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ISANDI SOLWIMI LWESIXHOSA: A VOCAL WESTERN CLASSICAL APPROACH TO XHOSA LANGUAGE AND ITS UNIQUE CLICK SOUNDS

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Amanda Kosi
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ISANDI SOLWIMI LWESIXHOSA: A VOCAL WESTERN CLASSICAL APPROACH TO XHOSA LANGUAGE AND ITS UNIQUE CLICK SOUNDS

A DOCUMENT APPROVED FOR

THE SCHOOL OF MUSIC

BY THE COMMITTEE CONSISTING OF:

Dr. Joel Burcham, Committee Chair

Dr. Sanna Pederson

Dr. Vivian Luong

Dr. Karlos Hill

Professor Lorraine Ernest

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ABSTRACT

The document examines the incorporation of Xhosa click consonants into Western classical vocal techniques and compositions, focusing on works by South African composer Nqobile Nkonzo. This study explores the preservation of indigenous languages and the expansion of vocal classical music boundaries, highlighting the potential for cultural enrichment and artistic innovation. It investigates the integration of Xhosa's three primary click types - dental (c), alveolar lateral (x), and alveolar (q) - in Western classical music, using a mixed-methods approach combining acoustic analysis, linguistic examination, and cultural interpretation. Spectrographic software analyzes click properties in both linguistic and musical contexts, while phonetic transcription explores click distribution within musical frameworks.

By comparing click usage in Western art music, Xhosa traditional music, and everyday speech patterns, the study evaluates how this incorporation contributes to linguistic preservation and cultural promotion. The research aims to bridge ethnomusicology, linguistics, and classical music studies, offering new perspectives on notating and teaching Xhosa clicks in Western classical contexts. This interdisciplinary approach fills a significant gap in current research, ultimately contributing to the diversification of classical music repertoire and fostering cross-cultural understanding in an increasingly globalized world. Each chapter contains information that plays a vital role in the creation and development of this research project, especially female Xhosa singers like Miriam Makeba, who introduced the Xhosa click consonants to internationally diverse audiences.

CHAPTER ONE: INTRODUCTION

Miriam Makeba, affectionately known as "Mama Africa," was a South African singer and civil rights activist whose artistry and activism made her an international icon. Born in Johannesburg in 1932 to a Xhosa father and Swazi mother, Makeba's musical talent was evident from a young age, and she began her professional singing career in the 1950s with groups like the Manhattan Brothers and the Skylarks. She became the first African artist to bring the sounds of African music-including traditional Xhosa songs and their signature click consonants-to audiences around the world, most famously through hits like "Pata Pata" and "Qongqothwane" (The Click Song).[1] Makeba's music was inseparable from her activism. As apartheid tightened its grip on South Africa, she used her global platform to speak out against racial injustice, testifying before the United Nations and performing songs that highlighted the struggles of her people. Her outspoken stance led to her exile from South Africa for three decades, yet she continued to serve as a voice for the oppressed and a symbol of resilience and hope. [2]

Makeba stands as a powerful symbol of how music can bridge cultures and preserve linguistic heritage.[3] Her effortless use of Xhosa click consonants-C, Q, and X-not only introduced these unique sounds to Western ears but also transformed them into a hallmark of her artistry. For Western audiences, Makeba's clicks were both a marvel and a mystery, often remarked upon for their rhythmic complexity and sonic beauty. Through her music, Makeba preserved and celebrated Xhosa language and culture, making the clicks not just a linguistic

[1] Veit Erlmann, "Miriam Makeba," In *Oxford Bibliographies in Music*, Oxford University Press, 2021, https://www.oxfordbibliographies.com/abstract/document/obo-9780199757824/obo-9780199757824-0298.xml
[2] Ibid.
[3] "Makeba, Miriam," *Oxford Research Encyclopedia of African History*. Oxford University Press, 2021, https://oxfordre.com/africanhistory/display/10.1093/acrefore/9780190277734. 001.0001/acrefore-9780190277734-e-774

feature but a global phenomenon. Her performances highlighted the expressive potential of these consonants, inspiring curiosity and respect for Xhosa and other Southern African languages.

Inspired by Makeba's pioneering work, the study-Isandi Solwimi LwesiXhosa translation 'the sound of the Xhosa Language": A Vocal Western Classical Approach to Xhosa Language and Its Unique Click Sounds-seeks to extend her legacy by exploring a new approach: incorporating Xhosa click consonants into Western classical vocal techniques and compositions. Makeba's international success demonstrated the power of music to transcend linguistic barriers and foster cultural appreciation. Building on this foundation, there is a compelling need to develop practical teaching methods for the three principal Xhosa clicks-C (dental), Q (alveolar), and X (lateral). By integrating these sounds into Western vocal pedagogy, I aim to preserve the Xhosa language and expand the expressive palette of classical singing.

In this way, Miriam Makeba serves not only as a model but as a metaphor: her voice carried the sounds of her heritage across continents, inspiring new generations to listen, learn, and sing the language of the clicks. This work aims to continue her mission-preserving Xhosa through innovation, education, and the universal language of music.

As a native Xhosa speaker, I am thrilled to guide you into the vibrant and sonically rich world of our language, specifically through the lens of its distinctive click consonants. While this exploration resonates within my own cultural heritage, it also holds tremendous potential to broaden the scope of vocal performance studies. Xhosa shares certain linguistic features with related languages, such as Zulu, particularly its tonality.[4] In both languages, variations in pitch – high and low tones – contribute an added layer of musicality and meaning to spoken communication.[5] However, it is the presence and skillful manipulation of click consonants that

[4] L. W. Lanham, *The Comparative Phonology of Nguni*, Rhodes University, 1960.
[5] Ibid.

most profoundly define Xhosa and set it apart within the broader landscape of languages.

For those unfamiliar with Xhosa, these clicks might initially seem unusual or perhaps even exotic. However, within the daily lives and interactions of Xhosa speakers, these sounds function as an utterly seamless and indispensable element of communication. They are deeply interwoven with both our cultural identity and our linguistic expression. IsiXhosa, also known as Xhosa, is a provincial language in the Eastern Cape and Western Cape Provinces and is one of the twelve official languages of South Africa according to the Constitution of Republic of South Africa a 1996.[6]

The forms Xosa, Xhosa, and isiXhosa reflect the historical development of orthographies in Southern Africa. Speakers refer to themselves as amaXhosa and to the language as isiXhosa.[7] In Xhosa, we employ three primary types of click consonants:

- Dental click (represented by "c"): Produced by placing the tip of the tongue against the upper front teeth and sharply drawing it back, generating a sound often likened to the "tsk tsk" expression of mild disapproval or scolding.
- Lateral click (represented by "x"): Formed by positioning the tongue along the side teeth and flicking it outwards, creating a sound similar to the vocalization used to encourage a horse to move forward.
- Alveolar click (represented by "q"): Involves placing the tongue against the alveolar ridge (the gum ridge just behind the upper front teeth) and rapidly releasing it, producing a sound reminiscent of a cork forcefully popping from a bottle.

[6] Constitution of the Republic of South Africa, 1996, http://www.gov.za/documents/constitution-republic-south-africa-1996.
[7] Mantoa Motinyane-Masoko and Aquilina Mawadza, *Introduction to Xhosa, Xhosa Dictionary & Phrasebook*, Cape Town: Phambili Agencies cc, 2017.

It is essential to underscore that these click consonants are far more than mere phonetic curiosities or ornamental embellishments. They fulfill a vital and meaning-bearing function within the Xhosa language, featuring in approximately 15% of all Xhosa words and spanning a diverse range of concepts and grammatical functions.[8] Intriguingly, even the very name of the language itself, "Xhosa," incorporates one of these characteristic click sounds.[9]

The history of these click consonants within the Xhosa language provides a compelling testament to the centuries of dynamic cultural exchange and linguistic interaction that have shaped this region of Southern Africa. Although click consonants are most commonly associated with the Khoisan language families (the indigenous languages of Southern Africa), their incorporation into Xhosa represents a comparatively recent adoption, estimated to have occurred within the past few hundred years. The most widely accepted theory proposes that Khoisan women, upon marrying into Xhosa-speaking communities, introduced these sounds as a subtle yet effective means of circumventing culturally taboo words.[10]

From the specialized vantage point of phonetics (the scientific study of speech sounds), these click consonants present an extraordinary degree of articulatory and acoustic complexity. They exhibit distinctive acoustic properties that set them apart from other types of speech sounds, characterized by unique patterns of sound frequency and distribution of acoustic energy. Bringing Xhosa clicks into the realm of Western classical vocal studies is not just enriching the art form-it is building bridges between cultures and celebrating the incredible diversity of human language and music.

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[8] Sandile Gxilishe, "The Acquisition of Clicks by Xhosa-Speaking Children," *Per Linguam* 20, no. 2 (2004): 1-12.
[9] Mantoa Motinyane-Masoko and Aquilina Mawadza, *Introduction to Xhosa, Xhosa Dictionary & Phrasebook*, Cape Town: Phambili Agencies cc, 2017.
[10] Don Pinnock, *The Brotherhoods: A Sociological Study of South African Gang Culture*, Cape Town: David Philip Publishers, 1998.

LIMITATIONS

While this study benefits from the researcher's deep connection to the Xhosa language and culture, it is important to acknowledge potential limitations. The research primarily focuses on Xhosa click sounds, rather than offering a comprehensive analysis of all aspects of the Xhosa language. Geographical constraints limit the study to the Qonce region, potentially excluding variations in click usage across different Xhosa-speaking communities. The depth of analysis is constrained by the sample size of compositions and performances that can be examined in detail. As an academic study rooted in classical music traditions, there may be inherent cultural biases that could influence the interpretation of Xhosa linguistic elements.

It is crucial to note that the findings may only be directly applicable to the specific aspects of Xhosa clicks in classical vocal music being examined and may not generalize to other contexts or languages. The evolving nature of language means that while the research will capture the current state of Xhosa click usage, some findings may have limited long-term applicability. Additionally, cross-cultural interpretation presents another challenge; the reception and understanding of Xhosa clicks in vocal classical music by non-Xhosa speakers or listeners unfamiliar with the language may affect assessments of their impact. To address this, the study will strive to respect multiple perspectives, acknowledging that there may be various valid interpretations of Xhosa click sounds in a musical context.

