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CLICKS IN XHOSA AND NAMA: A COMPARATIVE ANALYSIS

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by

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ABSTRACT. This study is a comparative analysis of Xhosa and Nama clicks. It contains an acoustic pilot study for which one Nama speaker and one Xhosa speaker were recorded. Differences and similarities in place of articulation and accompaniment were measured between clicks in word-initial position for both languages. Previous studies showed that clicks with the same accompaniment are similar across both languages. For the clicks measured in the study, this was not exclusively the case. Overall, measuring differences and similarities between clicks of the two languages, a larger sample with more speakers is needed, which exceeds the scope of this thesis.

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CHAPTER 1

INTRODUCTION

This thesis contains a comparative analysis of clicks. The languages investigated by the study pertaining to this thesis are Xhosa, a Bantu language (Niesler, Louw, Roux 2005:460), and Nama, a Khoisan language (Sands 1998:77). The two languages have different click inventories but some clicks are similar. An acoustic pilot study analyzes mainly the temporal differences and similarities of those clicks using spectrograms and waveforms looking at overall duration, burst duration, voice onset time, and accompaniment. While previous studies analyze the clicks of one language at a time or of one language group at a time, or give a comprehensive presentation of several languages and language groups, this thesis will compare the clicks of two languages from different language groups with different clicks. For this pilot study, two subjects were recorded at a Midwestern University: one speaker of Xhosa and one speaker of Nama.

The work will illustrate the complexity of click sounds by addressing click production, cultural background, phonetic properties, click inventories of Nama and Xhosa and the representation of clicks which differ among previous studies as already addressed by several researchers, such as Ladefoged and Maddieson (1996) comparing several click languages and Roux (2007) looking at Xhosa and Zulu. This study focuses on the previous studies by Ladefoged and Traill (1980a, 1984, 1994) for transcription, and Sands (1991) and Kagaya (1978) for measurements. Both differences and similarities can be expected from the results in this study because the two languages are different and belong to different language groups, but the clicks can also be expected to have similar phonetic properties.

Previous studies have shown that there are four places of articulation for Nama clicks (dental, alveolar, lateral, and palatal) and three for Xhosa clicks (dental, alveolar, lateral) (Ladefoged & Maddieson 1996:248). Clicks in both languages can have a voiceless unaspirated accompaniment, a voiceless aspirated accompaniment, or a nasalized accompaniment (Ladefoged & Traill 1980a). Nama clicks can have a delayed aspirated accompaniment and a glottal closure accompaniment, while Xhosa clicks can have a breathy-voiced accompaniment and a nasalized breathy accompaniment (Ladefoged & Traill 1980a, Sands 1991).

The study revealed that the palatal clicks had the longest overall duration and that the alveolar clicks had the shortest overall duration. Moreover, the palatal clicks had the longest burst duration on average, while the dental clicks had the shortest one. The longest voice onset time on average was also measured for the palatal clicks. The dental and the alveolar clicks had the shortest voice onset time on average. In contrast to that, the dental clicks had the longest accompaniment duration on average, while the alveolar and the lateral clicks had the shortest ones. The palatal clicks had the longest average durations in all categories except for the accompaniment. Comparing the two languages directly, there were almost no differences in average overall duration or burst duration average. However, this study revealed differences in voice onset time and accompaniment average, namely that the voice onset time was remarkably longer for the Nama clicks on average than for the Xhosa clicks and that the accompaniment was slightly longer for the Xhosa clicks on average than for the Nama clicks. The accompaniment comparison showed that the nasalized accompaniment and the nasalized breathy accompaniment were the longest on average and are similar. They were followed in length by the voiceless aspirated accompaniment and the delayed aspirated

accompaniment that were also similar. The breathy voice accompaniment and the glottal closure accompaniment were similar as well and had the shortest values of the comparable accompaniments. The voiceless unaspirated accompaniment had the overall shortest duration.

The study also suggests that the palatal Nama clicks followed by front vowels sounded fronted as opposed to the clicks followed by a back vowel, according to the researcher's audible perception. Moreover, some Xhosa clicks showed different places of articulation than expected from the orthography, such as the orthography showed a dental click but it looked and sounded like a lateral. Those clicks were either dismissed from the study or used in other categories. In addition, both Xhosa and Nama clicks showed different accompaniments than expected from the orthography. The study cannot explain these phenomena because they exceed its scope.

CHAPTER 2

LITERATURE REVIEW

2.1. Historical and cultural background of Nama and Xhosa. Nama, or Khoekhoe, belongs to the Central Khoisan group (Sands 1998:77) (called Khoesan by Traill (2002:27, 45) but Khoisan here). Nama is the largest language of the Khoisan group (Ager 2010). It is spoken in Namibia, in some parts of South Africa, and Botswana, by around 233,700 people (Ager 2010). Bleek (1862:4) calls Nama the 'most important Hottentot dialect.' Traill (2002:44) notes that Nama is threatened since many speakers have shifted to English or Afrikaans. In addition, Traill (2002:27) says that a significant amount of Khoesan languages are extinct: they vanished due to diseases and as a result of political conflicts, such as the Eastern Khoisan languages being taken over by Xhosa or replaced by Dutch. A close variety to Nama is Damara (Lewis 2009), (Kohler, Ladefoged, Snyman, Traill, Vossen 1989:165).

Speakers of Nama have employed the term Nama to denote their language and their 'tribe' (Ager 2010). The name of the language family, 'Khoisan' is made up of two words: 'khoi' is the Nama word for the Nama people, and 'san' is the Nama word for 'bushman,' denoting a smaller tribe (Ager 2010). The term 'Hottentot' is used by older sources cited in this thesis (Beach 1938, Hagman 1977, Bleek 1862), and it originates from Dutch settlers perceiving the words and sounds of Nama as 'hot' and 'tot' (Ager 2010).

Xhosa is a Nguni language, a subgroup of Bantu (Niesler et al. 2005:460, Dart 1937:23, Sands 1991:7). Slabbert and Finlayson (1998:290) classify Xhosa as Southern Nguni. It is one of the official languages of South Africa, spoken by around 6.5 million people in the Eastern Cape Province, Ciskei, the Orange Free State, Transkei of South

Africa, and in Lesotho and Botswana (Ager 2010, Slabbert & Finlayson 1998:290). The number of Xhosa speakers is much higher than the number of Nama speakers. However, Doke (1937:314) in an earlier study estimated the speakers of all Nguni languages at only 3 million. Therefore, the number of Xhosa speakers must have grown.

Bleek (1862:5, 6) considers Xhosa the most important language of the Southeastern Bantu branch. Xhosa is related to Swati and Zulu (Ager 2010), which are both languages the Xhosa speaker participating in the study pertaining to this thesis speaks. Whereas Khoisan languages are very different from each other, according to Sands (1998:75), Nguni languages are very closely related, and they are separate languages more so for political and identity reasons than linguistic reasons (Slabbert & Finlayson 1998:290, 291).

Xhosa used to be referred to as 'Kafir' (Bleek 1862) or 'Kaffir,' which is a derogatory term to denote a black person, used mostly in southern Africa (Online Encyclopedia 2010). European settlers used it to denote Xhosa people who belong to the Xhosa-speaking people of South Africa (Online Encyclopedia 2010). Later, the term was used as an offensive term for all black Africans (Online Encyclopedia 2010). This thesis will not make use of derogatory terms and thus employ the terms accepted by the people denoted.

2.2. Historical and cultural background of clicks. Güldemann and Stoneking (2008) say that clicks are perceived as unusual sounds and thought to be old, which leads to the assumption that click languages come from one common ancestral language. Therefore, Güldemann and Stoneking (2008) came up with the question how the current click distribution in the world emerged. Herbert (2002:297) cites van Ginneken (1911) and Stopa (1935, 1979) with the idea that clicks are sounds from which human language

developed. The author adds that researchers have given up identifying how click sounds originated (Herbert 2002:297). However, Güldemann and Stoneking (2008) investigated this question, and give a hypothesis they favor, which is that clicks have always been common as nonphonemic sounds in languages, and only rarely became phonemic in a language.

As phonemic speech sounds, clicks can be found in two regions in Africa: in the South, the Southern and Northern Khoisan and ǂHoan, Central Khoisan and Kwadi, and some Bantu, namely the Nguni languages, such as Xhosa, and in the East of the continent, Sandawe, Hadza, and Dahalo, and in one in Northern Australia: Damin, a variety of Lardil (Güldemann & Stoneking 2008:97, Ladefoged & Traill 1994:34). Bleek (1862:14) says that there is a language in Guatemala, '|iχe,' that has clicks as well. Some sources do not mention the Australian or the Guatemalan varieties at all (Rogers 2000:257, Bradlow 1992, Kohler et al. 1989:164, Sands 1991:6) but only the click languages of southern Africa. Investigating Xhosa and Nama, this thesis will focus on the click languages of the southern part of Africa.

Some click languages, such as some Bantu languages, acquired their clicks through contact because of geographic vicinity (Güldemann & Stoneking 2008:99). They borrowed the clicks from Khoisan languages (Güldemann & Stoneking 2008:99, Hagman 1977:7, Dart 1937:23, Ladefoged & Traill 1994:62, Sands 1991:6). Herbert (2002:301) points clicks out to be remarkable sounds to borrow since they are typologically highly marked. According to Herbert (2002:302), clicks were borrowed because they filled a 'phonetic gap' in Bantu. Bleek (1862:12) notes that only the Bantu languages adjacent to the Khoisan languages have clicks; the other Bantu languages do not. The Nguni subgroup is the group with the most click languages among the Bantu

(Herbert 2002:297). The fact that the Bantu languages borrowed the clicks from the Khoisan languages was assumed early on, as the years of the sources show. According to Bleek (1862:12), the 'cerebral' (alveolar [!]) and the 'dental' ([|]) click, denoted 'easiest' Nama clicks, were adopted in Xhosa without being changed considerably.

Bleek (1862:13) notes that clicks in Xhosa varieties gradually decrease the further away the variety is from Khoisan geographically. Moreover, there seems to be a tendency towards clicks vanishing according to Bleek (1862:47), since clicks have disappeared from grammatical elements. In the case of Nama, however, three fourths of the words still contain clicks (Bleek 1862:47). Ladefoged and Maddieson (1996:246) name Nama as one of the languages in which clicks occur most commonly. Other languages that have the most clicks are !Xóõ and !Xũ, two other Khoisan languages (Ladefoged & Maddieson 1996:246). According to Herbert (2002:297), 15% of Xhosa words have clicks. Sands (1991:7) disagrees saying that 38% of the words in a Xhosa dictionary contain clicks. Those numbers are different, but they show that in Bantu languages, such as Xhosa, clicks occur much less frequently than in the Khoisan languages (Ladefoged & Maddieson 1996:246, Sands 1991:12). Rogers (2000:258) says that if languages have clicks, they mostly have a large amount of them.

2.3. Click production. Ladefoged and Maddieson (1996:279, 280) say that clicks in isolation are easily learned, but the sounds that accompany those clicks make more difficulty for learners. Sands (1991:6) considers clicks 'complex in articulation.' A click is produced by closing off the oral passage in two spots, one in the back and one in the front, either with the tongue or with the lips (Malmberg 1963:29). The back of the tongue and the velum start the process of click production (Rogers 2000:257). A cavity that is closed off is thus created; its volume is increased by pulling the tongue down and

back (Rogers 2000:257), which causes the air pressure inside the cavity to decrease (Malmberg 1963:29). When the cavity is opened in the front, the outside air gets in quickly, which is what causes the click to sound (Malmberg 1963:29, Schapera 1930:421, Ladefoged & Traill 1994:34).

Click production uses a 'velaric air stream mechanism' (Rogers 2000:257, Ladefoged and Maddieson 1996:246, Ladefoged & Traill 1994:34, Bradlow 1992:83). Clicks are 'velaric ingressive stops' (Rogers 2000:257). Ladefoged and Maddieson (1996:246) also classify clicks as 'stops.'

Viljoen and Daniel (1998) give the following instructions for English speakers to produce the 'plain dental' Xhosa click orthographically represented as <c> and phonetically transcribed [|] by Roux (2007) in their pronunciation guide preceding their Xhosa grammar: 'Place the tip of the tongue behind your top front teeth. Now withdraw your tongue with a sucking movement, producing a sound sometimes used to express disappointment, pity or annoyance.' The same articulation is suggested for Nama (Ladefoged & Maddieson 1996:251). Bleek (1862:12) also compares the dental click to a sound of annoyance in English and says the tongue is withdrawn with a sudden and forcible movement in Nama. Some Xhosa speakers articulate that click at their lower teeth, according to Louw (1977), as cited in Ladefoged and Maddieson (1996:251). The blade of the tongue, which touches the teeth and the front part of the alveolar ridge, is always used during dental clicks (Ladefoged & Traill 1994:37). The dental click is the one existing in most click languages (Ladefoged & Traill 1994:37).

For <q> in Xhosa orthography, which Roux (2007) considers 'plain alveolar' and transcribes as [!], Viljoen and Daniel (1998) provide the following production instructions: 'Place the tip of your tongue at the front of your palate and raise your

tongue into your palate.' The sound produced is the one of a popping cork. Bleek (1862:12) describes the tongue movement as 'curling up' the apex against the palate and a sudden and forcible withdraw for Nama. According to Beach, the tongue can be curled up further toward the front or back of the palate for the same click (1938:82).

The Xhosa click <x>, as represented orthographically, or the 'plain lateral,' transcribed [‖] as of Roux (2007), is produced as follows according to Viljoen & Daniel (1998): 'Raise your tongue so that its sides come into contact with your back teeth.' The lateral click can be sounded by lowering one tongue side first, which is usually the case, or lowering both sides at the same time, as some Nama speakers do it (Beach 1938:79). Moreover, it is described as the sound as the one made in English when encouraging a horse to follow (Rogers 2000:257, Beach 1938:79). According to Bleek (1862:12), the lateral click in Nama, as opposed to Xhosa, is produced with the tongue covering the palate and making the sound the furthest back possible on the palate. The Xhosa lateral click sounds 'harsh' and 'foreign' to Nama speakers (Bleek 1862:13).

A sound that according to Bleek (1862:13) and Sands (1991:12, 13) is usually not found in Xhosa is the palatal click [ǂ] in Nama. The production of this click is described by Bleek (1862:13) as follows: the apex is pressed flatly against the palate by the gums, and is forcibly and suddenly withdrawn. Bleek (1862:13) labels this click 'difficult.'

Researchers divide the click production into four steps (Ladefoged & Traill 1994:34), namely the 'onset,' the 'suction,' the 'influx,' and the 'efflux' (Hagman 1977:7). Nothing is audible until the steps of 'influx' and 'efflux,' which are terms by Beach (1938) (Hagman 1977:7, Ladefoged & Traill 1994:34, 35). During the 'onset,' the active articulator, the tongue, is put in position to produce the click sound with its body moving toward the roof of the mouth (Hagman 1977:8). During the 'suction,' the

central part of the tongue is pulled down and back, while the front and back of the tongue still touch the passive articulators (Hagman 1977:8). The 'influx' denotes the step in which the suction is enhanced and the front part of the articulation gets released, causing air to flow into the cavity (Hagman 1977:8). Ladefoged and Maddieson (1996:247) describe this part of the step as air rushing 'into the mouth to equalize the air pressure, producing a sharp transient.'

According to Hagman (1977:8), there are four influxes: sudden gingivial, sudden post-alveolar, affricated gingivial, and affricated post-alveolar. 'Gingivial' and 'post-alveolar' describe the onset, while 'sudden' and 'affricated' denote the 'manner of influx' (Hagman 1977:8). As will be specified in section 2.4., there are many other terms for these. Upon completion of this step, the back of the tongue still touches the velum, since if it had released, the sound would not be as forceful (Hagman 1977:9). Ladefoged and Maddieson (1996:247) explain that Beach's (1938) influx assigns the 'click type.'

During the 'efflux,' the fourth step, the back closure of the click is released and the glottis becomes active by closing or the vibration of the vocal cords if a vowel follows (Hagman 1977:9). According to Ladefoged and Maddieson (1996:247), Beach's (1938) effluxes denote the properties of the articulation in the back of the oral cavity along with pulmonic, laryngeal, or nasal activity; thus the phonetic feature simultaneously produced with a click. This means clicks are accompanied by nasalization, voicing (Malmberg 1963:29), or aspiration (Sands 1991:7). Ladefoged and Maddieson (1996:247) and Ladefoged and Traill (1994:35) prefer the use of the term 'accompaniment.' More details about accompaniments are given in section 2.4.

2.4. Phonetic properties of clicks. Ladefoged and Traill (1994:33) describe the acoustics and articulation of clicks, covering all clicks that have been found in the field; there are 105 of which 70 are 'phonetically distinct.' According to Ladefoged and Maddieson (1996:247), no click language has more than five click types (places of articulation), which are alveolar, lateral, dental, palatal, and bilabial. Thus, every click sound found as a phoneme in a language has to be classified as one of the above (Ladefoged & Maddieson 1996:247). While Xhosa has three places of articulation for clicks or click types, namely dental [|], alveolar [!], and lateral [‖], most other Bantu languages only have [|, !] or only [!] (Herbert 2002:297). Thus, [!] is typologically the least marked and most likely to occur, and [‖] is the least likely to occur in a Bantu language, and therefore the most marked (Herbert 2002:297). Khoisan languages have those three and the palatal [ǂ] (Ladefoged & Maddieson 1996:248). Neither Nama nor Xhosa have a bilabial click; only the Southern Khoisan languages, such as |Xam and !Xóõ do (Ladefoged & Maddieson 1996:249). Ladefoged and Traill (1994:61) find 21 contrastive click accompaniments by investigating several languages.

Beach (1938) is said to present an adequate description of Nama clicks (Ladefoged & Traill 1980a, 1984:1). Ladefoged and Traill (1994) focus on the accompaniments of all clicks and describe their contrasts assigning them transcription symbols as will be discussed below. Roux (2007) leaves the accompaniments out because he argues that they are not necessary. Ladefoged and Traill (1994:46) and Ladefoged and Maddieson (1996:260), however, emphasize that 'there cannot be a click without an accompaniment,' which is why it needs to be indicated in transcription. Sands (1991:11) says the velar symbols used to specify the accompaniment are put ahead of the click

symbol so that it will not be confused with a velar stop or nasal actually produced after the click.

Ladefoged and Traill (1980a, 1984) present phonetic details of clicks of the Khoisan languages Nama and !Xóõ showing how complex these sounds are, while according to them, previous studies, such as Chomsky and Halle (1968) and Jakobson (1968), focused on the phonological description of clicks. The phonological description, according to Ladefoged and Traill (1980a:1, 3, 1984:1), leaves out how the sounds are actually produced, which is why they do not agree with solely describing clicks with phonological features. For instance, the authors say that phonologically, clicks can be classified according to the features [+/-] voiced, [+/-] aspirated, [+/-] glottal, and [+/-] nasal (Ladefoged & Traill 1980a:13). However, these features do not match with all phonetic facts since clicks are complex sounds during which several things occur (Ladefoged & Traill 1980a:14). For instance, the different movements that are part of the clicks may occur faster in some clicks than in others and pitches may be different as in the alveolar click having a lower pitch than the palatal click in Nama (Ladefoged & Traill 1980a:25).

According to Ladefoged and Traill's (1980a:8, 9, 11, 1984:1) study, the first click accompaniment type is 'voiceless unaspirated,' which they transcribe as [k|], [k‡], [k!], and [k‖]. Ladefoged and Traill (1994:46) use velar symbols to denote click accompaniments because the back closure is mostly taking place on the velum. During those clicks, the onset of voicing sets in almost right after the velar occlusion is released (Ladefoged & Traill 1980a:8, 10, 1984:4). According to Sands (1991:11), clicks can occur 'with an oral, voiceless, unaspirated accompaniment,' also referred to as the 'radical form of the click.' Often, they are transcribed as plain clicks, but in some

studies, a [k] is added preceding them in phonetic transcription (Sands 1991:11). Sands (1991:11) quotes Beach (1938) saying that in Nama, the release of the velar closure is actually audible in contrast to Xhosa. Hagman (1977:9) calls this Nama click 'smooth velar release,' and even says a voiced [g] can be audible at times. In Xhosa, the voiceless unaspirated clicks [|], [!], and [‖] are spelled <c>, <q>, <x>.

The clicks categorized with 'glottal closure,' [|ʔ], [ǂʔ], [!ʔ], and [‖ʔ], in Khoisan languages have a closure of the larynx and are different from the voiceless unaspirated clicks (Ladefoged & Traill 1980a:9, 10, 11, 1984:6). In their earlier study on Khoisan languages, Ladefoged and Traill (1980a:12) do not assign the clicks of the type [|ʔ] and [|h] a velar symbol saying it is not audible. However, in their later study (Ladefoged & Traill 1994), they assign a [k] for Nama clicks. In Xhosa, the clicks with the accompaniment 'voiceless unaspirated' can resemble both glottalized and voiceless unaspirated clicks in Khoisan languages, although Xhosa does not have glottalized click phonemes (Sands 1991:13). Moreover, nasalized Xhosa clicks, phonemes in the Xhosa click system, can resemble glottalized clicks in Khoisan languages that are followed by nasalized vowels (Sands 1991:13).

