu* | *i-zuja* |
| *i-tlo* | *i-butye* |

### *Block B (Class 6 plurals)*

| Monosyllabic roots | Disyllabic roots |
|---|---|
| *ama-tu* | *ama-sola* |
| *ama-nyu* | *ama-sopo* |
| *ama-ga* | *ama-zazu* |
| *ama-dyu* | *ama-wifa* |
| *ama-khu* | *ama-vuga* |
| *ama-qho* | *ama-thatye* |
| *ama-pa* | *ama-juhla* |
| *ama-we* | *ama-khema* |
| *ama-xi* | *ama-gcofu* |
| *ama-gqe* | *ama-lufa* |

## Appendix B: Regression tables

### *Experiment 1*

| Parameter | Coefficient | CI (95%) | t | p |
|---|---|---|---|---|
| (Intercept) | -2.38 | [-3.68, -1.08] | -3.58 | < 0.001 |
| root length (monosyllabic) | 2.21 | [1.23, 3.19] | 4.42 | < 0.001 |
| block B | -21.26 | [-240.24, 197.72] | -0.19 | 0.85 |
| root length (short) × block B | 19.36 | [-199.62, 238.35] | 0.17 | 0.86 |

### *Experiment 2*

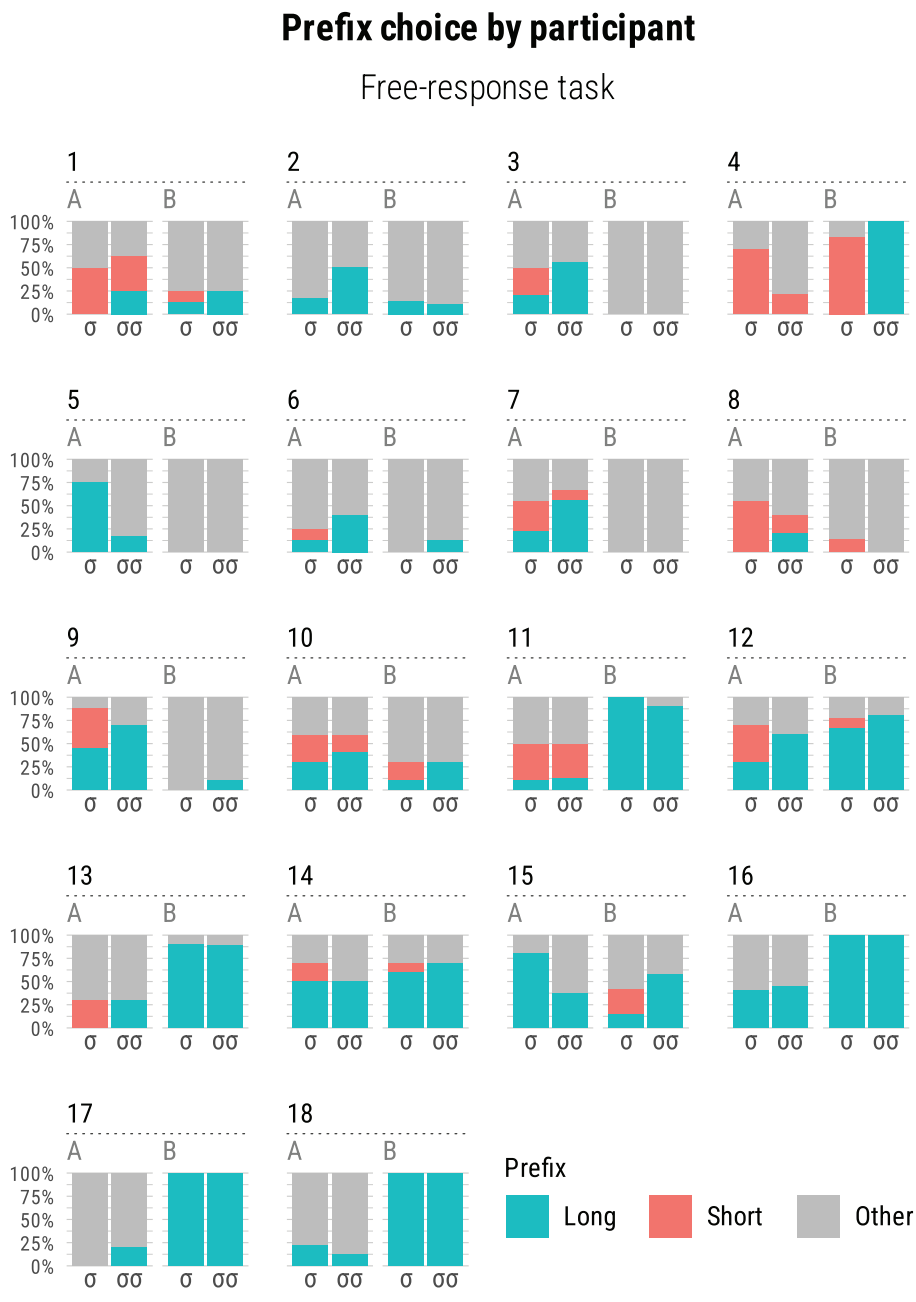
| Parameter | Coefficient | CI (95%) | t | p |
|---|---|---|---|---|
| (Intercept) | -1.29 | [-2.31, -0.26] | -2.45 | 0.01 |
| root length (monosyllabic) | 1.48 | [0.62, 2.33] | 3.39 | < 0.001 |
| modality (web) | 0.15 | [-1.09, 1.38] | 0.23 | 0.82 |
| root length (short) × modality (web) | 0.90 | [-0.09, 1.88] | 1.78 | 0.07 |