CHAPTER TWO: RELATED LITERATURE

2.1 IsiXhosa Language

IsiXhosa, a Nguni Bantu language, is notable for its incorporation of click consonants, a feature that has garnered significant scholarly attention. These clicks, believed to have originated from contact with Khoisan languages, play a crucial role in the phonology, lexicon, and cultural identity of isiXhosa speakers.[11] The presence of clicks in isiXhosa is attributed to prehistoric language contact between Bantu and Khoisan speakers. This linguistic exchange occurred over the past 1,500 years, coinciding with the Bantu expansion into southern Africa.[12] Approximately 15% of Xhosa words contain clicks, including the name of the language itself.[13] This percentage is consistent with estimates provided by other researchers.[14,15]

IsiXhosa features a complex system of click consonants, including dental (represented by 'c'), lateral (represented by 'x'), and alveolar (represented by 'q') clicks.[16] These basic clicks can be modified through aspiration, nasalization, and voicing, resulting in a rich variety of click phonemes.[17] The cultural significance of clicks in isiXhosa extends beyond their linguistic function. Clicks are used to mark identity and are integral to sound-symbolic expressions in the language, highlighting their role in shaping and expressing Xhosa identity.[18] The incorporation

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[11] Hilde Gunnink, Bonny Sands, Brigitte Pakendorf, and Koen Bostoen, "Prehistoric Language Contact in the Kavango-Zambezi Transfrontier Area: Khoisan Influence on Southwestern Bantu Languages," *Journal of African Languages and Linguistics* 36, no. 2 (2015): 193-232.
[12] Ibid.
[13] Robert K. Herbert, "The Relative Markedness of Click Sounds: Evidence from Language Change, Acquisition, and Avoidance," *Anthropological Linguistics* 32, no. 1-2 (1990): 120-138.
[14] "A Brief History of African Click Words," *The Week* online, January 11, 2015. https://theweek.com/articles/457951/brief-history-african-click-words.
[15] Sandile Gxilishe, "The Acquisition of Clicks by Xhosa-Speaking Children," *Per Linguam* 20, no. 2 (2004): 1–12.
[16] Peter Ladefoged & Anthony Traill, Clicks and their accompaniments, *Journal of Phonetics* 22, no. 1 (1994): 33-64.
[17] Michael Jessen and Justus C. Roux, "Voice Quality Differences Associated with Stops and Clicks in Xhosa," *Journal of Phonetics* 30, no. 1 (2002): 1-52.
[18] Hilde Gunnink, *Click Adoption and Insertion in Xhosa: Revisiting the Role of Hlonipha*. Unpublished manuscript, 2020.

of clicks into isiXhosa represents a fascinating example of language contact and evolution. These distinctive sounds have become an integral part of the language's phonological system and cultural identity. As research continues, the study of clicks in isiXhosa offers valuable insights into linguistic adaptation, cultural exchange, and the dynamic nature of language development in southern Africa.

2.2 IsiXhosa Dialects and Tribal Identity

IsiXhosa, a Nguni Bantu language, is characterized by a rich diversity of dialects, each associated with specific tribal groups within the Xhosa nation. These groups include the Mpondo, Bomvana, Bhaca, Thembu, Mpondomise, Xesibe, Mfengu, and Hlubi, among others. Each dialect reflects the unique cultural practices and geographical contexts of its speakers, contributing to a vibrant linguistic tapestry that underscores the complexity of Xhosa identity.

Tribal Identity and Linguistic Variation

The dialects of isiXhosa are not merely variations in speech; they serve as markers of tribal identity and pride. For instance, the Mpondo dialect is distinct from that of the Thembu, reflecting differences in cultural heritage and historical experiences. This linguistic diversity allows speakers to identify one another's origins based on accent and vocabulary, effectively creating a "linguistic map" of the Xhosa people.

Standardization of isiXhosa

Despite this diversity, a standard form of isiXhosa exists, which is taught in schools and used in official contexts. This standardization ensures that Xhosa speakers from different tribal

backgrounds can communicate effectively with one another. The balance between dialect diversity and a shared standard language reflects the unity and diversity that define the Xhosa people.

Classification within Bantu Languages

IsiXhosa is classified within the S41 group of Bantu languages, according to Guthrie's system.[19] This classification highlights the language's place within a broader linguistic and cultural context, demonstrating how isiXhosa interacts with other Bantu languages. The S41 group is part of a larger linguistic tapestry that reflects the complex interactions and overlaps between languages and cultures in southern Africa. Recent studies have emphasized the importance of understanding these dialects not just as variations but as integral components of Xhosa cultural identity. For example, research on language contact and linguistic change has shown how dialects evolve over time due to historical interactions between different groups.[20] Additionally, sociolinguistic studies have explored how dialect use reflects and shapes social relationships within Xhosa communities.[21]

[19] Malcom Guthrie, *Comparative Bantu: An Introduction to the Comparative Linguistics and Prehistory of the Bantu Languages*, 4 vols. Farnborough: Gregg Press, 1967-1971.
[20] Robert K. Herbert, "The Relative Markedness of Click Sounds: Evidence from Language Change, Acquisition, and Avoidance," *Anthropological Linguistics* 32, no. 1-2 (1990): 120-138.
[21] Rosalie Finlayson, "Linguistic and Cultural Aspects of Identity: A Case Study of Xhosa Male Initiation," In *Democratically Speaking: International Perspectives on Language Planning,* 107-116, Edited by Nigel Crawhall, Salt River: National Language Project, 1998.

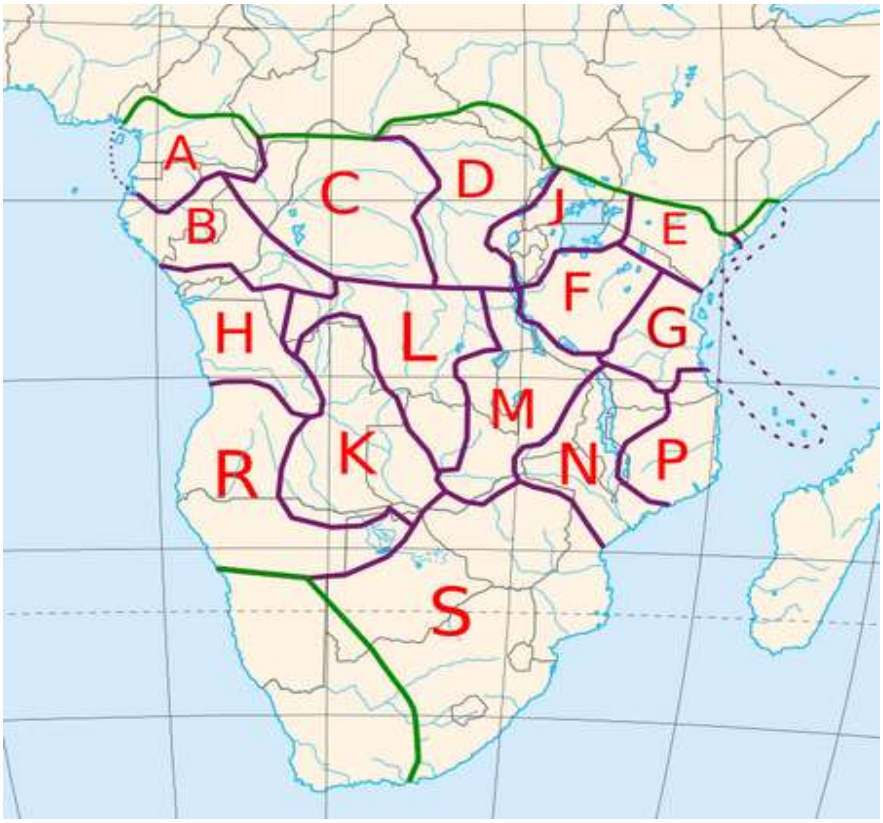

Illustration 1: https://www.wikiwand.com/en/Guthrie_classification_of_Bantu_languages

2.3 Connection Between Language and Culture

The intricate relationship between language and culture is particularly evident in Xhosa society. Matsumoto's definition of culture is "the set of attitudes, values, beliefs, and behaviors shared by a group of people, but different for each individual, communicated from one generation to the next"[22] resonates strongly with the Xhosa experience. This definition aligns with Jiang's[23] observation of the inextricable link between language and culture, suggesting that one cannot be fully understood without the other. In the Xhosa context, language serves as more than just a means of communication; it is a reflection and repository of cultural values.

[22] David Matsumoto, *Culture and Psychology*, Pacific Grove, CA: Brooks/Cole, 1996, Matsumoto, quoted in Spencer-Oatey and Franklin, *Intercultural Interaction: A Multidisciplinary Approach to Intercultural Communication*, 1.
[23] Wenying Jiang, "The Relationship Between Culture and Language," *ELT Journal* 54, no. 4 (October 2000): 328-334. https://doi.org/10.1093/elt/54.4.328.

As Kramsch and Widdowson[24] note, "the way in which people use the spoken, written, or visual medium itself creates meanings that are understandable to the group they belong to, for example, through a speaker's tone of voice, accent, conversational style, gestures and facial expressions." This observation highlights how language use in Xhosa society extends beyond mere words to encompass a range of non-verbal cues that carry cultural significance. The deep cultural embeddedness of isiXhosa is evident in everyday phrases, particularly those related to important rites of passage. For instance, discussions about traditional circumcision often employ euphemisms that might seem unrelated to outsiders but carry clear meaning for Xhosa speakers.

Phrases like "Sitya nini ngawe?" (When are we eating on account of you?) or "Usityisa nini?" (When are you feeding us?) are understood within the community to inquire about a boy's readiness for circumcision, demonstrating how language encodes cultural practices. Bereavement rituals further illustrate the language-culture connection in Xhosa society. Van Heerden's[25] research on the umkhapho and umbuyiso rituals demonstrates how language plays a crucial role in maintaining relationships between the living and the deceased. The umkhapho ritual, which "is intended to help facilitate the movement beyond so that the ancestor can return later",[26] and the umbuyiso ritual, which "literally means to bring the spirit of the ancestor back home",[27] both rely heavily on specific linguistic formulations to achieve their cultural purposes.