For the 'voiceless aspirated' clicks, [k|h], [kǂh], [k!h], and [k‖h], the voice onset occurs later than for the first group (Ladefoged & Traill 1980a:8-11, 1984:4). Moreover, the aspirated clicks have affrication after the velar occlusion gets released (Ladefoged & Traill 1980a:10, 1984:4). There is one issue Ladefoged and Traill (1984:2) address: in the Nama variety Ladefoged and Traill (1984:2) investigated, they heard [click + kh] and therefore no 'scraping sound' where Beach (1938) heard [click + kx] in aspirated Nama clicks. Hagman (1977:9) orthographically represents this Nama click as <|h>. In Xhosa, those clicks also have aspiration after the releases, and a 'burst noise' and

'glottal friction' until the voice sets in can be perceived (Sands 1991:11). Aspiration in Xhosa is represented in the orthography (Jessen 2002:153): <ch>, <qh>, <xh> (Jessen & Roux 2002:2). An aspirated click is produced with delayed onset of voicing (Rogers 2000:258).

The clicks with 'delayed aspiration,' [ǀh], [ǂh], [!h], and [ǁh], have decreasing nasal airflow and increasing oral air flow, which triggers aspiration after the release of the click (Ladefoged & Traill 1980a:9, 10, 11, 1984:6). Hagman (1977:9) calls this a 'delayed velar release' and represents it as <ǀx> orthographically. Xhosa does not have this click accompaniment (Sands 1991:11,12).

The 'voiced nasal' clicks, [ŋǀ], [ŋǂ], [ŋ!], and [ŋǁ], have a sound that corresponds to a velar nasal before the click is released and the oral air flow set in quickly after the click, which sounds like a short nasalized vowel (Ladefoged & Traill 1980a:9, 10, 11, 1984:6). A voiced click is accompanied by vibrating vocal cords (Rogers 2000:258). Ladefoged (1980:101) refers to those clicks as 'laryngealized.' Hagman (1977:9) considers it a nasalization of a click during the entire production process. The sound [ŋ] is produced at the same time the click is produced if it is nasal (Rogers 2000:258). These clicks are transcribed and denoted equally in Xhosa and spelled <nc>, <nq>, <nx> (Sands 1991:11). Moreover, Xhosa has another nasalized accompaniment that does not exist in the Nama inventory: the 'prenasalized voiceless click,' spelled <nkc>, <nkq>, and <nkx>, and transcribed as [ŋkǀ], [ŋk!], and [ŋkǁ] (Sands 1991:12). However, Sands (1991:12) sees this click as a sequence of a nasal and a click and therefore not as a contrastive accompaniment.

Xhosa also has an oral voiced click accompaniment, spelled <gc>, <gq>, <gx> and transcribed as [g!ɦ] by Sands (1991:11). This accompaniment has been denoted

‘murmur’ and ‘delayed breathy voiced,’ often voiceless to a certain degree until the release (Sands 1991:11). Nama does not have this click accompaniment. In Xhosa, some of the clicks that are denoted as ‘voiced’ by some authors are actually voiceless phonetically if they do not occur after a nasal according to Jessen (2002:152, 153). Besides the plain breathy voiced clicks, there are nasalized breathy voiced clicks in Xhosa: <ngc>, <ngq>, and <ngx>, transcribed as [ŋ|ɦ], [ŋ!ɦ], [ŋ‖ɦ] (Sands 1991:11, 12). According to Sands (1991:13), Xhosa has a smaller number of click accompaniment contrasts than Nama. However, Ladefoged and Traill (1994) appear to count five for both languages. To summarize, the clicks with nasalized, voiced, and aspirated accompaniment in both Xhosa and Nama are similar (Sands 1991:13), while Xhosa does not have clicks accompanied by a glottal stop or delayed aspiration and Nama does not have murmur or breathy voice as accompaniments (Ladefoged & Traill 1994:47).

Ladefoged and Traill (1980a:10, 1984:6) measured in their study of Nama that the alveolar, dental, and palatal clicks all have significant nasal air flow. If clicks with a glottal stop or with delayed aspiration occur in the middle of the word, they add a velar nasal after the preceding vowel and before the click, but if the clicks are at the beginning of the word, they do not add a nasal (Ladefoged & Traill 1980a:12, 1984:6).

Ladefoged and Traill (1994:40, 41) present waveforms of !Xóo clicks, which turn out to differ among click types, ‘determined by the place and manner of the click release, and by the cavity and walls of the vocal tract anterior to the posterior closure’. While the bilabial and the dental click look similar, the dental one is slightly longer and has higher ‘oscillations’ (Ladefoged & Traill 1994:42). Both clicks have lower oscillations compared to the alveolar click, and especially the lateral and palatal clicks.

The palatal click has higher oscillation than the alveolar click, which means that the palatal click is produced with a smaller cavity (Ladefoged & Traill 1994:42). The lines of the waves of the lateral and alveolar clicks are further apart than the ones of the other three clicks. The differences described show click length, and noise, which is the 'burst' (Ladefoged & Traill 1994:41). The bilabial, dental, and lateral clicks are long and noisy because the articulators move more slowly during their release than during the palatal and alveolar clicks (Ladefoged & Traill 1994:41).

Ladefoged and Traill's (1994:42) study analyzing spectra shows that clicks followed by [a] and [u] show diverging results. Therefore, vowels have an influence on clicks. The four clicks relevant for this study, [ǀ, ǂ, ǁ, !], are usually more intense, and thus louder than the following vowel (Ladefoged & Traill 1994:45, Ladefoged & Maddieson 1996:259).

Sands' (1991:17) study revealed that in Xhosa, the dental and the lateral clicks were affricated but the alveolar click was not. The voice onset time of all voiceless aspirated clicks was mostly similar, but there were remarkable differences between lateral and dental clicks, which were similar for most other accompaniments (Sands 1991:22). Dental and lateral clicks tended to have longer voice onset times than the alveolar clicks (Sands 1991:22). In terms of overall click length, the alveolar and the lateral voiceless unaspirated clicks were longer than the dental ones (Sands 1991:23). Sands (1991:30) could not find any considerable evidence for influences of vowels on preceding clicks in Xhosa.

The Xhosa voiceless unaspirated click has another sound following almost immediately, whereas the aspirated click has a period of aspiration, shown by almost no oscillation in the waveform (Ladeoged & Traill 1994:46). The breathy-voiced click

shows no nasalization, whereas the nasalized click and the nasalized breathy-voiced click show nasalization before the click release (Ladefoged & Traill 1994:47). The difference between the waveforms of the breathy-voiced and the voiceless unaspirated click is that the wave of the voiceless unaspirated one has higher oscillations after the click (Ladefoged & Traill 1994:47).

2.5. Nama and Xhosa click inventories and representation in transcription. Xhosa has 18 clicks according to Jessen and Roux (2002:2). However, Sands (1991:7), Ladefoged and Traill (1994:46), and Herbert (2002:301) assign Xhosa only 15 clicks. The difference in numbers occurs due to the 'prenasalized voiceless click' being seen as a sequence rather than a contrastive accompaniment (Sands 1991:12).

The primary places of articulation for Xhosa clicks are dental [ǀ], alveolar [ǃ], and lateral [ǁ] (Jessen & Roux 2002:2). What are alveolar clicks to Jessen and Roux (2002:2) are alveolopalatal clicks to Sands (1991:7). The accompaniments are voiceless unaspirated ([kǀ]), voiceless aspirated ([kǀh]), breathy voiced ([gǀɦ]), nasalized ([ŋǀ]), and nasalized breathy ([ŋǀɦ]), according to Sands (1991:7). Jessen and Roux (2002:2) call the clicks 'plain' ([kǀ]), 'aspirated' ([kǀ^{h}]), 'voiced' ([g̊ǀ^{ɦ}]), 'nasal' ([ŋǀ]), and 'voiced postnasal' ([ŋǀ^{ɦ}]) respectively. Herbert (2002:297), like Sands (1991), prefers the term 'breathy' to 'voiced'. They include the prenasalized voiceless clicks, or 'plain postnasal clicks' ([ŋkǀ]), as they call them, and they therefore assign Xhosa 18 clicks (Jessen and Roux 2002:2). The transcriptions do not differ largely. Sands (1991:7) did not use diacritics and used older symbols, which were substituted in this work for better intelligibility.

In a different article from 2002, Jessen explains the terms 'initial,' 'postnasal,' and 'postvocalic' used in the inventory by Jessen and Roux (2002:2): 'initial' means that a

click is 'word-initial,' 'postnasal' means that a click is preceded by a morpheme ending in a nasal, and 'postvocalic' means that a click is preceded by a morpheme ending in a vowel. Most clicks can be word-initial, which is the environment investigated in the pilot study: the voiceless unaspirated click, the voiceless aspirated click, the breathy voiced click, and the nasal click, as Sands refers to them (1991:7). The clicks that can be found in postnasal position only are the prenasalized voiceless clicks and the nasalized breathy ones (Sands 1991:7).

Although Fischer's (1985) Xhosa dictionary indicates that words usually have clicks in the middle by marking words, such as verbs and nouns with a hyphen to indicate that they have a prefix, Johnson (1993:36) shows that there are words in Xhosa beginning with a click using those for his study. Thus, this thesis will use word-initial Xhosa clicks, which makes them easier to compare to the mostly word-initial Nama clicks (Bleek 1862:11). Another source that supports that Xhosa words have clicks word-medially more commonly is the Xhosa grammar by Viljoen and Daniel (1998:4, 5), which displays that verbs have prefixes starting with vowels or non-click consonants, and so do nouns. Some of these prefixes to verbs are personal pronouns (Viljoen and Daniel 1998:4). For instance, the verb <-nceda> 'help' has a hyphen indicating a prefix, but <nceda> can also stand alone (Viljoen and Daniel 1998:10). Moreover, Bleek (1862:13) states that Xhosa clicks function as consonants syllable-initially, which makes them possible word-initially. However, clicks cannot be syllable-final in either of the languages investigated (Bleek 1862:45). The one click not found in initial position for the study pertaining to this thesis is the lateral 'prenasalized voiceless click,' <nkx>, which may be because it is rare in general and really is a sequence of two sounds, as Sands (1991:12) presumes.

Nama has 20 clicks (Ladefoged & Traill 1984, Hagman 1977, Beach 1938): four places of articulation and five accompaniments. Only one source assigns Nama 28 clicks (Ager 2010). The primary articulations of the clicks, according to Beach (1938) are dental affricate [|], denti-alveolar [ǂ], lateral affricate [‖], and alveolar implosive [!], but according to Ladefoged and Maddieson (1996), dental [|], palatal [ǂ], lateral [‖], and alveolar [!]. Thus, [ǂ] is viewed differently within the same language: denti-alveolar and palatal.

Nama clicks occur 'only initially' (Beach 1938:88). Three quarters of the words in Nama begin with a click (Bleek 1862:11). The data for the pilot study pertaining to this thesis, however, suggest that some Nama words have clicks word-internally as well. While Bantu languages are 'polysyllabic,' Nama is a 'monosyllabic' language, which means that its morphemes do not have more than one syllable, unless they are loanwords (Bleek 1862:11). If a word has an internal click, it must thus be a longer utterance consisting of several morphemes or be a loanword (Bleek 1862:11). In addition, Nama clicks can be accompanied by a consonant such as <k, kh, g, h, or n> and form the syllable onset (Bleek 1862:13).

Ladefoged and Traill's (1980a, 1984, 1994) phonetic transcription of Nama clicks changed after 1984. They term the accompaniments 'voiceless unaspirated,' transcribed [k|] in all respective articles, 'voiceless aspirated,' transcribed as [k|h] in earlier articles but [k|^{h}] in later articles, 'delayed aspiration,' transcribed as [|h] in earlier articles but [ŋ|^{h}] in later articles, 'voiced nasal,' transcribed as [ŋ|] in all articles, and 'glottal,' transcribed as [|ʔ] in earlier articles but [k|^{ʔ}] in later articles (Ladefoged and Traill 1980a, 1984, 1994). In the later inventory, diacritics were used. The clicks labeled with 'delayed aspiration' have a 'voiceless velar nasal with a pulmonic egressive airstream,'

as Ladefoged and Traill (1994:61, 48) note more in detail: no velar release is audible and possible pressure comes out through the nose. In the article from 1994, they also assign the glottal closure click a voiceless velar stop although it is not audible since data show a lowered velum (Ladefoged & Traill 1994:48).

Hagman's (1977:10) inventory does not seem to match Ladefoged and Traill's (1994:48) description, because he says occasionally a voiced [g] can occur as a 'transitional velar sound' after click production and before vowel production: |(g). Rogers (2000:258) agrees with Hagman (1977:10). Moreover, Hagman (1977:10) has clicks followed by [n] in his inventory instead of [ŋ]: |n. Velar [g] is a voiced sound, but Ladefoged and Traill's (1994:48) inventory calls the accompaniment 'voiceless' and has a [k]. In addition, the voiceless aspirated click [k|h], as in Ladefoged and Traill (1984:2) and in Rogers (2000:258) is transcribed as [|x] in Hagman (1977:10). Compared to Hagman's (1977:10) representation, Rogers (2000:258) and Ladefoged and Traill (1994:48) do not use [|'] to represent a glottal stop. The only other source used in this thesis that uses [|'] is a word list in the UCLA phonetics lab archive (Ladefoged 2009). Hagman (1977:10) uses [|h] for delayed aspiration as Ladefoged and Traill (1994:48) do. Other, more recent sources than Hagman (1977:10) who agree with Rogers (2000:258) are Haacke and Eiseb (1999) and the Curriculum Committee for Khoekhoegowab (2003). It has to be stressed that those sources use <|,> <|g,> <|h,> <|n,> <|kh> for the orthography.

The inventory that has 28 clicks, 8 clicks more than the other inventories, is a combination of the inventories by Hagman (1977:10) and Ladefoged and Traill (1994:48) containing orthography as well as phonetic transcription. Besides that, the

additional 8 clicks may be allophones of click phonemes, such as <|> and <|’,> <|> and <|g,> or <|k> and <|x>.

Although click languages have received large interest in research, Roux (2007:8) considers the different phonetic transcription systems for clicks and the specification of places of articulation still ‘unresolved.’ When the IPA decided on a uniform transcription system for clicks in 1989, namely [|, ǂ, ‖, !, ʘ], no decision was made about the presentation of click accompaniments (Kohler et al. 1989:164, 165). According to Kohler et al. (1989:164), the symbols were developed by Lepsius as early as 1855. However, as Roux (2007:8, 9) points out, the place of articulation denotation is still in question as well for some languages.

Addressing the places of articulation problem, Roux (2007:18) points to Ladefoged and Maddieson’s (1996:248) table that contains an overview of the place of articulation problem of clicks for all languages, which mostly concerns the ‘dental/alveolar, alveolar/palatal, and palatal places of articulation’ (Roux 2007:18). According to Ladefoged and Maddieson (1996:249), there has been an immense divergence in ‘articulatory descriptions’ of clicks that are the same.

Ladefoged and Maddieson’s (1996:248) table shows that researchers agree in calling [|] a dental click in all languages represented. Some give it additional features, such as ‘affricated,’ or ‘alveolar’ (Ladefoged & Maddieson 1996:248). The case of [!] seems a little more complicated, as pointed out by Roux (2007:8) already. Comparing Xhosa and Zulu, Roux (2007:18) found that in Zulu, some researchers use [!] for ‘apico-palatal’ or ‘palatal’ clicks, whereas in Xhosa, they use [!] to represent a ‘palato-alveolar.’ For Nama, the click is denoted ‘alveolar’ (Ladefoged & Maddieson 1996:248). Bleek (1862:12) says that the dental and the alveolar clicks in Nama and Xhosa are very

similar, and thus the same symbols for those can be used. Ladefoged and Maddieson's (1996:248) table shows four different places of articulation for [!]: 'alveolar,' 'palatal,' 'cerebral,' or 'palato-alveolar' (Ladefoged & Maddieson 1996:248).

The click [ǂ], which is part of the Nama inventory, is denoted 'denti-alveolar implosive,' or 'palato-alveolar' by different authors (Ladefoged & Maddieson 1996:248). Ladefoged and Maddieson (1996) disagree with Beach (1938) and to a certain degree with Maddieson (1984a) by denoting it 'palatal.' Therefore, they create a larger difference in place of articulation between [!] and [ǂ]. The click [!] is 'palatal' according to Snyman (1975) as cited in Ladefoged and Maddieson (1996:248) and 'alveolar' according to Ladefoged and Maddieson (1996) and the click [ǂ] is 'alveolar' according to Snyman (1975) as cited in Ladefoged and Maddieson (1996:248) and 'palatal' according to Ladefoged and Maddieson (1996). The click [ǁ] is mostly considered 'lateral' (Ladefoged & Maddieson 1996:248). One author adds 'post-alveolar' to the lateral click for Zulu, and another author adds 'alveolar' for Nama (Ladefoged & Maddieson 1996:248). This concerns where the tip of the tongue makes the front closure.

Ladefoged and Maddieson (1996:249) name a couple of reasons for these different denotations: first, the closure during the click is larger than the closure right before the release of the click; it depends whether the place of articulation chosen refers to the closure during the click or the one right before the click. According to Ladefoged and Traill (1980a:25, 1994:37), the place of articulation is to be described according to the place of the occlusion during the release of the click and not during the suction, and thus the spot where the inner edge of the tongue closes off the click cavity. Second, different speakers may use different articulations when producing the same click

(Ladefoged & Maddieson 1996:249, Sands 1991:11). Third, different authors focus on different parts of articulation, such as adding accompaniments (Ladefoged & Maddieson 1996:249, Sands 1991:11).

Ladefoged and Maddieson (1996:252) say that [!] can be produced in several ways: the places of articulation might slightly differ (alveolar, post-alveolar, post-dental), and the part of the tongue closing off the front (apex, sub-apex). In both Xhosa and Nama, all those clicks are seen as [!], and are therefore allophones of /!/ (Ladefoged & Maddieson 1996:252).

[ǂ] is denoted denti-alveolar by earlier researchers on ground of the tongue tip actually touching that part of the mouth during click production (Ladefoged & Maddieson 1996:255). However, Ladefoged and Maddieson (1996:255) claim this is not the right aspect to be described for a click, but, as already mentioned, the front part of the cavity between tongue and roof of mouth, which during the production of [ǂ] is further back toward the palate, particularly during the release. Ladefoged and Maddieson (1996:256, 257) argue like Bradlow (1992:84), and Ladefoged and Traill (1994:39) that if there are alveolar and palatal clicks in a language inventory, the articulatory difference is what part of the tongue is used: apex for central [!] and lateral [ǁ], or lamina for [ǀ] with closure on the teeth and [ǂ] with closure on the palate. According to Ladefoged and Maddieson (1996:249), the tongue closes off the cavity further back in the mouth during the alveolar and palatal clicks than during the dental and lateral ones.

Ladefoged and Traill (1984, 1994) denote clicks by first putting a symbol for the back closure, the accompaniment, with nasality and/or voicing, which is a velar stop or nasal, followed by the actual symbol for the click, and then the kind of back closure

release, such as aspiration, affrication, or glottal release (Ladefoged & Traill 1994:50). Roux (2007:22), however, argues that accompaniments denoting the back closure are not needed in the phonetic transcription of clicks and proposes a simplified representation for clicks of the related Bantu languages Xhosa and Zulu that resemble the 'traditional representation' of the clicks more than Ladefoged and Traill's (1994) representation; for instance, the plain voiceless clicks can be transcribed with [ǀ], [!], [ǁ], the aspirated clicks can be represented as [ǀʰ], [!ʰ], [ǁʰ] the voiced clicks can receive the voice-diacritic below the click, as in [ǀ̬], [!̬], and [ǁ̬], the nasal clicks can be transcribed with a nasal diacritic, as in [ǀ̃], [!̃], and [ǁ̃], and the voiced nasal clicks can be represented as [ǀ̬̃], [!̬̃], [ǁ̬̃], without any accompaniments. The simplicity of the traditional symbols also convinces students of the phonetics of Xhosa (Roux 2007:23). Furthermore, Roux (2007:11) argues that the phonetic details as described by Ladefoged and Traill in several articles cause confusion about clicks in Xhosa and Zulu, since only some articulatory features are named on the cost of other features that should be considered. Bradlow (1992:83), in contrast, argues that the accompaniments are important for representation of clicks because in her opinion, clicks are complex consonants with 'double articulation' and primarily to be seen as back consonants, which makes the velar closure the crucial part of articulation.

Kohler et al. (1989:165) give a chart that shows considerable differences of accompanying symbols as assigned by different researchers. For instance, the voiced nasal alveolar click [!] before [a] is transcribed with a different accompaniment by different authors: [!̃na] (Kohler 1981, Vossen 1986a, b), as cited in Kohler et al. (1989:165), [ŋ!a] (Ladefoged & Traill 1984, Snyman 1975), as cited in Kohler et al. (1989:165), and [!na] (Traill 1985), as cited in Kohler et al. (1989:165). Five different

authors use three different ways to denote the same accompaniment (Kohler et al. 1989:165), which is why Roux (2007) proposes a uniform system without accompaniments and as few diacritics as possible. However, some clicks require two diacritics, which is complicated to type. Therefore, there are several pros and contras for accompaniments. A suggestion could be, if it is not too complicated, to add them as diacritics as well, which may add up to three diacritics and may therefore be too complicated.