## Appendix C: Stimuli from experiment 2

| **Monosyllabic roots** | **Disyllabic roots** |
|---|---|
| *i-hu* | *i-hamo* |
| *i-la* | *i-lama* |
| *i-lwe* | *i-luva* |
| *im-fi* | *i-lwige* |
| *im-pe* | *im-baqi* |
| *in-di* | *im-bonza* |
| *in-dyo* | *im-fela* |
| *in-go* | *im-fongo* |
| *in-ta* | *im-poto* |
| *in-tlo* | *in-dela* |
| *in-tse* | *in-joxo* |
| *in-tshu* | *in-tilu* |
| *in-zo* | *in-tuvo* |
| *i-wi* | *in-zuje* |
| *i-wu* | *i-wifa* |

## Appendix D: By-speaker results for Experiments 1 and 2

**Experiment 1**
Prefix choice by block in the free-response task. Bars show the percent of long prefixes (block A: izi(N)-; block B: ili-), short prefixes (block A: ii(N)-; block B:i-) and other responses.

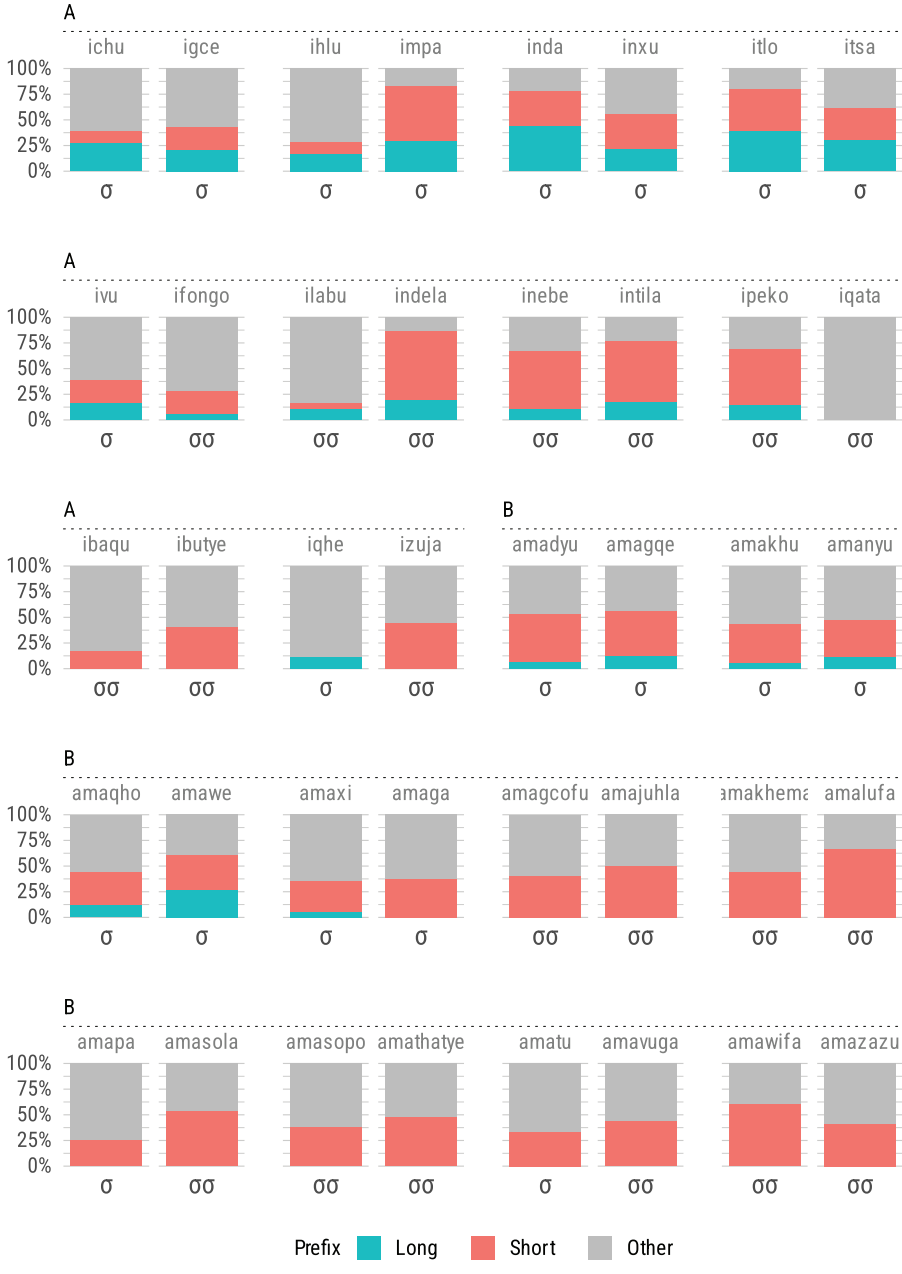


**Experiment 2**
Prefix choice by participant in the forced-choice task. Bars show the percent of long prefixes and short prefixes. Participants with an asterisk participated in-person.

## Appendix E: By-item results for Experiments 1 and 2

### Experiment 1

Prefix choice by item in the free-response task. Bars show the percent of long prefixes (block A: izi(N)-; block B: ili-), short prefixes (block A: ii(N)-; block B:i-) and other responses.



**Experiment 2**

Prefix choice by item in the forced-choice task. Bars show the percent of long prefixes and short prefixes (block A: ii(N)-; block B: i-).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