The use of language in these rituals goes beyond mere communication to become an integral part of the cultural practice itself. As Coplan observes in the context of Basotho funeral songs, such linguistic expressions allow "the death to be communally shared." [28] Similarly, in

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[24] Claire Kramsch *Language and Culture*, Oxford: Oxford University Press, 1998.
[25] Gary Paul Van Heerden, "Holding on or Letting Go? The Resolution of Grief in Relation to Two Xhosa Rituals in South Africa," Master's thesis, Rhodes University, 2002.
[26] Ibid.
[27] Ibid.
[28] David B. Coplan, "Basotho and the Experience of Death, Dying, and Mourning in the South African Mining Compounds," *Journal of Southern African Studies* 24, no. 2 (1998): 197-213.

Xhosa bereavement ceremonies, phrases like "Makudede ubumnyama kuvele ukukhanya" (Surpass darkness, rise light) carry deep cultural significance, embodying hopes for renewal and resilience in the face of loss. Music, too, plays a significant role in the language-culture nexus of Xhosa society. The Somagwaza song, primarily associated with initiation ceremonies but also present in bereavement rituals, exemplifies how musical expressions can evoke powerful cultural memories and emotions. Dowling et al.[29] observes that the song elicited strong emotional responses across generations underscores its role as a vehicle for cultural continuity and collective expression. The Xhosa experience demonstrates how language and culture are deeply intertwined, with linguistic expressions serving as both reflections and shapers of cultural identity. From everyday phrases to ritual utterances and musical traditions, isiXhosa embodies the values, beliefs, and practices of its speakers, illustrating the inseparable nature of languages and culture in this rich African tradition.

2.4 The Role of Traditional Songs and Music in Xhosa Culture

The role of music in Xhosa culture and broader African societies is multifaceted, serving as a powerful medium for cultural expression, communication, and preservation of heritage. Music in African cultures extends far beyond mere entertainment, permeating various aspects of daily life and significant events. In African societies, music is deeply woven into the fabric of everyday life and cultural practices. As Obaje[30] notes, African cultures are often defined by their unique musical traditions, which form an integral part of community life. Traditional African

[29] Tessa L. Dowling, Somikazi Deyi, and Anele Gobodwana, "When Culturally Significant Songs Are Decontextualised: The Initiation Song Somagwaza, A Case Study," *Southern African Journal for Folklore Studies* 28, no. 2 (2018): 1-19, https://doi.org/10.25159/1016-8427/3919.
[30] Ojochogwu Obaje, "Aesthetics in African Cultural Performance: A Critical Study of Ote'gwu Festival among the Igala People in Nigeria," PhD diss., University of KwaZulu-Natal, 2018

music typically incorporates indigenous instruments such as drums, flutes, gongs, and rattles, alongside vocal performances.[31]

The core principle of music performance in African cultures is group participation, which fosters community cohesion and shared cultural experiences.[32] This communal aspect of music-making reflects the holistic nature of African societies, where music is intrinsically linked to social, cultural, and spiritual dimensions of life. In Xhosa culture specifically, music plays a crucial role in marking important life events and rituals. Nnamini[33] highlights that songs are often performed as part of specific rituals and ceremonies, such as initiation rites and healing practices.

For instance, during initiation ceremonies, songs serve both celebratory and educational functions, often used to instill cultural values and correct undesirable behaviors among youth.[34] The concept of "ihlombe" is central to understanding the power of Xhosa traditional music. As described by Cilliers,[35] ihlombe refers to a transcendent feeling induced by music, transporting individuals to a state of overwhelming joy and fostering a sense of unity and spiritual connection. This phenomenon is particularly evident during ceremonies when songs rise in volume and pitch, often leading participants into a trance-like state. Traditional Xhosa music also serves as a medium for communication with ancestors, who are regarded as guides and protectors even after

[31] Celestine Chukwuemeka Mbaegbu, "The Effective Power of Music in Africa," *Open Journal of Philosophy* 5, no. 3 (2015): 176-183, https://doi.org/10.4236/ojpp.2015.53021.
[32] Paul F. Berliner, *The Soul of Mbira: Music and Traditions of the Shona People of Zimbabwe, Chicago*: University of Chicago Press, 1993.
[33] Sunday N. Nnamani, "The Role of Music Therapy in the Healing Process of Traditional African Society: A Case Study of Igbo Area of Nigeria," *Proceedings of INTCESS14 - International Conference on Education and Social Sciences* (2014): 453-460.
[34] Zandile Zamela, *The Role of Westernisation in Xhosa Women's Beauty Ideals, Everyday Dress Practices and Acculturation Strategies*, University of Pretoria, 2023.
[35] Cilliers, Johan. *Timing Grace: Reflections on the Temporality of Preaching*. Stellenbosch University, 2014: 125-142.

death. Sandlana[36] observes that traditional healers and initiates often use song and drumming to invoke ancestors, seeking their blessings, protection, and guidance.

The educational aspect of Xhosa traditional songs is significant, with many songs serving instructional purposes. These songs often incorporate direct words, idioms, metaphors, and proverbs to promote moral values and ethical principles.[37] This musical tradition thus acts as a powerful tool for cultural transmission and the shaping of community values. However, as Sibani[38] points out, many traditional African societies, including Xhosa communities, have been increasingly influenced by external cultures, particularly Western influences. This has led to a state of cultural confusion among many young people, resulting in a potential loss of traditional musical heritage.[39] This situation underscores the urgent need for the revival and preservation of traditional musical arts in Xhosa communities, highlighting the socio-cultural role of music for current and future generations. Xhosa traditional music, like music in many African cultures, is not just about performance; it is about connection. It celebrates life's significant moments while honoring ancestral ties, keeping the community rooted in its cultural heritage. This rich musical tradition continues to play a vital role in maintaining the cultural identity and spiritual practices of the Xhosa people, serving as a living link between past, present, and future generations.

[36]Nonkululeko Sandlana, "A Review of the Sociocultural Roles of Traditional Musical Arts in Xhosa Society," *Mediterranean Journal of Social Sciences* 5, no. 3 (2014): 544-550.
[37] Ruth Finnegan. *Oral Literature in Africa. Oxford*: Oxford University Press, 1970, Journal of Literature, Languages and Linguistics, "Literary Analysis of 'Kpaa' Songs: A Didactic Legacy of Oral Tradition," *Journal of Literature, Languages and Linguistics* 36 (2017): 21-22.
[38] Clifford Sibani, "The Role of Westernization in the Changing African Family Structures," *Humanities, Society, and Community* 62 (2018): 123.
[39] Zandile Zamela, *The Role of Westernisation in Xhosa Women's Beauty Ideals, Everyday Dress Practices and Acculturation Strategies*, University of Pretoria, 2023.

2.5 The Colonial Impact and Resurgence of Xhosa Music

The colonial era had a profound impact on Xhosa musical traditions. European missionaries often discouraged traditional Xhosa musical practices, leading to the decline of certain instruments and styles.[40] However, this period also saw creative adaptations that allowed for the preservation of Xhosa musical heritage. One notable example is the work of early Xhosa Christian converts like Ntsikana, who composed new music blending traditional Xhosa styles with Christian themes.[41] This fusion led to the integration of Xhosa musical elements into Anglican liturgy, including the use of traditional instruments, indigenous melodies, and choral traditions.[42]

Choirs, both in churches and communities, became cultural refuges where traditional Xhosa melodies and rhythms were incorporated into new musical forms. This adaptation allowed for the transmission of musical traditions to new generations despite colonial pressures.[43] As colonial influence waned, a resurgence of cultural pride emerged. Xhosa communities actively worked to revive their musical traditions as part of a broader movement celebrating Pan-African identity and liberation. Visionary composers like Hugh Masekela played a crucial role in reimagining Xhosa music, blending traditional instruments with Western classical forms to create a new, vibrant musical style.[44]

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[40] David J. Dargie, *Techniques of Xhosa Music: A Study Based on the Music of the Lumko District*. (PhD diss., Rhodes University, 1986), 105-106.
[41] Michael Hawn, *Singing Freedom: David Dargie and South African Church Music*, Nashville: Abingdon Press, 2003.
[42] Charles Burnett, "Resonating Across an Anglican-Xhosa Mission Soundscape: A Case Study," *Journal of Mission Studies* 28, no. 3 (2023): 307-325.
[43] Jonathan T. Knight, "Sing On, Ntsikana: The Story of Christian Music among the Xhosa People of South Africa" *Musical Offerings* 1, no. 1 (2010): 26-32.
[44] David B. Copeland, *In Township Tonight!: South Africa's Black City Music and Theatre*, Chicago: University of Chicago Press, 2008.

The ongoing evolution of Xhosa music demonstrates both resilience and adaptability. Modern Xhosa musicians continue to draw inspiration from this revival, creating innovative sounds that bridge tradition and contemporary styles. This process of "classical re-indigenization" reflects the complex interplay between preserving cultural heritage and adapting to changing social contexts.[45] However, debates persist around the "African" musical content in colonial-era Black South African choral music, highlighting the complex relationship between race, culture, and musical expression in post-colonial contexts.[46] These discussions underscore the importance of critically examining the preservation and evolution of indigenous musical knowledge for maintaining cultural identity and providing guidance for future generations.

2.6 The Preservation of Xhosa Language and Culture through Music: Nqobile Nkonzo's Contributions to Contemporary Classical Composition

The role of music in preserving indigenous languages is crucial, especially for Xhosa, a Bantu language primarily spoken in South Africa. Composers who merge traditional Xhosa elements with Western classical music have demonstrated vocal music's effectiveness in language conservation. In Xhosa society, music transcends mere entertainment, serving as a powerful tool for communication, narration, and emotional expression. This is exemplified in the works of composers such as Nqobile Nkonzo, who skillfully combines Xhosa heritage with European classical techniques. Nkonzo's compositions frequently feature rhythms evocative of Xhosa dance and call-and-response patterns, fostering a musical dialogue across continents. A key feature of Nkonzo's compositional style is his utilization of tonic sol-fa notation, a system

[45] Viwe Mkizwana, The Influence of Xhosa Traditional Music and Culture on Modern South African Jazz, *University of Pretoria*, 2023.
[46] Grant Olwage, ed. *Composing Apartheid: Music For and Against Apartheid*, Johannesburg: Witwatersrand University Press, 2008.

using syllables like "do, re, mi" to denote musical pitches. This method, developed by Sarah Ann Glover and popularized by John Curwen, employs a movable-do approach where "do" consistently represents the tonal center. Introduced to South Africa in the mid-19th century by Christian missionaries and later adopted by professional educators, tonic sol-fa became a fundamental tool in choral music education.[47]

The application of tonic sol-fa notation has broader implications in South Africa, where musical literacy varies. By employing this system, Nkonzo enhances the accessibility of his music to singers from diverse backgrounds, particularly in choral settings. This approach not only bridges musical traditions but also addresses literacy gaps, encouraging wider participation in music-making. Nkonzo's compositions are deeply embedded in Xhosa cultural traditions, where language and sound intertwine to create a distinctive musical landscape. A defining characteristic of this landscape is the incorporation of click consonants, which add rhythmic complexity and serve as a link to Nkonzo's cultural roots. Xhosa incorporates three main types of clicks, each contributing unique qualities to Nkonzo's compositions:

1. The dental click "C": A sharp, bright sound adding crisp, percussive elements.
2. The palatal click "Q": A deeper, more guttural sound used to convey power and drama.
3. The lateral click "X": A unique sound that adds subtle texture to the compositions.