2.6. Measurements of clicks in previous studies. In their studies, looking at phonetic properties of clicks and accompaniments, Ladefoged and Traill (1980b:30) recorded 'aerodynamic parameters,' such as buccal air pressure, pharyngeal air pressure, nasal air flow in both directions, and buccal air flow in both directions. This method has been used especially for clicks (Ladefoged & Traill 1980a, 1984). A tube through the nose to get recordings of expiratory nasal air flow, expiratory oral air flow, pressure of air in the pharynx, and a microphone in the oral flow mask to obtain a wave form for Nama clicks were used in the field (Ladefoged & Traill 1984). Moreover, palatographic recordings give information where and when the tongue touched the roof of the mouth (Ladefoged & Traill 1980b:36). Beach (1938) used palatograms in his study as well. Roux' (2007) study, attempting to resolve click-related issues that are not agreed on by researchers, also contains palatograms.

Sands (1991) examines acoustic properties of Xhosa clicks. Sands (1991) analyzes the wideband spectrograms, waveforms, and LPC spectra made of the data for duration of frication, closure duration, VOT, overall duration, coarticulation, back closure duration, and frequency and amplitude comparing clicks to non-clicks. Jessen (2002), investigating Xhosa clicks and plosives acoustically, also analyzes waveforms and

spectrograms for VOT, closure duration, voicing duration and percentage, and burst amplitude using word-initial and word-medial clicks. Johnson (1993) looks at acoustic and auditory properties of Xhosa clicks and pulmonics using spectra and waveforms of Xhosa word parts with word-initial clicks for the analysis. Kagaya (1978) measures frequency properties and length of Naron clicks with spectrograms. The clicks in Kagaya's (1978:115) study occur word-initially.

CHAPTER 3

METHODOLOGY

3.1. The study. In a study for their 1980a article, Ladefoged and Traill made recordings of Nama files. However, they went further with measuring than was possible for the study carried out for this project. Ladefoged and Traill (1980a:6, 1984:2) measured the expiratory nasal and oral airflow, the pressure of air in the pharynx by means of a tube through the nose of a subject, and the waveform. This study measured click duration, burst duration, voice onset time, and accompaniment duration by means of spectrograms and waveforms, which resembled more the nature of Sands' (1991) and Jessen's (2002) studies on Xhosa. Thus, this study concentrated on temporal aspects of clicks. The research questions were stated as:

1. What are the phonetic differences of places of articulation of clicks in the two languages chosen?
2. What are the phonetic differences between the accompaniments of the clicks?
3. What are the allophones of the click phonemes?

3.2. The speakers. Since this thesis contains a comparative analysis of Nama and Xhosa clicks, an acoustic study was carried out. One speaker of Nama and one speaker of Xhosa were needed for the study, which is how many participated. Since this study was a pilot study, two speakers were a justifiable number. According to Ladefoged and Traill (1994), relying on only few speakers for some kinds of data is legitimate and necessary because they consider some field data hard to control, especially when looking at several languages. The speakers were treated with confidentiality in this work and were referred to as 'the Nama speaker' and 'the Xhosa speaker.' The speakers were

recruited through a third party at a Midwestern University in the United States and their participation was voluntary. They were asked to give demographic information prior to the recordings. See appendix A for the demographic information questions.

The Nama speaker was from Namibia and he was male. He was a student at a Midwestern University. He was 26 years old and was a native speaker of Nama. Nama was his first language. He used the language in everyday interaction with his family and friends. Other languages the Nama speaker was familiar with were Afrikaans and English. Nama was the only language he knew that contains click sounds.

The Xhosa speaker was from Swaziland and also male. He was a student at a Midwestern University. He was 40 years old and Xhosa was his first language. Xhosa was used in his village. He used it for daily interaction. The other languages he spoke were SiSwati, Zulu, and English. Both SiSwati and Zulu contain clicks. The language the Xhosa speaker used most was SiSwati, his tribe language. However, he switched to Xhosa easily if someone he talked to turned out to be a Xhosa speaker. Moreover, the service in his church was in Xhosa.

3.3. Word lists. For this study, word lists were made that include the clicks to be investigated. Therefore, words in isolation that had clicks in Nama and in Xhosa were chosen, along with an English translation. For this, the languages had to be researched for how and when clicks occur in words, and the entire click inventory of both languages had to be known. In most cases, the words used had clicks in initial position, followed by a front or a back vowel. Therefore, since the languages have around 20 clicks, 40-50 words were investigated. The words in Xhosa were taken from Fischer's (1985) English-Xhosa dictionary, from Parker's (2009) online dictionary and from Gutter and Gutter's (2010) online Xhosa dictionary. The Nama words were drawn from

Hagman's (1977) Nama grammar, from Krönlein's (1969) Nama dictionary, from the Nama dictionary developed by the Curriculum Committee for Khoekhoegowab (2003), and from Haacke and Eiseb's (1999) Khoekhoegowab-English, English-Khoekhoegowab glossary. See appendices B and C for word lists.

The two click environments used were word-initial clicks followed by the front vowel [i] and by the back vowel [u]. The different vowels following the clicks were suspected to show that there was influence on clicks by other sounds. However, this particular point was only considered with the researcher's perception by ear because nothing was visible in the spectrograms or waveforms, which were the only instruments available in this study. Not all clicks could be found followed by [i] or [u]. Therefore, there were additional or replacing measurements of clicks preceding other vowels, such as [e] and [o], or even [a] compared to [u]. Besides that, some of the clicks could only be found in word-internal position in Xhosa. This was the case for some Xhosa clicks, especially with nasalization because some of those were more likely to occur after a vowel than at the beginning of the word. However, since clicks are usually in word-initial position in Nama, this was the position to investigate because this position is possible in Xhosa with most clicks.

The words were presented to the speakers on flash cards in a random order in their respective language and in English in case the speakers did not recognize the words as their respective language. An example from the word list is Nama [!noná], 'three'. The lists contained words with the clicks in the inventories of the languages. The Xhosa and Nama words were presented as found in several sources since more sources give a larger and more representative variety of words. Previous studies suggest that the click types and accompaniments that exist in both languages are similar. However, since the

languages investigated are different languages from even different language groups, despite click borrowing from Khoisan into Bantu, differences were expected.

3.4. The recording. The recording took place in a quiet environment, namely in the Linguistics Laboratory at a Midwestern University. Ladefoged and Traill (1980b:29) suggest that audio files should have a quality as high as possible with as little background noise as possible. The instrument used for the recording was a MacBook Pro with an integrated microphone, and the software used for recording and acoustic data analysis was Praat (http://www.praat.org/). The laptop computer was sitting on a table between the subject and the researcher.

The speakers were asked to say every word twice when seeing it on a flash card as held up by the researcher. The speakers could sit in a chair comfortably while the recordings were being done. Jessen (2002:156) stresses comfort and random order of words in his study. The computer's microphone had a reach wide enough for decent quality so that subjects could be recorded in a comfortable position. As Jessen (2002:156) also emphasizes, the speakers were not too close to the microphone so that there was no influence from the 'breath stream' of the speakers. The subjects saw the word in their respective language with an English translation in case of lack of clarity. The researcher gave a thumb-up sign whenever the recording started and the subject could start talking. The Xhosa speaker said five words, each one twice, into one file. The Nama speaker, however, was recorded saying only one word twice per file since there were some words he did not know because they belonged to the Damara dialect. Dictionaries, glossaries, and grammars classify those Damara words as 'Nama,' as the speaker clarified to the researcher in several cases. After being tested for quality, the recorded files were saved on the researcher's computer.

3.5. Data analysis. The analysis was carried out with the acoustic analysis software Praat. Waveforms and spectrograms of the files were examined and compared for temporal aspects of clicks, namely overall duration, burst duration, voice onset time, and the accompaniments: voiceless unaspirated, voiceless aspirated, nasalized, breathy voice, nasalized breathy, delayed aspiration, and glottal closure.

Click duration measures the click from before its release (including accompaniments) until the onset of the following vowel (Sands 1991:23). In order to measure the closure duration preceding the click, the word-initial clicks had to be put in context in Jessen's (2002:155) study, since otherwise it could not be detected. Kagaya (1978:118) measures the duration of the click burst and for influence on it by accompaniments. Since the data have word-initial clicks, the first closure cannot be detected easily. However, burst and accompaniment can be measured, as Kagaya's (1978:118) study proves. For this reason, the current study did not measure closure duration, but burst duration, as in Kagaya (1978), and accompaniment duration. Prenasalization was measured where applicable. Voice onset time, or VOT, measures the click from right before the front release to the onset of the vowel (Sands 1991:21). According to Ladefoged (2006:146), VOT is 'the interval between the release of a closure and the start of the voicing,' which is measured from the release of the stop closure to the onset of voice. This means that if voicing sets in during the closure of a stop and thus prior to the release, the VOT is a negative value (Ladefoged 2006:146). This negative value, however, is not a mathematical but a conventional and thus symbolic value. This explains why the VOT values for clicks with nasalized accompaniments do not seem mathematically correct at first glance. The question about the allophones of clicks was answered during literature research and was referred back

to during the data analysis as well in questionable cases. With all clicks of the language inventories recorded, it was possible to make a comparative analysis between the two languages.

The transcription system used in this work was the one by Ladefoged and Traill (1994) because they have the most extensive studies and they give the most phonetic details. Moreover, taking transcriptions from two different sources or even researchers would have caused the transcriptions to be too different. Since Ladefoged and Traill show transcriptions for both languages investigated, their transcription system was used.

The clicks were transcribed by the researcher as analyzed in spectrograms and waveforms, and then the comparison was made. Tables present the results. The study compared all clicks with the same place of articulation and the same accompaniment in the two languages per table. The tables show overall duration, burst duration, VOT, and the respective accompaniment measured in milliseconds (ms). The discussion chapter compared all places of articulation, and presents tables with averages of all places of articulation, the differences for places of articulation between the two languages, and all individual accompaniment averages.

It was expected that the data showed some differences between the Xhosa and Nama clicks since there are more Nama clicks than Xhosa clicks, and although Xhosa borrowed the clicks from Khoisan languages, the two languages are different. As mentioned, there can be slight articulation differences for clicks that are largely the same in both languages. Moreover, the Xhosa clicks as said by the Xhosa speaker may have been influenced by the other languages he used frequently, namely SiSwati and Zulu. However, measuring this exceeds the scope of this study. Differences but also similarities between all clicks were expected.

CHAPTER 4

RESULTS

4.1. Dental clicks

4.1.1. Voiceless unaspirated dental clicks.

Voiceless unaspirated dental clicks exist in Xhosa and in Nama. In Xhosa, they are represented in the orthography by <c>. Xhosa words in which a voiceless unaspirated dental click was expected are in example (1).

(1) Xhosa voiceless unaspirated dental clicks

nkcenkceshela	[ᵢŋk‖ɛ̃ŋk‖ɛˈʃɛla]	‘water’
cinga	[ˈk|iːŋaː]	‘to think’
inkcubeko	[ᵢĩŋk!uˈbɛkɔ]	‘culture’
culisa	[k|uˈlisa]	‘direct’

In Nama, the voiceless unaspirated dental clicks are indicated in the orthography by <|>. Nama words expected to contain a voiceless unaspirated dental click are listed in (2).

(2) Nama voiceless unaspirated dental clicks

|íríp	[ˈk|iɾipʰ]	‘jackal’
|úí|úípese	[ᵢk|uik|uiˈpese]	‘one by one’

Table 4.1 shows the overall duration (in ms), the burst duration (in ms), the voice onset time (in ms), and the voice lag between the end of the click burst and the onset of the following vowel (in ms). This voice lag will be labeled ‘unaspirated’ throughout the study in order to maintain the name of the accompaniment. Results are displayed for individual clicks and averaged by language. Words that could not be used for calculations because they contained clicks with a different place of articulation than the

expected dental one are marked with asterisks. Their figures are marked with asterisks as well so that their invalidity is obvious. If a word has two relevant clicks, both are calculated but the word is not repeated. Therefore, there is a gap followed by numbers that refer to the second click in the word above.

Table 4.1. Voiceless unaspirated dental clicks

	Overall duration (ms)	Burst duration (ms)	VOT (ms)	Unaspirated (ms)
Xhosa				
*[ˌŋk‖ɛ̃ŋk‖ɛˈʃɛla]	*176	*118	*-77	*58
	*106	*35	*-69	*71
[ˈk|iːŋaː]	134	110	134	24
*[ˌĩŋkǃuˈbɛkɔ]	*143	*123	*143	*20
[k|uˈlisa]	105	99	105	6
Avg. Xhosa	120	104	120	15
Nama				
[ˈk|ɪripʰ]	62	52	62	10
[ˌk|uik|uiˈpese]	49	41	49	8
	52	41	52	11
Avg. Nama	54	45	54	10

Table 4.1 shows that the overall durations of the voiceless unaspirated dental clicks are very different in both Xhosa and Nama, which requires closer investigation.

The word [ˈk|iːŋaː] showed a long click with 134 ms compared to the others. The vowel set in late, which is a sign of aspiration or a glottal closure. Therefore, the VOT was relatively long as well with also 134 ms and longer than the VOTs of most other relevant clicks. Looking more closely, the click revealed that the burst duration took up most of it with 110 ms. The remaining 24 ms were the unaspirated accompaniment.

The click in [k|uˈlisa] was the shortest Xhosa click in the table with 105 ms with an equivalent VOT. For voiceless unaspirated clicks, VOT and overall duration were the same because the front closure duration could not be detected for word-initial clicks. The burst duration for this click was 99 ms, and the unaspirated accompaniment lasted 6 ms.

The first two clicks in the word [ˌŋk‖ẽŋk‖ɛˈʃɛla] had a nasal segment added to them, which was not part of the click, as explained in Ladefoged and Traill (1994). The clicks in [ˌŋk‖ẽŋk‖ɛˈʃɛla] sounded and looked more lateral than dental, although dental was expected for orthographic reasons. This may have several reasons. One reason could be that the following vowel, a front vowel, caused a fronted coronal back closure, as measured in Sands (1991), or another reason could be that the speaker actually uttered this word with lateral clicks. It could also be the case that this click was an allophone of the dental click. The two clicks had to be excluded from calculations for not being dental. They are marked with asterisks in the table to indicate that they are invalid.

The click in [ˌ̃ŋk!uˈbɛkɔ] had the longest duration in the table. This is because it was preceded by a nasal. Its VOT was the longest of the table as well with 143 ms, resulting from the speaker uttering this click with aspiration. The click sounded like an alveolar more than a dental because it may have been articulated further back although the orthography of the click was that of the dental. Another reason could be either that to this speaker, the click was alveolar or that it was an allophone of the dental click. The click was excluded from calculations. Therefore, two Xhosa clicks and three Nama clicks were used for calculation in Table 4.1.

The waveforms of the clicks in [k|uˈlisa], [ˌŋk‖ẽŋk‖ɛˈʃɛla], and [ˌ̃ŋk!uˈbɛkɔ] in figures 4.1, 4.2, and 4.3 highlight the differences:

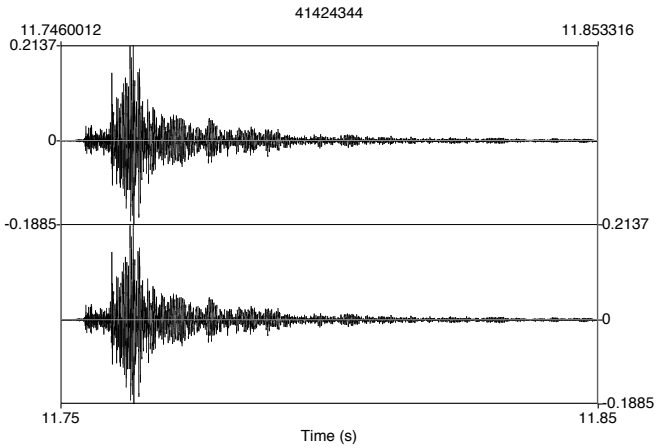

Figure 4.1. Waveform of click in [k|uˈlisa] – dental

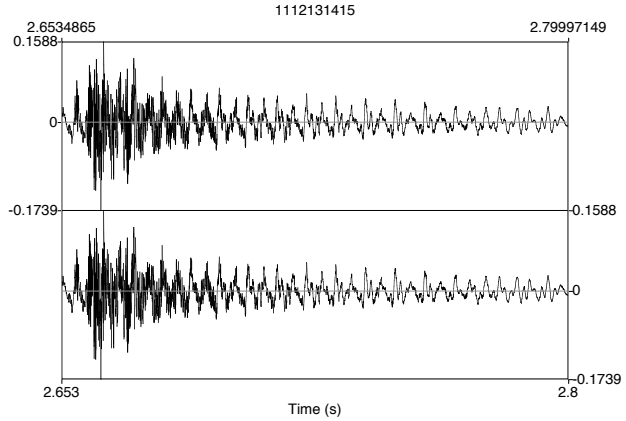

Figure 4.2. Waveform of first click in [ˌŋk‖ɛ̃ŋk‖ɛˈʃɛla] – lateral

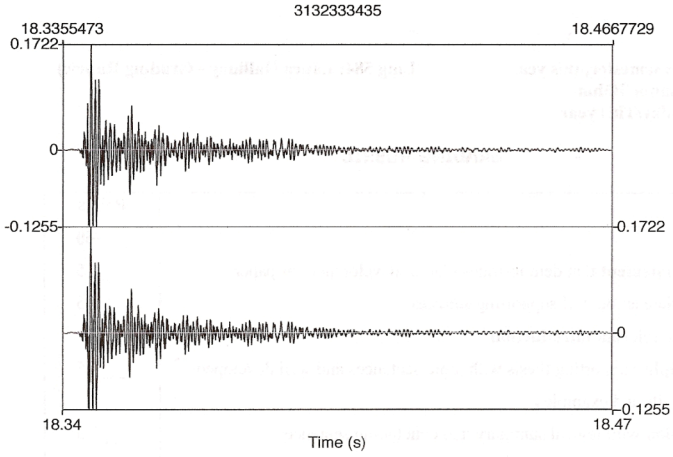

Figure 4.3. Waveform of click in [ˌĩŋk!uˈbɛkɔ] - alveolar

The waveforms show that the dental click in Figure 4.1 had the narrowest oscillations and that the lateral click in Figure 4.2 had the widest oscillations horizontally.

Moreover, the lateral click in Figure 4.2 and the alveolar click in Figure 4.3 had higher oscillations than the lateral click. The waveforms support that the clicks in [ˌŋk‖ɛ̃ŋk‖ɛˈʃɛla] and [ˌĩŋk!uˈbɛkɔ] cannot be included in the calculations.

The Nama clicks in Table 4.1 show some differences but also some similarities. The Nama click in [ˈk|ɪripʰ] was rather short with 62 ms compared to the Xhosa clicks, but it was longer than the first click in the Nama word [ˌk|uik|uiˈpese] with 49 ms. Both clicks had the same overall duration as VOT. The click in [ˈk|ɪripʰ] had a burst duration of 62 ms and the unaspirated accompaniment lasted 10 ms. The first click in [ˌk|uik|uiˈpese] had a burst duration of 41 ms and the unaspirated accompaniment was 8 ms. The second click in [ˌk|uik|uiˈpese] was 52 ms with a burst duration of 41 ms as well. Since that click was word-medial, the front closure of the click was visible, but it was not measured. Otherwise, it would distort the average for the other clicks that do not have it. Its unaspirated accompaniment was 11 ms.

The Nama click overall duration and VOT average was 54 ms. The Xhosa clicks were overall remarkably longer with 120 ms on average and had a longer VOT. Some of the Xhosa clicks were about twice as long as the Nama clicks, mainly because of longer burst durations in the relevant Xhosa clicks. They had a much longer burst duration with 104 ms on average than the Nama ones with 45 ms. The unaspirated accompaniment measured 15 ms on average for Xhosa and 10 ms on average for Nama. Thus, the burst duration was longer than the accompaniment.

4.1.2. Voiceless aspirated dental clicks. Voiceless aspirated dental clicks occur in Xhosa and in Nama as well. In Xhosa, they are represented in the orthography by <ch>. Xhosa words in which a voiceless aspirated dental click was expected are listed in (3).

(3) Xhosa voiceless aspirated dental clicks

chitha-chitha	[k|^{h}i^{l}t^{h}ak|^{h}i$_{l}$t^{h}a]	‘to scatter’
chuba	[^{l}k|^{h}uba]	‘to peel’

In Nama, the voiceless aspirated dental clicks are represented in the orthography by <|h>. Nama words expected to contain a voiceless aspirated dental click are shown in (4).

(4) Nama voiceless aspirated dental clicks

|hei	[k|^{h}ej]	‘to become pale’
|hūb	[k|^{h}ub$^{\neg}$]	‘scorpion’

Table 4.2 shows the overall duration (in ms), the burst duration (in ms), the voice onset time (in ms), and the aspiration duration (in ms). Results are shown for individual clicks and averaged by language.

Table 4.2. Voiceless aspirated dental clicks

	Overall duration (ms)	Burst duration (ms)	VOT (ms)	Aspiration (ms)
Xhosa				
[k|^{h}i^{l}t^{h}ak|^{h}i$_{l}$t^{h}a]	151	97	151	54
	131	94	131	37
[^{l}k|^{h}uba]	185	130	185	60
Avg. Xhosa	156	107	156	50
Nama				
[k|^{h}ej]	197	105	197	92
[k|^{h}ub$^{\neg}$]	247	77	247	170
Avg. Nama	222	91	222	131

Table 4.2 shows that there were more similarities between the voiceless aspirated clicks than there were for the unaspirated clicks. Three Xhosa clicks and two Nama clicks were measured.