Nkonzo's music also features a range of complex click combinations, including nasalized, aspirated, voiced, and nasalized-voiced clicks, as well as nasal and click combinations. By adeptly integrating these diverse click sounds, Nkonzo creates musical works that are both innovative and deeply rooted in Xhosa cultural identity. Analyzing Nkonzo's Xhosa arias and

[47] Robin Stevens, "Tonic Sol-fa in Contemporary Choral Music Practice: A South African Case Study," *Conference Contribution*, 2005.

songs can illustrate how non-native Xhosa speakers can learn and perform click consonants. This is particularly significant given the prevalence of clicks in Xhosa. As a dedicated music teacher and composer specializing in choral and classical music, Nkonzo is committed to inclusive education and sharing his passion for music.

His work exemplifies how traditional linguistic elements can be seamlessly integrated into contemporary classical compositions, offering listeners a unique auditory experience that bridges cultures and musical traditions. This review explores the intersection of the Xhosa language and Western classical music, examining how composers like Nkonzo contribute to language preservation and cultural exchange. It also investigates the role of tonic sol-fa notation in enhancing the accessibility of Xhosa vocal music and its potential impact on the global appreciation of Xhosa musical traditions.

2.7 Xhosa Music: A Celebration of Identity and Emotion

Expanding on Nkonzo's innovative fusion of Xhosa traditions and classical techniques, it is crucial to examine the broader cultural significance and roles of Xhosa music. Traditional Xhosa music and dance are transformative forces, especially in ceremonial settings, fostering connections with ancestors and facilitating spiritual experiences. In Xhosa society, music serves as more than entertainment; it is a fundamental medium for communication, storytelling, and emotional expression.[48] This is particularly evident in the incorporation of Xhosa musical elements into Anglican liturgy, creating a vibrant and spiritually engaging worship

[48] Benjamin Izu and Alethea DeVilliers, "The Societal Value of Music in the Xhosa Culture," *Nelson Mandela University*, July 19, 2021.

experience.[49,50] The integration of traditional instruments like drums and hand percussion with Western musical elements bridges Anglican practices and Xhosa cultural heritage.[51] Xhosa musical compositions often draw from indigenous melodies and rhythms, mirroring the poetic and metaphorical nature of Xhosa language.[52]

This poetic quality is also present in contemporary compositions, which can be analyzed similarly to traditional praise poetry (izibongo) to appreciate their artistic merit. The sociocultural roles of Xhosa music are multifaceted and significant. It is deeply woven into the fabric of daily life and important life events, serving religious, social, cultural, ritual, and moral functions. Xhosa music is often used in spiritual practices to communicate with ancestors, highlighting its profound spiritual importance.[53] Modern Xhosa music, as exemplified by Nkonzo's work, continues to evolve while maintaining its cultural essence. Contemporary composers contribute to this evolution by creating new works that address current issues, offering relevant expressions of faith and culture within the Xhosa context. By incorporating these traditional elements and functions into his classical compositions, Nkonzo not only preserves Xhosa musical heritage but also ensures its ongoing relevance in contemporary society. His work acts as a cultural bridge, connecting traditional Xhosa music with modern classical composition and inviting global audiences to experience the depth and richness of Xhosa musical traditions.

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[49] Lubabalo Qosi, "Expressing the Sacred: Music in Xhosa Culture," *Young Anglican Theology Blog*, July 8, 2024.
[50] Charles Burnett, "Resonating Across an Anglican-Xhosa Mission Soundscape: A Case Study," *Journal of Mission Studies* 28, no. 3 (2023): 307-325.
[51] Philip Burnett, "Resonating Across an Anglican-Xhosa Mission Soundscape: A Case Study of Instruments, Bells, and Processions," *Postcolonial Studies* 26, no. 3 (2023): 406-432, DOI: 10.1080/13688790.2023.2243073.
[52] Lubabalo Qosi, "Expressing the Sacred: Music in Xhosa Culture," *Young Anglican Theology Blog*, July 8, 2024.
[53] Benjamin Izu and Alethea DeVilliers, "The Societal Value of Music in the Xhosa Culture," *Nelson Mandela University*, July 19, 2021.

2.8 Pedagogical Approach

The use of music as a pedagogical tool for teaching Xhosa clicks represents an innovative approach for language learners, especially non-native speakers. This method integrates insights from linguistics, music education, and cognitive science to tackle the unique challenges presented by Xhosa's distinctive click sounds. Xhosa, primarily spoken in South Africa, incorporates three main types of clicks: dental, palatal, and lateral. These clicks are fundamental to the language's phonetic system and play a significant role in its musical traditions. The intricate nature of these sounds requires precise tongue positioning and movement, differing substantially from sounds in many other languages.[54]

Studies have demonstrated music's capacity to enhance various aspects of language learning. Research suggests that a musical approach could be particularly effective for teaching Xhosa vocabulary containing clicks, as singing has been shown to improve receptive vocabulary more effectively than spoken instruction in preschool children.[55] The benefits of integrating music into language learning go beyond vocabulary acquisition. Adding pitch information to speech can enhance word learning, a principle that could be applied to teaching Xhosa clicks. The melodic and rhythmic structures in songs may more effectively convey the subtle phonetic characteristics of these clicks, including their distinctive features in voicing duration and frequency modulation.[56]

Music in the classroom has been shown to improve learners' focus, interest, and attitude toward challenging material. This is especially relevant when teaching complex sounds like

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[54] Michael Jessen and Justus C. Roux, "Voice Quality Differences Associated with Stops and Clicks in Xhosa," *Journal of Phonetics* 30, no. 1 (2002): 1-52.
[55] Hye-Jung Kim, Hyun Ju Chong, and Min Lee, "Music Listening in Foreign Language Learning: Perceptions, Attitudes, and Its Impact on Language Anxiety," *Frontiers in Education* 9 (2024): Article 1372786. https://doi.org/10.3389/feduc.2024.1372786.
[56] "Why Music is a Must-Have Resource for Language Learning", *Lindsay Does Languages* (blog), March 10, 2022. https://www.lindsaydoeslanguages.com/why-music-is-a-must-have-resource-for-language-learning/

Xhosa clicks, which may initially appear daunting to non-native speakers.[57] The OPERA hypothesis, proposed by Patel, provides a neurological foundation for the benefits of musical training in language learning. It suggests that musical training can enhance the neural processing of speech, potentially extending to the processing of complex sounds like Xhosa clicks.[58]

2.9 Instructional Strategy

Teaching Xhosa clicks demands a systematic and multi-layered approach due to their unique articulatory and acoustic properties. The three fundamental click types—dental (c), lateral (x), and alveolar (q)—serve as the foundation for instruction. These clicks are produced through a velaric airstream mechanism, which involves creating a vacuum in the oral cavity by using two points of contact: the tongue against the soft palate or uvula at the back and the tip of the tongue or lips at the front. When the front seal is released, air rushes in, generating the distinctive click sound.[59,60] While this mechanism is intricate, Traill emphasizes that the auditory qualities of clicks are more significant for their linguistic function than their articulatory complexity.

A progressive learning strategy is recommended for teaching Xhosa clicks. This begins with mastering individual clicks, then combining them with vowels, and finally integrating them into words and phrases. Studies on Xhosa-speaking children have shown that click acquisition begins as early as age one, coinciding with the onset of speech. Gxilishe's longitudinal research revealed that children start using dental, lateral, and alveolar clicks earlier than previously

[57] "How Can Integrating Music into Your Classroom Benefit Students?" *Safe Supportive Learning*, January 1, 2011.
[58] Aniruddh D. Patel, "Why Would Musical Training Benefit the Neural Encoding of Speech? The OPERA Hypothesis," *Frontiers in Psychology* 2 (2011): Article 142.
[59] Anthony Traill, *Phonetic and Phonological Studies of !Xóõ Bushman*, Hamburg: Helmut Buske Verlag, 1985.
[60] Amanda L. Miller, Johanna Brugman, Bonny Sands, Levi Namaseb, Mats Exter, and Chris Collins, Differences in airstream and posterior place of articulation among N|uu clicks, *Journal of the International Phonetic Association* 40, no. 1(2010): 22-35.

thought, although full mastery continues beyond age three.[61] This gradual acquisition process highlights the importance of structured learning stages.

In addition to teaching basic clicks, learners should be introduced to variations such as aspiration, nasalization, and voicing, which expand the click inventory. Jessen & Roux[62] identified these variations as integral to understanding Xhosa's phonetic system. For example, aspirated lateral clicks often occur with back vowels, while dental clicks tend to pair with high front vowels.[63] These phonetic patterns provide valuable insights into how clicks function within spoken language.

Non-native speakers often face challenges when learning Xhosa clicks due to their unfamiliarity with velaric sounds. Research has shown that non-mother-tongue speakers require consistent practice and exposure to develop proficiency.[64] Immersive techniques such as listening to native speakers and practicing clicks in meaningful contexts—such as songs or conversational phrases—can enhance learning outcomes. These approaches align with findings that interactive methods improve language acquisition by engaging learners actively. Integrating cultural context into technical training is another effective strategy for teaching Xhosa clicks. Music can serve as a powerful pedagogical tool by embedding click sounds within traditional songs or compositions. This approach not only aids linguistic proficiency but also fosters cultural appreciation. For instance, incorporating songs composed by Xhosa musicians can connect learners to the cultural heritage of the language while providing practical opportunities to practice click production.