The Xhosa clicks were all between 130 and 190 ms long overall, on average 156 ms, and the Nama clicks were between 190 and 250 ms, with an average overall duration of 222 ms. The Nama clicks were longer than the Xhosa clicks in this case.

The VOTs were identical to the overall duration as for the voiceless unaspirated clicks. The biggest divergence in overall length could be found between the second Xhosa click in [k|^{h}i$^{!}$t^{h}ak|^{h}i$_{!}$t^{h}a] with 131 ms and the Nama click in [k|^{h}ub$^{\neg}$] with 247 ms. Aspiration was largely responsible for this divergence.

The second click in [k|^{h}i$^{!}$t^{h}ak|^{h}i$_{!}$t^{h}a] had the shortest aspiration duration with 37 ms and the one in [k|^{h}ub$^{\neg}$] had the longest aspiration with 170 ms. The aspiration average for the Xhosa clicks was 50 ms and 131 ms for the Nama clicks, which was remarkably longer.

The burst durations were more similar. The click with the longest overall duration and aspiration in [k|^{h}ub$^{\neg}$] had the shortest burst duration with 77 ms, and the click in [$^{!}$k|^{h}uba], the longest Xhosa voiceless aspirated click overall with 185 ms, had the longest burst duration with 130 ms. The burst duration average for Xhosa was 107 ms and 91 ms for Nama. The Xhosa average was slightly longer, but those were the only average values in this table that were very similar. For Xhosa, the burst duration average was longer than the aspiration, whereas for Nama, the opposite was the case.

The Xhosa click in [$^{!}$k|^{h}uba] was suspected to sound lateral, but the waveform could not verify that suspicion, which is why the click was included in the calculations.

4.1.3. Nasalized dental clicks. Nasalized dental clicks exist in both Xhosa and Nama. Xhosa orthography represents them as <nc>. Xhosa words in which a nasalized dental click was expected are named in (5).

(5) Xhosa nasalized dental clicks

ncinci	[ˈŋ͡ǀĩŋ͡ǀĩ]	‘small’
ncuma	[ˈŋ͡ǀũma]	‘to smile’

Nama orthography represents the nasalized dental clicks as <|n>. Nama words expected to have a nasalized dental click are in example (6).

(6) Nama nasalized dental clicks

|nǐ	[ŋ͡ǀĩː]	‘another’
|nùúku	[ˈŋ͡ǀuwku]	‘the legs’

Table 4.3 shows the overall duration (in ms), the burst duration (in ms), the voice onset time (in ms), and the nasalization/voicing duration (in ms). Results are presented for individual clicks and averaged by language.

Table 4.3. Nasalized dental clicks

	Overall duration (ms)	Burst duration (ms)	VOT (ms)	Nasalization/ voicing (ms)
Xhosa				
[ˈŋ͡ǀĩŋ͡ǀĩ]	197	87	-110	197
	220	122	-98	220
[ˈŋ͡ǀũma]	260	120	-140	260
Avg. Xhosa	226	110	-116	226
Nama				
[ŋ͡ǀĩː]	201	92	-109	201
[ˈŋ͡ǀuwku]	226	99	-127	226
Avg. Nama	214	96	-118	214

Three Xhosa clicks and two Nama clicks were measured for nasalized dental clicks, as displayed in Table 4.3.

The shortest click was the first click in Xhosa [ˈŋ|̃ĩŋ|̃ĩ] with 197 ms, and the longest click was the Xhosa click in [ˈŋ|ũma] with 260 ms overall. The Xhosa clicks showed more remarkable length divergences than the Nama clicks. On average, the Xhosa clicks were only slightly longer overall with 226 ms than the Nama clicks with 214 ms.

For the most part, the longer clicks also had longer burst durations. The burst durations ranged from 87 ms for the first click in Xhosa [ˈŋ|̃ĩŋ|̃ĩ] to 122 ms for the second click in the same word. The burst duration average for the Xhosa clicks was 110 ms and thus slightly longer than for the Nama clicks with 96 ms.

Since those clicks had prenasalization, the VOT obtained a negative value. The click with the shortest prenasalization was the second one in Xhosa [ˈŋ|̃ĩŋ|̃ĩ] with -98 ms and the click with the longest prenasalization was the one in Xhosa [ˈŋ|ũma] with -140 ms. The prenasalization and thus VOT average for Xhosa was -116 ms and the one for Nama was -118 ms, which was almost the same.

Nasalization and therefore voicing could be found throughout the entire click duration, which means that overall duration and nasalization/voicing had to be assigned the same figures.

4.1.4. Breathy voiced dental clicks – Xhosa. Breathy voiced clicks exist in Xhosa but not in Nama. They are indicated in Xhosa orthography by <gc>. Xhosa words in which a breathy voiced dental click was expected are given in (7).

(7) Breathy voiced dental clicks – Xhosa

gcina	[ˈg|ina]	‘to keep’
gcwala	[ˈg‖wala]	‘to get full’

Table 4.4 presents the overall duration (in ms), the burst duration (in ms), the voice onset time (in ms), and the breathy voice duration (in ms). Results are displayed for individual clicks. The clicks that had to be excluded from the study are marked with an asterisk throughout the line to show that they are not to be considered.

Table 4.4. Breathy voiced dental clicks – Xhosa

	Overall duration (ms)	Burst duration (ms)	VOT (ms)	Breathy voice (ms)
Xhosa				
[ˈg|ina]	83	70	83	38
*[ˈg‖wala]	*146	*70	*146	*76

The breathy voiced dental Xhosa clicks showed some differences. The click in the word [ˈg‖wala] had a longer overall duration than the click in the word [ˈg|ina] and also had a longer VOT. Overall duration and VOT were equal since there was no voicing until the vowel set in, as specified in chapter 2, and the front closure duration could not be detected. The click in [ˈg‖wala] sounded more lateral than dental, which was supported by its waveform. Therefore, the click could not be used for calculations of dental breathy voiced clicks, which left only one click of the kind for this study. The excluded example and its numbers are marked with asterisks. A dental click was expected due to orthography.

About the click in [ˈg|ina], it can be said that it was 83 ms long with an according VOT. The burst duration with 70 ms was much longer than the breathy voice accompaniment with 38 ms, which set in while the click was still in the process of bursting. Although not counted, the click in [ˈg‖wala] had a burst duration of 70 ms as well but a much longer breathy voice accompaniment of 76 ms.

4.1.5. Nasalized breathy dental clicks – Xhosa. Nasalized breathy clicks also exist in Xhosa but not in Nama. They are represented in the orthography by <ngc>. Xhosa words expected to contain a nasalized breathy dental click are in (8).

(8) Nasalized breathy dental clicks – Xhosa

ngcileza	[ˈg|iˈlɛza]	‘to hop’
ngcwele	[ˈŋ|wɛlɛ]	‘holy’

Table 4.5 shows the overall duration (in ms), the burst duration (in ms), the voice onset time (in ms), and the nasalized breathy duration (in ms). Results are given for individual clicks. Clicks that could not be included in calculations are marked with an asterisk.

Table 4.5. Nasalized breathy dental clicks – Xhosa

	Overall duration (ms)	Burst duration (ms)	VOT (ms)	Nasalized breathy (ms)
Xhosa				
*[ˈg|iˈlɛza]	*101	*91	*101	*10
[ˈŋ|wɛlɛ]	214	100	-92	214

First, it is obvious that the click in [ˈŋ|wɛlɛ] was twice as long with 214 ms as the click in [ˈg|iˈlɛza] with 101 ms. VOTs were also remarkably different with 101 ms in [ˈg|iˈlɛza] and -92 in [ˈŋ|wɛlɛ].

Moreover, the nasalized breathy accompaniment for the click in [ˈg|iˈlɛza] was 10 ms, while the accompaniment for the click in [ˈŋ|wɛlɛ] was over 20 times as long with 214 ms. The accompaniment was to be as long as the whole click because prenasalization and breathy accompaniment setting in during the click burst had to be counted. The reason for these differences is that the click in [ˈg|iˈlɛza] was not nasalized, and therefore was shorter and did not have negative VOT, although the

orthography had predicted that. This may be because nasalized clicks are more common in word-medial position and thus the speaker did not utter nasalization in this word.

In addition, the click in [ˈg|iˈlɛza] sounded lateral as opposed to dental, although dental was expected for orthographic reasons. That was a reason to exclude the click for average calculations although it may still be allophonic or simply an actual lateral click to this speaker or the word may not be in use by the speaker, so he made a guess. The burst durations were not much different in those clicks.

4.1.6. Delayed aspirated dental clicks – Nama. Delayed aspirated clicks exist in Nama but not in Xhosa. They are represented in the Nama orthography in several ways in different sources, as displayed below. Nama words in which a delayed aspirated dental click was expected are shown in (9).

(9) Delayed aspirated dental clicks – Nama

|kiri	[ˈn̊|ʰiːɾi]	‘to make (tea)’
|xií	[n̊|ʰiː]	‘to come’
|khunu	[ˈn̊|ʰũnu]	‘finger’

Table 4.6 shows the overall duration (in ms), the burst duration (in ms), the voice onset time (in ms), and the delayed aspirated duration (in ms). Results are given for individual clicks.

Table 4.6. Delayed aspirated dental clicks – Nama

	Overall duration (ms)	Burst duration (ms)	VOT (ms)	Delayed aspiration (ms)
Nama				
[ˈn̊|ʰiːɾi]	154	80	154	120
[n̊|ʰiː]	133	41	133	111
[ˈn̊|ʰũnu]	213	73	213	169
Avg.	167	65	167	133

The three delayed aspirated dental Nama clicks measured showed many differences. The click in [ˈŋ̊|ʰiːɾi] sounded almost like a dental stop and the click in [ˈŋ̊|ʰũnu] slightly did as well, probably because of the delayed aspiration. The delayed aspiration in all three dental clicks sounded like [x] for this speaker but was nevertheless transcribed according to Ladefoged and Traill (1994).

The overall shortest click was the one in [ŋ̊|ʰiː] with 133 ms and the overall longest click was the one in [ˈŋ̊|ʰũnu] with 213 ms. The average overall duration for the measured clicks was 167 ms for overall length and VOT. Again, VOT equaled overall duration because there was no prenasalization and no front closure could be identified for word-initial clicks.

There were also differences in burst duration. The click in [ŋ̊|ʰiː] had the shortest burst duration with 41 ms, which was almost half of the burst duration of the click in [ˈŋ̊|ʰiːɾi] with 80 ms. The burst duration average was 65 ms.

For delayed aspiration, some differences could be identified as well. The shortest delayed aspiration accompaniment could be found for the click in [ŋ̊|ʰiː] with 111 ms and the longest one could be detected for the click in [ˈŋ̊|ʰũnu] with 169 ms, almost twice as long as the shortest one. The average delayed aspiration duration was 133 ms. Therefore, the accompaniment of the clicks was much longer than the burst duration, especially because delayed aspiration set in while the click was still bursting.

4.1.7. Glottal closure dental clicks – Nama. Glottal closure clicks exist in Nama as well but not in Xhosa. Nama orthography represents them as <|’>. Nama words in which a glottal closure dental click was expected are given in (10).

(10) Glottal closure dental clicks – Nama

|’aé‖ams	[k|ˀajˈk‖ãms]	‘Windhoek’
|’oro	[ˈk|ˀɔɾɔ]	‘few’
|’urí|’uri	[ˌk|ˀuɾiŋˈk|ˀuɾi]	‘to make dirty’

Table 4.7 shows the overall duration (in ms), the burst duration (in ms), the voice onset time (in ms), and the glottal closure duration (in ms). Results are presented for individual clicks.

Table 4.7. Glottal closure dental clicks – Nama

	Overall duration (ms)	Burst duration (ms)	VOT (ms)	Glottal closure (ms)
Nama				
[k|ˀajˈk‖ãms]	176	89	176	87
[ˈk|ˀɔɾɔ]	184	129	184	55
[ˌk|ˀuɾiŋˈk|ˀuɾi]	154	83	154	71
	106	55	51	51
Avg.	155	89	141	66

Table 4.7 shows several differences for the glottal closure dental Nama clicks. Only the first click in the word [k|ˀajˈk‖ãms] was relevant for this table. In this case, [a] had to be used as a front-vowel example since no word with [i] or [e] could be found following the dental glottal closure click. The click in [ˈk|ˀɔɾɔ] was the overall longest click with 184 ms duration and VOT. The shortest click overall was the second one in [ˌk|ˀuɾiŋˈk|ˀuɾi] with 106 ms. It was preceded by a nasal because it was word-medial. The prenasalization was not considered for calculations. Since there was a nasal in front of the click, part of it was voiced. However, there was a voicing break between the click and the vowel, the glottal closure. This was treated as the VOT here with 51 ms.

The average overall duration for Nama dental glottal closure clicks was 155 ms and the VOT average was slightly shorter with 141 ms because of the nasalization in the second click in [ˌk|ˀuɾiŋˈk|ˀuɾi].

The longest burst duration could be found for the click in [ˈk|ˀɔɾɔ] with 129 ms and the shortest burst duration could be detected for the second click in [ˌk|ˀuɾiŋˈk|ˀuɾi] with 55 ms. The average burst duration was 89 ms.

The shortest glottal closure duration was 51 ms, found for the second click in [ˌk|ˀuɾiŋˈk|ˀuɾi], as already mentioned. The longest glottal closure duration could be found in [k|ˀajˈk‖ãms] with 87 ms. The average was 66 ms. The burst duration was longer than the glottal closure accompaniment in this case.

Comparing the dental clicks measured, the Xhosa nasalized clicks with 226 ms were the longest overall on average, closely followed by the Nama voiceless aspirated clicks with 222 ms overall length which also had the longest VOT on average with 222 ms. The overall shortest dental clicks were the Nama voiceless unaspirated clicks with 54 ms.

The longest burst duration could be measured for the Xhosa nasalized clicks with 110 ms. The shortest burst duration could be found for the Nama voiceless unaspirated clicks with 45 ms.

The longest accompaniment duration was measured for the Xhosa nasalized clicks with 226 ms. The Nama voiceless unaspirated clicks had the shortest accompaniment with 10 ms.

4.2. Alveolar clicks

4.2.1. Voiceless unaspirated alveolar clicks. Voiceless unaspirated alveolar clicks occur in Xhosa as well as in Nama. In Xhosa, they are indicated in the orthography by

<q>. Xhosa words in which a voiceless unaspirated alveolar click was expected are shown in (11).

(11) Xhosa voiceless unaspirated alveolar clicks

qikelela	[ˌk!ikɛˈlɛla]	‘to consider’
nkqi	[ŋkǃĩ]	‘quickly, full stop, end’
nkqo	[ŋk!ɔ]	‘straight’
qumba	[ˈk!ũmba]	‘to anger’
inkqubo	[ĩŋˈk!ubɔ]	‘advance’

In Nama, the voiceless unaspirated alveolar clicks are represented in the orthography by <!> or in some sources by <!g>. Nama words expected to have a voiceless unaspirated alveolar click are in example (12).

(12) Nama voiceless unaspirated alveolar clicks

!geib	[k!ejbˉ]	‘potion’
!gǐ	[kǃĩŋ]	‘to learn’
!guru	[ˈk!uɾu]	‘thunder’

Table 4.8 displays the overall duration (in ms), the burst duration (in ms), the voice onset time (in ms), and the voice lag between the end of the click burst and the onset of the following vowel or the unaspirated duration (in ms). Results are shown for individual clicks and averaged by language.

Table 4.8. Voiceless unaspirated alveolar clicks

	Overall duration (ms)	Burst duration (ms)	VOT (ms)	Unaspirated (ms)
Xhosa				
[ˌkǃikɛˈlɛla]	95	82	95	13
[ŋkǃĩ]	110	101	110	9
[ŋkǃɔ]	112	105	112	7
[ˈkǃũmba]	106	98	106	8
[ĩŋˈkǃubɔ]	158	107	158	52
Avg. Xhosa	116	99	116	18
Nama				
[kǃejbˉ]	42	42	33	0
[kǃĩŋ]	70	70	70	0
[ˈkǃuɾu]	65	65	54	0
Avg. Nama	59	59	52	0

There were many differences between the alveolar voiceless unaspirated clicks as listed in Table 4.8. First of all, the words [ŋkǃĩ], [ŋkǃɔ], and [ĩŋˈkǃubɔ] contained a nasal preceding the click, which had been denoted a separate segment before, and therefore was not part of the click. In [ĩŋˈkǃubɔ], the front closure could be seen but again was not measured because it was impossible to measure for the other clicks.

The longest click was the Xhosa click in [ĩŋˈkǃubɔ] with 158 ms and the shortest click was the Nama click in [kǃejbˉ] with 42 ms. On average, the Xhosa voiceless unaspirated alveolar clicks were longer overall with 116 ms than the Nama ones with 59 ms, including VOT with 116 ms for the Xhosa clicks and 52 ms for the Nama clicks, but excluding nasals preceding the clicks.

The Nama VOT was slightly shorter on average with 52 ms than the Nama overall duration average because in some cases, the voicing of the following vowel set in before the end of the burst.

The longest burst duration could be found in Xhosa [ĩŋˈkǃubɔ] with 107 ms and the shortest one could be detected in Nama [kǃejbˉ] with 42 ms. The average burst duration for Xhosa was 99 ms which was longer than 59 ms for Nama.

The click in the Xhosa word [ĩŋˈkǃubɔ] had the longest unaspirated accompaniment duration with 52 ms, while all Nama clicks had 0 ms for it. Therefore, the Nama average was 0, whereas the Xhosa average was 18 ms. For the Nama clicks, most clicks were still released while the vowels already set in which explains the 0 value. The burst duration was thus longer than the accompaniment.

More Xhosa clicks were examined for alveolar voiceless unaspirated clicks than Nama clicks because of the nasalized versions having been classified as separate clicks before, which accounts for fewer differences in the Nama clicks.

4.2.2. Voiceless aspirated alveolar clicks. Voiceless aspirated alveolar clicks occur in both Xhosa and Nama. In Xhosa, they are represented in the orthography by <qh>. Xhosa words in which a voiceless aspirated alveolar click was expected are in (13).

(13) Xhosa voiceless aspirated alveolar clicks

iqhina	[ĩˈkǂʰina]	‘knot’
qhekeza	[kǃʰɛˈkɛza]	‘crack’
qho	[kǃʰɔ]	‘always’
qhuba	[kǃʰuˈba]	‘drive’

In Nama, the voiceless aspirated alveolar clicks are represented in the orthography by <!h>. Nama words expected to contain a voiceless aspirated alveolar click are listed in (14).

(14) Nama voiceless aspirated alveolar clicks

!hōs	[k!^{h}os]	'shoulder'
!hùú	[k!^{h}ŭː]	'land'
!hóá	[k!^{h}wa]	'to speak'

Table 4.9 displays the overall duration (in ms), the burst duration (in ms), the voice onset time (in ms), and the aspiration duration (in ms). Results are shown for individual clicks and averaged by language. Clicks that had to be dismissed from the study are marked with an asterisk.

Table 4.9. Voiceless aspirated alveolar clicks

	Overall duration (ms)	Burst duration (ms)	VOT (ms)	Aspiration (ms)
Xhosa				
*[ĩˈkǃĩna]	*138	*99	*138	--
[k!^{h}ɛˈkɛza]	88	74	88	14
[k!^{h}ɔ]	230	83	230	147
[k!^{h}uˈba]	183	95	183	88
Avg. Xhosa	167	84	167	83
Nama				
[k!^{h}os]	192	123	192	69
[k!^{h}ŭː]	207	90	207	117
[k!^{h}wa]	130	83	130	47
Avg. Nama	176	99	176	78

Table 4.9 shows remarkable duration differences for the voiceless aspirated alveolar clicks, especially in Xhosa. This goes for VOT as well. The click in [ĩˈkǃĩna] had more

of a pre-aspiration than aspiration, which is why it had to be excluded for calculations. The overall longest click was the Xhosa click in [k!^{h}ɔ] with 230 ms with a VOT of 230 ms, and the overall shortest click was the one in Xhosa [k!^{h}ɛˈkɛza], 88 ms long with a VOT of 88 ms. The range of the Xhosa clicks was 142 ms and the range of the Nama clicks was about half that, 77 ms. The average overall duration and VOT for Xhosa was 167 ms and 176 ms, slightly longer, for Nama.

The longest burst duration occurred in the Nama word [k!^{h}os] with 123 ms and the shortest one occurred in Xhosa [k!^{h}ɛˈkɛza] with 74 ms. The burst duration average for Xhosa was 84 ms, a little shorter than Nama with 99 ms.

The longest aspirated accompaniment could be detected in Xhosa [k!^{h}ɔ] with 147 ms, and the shortest one could be found in Xhosa [k!^{h}ɛˈkɛza] with 14 ms with very short aspiration. The average for Xhosa was 83 ms, barely longer than Nama 78 ms. The burst duration average was almost equal to the accompaniment duration in Nama, but in Xhosa, the burst duration was longer than the aspirated accompaniment on average. For the Nama voiceless aspirated alveolar clicks, no words could be found that had a front vowel following them.

4.2.3. Nasalized alveolar clicks. Nasalized alveolar clicks exist in Xhosa and in Nama. In Xhosa, they are indicated in the orthography by <nq>. Xhosa words in which a nasalized alveolar click was expected are named in (15).

(15) Xhosa nasalized alveolar clicks

nqika	[ˈŋ!ika]	‘to uncover’
nqunqa	[ˈŋ!ũŋ!a]	‘to slice’

In Nama, the nasalized alveolar clicks are represented in the orthography by <!n>. Nama words expected to have a nasalized alveolar click are named in example (16).

(16) Nama nasalized alveolar clicks

!neib	[ŋ!ejbˈ]	‘giraffe’
!noná	[ˈŋ!õna]	‘three’

Table 4.10 shows the overall duration (in ms), the burst duration (in ms), the voice onset time (in ms), and the nasalization/voicing duration (in ms). Results are presented for individual clicks and averaged by language.

Table 4.10. Nasalized alveolar clicks

	Overall duration (ms)	Burst duration (ms)	VOT (ms)	Nasalization/ voicing (ms)
Xhosa				
[ˈŋ!ika]	230	60	-170	230
[ˈŋ!ũŋ!a]	140	62	-78	140
	217	102	-115	217
Avg. Xhosa	196	75	-121	196
Nama				
[ŋ!ejbˈ]	219	94	-125	219
[ˈŋ!õna]	168	92	-76	168
Avg. Nama	194	93	-101	194

There were several differences among the nasalized alveolar clicks. Both Xhosa and Nama clicks showed duration differences, particularly the Xhosa clicks with the longest click in [ˈŋ!ika] being 230 ms and the shortest click, the first click in [ˈŋ!ũŋ!a], being 140 ms long. Nasalization/voicing duration was equivalent to overall duration because the voicing continued throughout the whole click. The average for those values for Xhosa was 196 ms and almost the same number for Nama, 194 ms.

The longest burst duration could be detected for the second click in Xhosa [ˈŋ!ũŋ!a] with 102 ms and the shortest one could be found in Xhosa [ˈŋ!ika] with 60 ms, which

means that Xhosa had a bigger range than Nama. The average burst duration for Xhosa was 75 ms, which was shorter than 93 ms for Nama.

The VOTs had negative values because of prenasalization. The longest VOT, and therefore prenasalization, could be found in Xhosa [ˈŋ!ika] with -170 ms and the shortest VOT occurred in Nama [ˈŋ!ɔ̃na] with -76 ms. The range in VOT was bigger in Xhosa with 92 ms. The average VOT for Xhosa was -121 ms, longer than -101 ms for Nama. Three Xhosa clicks, but only two Nama clicks were investigated due to [ˈŋ!ũŋ!a] having two clicks.

4.2.4. Breathy voiced alveolar clicks – Xhosa. Breathy voiced clicks exist in Xhosa but not in Nama. They are represented in Xhosa orthography by <gq>. Xhosa words in which a breathy voiced alveolar click was expected are shown in (17).

(17) Breathy voiced alveolar clicks – Xhosa

gqiba	[ˈg̈!iba]	‘to complete, finish’
gquma	[ˈg̈!ũma]	‘to cover’

Table 4.11 presents the overall duration (in ms), the burst duration (in ms), the voice onset time (in ms), and the breathy voice duration (in ms). Results are displayed for individual clicks.

Table 4.11. Breathy voiced alveolar clicks – Xhosa

	Overall duration (ms)	Burst duration (ms)	VOT (ms)	Breathy voice (ms)
Xhosa				
[ˈg̈!iba]	157	102	157	82
[ˈg̈!ũma]	130	101	130	29
Avg.	144	102	144	56

Two Xhosa breathy voiced alveolar clicks were recorded. The longer click in [ˈg!iba] had an overall duration of 157 ms and a VOT of 157 ms, while the shorter click in [ˈg!ũma] had an overall duration of 130 ms, and a VOT of 130 ms. The average of the two clicks measured was 144 ms for overall duration and the same for VOT because there was no prenasalization or voicing for breathy voice accompaniment.

The burst duration for the click in [ˈg!iba] with 102 ms was almost the same as for the click in [ˈg!ũma] with 101 ms. The average burst duration resulting from those two clicks was 102 ms rounded up.

The breathy voice accompaniment was longer for the click in [ˈg!iba] with 82 ms, setting in during the click burst, than for the click in [ˈg!ũma] with 29 ms. The breathy voice accompaniment average according to those two clicks was 56 ms. The burst duration was almost twice as long as the breathy voice accompaniment for alveolar breathy-voiced Xhosa clicks.

4.2.5. Nasalized breathy alveolar clicks – Xhosa. Nasalized breathy clicks also exist in Xhosa but not in Nama. Xhosa orthography represents them as <ngq>. Xhosa words expected to have a nasalized breathy alveolar click are in example (18).

(18) Nasalized breathy alveolar clicks – Xhosa

ngqithisela	[ˌŋ!itʰiˈsɛla]	‘to pass’
ngquba	[ˈg!uba]	‘to bump’

Table 4.12 displays the overall duration (in ms), the burst duration (in ms), the voice onset time (in ms), and the nasalized breathy duration (in ms). Results are given for individual clicks. Clicks that had to be dismissed from the study are marked with an asterisk.

Table 4.12. Nasalized breathy alveolar clicks – Xhosa

	Overall duration (ms)	Burst duration (ms)	VOT (ms)	Nasalized breathy (ms)
Xhosa				
[ᵢᵑǃitʰiˈsɛla]	192	88	-104	192
*[ˈgǃuba]	*171	*126	*162	--

Table 4.12 displays two Xhosa nasalized breathy alveolar clicks. The click in [ᵢᵑǃitʰiˈsɛla] was longer overall with 192 ms than the click in [ˈgǃuba] with 171 ms. This was because the click in [ˈgǃuba], although expected due to the orthography, was not nasalized. Thus, the VOT was positive and there was no nasalized breathy accompaniment. The click could not be used for further calculation, which left only one alveolar nasalized breathy Xhosa click. Nasalization and thus the negative value VOT accounted for a large portion of the click in [ᵢᵑǃitʰiˈsɛla], namely -104 ms. The nasalized breathy accompaniment was as long as the overall duration, 192 ms, because it continued throughout the click. The burst duration was 88 ms and therefore shorter than accompaniment and VOT.

4.2.6. Delayed aspirated alveolar clicks – Nama. Delayed aspirated clicks exist in Nama but not in Xhosa. They are represented in the Nama orthography in several ways in different sources but mostly by <!kh>. Nama words in which a delayed aspirated alveolar click was expected are shown in (19).

(19) Delayed aspirated alveolar clicks – Nama

!khē	[ᵑǃʰeː]	‘to keep guard’
!khoi-!khoi	[ˈᵑǃʰweᵑǃʰwe]	‘to make run’
!khū-!khū	[ˈᵑǃʰuːᵑǃʰu]	‘to make rich’

Table 4.13 presents the overall duration (in ms), the burst duration (in ms), the voice onset time (in ms), and the delayed aspirated duration (in ms). Results are given for individual clicks.

Table 4.13. Delayed aspirated alveolar clicks – Nama

	Overall duration (ms)	Burst duration (ms)	VOT (ms)	Delayed aspiration (ms)
Nama				
[ǹ!^{h}eː]	162	114	162	48
[ˈǹ!^{h}weǹ!^{h}we]	103	90	103	69
	106	96	106	73
[ˈǹ!^{h}uːǹ!^{h}u]	113	98	113	72
	96	75	96	76
Avg.	116	95	116	68

Five Nama delayed aspirated alveolar clicks are shown in Table 4.13 because some words have two clicks in them.

The longest click, in [ǹ!^{h}eː], lasted 162 ms. The click with the shortest overall duration was the first one in [ˈǹ!^{h}uːǹ!^{h}u] with 98 ms. The average overall duration was 116 ms. Those values applied to VOT as well. In both words that had two clicks, [ˈǹ!^{h}weǹ!^{h}we] and [ˈǹ!^{h}uːǹ!^{h}u], the second clicks showed the closure duration which was not measured. In [ˈǹ!^{h}weǹ!^{h}we], the second click was longer, while in [ˈǹ!^{h}uːǹ!^{h}u], the first click was longer.

The longest burst duration could be found for the click in [ǹ!^{h}eː] with 114 ms and the shortest burst duration could be detected for the second click in [ˈǹ!^{h}uːǹ!^{h}u] with 75 ms. The burst duration average resulting from the five clicks measured was 95 ms.

The second click in [ˈǹ!^{h}uːǹ!^{h}u] had the longest delayed aspirated accompaniment with 76 ms, while the click in [ǹ!^{h}eː] had the shortest delayed aspirated accompaniment

with 48 ms. The average of the delayed aspirated accompaniment was 68 ms. Therefore, the delayed aspirated accompaniment average was shorter on average than the burst duration average, but not in all individual cases.

4.2.7. Glottal closure alveolar clicks – Nama. Glottal closure clicks exist in Nama as well but not in Xhosa. They are indicated in the Nama orthography by <!’>. Nama words expected to contain a glottal closure alveolar click are named in (20).

(20) Glottal closure alveolar clicks – Nama

!’áróma	[k!ʔaˈɾoma]	‘because (of)’
!’ũi’aop	[ˈk!ʔwiʔawpʰ]	‘the shepherd’

Table 4.14 displays the overall duration (in ms), the burst duration (in ms), the voice onset time (in ms), and the glottal closure duration (in ms). Results are shown for individual clicks.

Table 4.14. Glottal closure alveolar clicks – Nama

	Overall duration (ms)	Burst duration (ms)	VOT (ms)	Glottal closure (ms)
Nama				
[k!ʔaˈɾoma]	172	147	172	25
[ˈk!ʔwiʔawpʰ]	188	115	188	73
Avg.	180	131	180	49

Table 4.14 shows two Nama glottal closure alveolar clicks.

The click in [ˈk!ʔwiʔawpʰ] was only slightly longer overall and had a longer VOT with 188 ms, which consisted of glottal closure and click release, than the click in [k!ʔaˈɾoma] with 172 ms. The average overall duration and VOT of the Nama alveolar glottal closure clicks was 180 ms.

The click burst duration in [k!ˀaˈroma] was remarkably longer with 147 ms than the one in [ˈk!ˀwiʔawpʰ] with 115 ms. The average of those two values was 131 ms.

The glottal closure accompaniment was longer in the word [ˈk!ˀwiʔawpʰ] with 73 ms and shorter in [k!ˀaˈroma] with 25 ms. The average of glottal closure duration resulting from those two clicks was 49 ms. Thus, the burst duration was more than twice as long as the glottal closure.

No word could be found in the sources that had [i] or [e] follow this kind of click, which was why [a] was used as a front vowel example to get a click followed by a different kind of vowel.

Comparing all alveolar clicks in this study, the Xhosa nasalized clicks with 196 ms had the longest overall duration on average, closely followed by the Nama counterparts with 194 ms, and the Nama glottal closure clicks had the longest VOT with 180 ms. The shortest overall duration was measured for the Nama voiceless unaspirated alveolar clicks with 59 ms, which also had the shortest VOT of 52.

The longest burst duration could be found for the Nama glottal closure clicks with 131 ms, while the shortest burst duration could be detected for the Nama voiceless unaspirated clicks with 59 ms.

The longest accompaniment duration could be found for the Xhosa nasalized clicks with 196 ms, immediately followed by its Nama counterparts with 194 ms. The shortest accompaniment was measured for the Nama voiceless unaspirated clicks with a value of 0 ms.

4.3. Lateral clicks

4.3.1. Voiceless unaspirated lateral clicks. Voiceless unaspirated lateral clicks exist in Xhosa and in Nama. Xhosa orthography represents them as <x>. Xhosa words expected to contain a voiceless unaspirated lateral click are shown in (21).

(21) Xhosa voiceless unaspirated lateral clicks

xilonga	[k‖iˈlɔ̃ŋa]	‘to examine’
inkxaso	[ɲ̃ˈŋk‖ʰasɔ]	‘adhesion, support’
inkxwaleko	[ˌɲ̃ŋk‖waˈlɛkɔ]	‘abjection’
xuba	[ˈk‖uba]	‘to mix’

In Nama, the voiceless unaspirated lateral clicks are represented in the orthography by <‖> or in some sources by <‖g>. Nama words in which a voiceless unaspirated lateral click was expected are in (22).

(22) Nama voiceless unaspirated lateral clicks

‖geisi	[ˈk‖ejsiː]	‘ugly’
‖úí	[ˈk‖ui]	‘to lay down (something)’

Table 4.15 presents the overall duration (in ms), the burst duration (in ms), the voice onset time (in ms), and the unaspirated duration (in ms). Results are given for individual clicks and averaged by language. Clicks that were excluded are marked with asterisks.

Table 4.15. Voiceless unaspirated lateral clicks

	Overall duration (ms)	Burst duration (ms)	VOT (ms)	Unaspirated (ms)
Xhosa				
[k‖iˈlɔ̃ŋa]	91	84	91	7
*[ɪ̃ˈŋk‖ʰasɔ]	*184	*150	*184	--
[ˌɪ̃ŋk‖waˈlɛkɔ]	131	87	131	37
*[ˈk‖uba]	*170	*83	*170	--
Avg. Xhosa	111	86	111	22
Nama				
[ˈk‖ejsiː]	55	55	55	0
[ˈk‖ui]	87	87	87	0
Avg. Nama	71	71	71	0

Looking at the voiceless unaspirated lateral clicks, it was obvious in the spectrogram and waveform that the click in [ɪ̃ˈŋk‖ʰasɔ] had aspiration, although the orthography had not predicted that. Therefore, the click was not considered in the calculations. The aspiration accounted for both high overall duration and VOT. The click in [ˈk‖uba] had a breathy-voiced accompaniment instead of an unaspirated one. Thus, the click had to be dismissed from the study as well, which made an equal number of Nama and Xhosa clicks investigated.

Omitting these clicks, the other two Xhosa clicks still had a longer overall duration with 111 ms on average and VOT with 111 ms on average than the Nama clicks with 71 ms overall duration average and 71 ms VOT average. Overall duration and VOT were the same because there was no prenasalization and the front closure could not be located. The Xhosa click in [ˌɪ̃ŋk‖waˈlɛkɔ] was in the middle of the word, which means that the front closure duration could be found. However, it was not measured, as it was

not in previous cases. The click was nonetheless longer with 131 ms than the other Xhosa click in [k‖iˈlɔ̃ŋa] with 91 ms. The Nama click in [ˈk‖ejsiː] was the shortest one in the table with 55 ms overall duration and VOT.

There was a difference between the two Nama clicks measured: the click in [ˈk‖ejsiː] sounded fronted, while the click in [ˈk‖ui] sounded like it was released further back. This difference may be due to the click in [ˈk‖ejsiː] being followed by a front vowel and the click in [ˈk‖ui] being followed by a back vowel.

The longest burst durations could be found in both Xhosa [ˌ̃ɪŋk‖waˈlɛkɔ] and Nama [ˈk‖ui] with 87 ms, closely followed by Xhosa [k‖iˈlɔ̃ŋa] with 84 ms. The shortest burst duration could be detected for Nama [ˈk‖ejsiː] with 55 ms. The average burst duration for Xhosa was 86 ms and 71 ms for Nama.

For the Nama lateral voiceless unaspirated clicks, overall duration, burst duration, and VOT were the same because the unaspirated accompaniment is 0 ms in both cases, which means that there was no break at all between click and following vowel, giving only one length for all categories measured. In the case of Xhosa, there was an unaspirated accompaniment with 37 ms for the click in [ˌ̃ɪŋk‖waˈlɛkɔ] and 7 ms for the click in [k‖iˈlɔ̃ŋa], which averages to 22 ms. The click burst duration was longer than the accompaniment in all lateral voiceless unaspirated clicks.

4.3.2. Voiceless aspirated lateral clicks. Voiceless aspirated lateral clicks exist in both Xhosa and Nama. In Xhosa, they are indicated in the orthography by <xh>. Xhosa words expected to contain a voiceless aspirated lateral click are listed in example (23).

(23) Xhosa voiceless aspirated lateral clicks

xhela	[ˈk‖ʰɛla]	‘to kill’
Xhosa	[ˈk‖ʰɔsa]	‘Xhosa’
xhumaxhuma	[ˌk‖ʰumaˈk‖ʰuma]	‘to jump’

In Nama, the voiceless aspirated lateral clicks are represented in the orthography by <‖h>. Nama words in which a voiceless aspirated lateral click was expected are listed in (24).

(24) Nama voiceless aspirated lateral clicks

‖hĩ-dom	[k‖ʱĩˈdõm]	‘to choke’
‖huwu	[k‖ʰuˈwu]	‘(to be) soft’

Table 4.16 displays the overall duration (in ms), the burst duration (in ms), the voice onset time (in ms), and the aspiration duration (in ms). Results are shown for individual clicks and averaged by language.

Table 4.16. Voiceless aspirated lateral clicks

	Overall duration (ms)	Burst duration (ms)	VOT (ms)	Aspiration (ms)
Xhosa				
[ˈk‖ʰɛla]	169	128	169	103
[ˈk‖ʰɔsa]	183	167	183	132
[ˌk‖ʰumaˈk‖ʰuma]	150	120	150	30
	164	117	164	47
Avg. Xhosa	167	133	167	78
Nama				
[k‖ʱĩˈdõm]	232	163	232	69
[k‖ʰuˈwu]	156	99	156	57
Avg. Nama	194	131	194	63

Four Xhosa clicks and two Nama clicks were measured for the voiceless aspirated lateral clicks.

The Nama clicks had longer overall duration with 194 ms on average and VOT with 194 ms on average than the Xhosa clicks that had an average overall duration of 167 ms and an average VOT of 167 ms. The longest click in the table was the Nama click in [k‖^{h}ĩˈdõm] with 232 ms and a corresponding VOT of 232 ms. The shortest click was the first Xhosa click in [ˌk‖^{h}umaˈk‖^{h}uma] with 150 ms. The second click in that word was longer with 164 ms.

The longest burst duration could be found for the Xhosa click in [ˈk‖^{h}ɔsa] with 167 ms and the shortest burst duration could be detected for the Nama click in [k‖^{h}uˈwu] with 99 ms, the only lateral voiceless aspirated click below 100 ms. The average burst duration for Xhosa was 133 ms and the one for Nama was 131 ms, which was almost equal.

The longest aspirated accompaniment was measured for the click in [ˈk‖^{h}ɔsa] with 132 ms, since the aspiration set in during the click burst, and the shortest one was found for the first click in [ˌk‖^{h}umaˈk‖^{h}uma] with only 30 ms. In the word [ˈk‖^{h}ɛla], the click aspiration lasting 103 ms set in during the click burst as well. The average aspiration duration for Xhosa was 78 ms and 63 ms for Nama, slightly shorter than for Xhosa. Therefore, the aspirated accompaniment was considerably shorter on average than the burst duration for lateral voiceless aspirated clicks.

4.3.3. Nasalized lateral clicks. Nasalized lateral clicks occur in both Xhosa and in Nama. Xhosa orthography represents them as <nx>. Xhosa words expected to have a nasalized lateral click are named in (25).

(25) Xhosa nasalized lateral clicks

ubunxele	[ˌubuˈŋǁɛlɛ]	‘left-handedness’
nxiba	[ˈŋǁeba]	‘to wear, dress’
unxweme	[ũˈŋǁwɛmɛ]	‘beach’

The nasalized lateral clicks are represented by <ǁn> in the Nama orthography. Nama words expected to contain a nasalized lateral click are given in (26).

(26) Nama nasalized lateral clicks

ǁnīra	[ˈkǁʔiːɾa]	‘the two ladies’
ǁnū	[ŋǁuː]	‘to accompany’

Table 4.17 presents the overall duration (in ms), the burst duration (in ms), the voice onset time (in ms), and the nasalization/voicing duration (in ms). Results are given for individual clicks and averaged by language. Clicks that had to be dismissed from the study are marked with asterisks.

Table 4.17. Nasalized lateral clicks

	Overall duration (ms)	Burst duration (ms)	VOT (ms)	Nasalization/ voicing (ms)
Xhosa				
[ˌubuˈŋǁɛlɛ]	267	153	-114	267
[ˈŋǁeba]	200	130	-70	200
[ũˈŋǁwɛmɛ]	180	90	-90	180
Avg. Xhosa	216	124	-91	216
Nama				
*[ˈkǁʔiːɾa]	*264	*137	*264	--
[ŋǁuː]	171	106	-65	171
Avg. Nama	171	106	-65	171

First, it was obvious that the Nama word [ˈk‖ˀiːɾa] did not have a nasalized click, although orthography had predicted it. It was a glottal closure click. The click in [ˈk‖ˀiːɾa] was one of the longest clicks overall with a long positive VOT, which showed that there was something after the click rather than before, in this case a glottal closure. Since this click was not nasalized, it could not be used for calculations of nasalized clicks. Thus, three Xhosa clicks, but only one Nama click were measured for lateral nasalized clicks.

Two clicks were not at the beginning of the word, namely those in [ˌubuˈŋ‖ɛlɛ] and [ũˈŋ‖wɛmɛ], because no back vowel following a click of that kind at the beginning of the word could be found in the sources. [ũˈŋ‖wɛmɛ] was initially added for better comparison in the same environment.

The longest click was the one in Xhosa [ˌubuˈŋ‖ɛlɛ] with 267 ms. The shortest click was the Nama click in [ŋ‖uː] with 171 ms. The longest prenasalization or negative VOT could be found for the click in [ŋ‖uː] with -65 ms and the shortest one could be detected for the one in [ˌubuˈŋ‖ɛlɛ] with -114 ms. The Xhosa clicks had longer overall duration with 216 ms on average than the Nama click with 171 ms, and average VOTs are -91 ms and -65 ms.