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[61] Sandile Gxilishe, "The Acquisition of Clicks by Xhosa-Speaking Children," *Per Linguam* 20, no. 2 (2004): 1-12.
[62] Michael Jessen and Justus C. Roux, "Voice Quality Differences Associated with Stops and Clicks in Xhosa," *Journal of Phonetics* 30, no. 1 (2002): 1-52.
[63] Sandile Gxilishe, "The Acquisition of Clicks by Xhosa-Speaking Children," *Per Linguam* 20, no. 2 (2004): 1-12.
[64] Anne T. Henderson and Nancy Berla, eds, *A New Generation of Evidence: The Family Is Critical to Student Achievement,* Washington, DC: National Committee for Citizens in Education, 1994.

Finally, acoustic analysis tools like Praat can be utilized to investigate the phonetic properties of clicks during instruction. Parameters such as pitch, jitter, shimmer, and harmonicity can be analyzed to provide learners with a deeper understanding of click sounds.[65] Such tools allow instructors to offer precise feedback on articulation and help learners refine their production techniques. In summary, teaching Xhosa clicks requires a combination of structured progression, cultural immersion, and technological support. By emphasizing both linguistic precision and cultural relevance, this instructional strategy promotes mastery of Xhosa clicks while celebrating the richness of the language.

[65] Michael Jessen and Justus C. Roux, "Voice Quality Differences Associated with Stops and Clicks in Xhosa," *Journal of Phonetics* 30, no. 1 (2002): 1-52.

CHAPTER THREE: METHODOLOGY

3.1 Introduction

This chapter outlines a comprehensive mixed-methods approach designed to examine the incorporation of Xhosa clicks in Western classical vocal compositions. The methodology combines music analysis, quantitative acoustic analysis, and qualitative musical score analysis, providing a multifaceted exploration of this unique linguistic-musical intersection. The study's foundation is strengthened by the researcher's background as a native Xhosa speaker.
This linguistic expertise ensures an authentic and nuanced analysis of Xhosa click sounds in both spoken and musical contexts, eliminating the need for external language consultants and enhancing the reliability of comparisons between musical and everyday usage of clicks.

The research focuses on eight musical pieces composed by South African Xhosa composer Nqobile Nkonzo, encompassing a diverse range of vocal types:

- Four pieces for soprano (aria and art songs)
- One aria for mezzo-soprano
- One aria and one art song for tenor
- One aria for baritone

These compositions incorporate 24 distinct Xhosa click consonants representing dental (C), lateral (X), and palatal (Q) sounds. From this rich phonetic palette, 20 click consonants were selected for comparative analysis between their spoken and sung forms:

1. Dental clicks: "co" (unaspirated), "nca" (nasalized)
2. Lateral clicks: "xe" (unaspirated), "nxa" (nasalized), "xho & xhe" (aspirated), "gxe" (voiced), "ngxa" (nasalized voiced)

3. Palatal clicks: "qu" (unaspirated), "nqa" (nasalized), "qhe" (aspirated), "ngqi" (nasalized voiced), "nkqwi" (nasal-palatal combination)

Additionally, several clicks were analyzed exclusively in their spoken forms to provide a broader context:

- Dental: "ci" (unaspirated), "xa" (nasalized voiced)
- Lateral: "xhwa" (aspirated)
- Palatal: "qa" (unaspirated), "gqo-gqa" (voiced)

This carefully curated sample balances depth of analysis with breadth of representation, allowing for detailed examination while providing sufficient variety to identify patterns in click usage across different vocal contexts. The acoustic analysis employs Praat software to examine the spectrograms and waveforms of Xhosa clicks in the selected compositions. Key acoustic parameters under investigation include:

1. Spectrogram analysis
2. Pitch contours
3. Intensity profiles
4. Pulse patterns
5. Formant structures

Following the spectrogram analysis, vocal reports generated from Praat are analyzed, focusing on properties such as:

- Pitch (fundamental frequency)
- Pulses
- Voicing characteristics

- Jitter (frequency perturbation)
- Shimmer (amplitude perturbation)
- Harmonicity of voiced segments

By examining these parameters, the study aims to provide a detailed understanding of the acoustic characteristics of Xhosa clicks in both spoken and sung contexts.

Music Analysis

The first aria analyzed in this study is "Wasithanda Mandela," composed by Nqobile Nkonzo in 2018 to celebrate Nelson Mandela's centenary. This piece honors Mandela's struggle and victory while incorporating Xhosa click consonants to reflect his heritage and legacy. By blending linguistic and musical elements, the composition creates a rich cultural narrative that celebrates Mandela's life through sound. One of the key click consonants featured in the piece is "ngqo," an alveolar nasalized voiced palatal click found in the word "ngqolomsila," a Xhosa clan name used as praise poetry to signify Mandela's heritage. Notated at middle C, this click is placed in the middle register to ensure clear articulation and projection. It is produced by pressing the tongue against the hard palate and releasing it quickly, creating a sound similar to a "popping cork."

Another significant click combination is "xh" (alveolar aspirated lateral) and "nx" (alveolar nasalized lateral), which appear in the word "sixhenxe," meaning "seven." Notated at B below middle C, these clicks form part of a percussive melody with contrasting note values: the aspirated click has a shorter duration, while the nasalized click is longer. This rhythmic variation adds dynamism to the composition. The dental nasalized voiced click "ngci" appears in the word "ngcindezelo," meaning "oppression." Notated at A below middle C, this click is articulated with

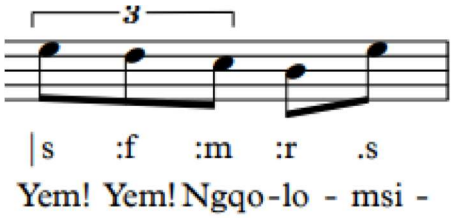
sharp energy, allowing for clear projection even within fast rhythmic phrasing. The vowel "i" following the click enhances its brightness and focus, contributing to its clarity. The alveolar nasalized lateral click "nxa" is found in the word "ngenxa," meaning "because." Notated at A above high F, it is sung in a syncopated rhythm that foreshadows the celebratory tone of Mandela's release from prison. In singing, this click requires modified articulation with lighter tongue pressure compared to its spoken form for ease of execution. Lastly, the alveolar lateral nasalized voiced click "ngxa" appears in the word "ngxatsho," an exclamation of approval. Notated at B sharp (middle C), this click involves a strong press of the tongue against the hard palate before release due to the preceding consonants ("ng"). The chromatic note leading into this click adds emotional intensity as the music approaches its climax.

Overall, Nkonzo's strategic placement of Xhosa clicks within specific registers ensures their clarity and projection while maintaining their linguistic integrity. By integrating these clicks into both rhythmic and melodic structures, the composition bridges cultural heritage with musical expression, creating a powerful tribute to Nelson Mandela's legacy.

Click consonants featured in the music:

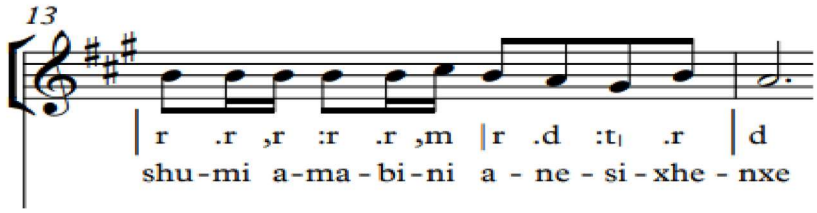
1. "Ngqolomsila"

Figure 1. Ngqo Click with Words and Music Notation from Measure 10 (The Treble clef and measure number are not indicated in this example.)



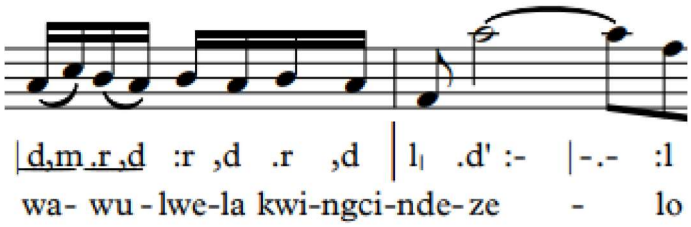
2. "Xhenxe"

Figure 2. Xhe and Nxe Clicks with Words and Music Notation from Measures 13-14



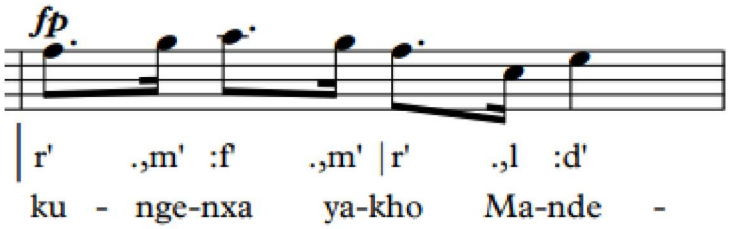
3. "Ngcindezelo

Figure 3. Ngci Click with Words and Music Notation from Measures 17-18 (The Treble clef and measure number are not indicated in this example.)



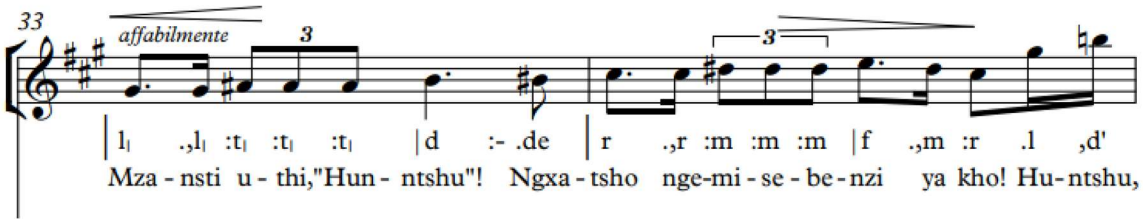
4. Kungenxa

Figure 4. Nxa Click with Words and Music Notation from Measure 23 (The Treble clef and measure number are not indicated in this example.)