The click in [ˌubuˈŋ‖ɛlɛ] also had the longest burst duration with 153 ms and the click in [ũˈŋ‖wɛmɛ] had the shortest one with 90 ms. Burst duration averages were 124 ms for Xhosa and 106 ms for Nama.

The nasal accompaniment was the longest for the click in [ˌubuˈŋ‖ɛlɛ] with 267 ms, corresponding to the overall duration, and the shortest for the click in [ŋ‖uː] with 171 ms. The nasal accompaniment duration averages were 216 ms for Xhosa and 171 ms for

Nama. This means that the accompaniment, continuing throughout the entire click duration, was longer than the burst duration.

4.3.4. Breathy voiced lateral clicks – Xhosa. Breathy voiced clicks exist in Xhosa but not in Nama. In Xhosa, they are indicated in the orthography by <gx>. Xhosa words in which a breathy voiced lateral click was expected are in example (27).

(27) Breathy voiced lateral clicks – Xhosa

gxeka	[ˈg‖ɛɣa]	'to mock'
gxotha	[g‖ɔˈtʰa]	'to expel'
gxuma	[ˈg‖u̯ma]	'to jump'

Table 4.18 shows the overall duration (in ms), the burst duration (in ms), the voice onset time (in ms), and the breathy voice duration (in ms). Results are displayed for individual clicks.

Table 4.18. Breathy voiced lateral clicks – Xhosa

	Overall duration (ms)	Burst duration (ms)	VOT (ms)	Breathy voice (ms)
Xhosa				
[ˈg‖ɛɣa]	90	90	90	23
[g‖ɔˈtʰa]	128	128	128	30
[ˈg‖u̯ma]	130	130	130	55
Avg.	116	116	116	36

Three Xhosa breathy voiced lateral clicks were measured in this study. For all three clicks, overall duration, VOT, and burst duration had the same length because there was no prenasalization and the breathy voice accompaniment set in during the click and ended with it in all cases. The longest overall duration, VOT, and burst duration was measured for the click in [ˈg‖u̯ma] with 130 ms and the shortest ones in the click in [ˈg‖ɛɣa] with 90 ms. Overall duration, VOT, and burst duration averages were 116 ms.

The click in [ˈg‖u̟ma] had the longest breathy voice accompaniment with 55 ms, while the click in [ˈg‖ɛɣa] had the shortest breathy voice accompaniment with 23 ms. The average was 36 ms. Thus, the breathy voice accompaniment was much shorter than the click burst duration.

4.3.5. Nasalized breathy lateral clicks – Xhosa. Nasalized breathy clicks also exist in Xhosa but not in Nama. Xhosa orthography represents them as <ngx>. Xhosa words expected to contain a nasalized breathy lateral click are listed in (28).

(28) Nasalized breathy lateral clicks – Xhosa

ngxi	[ŋ‖ej]	'still'
ngxeba	[ˈg‖ɛba]	'injury'
ngxola	[ˈk‖ɔla]	'to be loud'
umngxuma	[ũmˈŋ‖ũma]	'burrow'

Table 4.19 presents the overall duration (in ms), the burst duration (in ms), the voice onset time (in ms), and the nasalized breathy duration (in ms). Results are shown for individual clicks. Clicks that had to be excluded are marked with asterisks.

Table 4.19. Nasalized breathy lateral clicks – Xhosa

	Overall duration (ms)	Burst duration (ms)	VOT (ms)	Nasalized breathy (ms)
Xhosa				
[ŋ‖ej]	208	86	-122	208
*[ˈg‖ɛba]	*126	*103	*126	--
*[ˈk‖ɔla]	*134	*111	*134	--
[ũmˈŋ‖ũma]	221	78	-123	221
Avg.	215	82	-123	215

Four clicks were examined in this project for the nasalized breathy lateral accompaniment in Xhosa. Although orthography suggested that [ˈg‖ɛba] and [ˈk‖ɔla]

had lateral nasalized breathy clicks, the clicks lacked nasalization, which made them shorter with positive VOTs. This was a reason to not include them in calculations. Although [ũmˈŋǁũma] had a click in the middle, the word was used, since sources displayed no other word with that kind of click followed by [u] at the beginning.

The clicks in [ŋǁej] and [ũmˈŋǁũma] had similar overall durations with 208 ms and 221 ms and VOTs with -123 ms and -122 ms. The average overall duration was thus 215 ms and the average VOT was -123 ms.

The click in [ŋǁej] had the longer burst duration with 86 ms, and the click in [ũmˈŋǁũma] had the shorter one with 78 ms, which averages 82 ms.

The nasalized breathy accompaniment matched the overall duration because it continued throughout the click, which made it considerably longer than the burst duration.

4.3.6. Delayed aspirated lateral clicks – Nama. Delayed aspirated clicks exist in Nama but not in Xhosa. Nama orthography represents them in several ways in different sources but below by <ǁk>. Nama words in which a delayed aspirated lateral click was expected are shown in (29).

(29) Delayed aspirated lateral clicks – Nama

ǁkunab [ˈn̥ǁʰũnãbˉ] ‘summer’

Table 4.20 displays the overall duration (in ms), the burst duration (in ms), the voice onset time (in ms), and the delayed aspiration duration (in ms). Results are given for individual clicks.

Table 4.20. Delayed aspirated lateral clicks – Nama

	Overall duration (ms)	Burst duration (ms)	VOT (ms)	Delayed aspiration (ms)
Nama				
[ˡŋ̊‖ʰũnãbˉ]	165	93	165	115

It turned out that there was only one Nama delayed aspirated lateral click among the recordings, which is not enough for a comparative analysis. The click measured was shorter with 165 ms than the Nama lateral voiceless aspirated clicks and had a shorter VOT. Its burst duration with 93 ms was shorter than the delayed aspiration accompaniment with 115 ms. The accompaniment started already during the click burst.

4.3.7. Glottal closure lateral clicks – Nama. Glottal closure clicks exist in Nama as well but not in Xhosa. They are indicated in the Nama orthography by <‖’> or in some sources by <‖>. Nama words expected to contain a glottal closure lateral click are named in (30).

(30) Glottal closure lateral clicks – Nama

‖îb	[k‖ˀgibˉ]	‘he’
‖˜iiróp	[ˡk‖ˀiːɾop]	‘little him’
‖’õaku	[ˡk‖ˀwaku]	‘the arms’

Table 4.21 displays the overall duration (in ms), the burst duration (in ms), the voice onset time (in ms), and the glottal closure duration (in ms). Results are shown for individual clicks.

Table 4.21. Glottal closure lateral clicks – Nama

	Overall duration (ms)	Burst duration (ms)	VOT (ms)	Glottal closure (ms)
Nama				
[k‖ˀgibˉ]	212	154	212	58
[ˈk‖ˀiːɾop]	160	148	160	12
[ˈk‖ˀwaku]	146	122	146	24
Avg.	173	141	173	31

Three Nama glottal closure lateral clicks were measured.

The word [k‖ˀgibˉ] showed a sound after the glottal closure of the click that was similar to [g], which may have been an audible back closure release. The other two clicks or any of the Nama clicks measured so far did not show this. Previous studies say that the Nama velar closure can be audible as opposed to the one in Xhosa. This, however, was the only case in the study.

The clicks in the words [ˈk‖ˀiːɾop] and [k‖ˀgibˉ] sounded and looked different than the click in [ˈk‖ˀwaku]. The click in [ˈk‖ˀwaku] was followed by a back vowel, which may have caused a release further back in the mouth. Therefore, there may be two allophones of the lateral click.

The click in [k‖ˀgibˉ] was the longest one with 212 ms and an according VOT, while the click in [ˈk‖ˀwaku] was the shortest with 146 ms and a VOT of 146 ms. The average overall duration and VOT were 173 ms.

The longest burst duration could be detected for the click in [k‖ˀgibˉ] with 154 ms and the shortest one could be found for the click in [ˈk‖ˀwaku] with 122 ms. The average burst duration was 141 ms.

The click in [k‖ˀgibˉ] also had the longest glottal closure accompaniment with 58 ms, while the click in [ˈk‖ˀiːɾop] had the shortest one with 12 ms. The average glottal

closure accompaniment duration was 31 ms, and therefore considerably shorter than the burst duration.

Comparing the lateral clicks measured, the Xhosa nasalized clicks with 216 ms had the longest overall duration on average, closely followed by the Xhosa nasalized breathy clicks with 215 ms, while the Nama voiceless aspirated clicks had the longest VOT with 194 ms. The shortest overall duration was found for the Nama voiceless unaspirated clicks with 71 ms and the shortest VOT could be detected for the Nama nasalized clicks with -65 ms. Therefore, the nasalization was very short on average.

The longest burst duration was measured for the Nama glottal closure clicks with 141 ms and the shortest burst duration could be detected for the Nama voiceless unaspirated clicks with 71 ms.

The longest accompaniment duration was measured for the Xhosa nasalized breathy clicks with 215 ms, while the shortest accompaniment was measured for the Nama voiceless unaspirated clicks with 0 ms.

4.4. Palatal clicks

4.4.1. Voiceless unaspirated palatal clicks. Palatal clicks in general exist in Nama but not in Xhosa. The Nama orthography shows voiceless unaspirated palatal clicks as <ǂ> or in some sources as <ǂg> or <ǂk>. Nama words in which a voiceless unaspirated palatal click was expected are in example (31).

(31) Nama voiceless unaspirated palatal clicks

ǂkǐ-ǂkǐ	[ˈkǂʰ̃ɪŋǂʰi]	‘to satisfy’
ǂgī	[kǂ̃i]	‘to go blind’
ǂúro	[ˈkǂuɾo]	‘first’
ǂkui	[kǂui]	‘to be disgusted’

Table 4.22 presents the overall duration (in ms), the burst duration (in ms), the voice onset time (in ms), and the unaspirated duration (in ms). Results are given for individual clicks.

Table 4.22. Voiceless unaspirated palatal clicks

	Overall duration (ms)	Burst duration (ms)	VOT (ms)	Unaspirated (ms)
Nama				
[ˈkǂʰ̃iŋǂʰi]	157	131	157	--
	118	79	118	--
[kǂ̃i]	114	114	36	0
[ˈkǂuɾo]	113	113	47	0
[kǂui]	144	144	31	0
Avg.	124	124	38	0

Table 4.22 shows five voiceless unaspirated palatal Nama clicks. The clicks in [ˈkǂʰ̃iŋǂʰi] were aspirated despite the orthography not giving that away. These clicks were treated as delayed aspirated clicks because of containing a [x] following the click, and therefore not used for calculations of unaspirated clicks.

The click in [kǂui] was the longest overall with 144 ms and a considerably short VOT of 36 ms. In all cases, the VOT was short because the vowel set in during the click production.

Burst duration and overall duration were the same because there was a 0 value for the unaspirated accompaniment.

The shorter clicks had almost the same overall duration and burst duration values: [kǂ̃i] with 114 ms and [ˈkǂuɾo] with 113 ms. Their VOTs were 36 ms and 47 ms. The average overall length and burst duration of the palatal Nama voiceless unaspirated

clicks was 124 ms and the average VOT was 38 ms. As already mentioned, the accompaniment had a value of 0 ms in every case.

There was a difference between the sound of the clicks followed by front vowels and the clicks followed by back vowels. The ones followed by front vowels sounded fronted, and the ones followed by back vowels sounded like they are produced further back. Therefore, there was audible influence of vowels on clicks in Nama.

4.4.2. Voiceless aspirated palatal clicks. Voiceless aspirated palatal clicks exist in Nama but not in Xhosa. The Nama orthography represents voiceless aspirated palatal clicks as <ǂh>. Nama words expected to have a voiceless aspirated palatal click are given in example (32).

(32) Nama voiceless aspirated palatal clicks

ǂhīrab	[ˈkǂʰɪrapˀ]	‘hyena’
ǂhuwi	[ˈkǂʰuvi]	‘to burn down’

Table 4.23 displays the overall duration (in ms), the burst duration (in ms), the voice onset time (in ms), and the aspiration duration (in ms). Results are given for individual clicks.

Table 4.23. Voiceless aspirated palatal clicks

	Overall duration (ms)	Burst duration (ms)	VOT (ms)	Aspiration (ms)
Nama				
[ˈkǂʰɪrapˀ]	211	127	211	84
[ˈkǂʰuvi]	229	166	229	63
Avg.	220	147	220	74

Two Nama voiceless aspirated palatal clicks are compared in Table 4.23.

The longer click of the two was the one in [ˈkǂʰuvi] with 229 ms, and the shorter click was the one in [ˈkǂʰiɾapˉ] with 211 ms. The same values as for overall duration were measured for VOT. The overall duration and VOT average was 220 ms.

The click with the longer burst duration was the one in [ˈkǂʰuvi] with 166 ms and the click with the shorter burst duration was the one in [ˈkǂʰiɾapˉ] with 127 ms. This difference was slightly bigger than the one between both overall durations and both VOTs. The average burst duration calculated from these two clicks was 147 ms.

The click in [ˈkǂʰiɾapˉ], which was the shorter one, had a longer aspiration duration with 84 ms, and the longer click in [ˈkǂʰuvi] had the shorter aspiration duration with 63 ms. The burst duration of this click was considerably longer, which made the aspiration shorter. The average aspiration of these two clicks was 74 ms. The burst duration was longer than the aspiration accompaniment. The aspiration was not audible in both clicks. Moreover, the click followed by the front vowel again sounded fronted as compared to the click followed by the back vowel.

4.4.3. Nasalized palatal clicks. Nasalized palatal clicks occur in Nama but not in Xhosa. The nasalized palatal clicks are represented by <ǂn> in the Nama orthography. Nama words expected to contain a nasalized palatal click are given in (33).

(33) Nama nasalized palatal clicks

ǂnĩsa	[ˈŋǂisa]	‘proud’
ǂnũũ	[ŋǂu]	‘to sit’

Table 4.24 presents the overall duration (in ms), the burst duration (in ms), the voice onset time (in ms), and the nasalization/voicing duration (in ms). Results are shown for individual clicks.

Table 4.24. Nasalized palatal clicks

	Overall duration (ms)	Burst duration (ms)	VOT (ms)	Nasalization/ voicing (ms)
Nama				
[ˈŋǂisa]	237	123	-114	237
[ŋǂu]	235	123	-112	235
Avg.	236	123	-113	236

The two nasalized palatal clicks measured almost had the same values for everything. The furthest any values were apart are 2 ms.

The minimally longer click was the one in [ˈŋǂisa] with 237 ms and the minimally shorter click was the one in [ŋǂu] with 235 ms. The average was 236 ms.

Nasalization/voicing values were the same as the overall duration ones because voicing continued throughout the click.

The burst durations of both clicks were 123 ms, which averaged to 123 ms. The burst duration was longer than the prenasalization or VOT with -114 ms for the click in [ˈŋǂisa] and -112 ms for the click in [ŋǂu] and thus an average of -113 ms.

As with all palatal clicks measured so far, the click followed by a front vowel sounded fronted and the click followed by the back vowel sounded like it was produced further back in the mouth.

4.4.4. Delayed aspirated palatal clicks – Nama. Delayed aspirated palatal clicks exist in Nama but not in Xhosa. They are indicated in the Nama orthography in several ways in different sources, such as <ǂkh>. The example in (34) was expected to show a voiceless unaspirated click at first but it turned out to be delayed aspirated.

(34) Delayed aspirated palatal clicks – Nama

ǂkì-ǂkì [ˈŋ̊ǂʰ̃ɪŋǂʰi] ‘to satisfy’

Table 4.25 displays the overall duration (in ms), the burst duration (in ms), the voice onset time (in ms), and the delayed aspirated duration (in ms). Results are given for individual clicks.

Table 4.25. Delayed aspirated palatal clicks – Nama

	Overall duration (ms)	Burst duration (ms)	VOT (ms)	Delayed aspiration (ms)
Nama				
[ˈŋ̊ǂʰ̃ɪŋǂʰi]	157	131	157	136
	118	79	118	90
Avg.	138	105	138	113

As already mentioned, the two clicks in [ˈŋ̊ǂʰ̃ɪŋǂʰi] listed in this table were expected to be voiceless unaspirated clicks. They turned out to be the only delayed aspirated palatal clicks in the study and could therefore be used at this point. However, no palatal delayed aspirated click followed by a back vowel was found in the data.

The two clicks differed in overall length, and therefore in VOT. The first click was longer with 157 ms than the second click with 118 ms. The average overall duration and VOT average was 138 ms.

The burst duration for the first and longer click was considerably longer with 131 ms than the burst duration for the second click with 79 ms. The average burst duration measured from those two clicks was 105 ms.

The delayed aspiration measured was also longer for the first click with 136 ms, but only 90 ms for the shorter click. The average of those two clicks was 113 ms for the delayed aspiration accompaniment. Therefore, the accompaniment aws slightly longer than the burst duration of the click. The delayed aspiration set in during the click burst in both cases.

4.4.5. Glottal closure palatal clicks – Nama. Glottal closure palatal clicks exist in Nama as well but not in Xhosa. They are indicated in the Nama orthography by <ǂ’> or in some sources by <ǂ>. Nama words expected to contain a glottal closure palatal click are named in (35).

(35) Glottal closure palatal clicks – Nama

ǂ’áń	[kǂˀãŋ]	‘to know’
ǂ’ooˇi	[kǂˀɔːʔi]	‘salt’
ǂû	[kǂˀũ]	‘to eat’

Table 4.26 presents the overall duration (in ms), the burst duration (in ms), the voice onset time (in ms), and the glottal closure duration (in ms). Results are shown for individual clicks.

Table 4.26. Glottal closure palatal clicks – Nama

	Overall duration (ms)	Burst duration (ms)	VOT (ms)	Glottal closure (ms)
Nama				
[kǂˀãŋ]	236	142	236	94
[kǂˀɔːʔi]	172	127	172	45
[kǂˀũ]	239	131	239	108
Avg.	216	133	216	82

Three glottal closure palatal clicks were measured in this study. No palatal glottal closure clicks at the beginning of the word that were followed by a front vowel were found in the sources. In spite of that, the click in [kǂˀãŋ] sounded further fronted than the clicks in [kǂˀũ] and [kǂˀɔːʔi].

The click in [kǂˀũ] had the longest overall duration and VOT with 239 ms, immediately followed by the click in [kǂˀãŋ] with an overall duration and VOT of 236

ms. The click in [kǂˀɔːʔi] had the shortest overall duration and VOT with 172 ms, which was noticeably shorter. The overall duration and VOT average was 216 ms.

The click in [kǂˀãŋ], which was the second longest click, had the longest burst duration with 142 ms but not the longest glottal closure with 94 ms compared to the other clicks. The shortest burst duration was found for the shortest click, in [kǂˀɔːʔi], with 127 ms, but it was not as obviously shorter as the overall duration of this click.

The shortest click also had the shortest glottal closure with 45 ms, which was much shorter than the other burst durations measured and which accounted for the short overall duration of the click. The longest glottal closure could be detected for the click in [kǂˀũ] with 108 ms. The burst duration average was 133 ms and the glottal closure duration average was 82 ms, which means that the burst duration was longer than the accompaniment.

Comparing all the palatal Nama clicks, it was obvious that the nasalized clicks with 236 ms had the longest overall duration average and the voiceless unaspirated clicks had the shortest overall duration on average with 124 ms.

The longest VOT could be found for the voiceless aspirated clicks with 220 ms on average, while the shortest VOT was measured for the voiceless unaspirated clicks with 38 ms on average.

The longest burst duration could be found for the voiceless aspirated clicks with 147 ms and the shortest burst duration was measured for the delayed aspirated clicks with 105 ms.

The longest accompaniment duration could be detected for the nasalized clicks with 236 ms and the shortest accompaniment was found for the voiceless unaspirated clicks with 0 ms.

CHAPTER 5

DISCUSSION

5.1. Comparison of all places of articulation. Comparing all places of articulation, the Nama nasalized palatal clicks were the longest overall on average with 236 ms. They were followed by the Xhosa nasalized dental clicks with 226 ms. Xhosa does not have the palatal place of articulation for clicks. Looking at the three places of articulation existing in Xhosa, the tendency was that the Xhosa nasalized clicks were the longest ones. Overall, the tendency in this study was that nasalized clicks had the longest overall duration. The overall shortest clicks on average were the Nama voiceless dental unaspirated clicks with 54 ms. For all places of articulation, the Nama voiceless unaspirated clicks had the shortest overall duration on average. In this study, most clicks were overall longer than 100 ms and some of them were above 200 ms.

The longest VOT on average could be found for the Nama voiceless aspirated dental clicks with 222 ms, closely followed by the Nama voiceless aspirated palatal clicks with 220 ms. The tendency in this study was that the Nama voiceless aspirated clicks had the longest VOT on average for all places of articulation, except for alveolar. The longest VOT for alveolar clicks was found for Nama glottal closure clicks. The clicks with the longest VOT averages were all Nama clicks. The Nama voiceless unaspirated palatal clicks had the shortest VOT on average in this study with 38 ms. For all places of articulation, the shortest VOT on average was found for Nama clicks, and except for the lateral clicks, it was the voiceless unaspirated clicks. The lateral clicks with the shortest VOT on average were the Nama nasalized clicks. While nasalization tends to lengthen the click, the prenasalization in this case was rather short. Mostly, both VOT and overall duration depended on the accompaniment, as the results in this study showed.