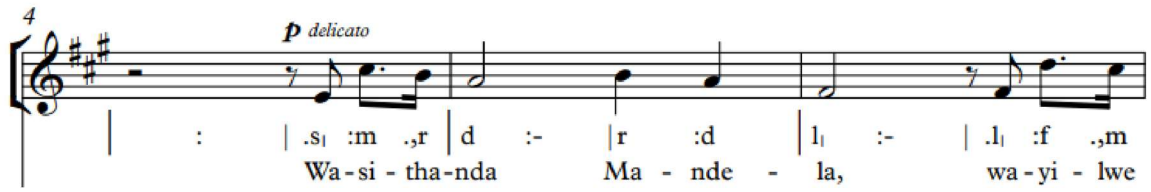
5. Ngxatsho

Figure 5. Ngxa Click with Words and Music Notation from Measures 33-34



In "Wasithanda Mandela," the composer skillfully integrates the sonic characteristics of Xhosa with musical elements, creating a harmonious blend of language and melody. This integration is particularly evident in the opening vocal line (measures 4-6), where the marking "delicato" guides performers to approach the phrase with a gentle touch. This musical direction complements the lyrical structure of the text, enhancing its expressive potential.

Figure 6. Opening Music of Wasithanda Mandela from Measures 4-6



Xhosa, as a tonal language, inherently possesses melodic qualities that the composer has skillfully incorporated into the piece. The opening lyrics, which convey Mandela's profound affection for South Africans, demand a tender delivery. By carefully aligning musical pitches with the natural cadence of spoken Xhosa, the composer achieves a seamless fusion of linguistic and melodic elements. The subtle rhyming patterns within the text further reinforce this musical-linguistic synergy. This thoughtful approach serves a dual purpose: it preserves the tonal integrity of Xhosa while effectively conveying the emotional depth of the narrative. The result is a composition that not only respects the linguistic nuances of Xhosa but also powerfully communicates the deep emotional bond between Mandela and his people. Through this method,

the composer has crafted a piece that is both linguistically authentic and emotionally compelling, demonstrating how music and language can work in concert to express complex sentiments and cultural significance.

Second Piece: "Uyehova nguMalusi," Opus 014

"Uyehova nguMalusi," Opus 014, is a soprano piece composed in 2023 as part of the song cycle "Songs of Growth," dedicated to Amanda Kosi. This composition explores life experiences through its narrative and incorporates several Xhosa clicks, showcasing the rich phonetic palette of the language within a musical context. The piece features five distinct clicks, each presenting unique challenges and opportunities for vocal expression. The first click encountered is the alveolar voiced palatal click "gqi" in the word "sigqithile," meaning "pass through." Notated as B-flat with a short duration, this click requires singers to articulate it quickly and lightly against the hard palate, maintaining the word's natural accent.

The second click, an alveolar nasalized voiced palatal click "ngqi," appears in "bungqina" (evidence). Notated on high A, this click poses a significant challenge, even for native Xhosa speakers, particularly in higher registers. Singers are advised to focus on the vowel "i" rather than the click itself to navigate this difficulty. The third click utilized is the alveolar voiced lateral click "gxe" in "ndagxekwa" (judged). Notated on F two octaves above middle C, this click demands a strong, flat tongue press against both sides of the hard palate, followed by a quick release. The placement of this click allows for clear projection and articulation without requiring vowel modification.

The fourth click, an alveolar nasalized lateral click "nxa," is found in "ngenxa" (because). Notated as E below high F, this click requires a different approach in singing compared to

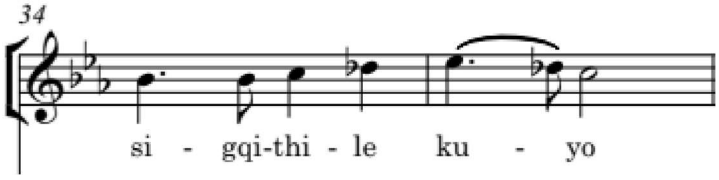
speech. Singers should use a gentler tongue release, resulting in a brighter tonal color than its spoken counterpart. The final click featured is the dental click "ci" in "ndacinga" (thinking). Notated as F above middle C, this click is generally considered easier to pronounce. Its position in the middle vocal register allows for a smooth, controlled tone that closely resembles speech. Singers should use a flat tongue placement, pressing the tip against the hard palate before releasing.

Throughout the composition, the strategic placement of these clicks within the vocal range demonstrates the composer's understanding of both linguistic and musical demands. This thoughtful integration allows for clear articulation and projection while maintaining the integrity of the Xhosa language within the musical framework. By incorporating these diverse clicks, "Uyehova nguMalusi" not only showcases the phonetic richness of Xhosa but also presents an engaging vocal challenge that bridges linguistic and musical expression.

Clicks consonants featured in the music:

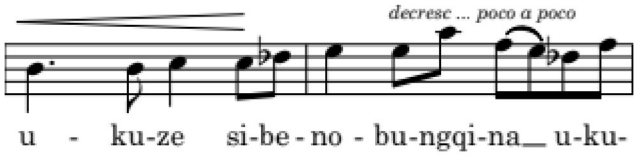
1. Sigqithile

Figure 7. Gqi Click with Words and Music Notation from measures 34-35



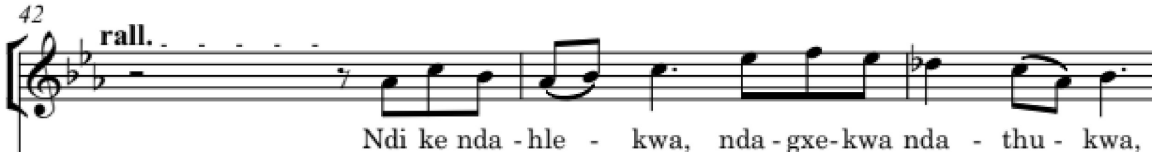
2. Bungqina

Figure 8. Ngqi Click with Words and Music Notation from Measures 36-37 (The Treble clef and measure number are not indicated in this example.)



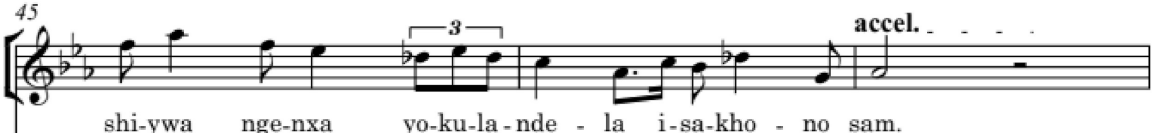
3. Ndagxekwa

Figure 9. Gxe Click with Words and Music Notation from measures 42-44



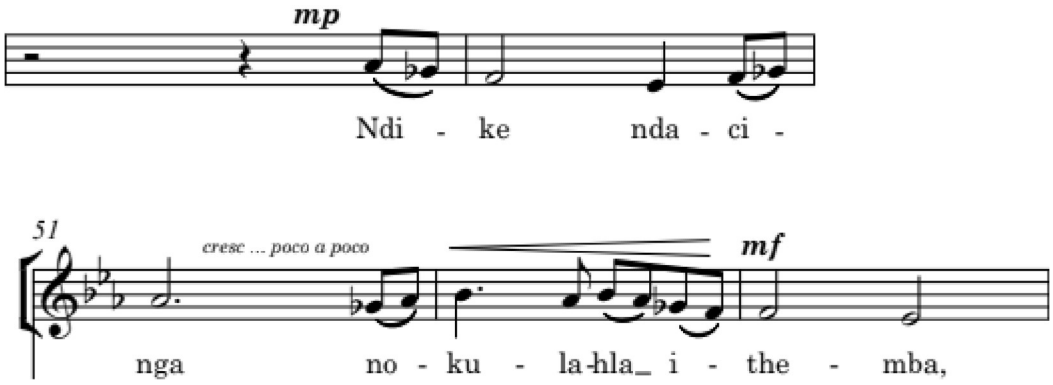
4. Ngenxa

Figure 10. Nxa Click with Words and Music Notation from Measures 45-47



5. Ndacinga

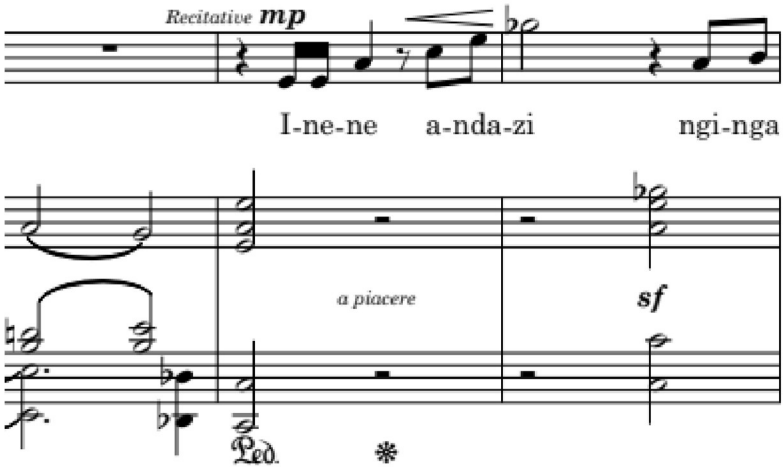
Figure 11. Ci Click with Words and Music Notation from measures 49-53 (The Treble clef and measure number are not indicated in this example.)

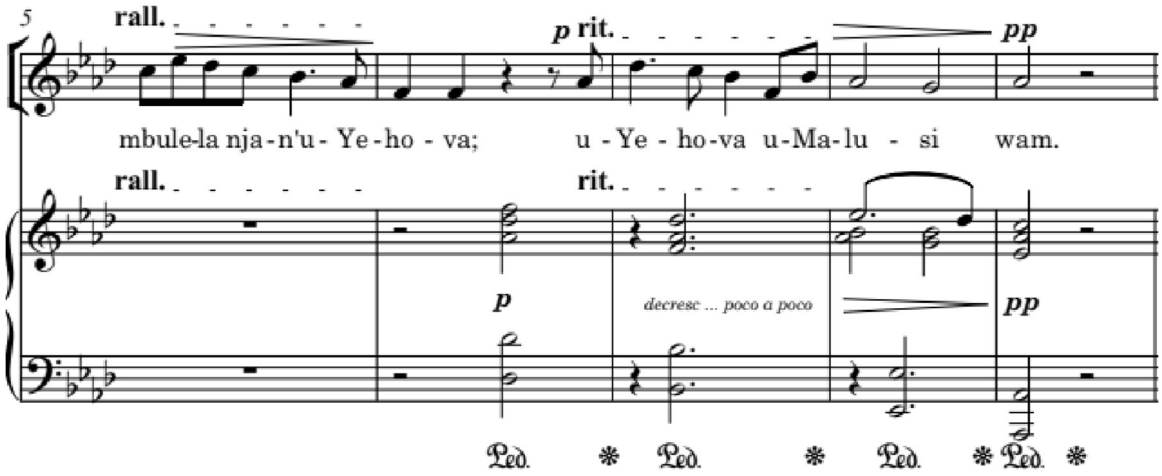


"Uyehova nguMalusi" distinguishes itself from "Wasithanda Mandela" through its innovative approach to recitative. While drawing inspiration from classical traditions, this piece

reimagines the concept of recitative, moving beyond the conventions of 18th-century Italian opera. Instead, it presents a more fluid and expressive vocal declamation that aligns closely with the tonal nuances of the Xhosa language. This contemporary interpretation of recitative serves as a bridge between traditional Western classical forms and the unique linguistic features of Xhosa. By adapting the recitative style, the composer creates a space where the natural rhythms and tones of Xhosa can flourish within a musical framework. This approach not only highlights the expressive potential of the language but also allows for a more intimate connection between the text and its musical setting.

Figure 12. Example of Melody Mirrors Language from Measures 2-9 (The Treble clef and measure number are not indicated in this example.)





"Uyehova nguMalusi" showcases a nuanced approach to vocal expression, where dynamic markings serve as a guide for phrasing that closely resembles whispered speech. This composition demonstrates a remarkable synergy between linguistic and musical structures, blurring the line between spoken and sung Xhosa. The piece ingeniously utilizes rhythm, melody, and harmonic foundations to echo the phonological patterns inherent in the Xhosa language. By doing so, it creates an auditory experience where the musical notes and spoken words share a common sonic landscape.

A distinctive feature of this work is its exploration of the upper vocal range. This choice of register significantly impacts the tonal quality, adding a unique timbre to the overall sound. The result is a composition that not only respects the tonal intricacies of Xhosa but also pushes the boundaries of vocal expression within a musical context. Through this careful integration of language and music, the composer has crafted a piece that authentically captures the essence of Xhosa speech while maintaining its artistic integrity as a musical work. This balance between linguistic authenticity and musical creativity sets "Uyehova nguMalusi" apart as a noteworthy example of cross-cultural composition.

Third Piece: Ihambo Yam, Opus 015

"Ihambo Yam," Opus 015, serves as the concluding piece in the "Songs of Growth" cycle. This composition delves into the challenging experiences faced by young South African children while emphasizing themes of resilience, hope, and the search for meaning amidst adversity. The piece showcases four distinct Xhosa clicks, each integrated thoughtfully into the musical framework. The first, an alveolar palatal click "qu," appears in "ndabaqumbela" (anger at them), notated on E below high F. This positioning allows for clear articulation without vocal strain. Singers may subtly modify the click's execution to maintain smooth vocal technique, using a gentler tongue release while preserving the characteristic popping sound.

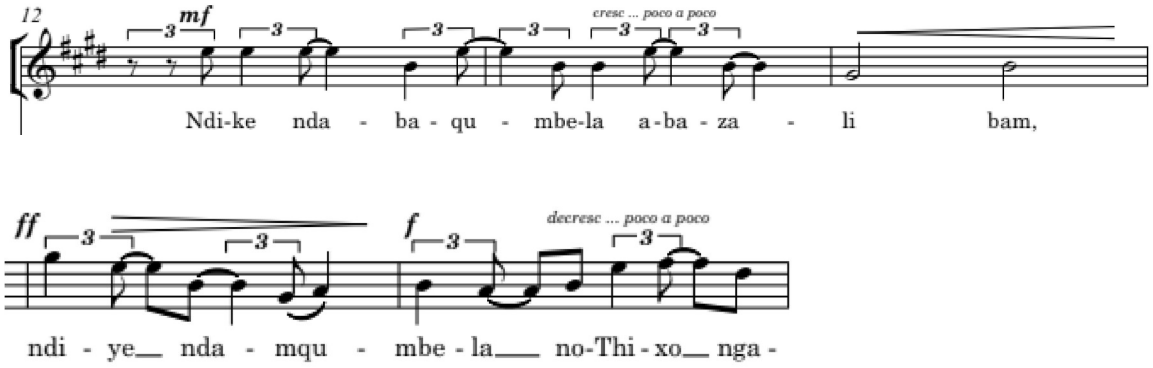
An alveolar lateral click "xo" features in "Thixo" (God), also notated on E below high F. This placement within a comfortable vocal range facilitates natural articulation. Another alveolar lateral click "xe" occurs in "xesha" (time), set on high A two octaves above middle C. This requires a lyrical, legato approach, with singers encouraged to use a softer tone to navigate the higher register while maintaining clarity.

The final click, "xa" (when), is an alveolar lateral click notated on B above middle C. Its middle-register placement allows for easy articulation and projection, with the accompanying "a" vowel contributing to the overall tonal quality. Both in speech and song, this click demands a firm tongue press and swift release against the hard palate. By carefully positioning these clicks within accessible vocal ranges, the composer ensures their clear articulation and projection while preserving their linguistic authenticity. This thoughtful integration of Xhosa phonetics with musical elements allows "Ihambo Yam" to capture both the rich sounds of the language and the emotional depth of its narrative, creating a piece that is linguistically faithful and musically expressive.

Click consonants featured in the music:

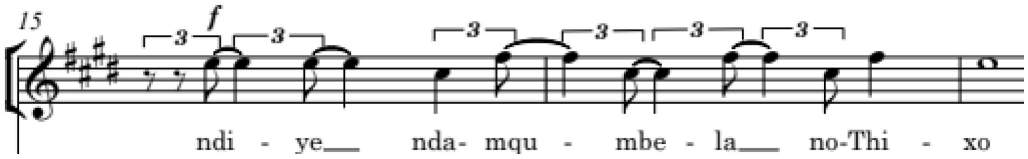
1. Ndabaqumbela

Figure 13. Qu Click with Words and Music Notation from Measures 12-14 and 19-20



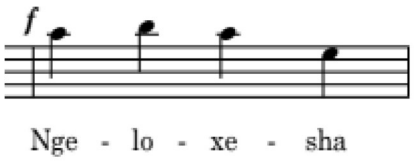
2. Thixo

Figure 14. Xo Click with Words and Music Notation from Measures 15-17



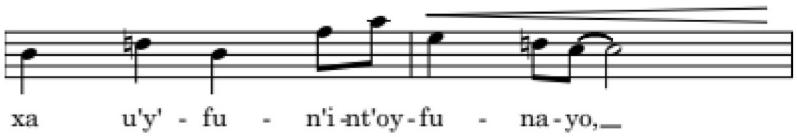
3. Xesha

Figure 15. Xe Click with Words and Music Notation from Measure 34 (The Treble clef and measure number are not indicated in this example.)



4. Xa

Figure 16. Xa Click with Words and Music Notation from Measures 83-84 (The Treble clef and measure number are not indicated in this example.)



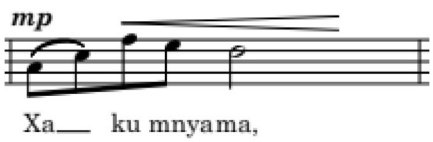
Fourth Piece: Umsimelelo, Opus 016

"Umsimelelo," composed in 2023, is the fourth piece in the song cycle *Songs of Growth*. This composition employs a single Xhosa click, "xa," which is an alveolar lateral click. The click appears in the word *Xakumyama*, meaning "when it's dark." It is notated on the note above middle C, a placement that sits comfortably within the vocal range. The combination of the "x" click followed by the vowel "a" allows for a relaxed mouth and jaw, enabling the click sound to project freely without tension. Both speaking and singing the "xa" click requires the tongue to press against the hard palate and hold briefly before releasing. When performed correctly, the sound resembles the clicking noise people make when calling a horse. This effect is achieved by pressing the tongue down on both sides of the teeth before releasing it. To maintain proper vocal technique, singers may need to slightly modify the click by softening its release to ensure smooth articulation and sound projection without interfering with vibrato. This thoughtful integration of the "xa" click into the composition highlights its linguistic authenticity while ensuring ease of vocal execution.

Click consonants featured in the music:

- Xa

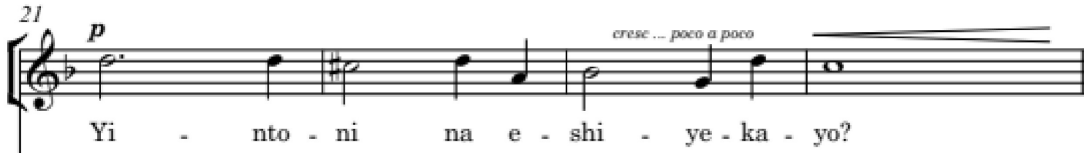
Figure 17. Xa Click with Words and Music Notation from Measure 15 (The Treble clef and measure number are not indicated in this example.)



The composer skillfully connects musical phrasing with the natural flow of the Xhosa language, intentionally structuring the music to reflect linguistic patterns and enhance the expression of the lyrics. The phrasing is designed to mirror the structure of spoken Xhosa sentences, creating a seamless and intuitive musical flow that allows listeners to follow along effortlessly.

Example:

Figure 18. Music Notation of Xhosa Syllables Measures 21-24



In this phrase *"Yintoni na eshiyekayo?"* (What is left?), the dynamic markings and timing closely align with how syllables are stressed in Xhosa speech. This thoughtful integration of language and music enhances emotional expression through carefully crafted dynamics and articulation. While this piece does not rely heavily on clicks, it effectively combines speech sounds with pitch, timbre, and rhythm to create a communicative and expressive musical experience. This approach highlights the interplay between language and melody, resulting in a composition that feels both authentic and emotionally resonant.

Fifth Piece: Ndakwenza Ntoni Na?