The longest burst duration was measured for the Nama voiceless aspirated palatal clicks with 147 ms. For both the alveolar and lateral clicks, the Nama glottalized clicks had the longest burst duration. In this study, the shortest burst duration was measured in the Nama voiceless unaspirated dental clicks with 45 ms. The Nama voiceless unaspirated clicks had the shortest burst duration of the dental, alveolar, and lateral clicks. The shortest palatal clicks were the Nama delayed aspirated ones. Therefore, there was a tendency of Nama voiceless unaspirated clicks having the shortest burst duration in this study, which was consistent with the overall duration that was the shortest for them also on average.

Overall, the longest accompaniment duration could be found for the Nama nasalized palatal clicks with 236 ms. For all places of articulation, the longest accompaniment had nasalization. For dental and alveolar, it was the Xhosa nasalized clicks that had the longest accompaniment, and for lateral, it was the Xhosa nasalized breathy clicks. The reason for this was that the nasalization continued throughout the click, and that both nasalization and the breathy voice accompaniment were counted together. Since the Xhosa nasalized clicks were the longest overall on average in this study, the accompaniments would have to be as well because they continued throughout the entire click. The shortest accompaniment duration was measured for the alveolar, lateral, and palatal Nama voiceless unaspirated clicks with 0 ms. Since there was no voicing and no aspiration, 0 ms was to be expected as a value. However, ‘voiceless unaspirated’ was labeled an accompaniment and therefore measured and treated like the other ones. Moreover, not all of the voiceless unaspirated accompaniment cases measured came out to be 0 ms. The dental Nama one measured 10 ms. This value came from a short period between the end of the burst and the voice onset of the following vowel, but it was not a

glottal closure. As mentioned, it was a voice lag between the end of the click burst and the onset of the following vowel. Furthermore, none of the Xhosa voiceless unaspirated clicks had an accompaniment of 0 ms.

5.1.1. Dental click averages. The overall duration averages (in ms), the burst duration averages (in ms), the VOT averages (in ms), and the accompaniment averages (in ms) for all dental clicks in Xhosa and Nama, are presented in Table 5.1. This table also provides the averages of all the dental clicks in both languages, and the combined average of the two languages.

Table 5.1. Dental click averages

	Overall duration (ms)	Burst duration (ms)	VOT (ms)	Accompaniment (ms)
Voiceless unasp. Xhosa	120	104	120	15
Voiceless unasp. Nama	54	45	54	10
Voiceless asp. Xhosa	156	107	154	50
Voiceless asp. Nama	222	91	222	131
Nasalized Xhosa	226	110	-116	226
Nasalized Nama	214	96	-118	214
Breathy voice Xhosa	83	70	83	38
Nasalized breathy Xhosa	214	100	-92	214
Delayed asp. Nama	167	65	167	133
Glottal closure Nama	155	89	141	66
Avg. Xhosa	160	98	30	109
Avg. Nama	162	77	93	111
Avg. Overall	161	88	62	110

The dental clicks showed that the Xhosa and Nama clicks were almost equally long overall on average with around 161 ms. While the Xhosa average burst duration with 98 ms was overall longer than the Nama one with 77 ms, the average of both is 88 ms. The VOT was longer for Nama on average with 93 ms than for Xhosa with 30 ms. The

reason for that was that Xhosa had more negative values for VOT than Nama because it had one nasalized accompaniment that was not present in Nama. Despite its being longer, the VOT value for Xhosa was influenced by the negative value. The average of both and thus the dental VOT average was 62 ms. Overall, the Nama and Xhosa accompaniments were almost equal with 111 ms and 109 ms. The dental accompaniment average was 110 ms.

5.1.2. Alveolar click averages. The overall duration averages (in ms), the burst duration averages (in ms), the VOT averages (in ms), and the accompaniment averages (in ms) for all alveolar clicks in Xhosa and Nama, are presented in Table 5.2. This table also presents the averages of all alveolar clicks in both languages, and the combined average of the two languages.

Table 5.2. Alveolar click averages

	Overall duration (ms)	Burst duration (ms)	VOT (ms)	Accompaniment (ms)
Voiceless unasp. Xhosa	116	99	116	18
Voiceless unasp. Nama	59	59	52	0
Voiceless asp. Xhosa	167	84	167	83
Voiceless asp. Nama	176	99	176	78
Nasalized Xhosa	196	75	-121	196
Nasalized Nama	194	93	-101	194
Breathy voice Xhosa	144	102	144	56
Nasalized breathy Xhosa	192	88	-104	192
Delayed asp. Nama	116	95	116	68
Glottal closure Nama	180	131	180	49
Avg. Xhosa	163	90	40	109
Avg. Nama	145	95	85	78
Avg. Overall	154	93	63	93

The alveolar click averages showed that the Xhosa clicks were overall longer with 163 ms than the Nama clicks with 145 ms. The overall duration average of all alveolar clicks was 154 ms. The burst duration averages for Xhosa and Nama were more similar with 90 ms and 95 ms. Their average was 93 ms. The VOT average was again shorter for Xhosa with 40 ms because of one more nasal accompaniment that Nama with 85 ms did not have. The alveolar VOT average was 63 ms. The accompaniment was longer for Xhosa on average with 109 ms than for Nama with 78 ms. The alveolar accompaniment average was 93 ms.

5.1.3. Lateral click averages. The overall duration averages (in ms), the burst duration averages (in ms), the VOT averages (in ms), and the accompaniment averages (in ms) for all lateral clicks in Xhosa and Nama, are presented in Table 5.3. This table also gives the averages of all the lateral clicks in both languages, and the combined average of the two languages.

Table 5.3. Lateral click averages

	Overall duration (ms)	Burst duration (ms)	VOT (ms)	Accompaniment (ms)
Voiceless unasp. Xhosa	111	86	111	22
Voiceless unasp. Nama	71	71	71	0
Voiceless asp. Xhosa	167	133	167	78
Voiceless asp. Nama	194	131	194	63
Nasalized Xhosa	216	124	-91	216
Nasalized Nama	171	106	-65	171
Breathy voice Xhosa	116	116	116	36
Nasalized breathy Xhosa	215	82	-123	215
Delayed asp. Nama	165	93	165	115
Glottal closure Nama	173	141	173	31
Avg. Xhosa	165	108	36	129
Avg. Nama	155	108	108	76
Avg. Overall	160	108	72	95

The lateral click averages showed that the Xhosa clicks were overall longer with 165 ms than the Nama clicks with 155 ms. The lateral overall duration average was 160 ms. The burst duration averages for Xhosa and Nama were exactly the same with 108 ms, which was therefore the lateral burst duration average as well. The average VOT for Xhosa was remarkably shorter with 36 ms than the one for Nama with 108 ms because of more negative values. The lateral VOT average was 72 ms. The Xhosa burst duration average was higher with 129 ms than the Nama one with 76 ms. The lateral burst duration average was 95 ms.

5.1.4. Palatal click averages. The overall duration averages (in ms), the burst duration averages (in ms), the VOT averages (in ms), and the accompaniment averages (in ms) for all palatal clicks in Nama, are presented in Table 5.4. This table also provides the averages of all the palatal clicks.

Table 5.4. Palatal click averages

	Overall duration (ms)	Burst duration (ms)	VOT (ms)	Accompaniment (ms)
Voiceless unasp. Nama	124	124	38	0
Voiceless asp. Nama	220	147	220	74
Nasalized Nama	236	123	-113	236
Delayed asp. Nama	138	105	138	113
Glottal closure Nama	216	133	216	82
Avg.	187	126	100	101

The palatal click averages only pertained to Nama clicks, as already mentioned. The overall duration average was 187 ms and the burst duration average was 126 ms. The VOT average was 100 ms, and there was one negative value because of prenasalization. The accompaniment average was 101 ms.

5.2. Click type averages. The overall duration averages (in ms), the burst duration averages (in ms), the VOT averages (in ms), and the accompaniment averages (in ms) of all places of articulation in Xhosa and Nama are presented in Table 5.5. This table also presents the combined average of the two languages.

Table 5.5. Click type averages

	Overall duration (ms)	Burst duration (ms)	VOT (ms)	Accompaniment (ms)
Dental Xhosa	160	98	30	109
Dental Nama	162	77	93	111
Avg. dental	161	88	62	110
Alveolar Xhosa	163	90	40	109
Alveolar Nama	145	95	85	78
Avg. alveolar	154	93	63	93
Lateral Xhosa	165	108	36	129
Lateral Nama	155	108	108	76
Avg. lateral	160	108	72	95
Palatal Nama	187	126	100	101

Table 5.5 presents the averages for click types. The palatal clicks that only occur in Nama had the longest overall duration with 187 ms. The shortest overall duration was the alveolar one with 154 ms. The longest burst duration on average was the duration of the palatal clicks with 126 ms. The shortest burst duration on average was calculated for the dental clicks with 88 ms. The palatal clicks had the longest VOT on average with 100 ms. The shortest VOT average was the dental one with 62 ms, closely followed by the alveolar one with 63 ms. The longest accompaniment duration was the dental one with 110 ms on average. The shortest accompaniment duration on average was the alveolar one with 93 ms, immediately followed by the lateral one with 95 ms. Except for the accompaniment, the palatal clicks had the longest durations on average in all categories.

5.3. Xhosa and Nama averages. The overall duration averages (in ms), the burst duration averages (in ms), the VOT averages (in ms), and the accompaniment averages

(in ms) of all places of articulation in Xhosa and Nama are given in Table 5.6. This table also presents the averages of all the places of articulation per language.

Table 5.6. Xhosa and Nama averages

	Overall duration (ms)	Burst duration (ms)	VOT (ms)	Accompaniment (ms)
Dental Xhosa	160	98	30	109
Dental Nama	162	77	93	111
Alveolar Xhosa	163	90	40	109
Alveolar Nama	145	95	85	78
Lateral Xhosa	165	108	36	129
Lateral Nama	155	108	108	76
Palatal Nama	187	126	100	101
Avg. Xhosa	163	99	35	116
Avg. Nama	162	102	97	92

Table 5.6 compares the two languages directly looking at all clicks measured for the study. It shows that the average overall duration for Nama and Xhosa clicks was only different by 1 ms. The Xhosa clicks were 163 ms long on average, considering all places of articulation, and the Nama clicks were 162 ms long on average. Therefore, the study cannot report a difference in terms of overall duration average. The case of the burst duration averages was very similar: they were only 2 ms apart. Xhosa clicks had a burst duration average of 99 ms and the Nama ones had a burst duration average of 102 ms. VOT average differences result from the two negative values in Xhosa as opposed to one in Nama per place of articulation. Therefore, the VOT averages cannot be directly compared. The accompaniment averages showed differences as expected because the two languages have different accompaniments. Yet, the actual difference as presented in the table is not remarkable with 24 ms. The Xhosa clicks had an accompaniment average of 116 ms and the Nama clicks had an accompaniment average

of 92 ms. Thus, this study can only report minimal differences in accompaniment average due to different sets of accompaniments in the two languages.

5.4. Accompaniment averages. The averages of all accompaniments, namely voiceless unaspirated, voiceless aspirated, nasalized, breathy voice, nasalized breathy, delayed aspirated, and glottalized, per place of articulation in Xhosa and Nama are presented in Table 5.7. This table also gives the averages of all the places of articulation in both languages, and the combined average of the two languages.

Table 5.7. Accompaniment averages

	v-less unasp.	v-less asp.	nasal.	breathy voice	nasal. breathy	delayed asp.	glottal closure
Dental Xhosa	15	50	226	38	214	--	--
Dental Nama	10	131	216	--	--	133	66
Avg. dental	13	91	221	38	214	133	66
Alv. Xhosa	18	83	196	56	192	--	--
Alv. Nama	0	78	194	--	--	68	49
Avg. alveolar	9	81	195	56	192	68	49
Lat. Xhosa	22	78	216	36	215	--	--
Lat. Nama	0	63	171	--	--	115	31
Avg. lateral	11	71	194	36	215	115	31
Palat. Nama	0	74	236	--	--	113	82
Avg. Xhosa	18	70	213	43	207	--	--
Avg. Nama	3	87	204	--	--	107	57

Table 5.7 compares all the accompaniment averages. The longest voiceless unaspirated accompaniment on average was the dental one with 13 ms. The shortest one on average was the palatal one with 0 ms. The reason for this was that the palatal clicks are all Nama clicks, and the Nama voiceless unaspirated accompaniment mostly measured 0 ms while the Xhosa one did not. Therefore, this accompaniment was longer on average for Xhosa with 18 ms than for Nama with 3 ms. The longest voiceless aspirated

accompaniment on average was the one for the dental clicks with 91 ms. The shortest voiceless aspirated accompaniment was the one for the lateral clicks with 71 ms, closely followed by the palatal clicks with 74 ms. This accompaniment was slightly shorter for the Xhosa clicks with 70 ms than for the Nama clicks with 87 ms. The longest nasalized accompaniment on average was the palatal one with 236 ms, the longest accompaniment average in the study. The shortest nasal accompaniment on average was the lateral one with 194 ms, immediately followed by the alveolar one with 195 ms. This accompaniment was slightly longer for the Xhosa clicks with 213 ms on average than for the Nama clicks with 204 ms on average.

The longest Xhosa breathy voice accompaniment was the one for the alveolar clicks with 56 ms, while the shortest Xhosa breathy voice accompaniment was the one for the lateral clicks with 36 ms, closely followed by the lateral clicks with 38 ms. The overall breathy voice accompaniment average was 43 ms, and it could not be compared to Nama because that language does not have it. The longest Xhosa nasalized breathy accompaniment was the one for the lateral clicks with 215 ms, immediately followed by the dental clicks with 214 ms. The alveolar clicks had the shortest nasalized breathy accompaniment average with 192 ms. The overall average of the nasalized breathy accompaniment only existing in Xhosa was 207 ms.

The longest Nama delayed aspiration accompaniment was the one for the dental clicks with 133 ms and the shortest Nama delayed aspiration accompaniment was the one for the alveolar clicks with 68 ms. The overall average was 107 ms, and it could not be compared to Xhosa because it does not exist in Xhosa. The palatal clicks had the longest glottal closure accompaniment average with 82 ms and the lateral clicks had the shortest glottal closure accompaniment average with 31 ms. The overall average was 57

ms and again could not be compared to any Xhosa clicks because Xhosa does not have it as a phonemically distinctive accompaniment.

The dental accompaniments were longer than the alveolar in almost all cases, except for the breathy voice accompaniment. The lateral accompaniments showed some values laying between the dental and alveolar ones, but they also displayed some extreme values towards both ends of the spectrum. The palatal clicks were below the mean with the voiceless unaspirated and voiceless aspirated accompaniments, and above the mean with the nasalized, the glottal closure, and the delayed aspiration accompaniments.

Comparing the three accompaniments existing in both Xhosa and Nama, the voiceless unaspirated one with 18 ms and the nasalized one with 213 ms were longer in Xhosa than in Nama with 3 ms and 204 ms respectively, but the voiceless aspirated one was longer in Nama than in Xhosa with 87 ms compared to 70 ms. The other four accompaniments could not be directly compared across the two languages because they do not exist in both.

The nasalized accompaniment and the nasalized breathy accompaniment showed rather similar averages. The nasalized accompaniment showed 213 ms for Nama and 204 ms for Xhosa and the nasalized breathy accompaniment showed 207 ms for Xhosa. This could be expected because both accompaniments showed nasalization throughout the whole click duration. Other accompaniments that showed similar values were the voiceless aspirated one with 70 ms in Xhosa and 87 ms in Nama and the delayed aspirated one with 107 ms in Nama. Since both accompaniments had a type of aspiration, this could be expected. However, the delayed aspiration accompaniment was obviously longer, presumably because it was delayed. The last two accompaniments that showed similar values were the Xhosa breathy voice accompaniment with 43 ms and

the Nama glottal closure accompaniment with 57 ms, even though they exist in different languages. In this study, those two accompaniments had in common that they showed no voicing or aspiration but a lag between the end of the click burst and the following vowel. Some studies say the breathy voice accompaniment is voiced and others call it voiceless unless a nasal is involved. This study called it voiceless.

5.5. Comparison of all clicks per accompaniment

5.5.1. Voiceless unaspirated clicks. The averages of all voiceless unaspirated clicks, dental, alveolar, lateral Xhosa and dental, alveolar, lateral, palatal Nama, are compared in Table 5.8 in terms of overall duration (in ms), burst duration (in ms), VOT (in ms), and accompaniment (in ms).

Table 5.8. Voiceless unaspirated clicks

	Overall duration (ms)	Burst duration (ms)	VOT (ms)	Unaspirated (ms)
Xhosa				
Dental	120	104	120	15
Alveolar	116	99	116	18
Lateral	111	86	111	22
Nama				
Dental	54	45	54	10
Alveolar	59	59	52	0
Lateral	71	71	71	0
Palatal	124	124	38	0

Table 5.8 shows that the Xhosa voiceless unaspirated clicks had a longer overall duration than the Nama ones except for the palatal clicks. The palatal voiceless unaspirated Nama clicks had the longest overall duration with 124 ms. The shortest overall duration was found for the Nama voiceless alveolar dental clicks with 54 ms.

Therefore, there was a range from 54 to 124 ms, which shows that there were considerable overall duration differences within the voiceless unaspirated clicks, especially for the Nama clicks.

For burst duration, the numbers were similar as for overall duration. The Xhosa voiceless unaspirated clicks had a slightly shorter burst duration than overall duration because of a voice lag before the following vowel. The Nama burst duration figures were almost all identical to the overall duration ones, except for the dental clicks that were 45 ms long. Thus, there was a range from 45 to 124 ms, which means that there were some differences in burst duration within the voiceless unaspirated clicks.

The VOT values for the Xhosa voiceless unaspirated clicks were the same as the overall duration values. However, the Nama VOT values were different for the voiceless unaspirated alveolar clicks and the palatal clicks. The alveolar clicks had a slightly shorter VOT with 52 ms than overall duration with 59 ms, but the palatal clicks had a VOT of 38 ms compared to an overall duration of 124 ms. These differences occurred because the following vowel set in during click produtcion. This caused the Nama voiceless unaspirated clicks to have overall shorter VOTs than the Xhosa voiceless unaspirated clicks.

The voiceless unaspirated accompaniment showed higher values for the Xhosa clicks than for the Nama clicks. Most of the Nama clicks had 0 ms, except for the dental clicks with 10 ms. The Xhosa values were all higher than that with up to 22 ms. As mentioned, these values resulted from a voice lag between the end of the click burst to the onset of the following vowel.

To summarize, the Xhosa voiceless unaspirated clicks were similar for all places of articulation, while the palatal Nama ones were different from the other Nama voiceless

unaspirated clicks. There were more differences within the Nama voiceless unaspirated clicks than within the Xhosa clicks, and Xhosa and Nama voiceless unaspirated clicks were rather different in values with the Nama clicks mostly having shorter values.

5.5.2. Voiceless aspirated clicks. The averages of all voiceless aspirated clicks, dental, alveolar, lateral Xhosa and dental, alveolar, lateral, palatal Nama, are compared in Table 5.9 in terms of overall duration (in ms), burst duration (in ms), VOT (in ms), and accompaniment (in ms).

Table 5.9. Voiceless aspirated clicks

	Overall duration (ms)	Burst duration (ms)	VOT (ms)	Aspiration (ms)
Xhosa				
Dental	156	107	154	50
Alveolar	167	84	167	83
Lateral	167	133	167	78
Nama				
Dental	222	91	222	131
Alveolar	176	99	176	78
Lateral	194	131	194	63
Palatal	220	147	220	74

Table 5.9 displays that the Xhosa voiceless aspirated clicks had similar overall duration. There were more differences within the overall durations of the Nama voiceless aspirated clicks, wich were overall longer than the Xhosa ones. The shortest clicks were the Xhosa voiceless aspirated dental clicks with 156 ms, and the longest clicks were the Nama voiceless aspirated dental clicks with 222 ms. In all of these cases, VOT equaled overall duration.

The Xhosa voiceless aspirated clicks showed some more differences in the burst durations. The Nama voiceless aspirated clicks showed differences as well. Overall, the Xhosa voiceless aspirated clicks were slightly shorter with a range from 84 ms for the alveolar clicks to 133 ms for the lateral clicks than the Nama ones with a range from 91 ms for the dental clicks to 147 ms for the palatal clicks.

The aspiration accompaniment for the Xhosa clicks ranged from 50 ms for the dental clicks to 83 ms for the alveolar clicks. For the Nama clicks, the aspiration accompaniment ranged from 63 ms for the lateral clicks to 131 ms for the dental clicks. Therefore, the Nama clicks showed a bigger range and more differences. The Nama voiceless aspirated clicks had a longer accompaniment than the Xhosa ones.

Overall, the Xhosa voiceless aspirated clicks were more similar to each other for all places of articulation than the Nama ones. The Nama voiceless aspirated alveolar clicks were the shortest ones for most values compared to the other Nama clicks. Overall, the Nama voiceless aspirated clicks were longer in all categories than the Xhosa ones.

5.5.3. Nasalized clicks. The averages of all nasalized clicks, dental, alveolar, lateral Xhosa and dental, alveolar, lateral, palatal Nama, are compared in Table 5.10 in terms of overall duration (in ms), burst duration (in ms), VOT (in ms), and accompaniment (in ms).

Table 5.10. Nasalized clicks

	Overall duration (ms)	Burst duration (ms)	VOT (ms)	Nasalization/ voicing (ms)
Xhosa				
Dental	226	110	-116	226
Alveolar	196	75	-121	196
Lateral	216	124	-91	216
Nama				
Dental	214	96	-118	214
Alveolar	194	93	-101	194
Lateral	171	106	-65	171
Palatal	236	123	-113	236

As shown in Table 5.10, the Xhosa nasalized clicks had an overall duration range from 196 ms for the alveolar clicks to 226 ms for the dental clicks. Therefore, they were rather similar in overall duration. The Nama nasalized clicks showed a wider range from 171 ms for the lateral clicks to 236 ms for the palatal clicks and were less similar in overall duration. The nasalization/voicing equaled the overall duration.

The burst duration of the Xhosa nasalized clicks showed more differences than the burst duration of the Nama ones. The Xhosa nasalized clicks ranged from 75 ms for the alveolar clicks to 124 ms for the lateral clicks, while the Nama nasalized clicks ranged from 93 ms for the alveolar clicks to 123 ms for the palatal clicks. Therefore, the Xhosa clicks showed more differences in burst duration. For both languages, the alveolar nasalized clicks had the shortest burst durations.

The voice onset time of the Xhosa nasalized clicks ranged from -91 ms for the lateral clicks to -121 ms for the alveolar clicks. They were rather similar in length. The Nama nasalized clicks ranged from -65 ms for the lateral clicks to -118 ms for the

dental clicks, which was a wider range than the one of the Xhosa clicks. Thus, the Nama clicks showed more differences in VOT.

Again, the Xhosa nasalized clicks were more similar to each other for all places of articulation than the Nama ones for most categories except for the burst duration. The Xhosa nasalized clicks were slightly longer than the Nama ones despite the high value of the Nama nasalized palatal clicks. The Nama nasalized lateral clicks were the shortest of all nasalized clicks.

5.5.4. Breathy voiced clicks. The averages of all breathy voiced clicks, dental, alveolar, and lateral Xhosa, are compared in Table 5.11 in terms of overall duration (in ms), burst duration (in ms), VOT (in ms), and accompaniment (in ms).

Table 5.11. Breathy voiced clicks

	Overall duration (ms)	Burst duration (ms)	VOT (ms)	Breathy voice (ms)
Xhosa				
Dental	83	70	83	38
Alveolar	144	102	144	56
Lateral	116	116	116	36

Table 5.11 shows that the dental breathy voiced clicks were the shortest in every category, except for the accompaniment. They had an overall duration of 83 ms. The clicks with the longest overall duration were the alveolar breathy voiced clicks with 144 ms. Therefore, there was a range from 83 ms to 144 ms, which means that the breathy voiced clicks were different from each other in terms of overall duration. The lateral breathy voiced clicks had the longest burst duration with 116 ms as compared to the overall longer alveolar clicks with 102 ms. VOT equaled overall duration in every case. The lateral breathy voiced clicks had the shortest accompaniment with 36 ms, closely

followed by the dental clicks with 38 ms. The alveolar breathy voiced clicks had the longest accompaniment duration with 56 ms. The range was from 36 ms to 56 ms, which showed that there were no remarkable differences.

5.5.5. Nasalized breathy clicks. The averages of all nasalized breathy clicks, dental, alveolar, and lateral Xhosa, are compared in Table 5.12 in terms of overall duration (in ms), burst duration (in ms), VOT (in ms), and accompaniment (in ms).

Table 5.12. Nasalized breathy clicks

	Overall duration (ms)	Burst duration (ms)	VOT (ms)	Nasalized breathy (ms)
Xhosa				
Dental	214	100	-92	214
Alveolar	192	88	-104	192
Lateral	215	82	-123	215

Table 5.12 displays that the nasalized breathy clicks had similar overall durations with a range from 192 ms for the alveolar clicks to 215 ms for the lateral clicks. The dental clicks were 214 ms long and thus almost exactly as long as the lateral ones. The overall longest nasalized breathy clicks, the lateral clicks, had the shortest burst duration with 82 ms. The nasalized breathy dental clicks had the longest burst duration with 100 ms. The lateral clicks had the longest VOT with -123 ms, while the dental clicks, which were second longest clicks overall, had the shortest VOT with -92 ms. The accompaniment equaled the overall duration in all cases. The ranges in every category were rather small, which means that the nasalized breathy clicks were similar across places of articulation.

5.5.6. Delayed aspirated clicks. The averages of all delayed aspirated clicks, dental, alveolar, lateral, and palatal Nama, are compared in Table 5.13 in terms of

overall duration (in ms), burst duration (in ms), VOT (in ms), and accompaniment (in ms).

Table 5.13. Delayed aspirated clicks

	Overall duration (ms)	Burst duration (ms)	VOT (ms)	Delayed aspiration (ms)
Nama				
Dental	167	65	167	133
Alveolar	116	95	116	68
Lateral	165	93	165	115
Palatal	138	105	138	113

Table 5.13 shows that there were overall duration differences in the Nama delayed aspirated clicks. They ranged from 116 ms for the alveolar clicks to 167 ms for the dental clicks, closely followed by the lateral ones with 165 ms. VOT and overall duration had the same values in all cases. The delayed aspirated dental clicks with the longest overall duration had the shortest burst duration with 65 ms. The delayed aspirated palatal clicks, which had an overall duration of 138 ms, had the longest burst duration with 105 ms. The burst duration of the dental clicks was the shortest by almost 30 ms, while the other figures are closer to each other with around 10 ms. The delayed aspiration accompaniment ranged from 68 ms for the alveolar clicks, which was the shortest value by far, to 133 ms for the dental clicks. Except for the burst duration, the delayed aspirated alveolar clicks had the shortest values and the dental ones had the longest values. All categories displayed differences.

5.5.7. Glottal closure clicks. The averages of all glottal closure clicks, dental, alveolar, lateral, and palatal Nama, are compared in Table 5.14 in terms of overall duration (in ms), burst duration (in ms), VOT (in ms), and accompaniment (in ms).

Table 5.14. Glottal closure clicks

	Overall duration (ms)	Burst duration (ms)	VOT (ms)	Glottal closure (ms)
Nama				
Dental	155	89	141	66
Alveolar	180	131	180	49
Lateral	173	141	173	31
Palatal	216	133	216	82

Table 5.14 displays overall duration similarities between the glottal closure dental, alveolar, and lateral clicks. The glottal closure palatal clicks were considerably longer than all other clicks with 216 ms. The alveolar ones were the next longest clicks with 189 ms, while the dental clicks were the overall shortest clicks with 155 ms. The dental clicks with the shortest overall duration also had the shortest burst duration with 89 ms. The lateral clicks had the longest burst duration with 141 ms but not the longest overall duration. The burst durations were similar for the glottal closure alveolar, lateral, and palatal clicks. The VOT values equaled the overall duration values in all cases except for the dental clicks. Thus, the dental clicks had the shortest VOT with 141 ms. The glottal closure palatal clicks which had the longest overall duration also had the longest accompaniment duration with 82 ms. The lateral clicks had the shortest glottal closure with 31 ms. Thus, every category showed differences and similarities.

5.6. Other results. There were audible differences among the palatal clicks, which could not be detected as easily for the other places of articulation. The clicks followed by a front vowel sounded more fronted than the ones followed by back vowels. However, this was perceived by ear exclusively. Measurements of this exceeded the scope of this thesis.

The Xhosa clicks showed unexpected results in terms of place of articulation in some cases, which resulted in them not being used for calculations. Some clicks that were dental according to the orthography sounded and looked lateral in the waveform, for instance. Whether those unexpected cases occurred due to allophonic variation or due to the speaker actually using a different click could not be cleared up in this study. Both Xhosa and Nama clicks showed cases in which the accompaniment was different than indicated by the orthography. The study could not determine why that was the case either. Those cases were dismissed from the study or used where appropriate.

CHAPTER 6

CONCLUSION

This pilot study showed that clicks are complex sounds, as laid out by citations of previous studies. Click production and phonetic properties of clicks are complex matters and have been investigated because clicks have received large interest in research. This complexity, however, is the reason why different studies give different representations of clicks focusing on different aspects of clicks. Looking at phonetic aspects of clicks, this study focused on previous studies by Ladefoged and Traill (1980a, 1984, 1994). Moreover, it focused on studies by Sands (1991) and Kagaya (1978) supporting the measurements carried out in them. Although Bantu languages most likely borrowed clicks from Khoisan, as explained in this work, differences in measurements were to be expected because the languages of interest are different. However, similarities were to be expected as well because of that.

More precisely, the pilot study revealed that of all clicks, the Nama nasalized palatal clicks had the longest overall duration on average. Overall, the nasalized clicks had the longest overall duration on average in this study. The clicks with the shortest overall duration on average were the Nama voiceless unaspirated dental clicks. Those clicks had the shortest overall duration on average for every place of articulation. The Nama voiceless aspirated dental clicks and the Nama voiceless aspirated palatal clicks had the longest VOT on average. The Nama voiceless unaspirated palatal clicks had the shortest VOT on average, as did most of the other voiceless unaspirated ones. Both overall duration and VOT depended on the click accompaniment, which was predictable. The clicks with the longest burst duration were the Nama voiceless aspirated palatal clicks and the clicks with the shortest burst duration were the Nama voiceless unaspirated

dental clicks. Those clicks had the shortest burst duration for the dental, alveolar, and lateral places of articulation. The clicks with the longest accompaniment duration were the Nama nasalized palatal clicks. In all places of articulation, nasalization involved in the longest accompaniment measurement because the nasalization continued throughout the click. The clicks with the shortest accompaniment duration were the alveolar, lateral, and palatal Nama voiceless unaspirated clicks because there was no voicing, no aspiration, and no lag before the onset of voicing.

Comparing places of articulation, the palatal Nama clicks had the longest overall duration and the alveolar clicks had the shortest overall duration. The palatal Nama clicks were also the ones with the longest burst duration on average. The dental clicks had the shortest burst duration on average. It was again the palatal clicks that had the longest VOT on average. The shortest VOT average was measured for the dental and the alveolar clicks. The dental clicks showed the longest accompaniment duration on average, while the alveolar and the lateral clicks showed the shortest accompaniment durations on average. Except for the accompaniment, the palatal clicks showed the longest average durations in all categories.

Sands (1991:23) discovered that the alveolar and the lateral voiceless unaspirated clicks were overall longer than the dental ones. This study showed that the Xhosa voiceless unaspirated dental clicks were the longest, followed by the alveolar ones and then by that lateral ones. In addition, Sands (1991:22) found out that the voice onset time of all voiceless aspirated clicks is mostly similar, which could be confirmed by this study. However, Sands (1991:22) detected remarkable differences between VOT for voiceless unaspirated lateral and dental clicks. The difference between those was not found to be remarkable in this study. Sands' (1991:22) results showed that lateral and

dental clicks are similar for most other accompaniments, which was the case in this study as well. Moreover, Sands' (1991:22) study revealed that dental and lateral clicks tend to have longer voice onset times than the alveolar clicks, which did not show in this study. The dental clicks had comparatively short VOT averages.

Looking at all clicks measured in the study comparing the two languages directly, overall duration of clicks in both Nama and Xhosa was similar. Burst duration was also similar in both languages. The VOT measurements were not comparable since Xhosa has two voiced series to one Nama voiced series. The accompaniment averages were minimally different, due to different sets of accompaniments in the two languages. Bleek (1862:12) pointed out that Nama clicks were adopted in Xhosa without being changed considerably, which could be confirmed by this study. However, the Nama lateral click is produced with the tongue covering the palate and making the sound the furthest back possible on the palate, as opposed to the Xhosa click (Bleek 1862:12). Thus, some differencs in production are implied, which this study suspected. Sands (1991:13) found out that the clicks with nasalized, voiced, and aspirated accompaniment in both Xhosa and Nama are similar, which was also the case in this study. Ladefoged and Traill's (1994) results match Bleek's (1862) and Sands' (1991) results.

About the accompaniments, it can be said that the nasalized accompaniment and the nasalized breathy accompaniment were similar and the longest. Moreover, the voiceless aspirated accompaniment and the delayed aspirated accompaniment were similar. Furthermore, the breathy voice accompaniment and the glottal closure accompaniment were similar and had the shortest values after the voiceless unaspirated accompaniment. that the Xhosa voiceless unaspirated clicks had a longer overall duration than the Nama ones except for the palatal clicks.

The comparison of all clicks per accompaniment revealed that the Xhosa voiceless unaspirated clicks were similar across all places of articulation, while the palatal Nama clicks were different from the other Nama voiceless unaspirated clicks. The Nama voiceless unaspirated clicks mostly had shorter values than the Xhosa ones.

The Xhosa voiceless aspirated clicks were more similar to each other across all places of articulation than the Nama clicks. The Nama voiceless aspirated alveolar clicks were the shortest of the Nama clicks for most values. The Nama voiceless aspirated clicks were longer than the Xhosa clicks in all categories.

The Xhosa nasalized clicks were also more similar to each other for all places of articulation than the Nama ones in all categories except for burst duration. The Xhosa nasalized clicks were slightly longer than the Nama clicks overall. The Nama nasalized palatal clicks were the longest nasalized clicks and the lateral clicks were the shortest ones.

The comparison of clicks per accompaniment existing in only one of the two languages showed that the breathy voiced clicks had overall durations and VOTs that differed from each other, but burst durations and accompaniment durations were rather similar. The nasalized breathy clicks were similar across places of articulation because the ranges in every category were small.

The Nama delayed aspirated clicks displayed relatively wide ranges and thus differences in every category. The Nama glottal closure clicks showed differences and similarities in every category. The dental, alveolar, and lateral clicks were similar, while the palatal clicks were considerably longer.

Other results in the study were the palatal clicks showing audible differences between clicks followed by front vowels and clicks followed by back vowels. The clicks

followed by front vowels sounded like they were produced further in the front than the clicks followed by a back vowel. Sands (1991:30) could not report any considerable evidence for influences of vowels on preceding clicks in Xhosa.

Furthermore, some of the Xhosa clicks sounded and looked different from what they were expected to be in terms of place of articulation. For instance, the orthography showed a dental click, but that click sounded and looked like a lateral in the waveform. Whenever this was the case, the respective clicks had to be dismissed from the study or used in the appropriate category. Those occurrences may have been due to allophonic variation or due to the speaker actually using a different click, but this could not be proven by this study. This did not happen with the Nama clicks in many cases. Distinction was easier among them. However, accompaniments for both Xhosa and Nama clicks were different than expected from the orthography. The study could not detect the reason for this.

In order to make this study more representative, more speakers for both languages are needed. The clicks of only two speakers were compared in this study. In addition, more clicks than one to four per phoneme will be needed to make a valid comparison in a bigger study. Moreover, other phonetic properties of the clicks can be measured with the appropriate instrumentation, such as influences on clicks by the following vowel, click pitch, etc.

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APPENDICES

APPENDIX A

Clicks in Xhosa and Nama: A comparative analysis – Susanne Bohm

Demographic information questions for subjects

1. Where exactly are you from? _____

2. How old are you? _____

3. When did you start learning Nama/Xhosa?

_____
_____

4. Where and how did you learn the language?

_____
_____

5. Where and how do you use the language?

_____
_____

6. What variety of the language do you speak? _____

7. What other languages do you speak?

_____
_____

8. Do you speak other languages that contain clicks?

_____
_____

a. If so, which one do you use more often? _____

APPENDIX B

Xhosa Word List

Xhosa	Xhosa transcription (Ladefoged and Traill 1994:46-47)	English
nqunqa	[ˈŋ!ũŋ!a]	to slice
xhumaxhuma	[ˌk‖ʰumaˈk‖ʰuma]	to jump
iqhina	[ĩˈkʃĩna]	knot
ubunxele	[ˌubuˈŋ‖ɛlɛ]	left-handedness
ngxola	[ˈk‖ɔla]	to be loud
ncinci	[ˈŋ|ĩŋ|ĩ]	small
qikelela	[ˌk!ikɛˈlɛla]	to consider
inkxaso	[ĩˈŋk‖ʰasɔ]	adhesion, support
gcina	[ˈg|ina]	to keep
Xhosa	[ˈk‖ʰɔsa]	Xhosa
nkcenkceshela	[ˌŋk‖ẽŋk‖ɛˈʃɛla]	water
chuba	[ˈk|ʰuba]	to peel
qhekeza	[k!ʰɛˈkɛza]	crack
nkqo	[ŋk!ɔ]	straight
gquma	[ˈg!ũma]	to cover
nqika	[ˈŋ!ika]	to uncover
qhuba	[k!ʰuˈba]	drive
xilonga	[k‖iˈlõŋa]	to examine
qho	[k!ʰɔ]	always
unxweme	[ũˈŋ‖wɛmɛ]	beach
ngqithisela	[ˌŋ!itʰiˈsɛla]	to pass
qumba	[ˈk!ũmba]	to anger
nxiba	[ˈŋ‖eba]	to wear, dress
gxeka	[ˈg‖ɛɣa]	to mock
cinga	[ˈk|iːŋaː]	To think
ncuma	[ˈŋ|ũma]	to smile
gxotha	[g‖ɔˈtʰa]	to expel
ngquba	[ˈg!uba]	to bump
gqiba	[ˈg!iba]	to complete, finish

xuba	[ˈk‖uba]	to mix
inkxwaleko	[ˌ̃iŋk‖waˈlɛkɔ]	abjection
ngcwele	[ˈŋ|wɛlɛ]	holy
inkqubo	[ˆ̃iŋˈk!ubɔ]	advance
inkcubeko	[ˌ̃iŋk!uˈbɛkɔ]	culture
chitha-chitha	[k|ʰiˈtʰak|ʰiˌtʰa]	to scatter
ngxi	[ŋ‖ej]	still
gxuma	[ˈg‖u̯ma]	to jump
ngcileza	[ˈg|iˈlɛza]	to hop
gcwala	[ˈg|wala]	to get full
ngxeba	[ˈg‖ɛba]	injury
nkqi	[ŋkǃ̃i]	quickly, full stop, end
xhela	[ˈk‖ʰɛla]	to kill
culisa	[k|uˈlisa]	direct
umngxuma	[ũmˈŋ‖ũma]	burrow

APPENDIX C

Nama Word List

Nama	Nama transcription (Ladefoged and Traill 1994:48)	English
|íríp	[ˈk|ɪrɪpʰ]	jackal
!guru	[ˈk!ʊrʊ]	thunder
ǂnīsa	[ˈŋǂisa]	proud
‖ʼõaku	[ˈk‖ˀwaku]	the arms
‖nīra	[ˈk‖ˀiːɾa]	the two ladies
|khunu	[ˈŋ̊|ʰũnu]	finger
ǂhīrab	[ˈkǂʰɪrapˀ]	hyena
!khū-!khū	[ˈŋ̊!ʰuːŋ̊!ʰu]	to make rich
|úí|úípese	[ˌk|uik|uiˈpese]	one by one
‖ˀiiróp	[ˈk‖ˀiːɾop]	little him
ǂû	[kǂˀũ]	to eat
|xií	[ŋ̊|ʰiː]	to come
!hōs	[k!ʰos]	shoulder
ǂkǐ-ǂkǐ	[ˈŋ̊ǂʱĩŋǂʰi]	to satisfy
|nǐ	[ŋ|ĩː]	another
‖geisi	[ˈk‖ejsiː]	ugly
ǂhuwi	[ˈkǂʰuvi]	to burn down
‖hī-dom	[k‖ʱĩˈdõm]	to choke
!khē	[ŋ̊!ʰeː]	to keep guard
|ʼaé‖ams	[k|ˀajˈk‖ãms]	Windhoek
|hei	[k|ʰej]	to become pale
ǂúro	[ˈkǂʊɾo]	first
‖huwu	[k‖ʰuˈwu]	(to be) soft
|ʼurí|ʼuri	[ˌk|ˀʊɾiŋˈk|ˀʊɾi]	to make dirty
!hùú	[k!ʰŭː]	land
ǂnũu	[ŋǂu]	to sit
!ʼáróma	[k!ˀaˈɾoma]	because (of)
ǂʼáń	[kǂˀãŋ]	to know
‖úí	[ˈk‖ui]	to lay down (something)

|hūb	[k|^{h}ub$^{\neg}$]	scorpion
!neib	[ŋ!ejb$^{\neg}$]	giraffe
‖kunab	[^{l}ŋ̊‖^{h}ũnãb$^{\neg}$]	summer
ǂkui	[kǂui]	to be disgusted
|nùúku	[^{l}ŋ|uwku]	The legs
!geib	[k!ejb$^{\neg}$]	potion
ǂgī	[kǂĩi]	to go blind
!’ũi’aop	[^{l}k!^{ʔ}wiʔawp^{h}]	the shepherd
|kiri	[^{l}ŋ̊|^{h}iːɾi]	to make (tea)
|’oro	[^{l}k|^{ʔ}ɔɾɔ]	few
!hóá	[k!^{h}wa]	to speak
‖îb	[k‖^{ʔ}gib$^{\neg}$]	he
!khoi-!khoi	[^{l}ŋ̊!^{h}weŋ̊!^{h}we]	to make run
ǂ’ooˀi	[kǂ^{ʔ}ɔːʔi]	salt
!gǐ	[k!ĩŋ]	to lean
‖nū	[ŋ‖uː]	to accompany
!noná	[^{l}ŋ!ɔ̃na]	three

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