"Ndakwenza Ntoni Na?" is a tenor aria from the song cycle "Ubomi," Opus 010, composed in 2019. This piece narrates the story of an individual grappling with unjust treatment from a neighbor, questioning why they face such adversity despite their kindness towards others. The composition skillfully incorporates several Xhosa clicks, showcasing the language's rich phonetic palette within a musical context. One of the most challenging click combinations appears in the word "ndizigqogqa" (meaning "search"), which features two instances of the "gq"

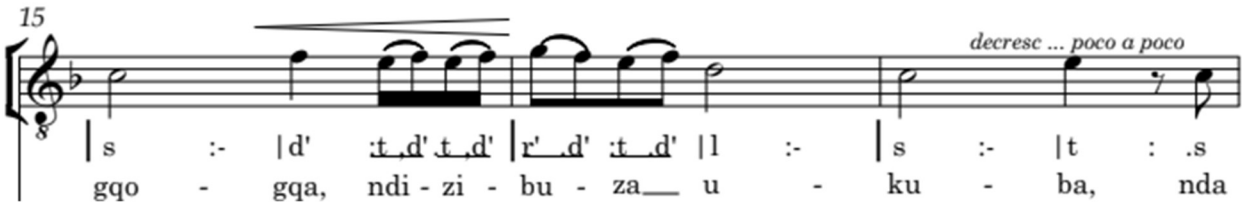
alveolar voiced palatal click. These clicks are notated on C and F above middle C, respectively. Interestingly, this notation inverts the natural tonal pattern of spoken Xhosa, where the first "gqo" is typically higher in pitch than the second "gqa". This compositional choice presents an intriguing challenge for performers, who must balance authentic pronunciation with adherence to the notated pitches.

The aria also incorporates the "ngxa" alveolar voiced lateral click in the word "andinangxaki" ("no problem"). Notated as D above middle C, this click requires a light articulation approach in singing, with some modification necessary to maintain vocal fluidity. The placement within the vocal range allows for clear articulation without undue strain. Another notable click is the alveolar lateral "xa," appearing twice in "xakaxa" ("mucus"). These clicks are notated on C and E above middle C, falling comfortably within the tenor range. The vowel "a" following each click aids in brightening the tone and facilitating manageable pronunciation. Throughout the piece, the composer demonstrates a keen understanding of both linguistic authenticity and vocal technique. The strategic placement of clicks within singable ranges allows performers to navigate the unique challenges of Xhosa phonetics while maintaining musical integrity. This thoughtful integration of language and music creates a compelling narrative experience, inviting listeners into the emotional landscape of the story while showcasing the expressive potential of Xhosa clicks in classical vocal composition.

Click consonants featured in the music:

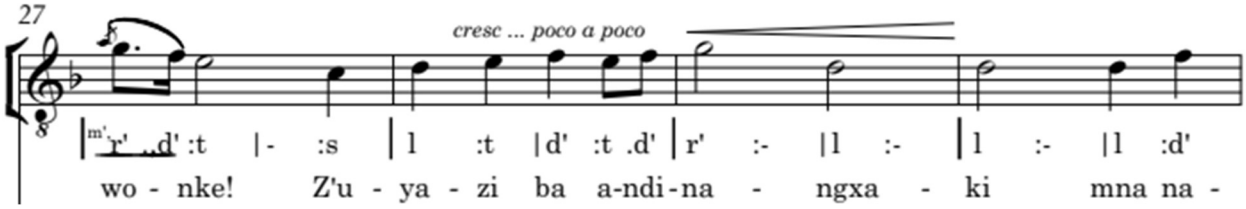
1. Ndizigqogqa

Figure 19. Gqo and Gqa Clicks with Words and Music Notation from Measures 15-17



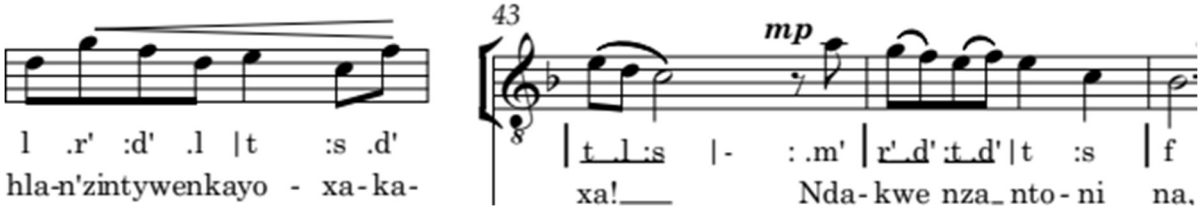
2. Andinangxaki

Figure 20. Ngxa Click with Words and Music Notation from Measures 27-30



3. Xakaxa

Figure 21. Xa Click with Words and Music Notation from Measures 42-43 (The Treble clef and measure number are not indicated in the example on the left.)



The inclusion of the voiced lateral click "ngxa" in a phrase meaning "no problem" enriches the composition with cultural depth. By combining this complex phonetic element with a casual expression, the piece highlights the integral role of unique sounds in everyday Xhosa language. This integration challenges performers to refine their vocal techniques while maintaining the linguistic authenticity of the clicks. The distinction between singing and speaking these clicks underscores the artistic skill required to merge traditional African linguistic features with classical vocal performance. The use of "xakaxa" in the composition not only adds

a unique phonetic dimension to the music but also serves as a cultural bridge between traditional Xhosa linguistics and classical singing techniques. By accurately reproducing these clicks in a musical context, performers help preserve and celebrate Xhosa's rich linguistic heritage while pushing the boundaries of classical vocal expression. Nqobile's approach to notation, using tonic solfa to make the music more accessible, reflects a thoughtful consideration for South African singers who may not read standard musical notation. The composition's musical phrasing, rhythm, and language usage are carefully coordinated to mirror the grammatical structure of Xhosa, resulting in a harmonious interplay of pitch and rhythm that enhances the overall musical flow. The composition features a harmonious relationship between the melodic line and accompaniment, with both elements moving in parallel ascending and descending patterns. This homophonic texture creates a cohesive musical landscape, where the supporting harmony reinforces the melodic progression, resulting in a unified and sonorous expression of the Xhosa text.

Sixth Piece: Kufa Ulutshaba, Opus.010

"Kufa ulutshaba," the fifth aria in the song cycle "Ubomi," presents a compelling exploration of death's impact on families through the lens of Xhosa language and classical vocal technique. Composed for baritone, this piece weaves together complex linguistic elements with emotive musical expression, creating a unique challenge for performers. The aria incorporates five distinct Xhosa clicks, each contributing to the rich phonetic tapestry of the piece. The alveolar nasalized palatal click "nqa" in "umnqantsa" (hope) opens the linguistic journey, notated as a sustained high A. This is followed by the alveolar nasalized voiced palatal click "ngqi" in

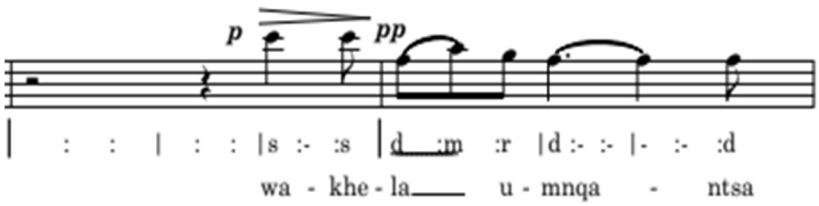
"ndiyangqina" (I agree), set to a high B natural with chromatic coloring that intensifies the emotional delivery.

As the piece progresses, singers encounter the alveolar palatal click "qa" in "sisiqalekiso" (it is a curse), notated on a challenging high C. The composer's choice of placing this click in the upper register necessitates careful vocal technique to maintain both linguistic authenticity and vocal health. The aspirated palatal click "qhe" in "kuqhekeke" (broken apart) pushes vocal boundaries further, set to a high D-flat with a mezzo-piano dynamic marking, requiring singers to balance clear articulation with controlled volume. The aria culminates with the dental nasalized voiced click "ngcu" in "uyingcungcuphela" (bothersome), appearing twice on a high A. This final click demands precise tongue placement and timing, exemplifying the intricate balance between linguistic accuracy and vocal performance that characterizes the entire piece. Through this thoughtful integration of Xhosa clicks within a classical vocal framework, "Kufa ulutshaba" not only tells a poignant story of loss and hope but also serves as a testament to the expressive potential of merging diverse linguistic and musical traditions. It challenges performers to expand their technical and interpretative skills, resulting in a performance that is both culturally rich and musically compelling.

Click consonants featured in the music:

1. Umnqantsa

Figure 22. Nqa Click with Words and Music Notation from Measures 14-15 (The Bass clef and measure number are not indicated in this example.)



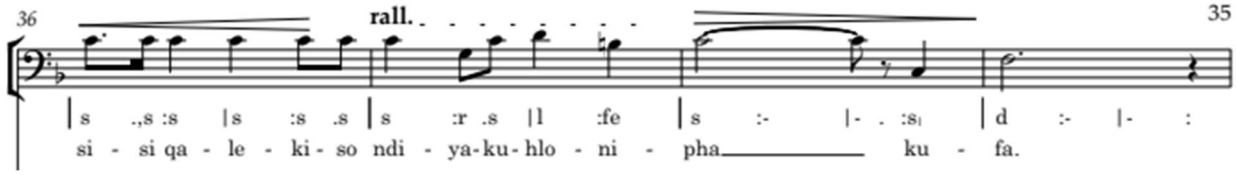
2. Ndiyangqina

Figure 23. Ngqi Click with Words and Music Notation from Measures 33-35



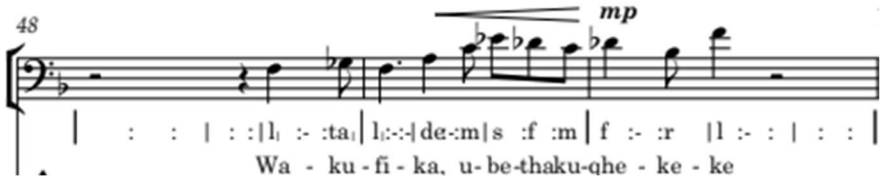
3. Siqalekiso

Figure 24. Qa Click with Words and Music Notation from Measures 36-39



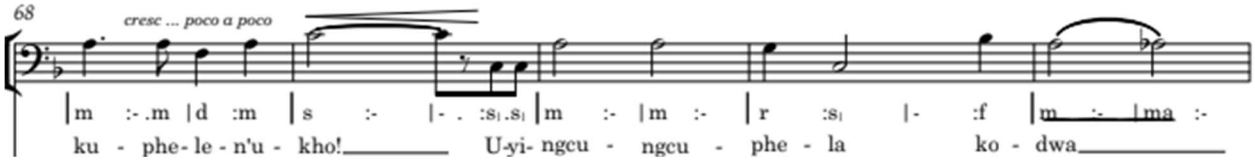
4. Kuqhekeke

Figure 25. Qhe Click with Words and Music Notation from Measures 48-50



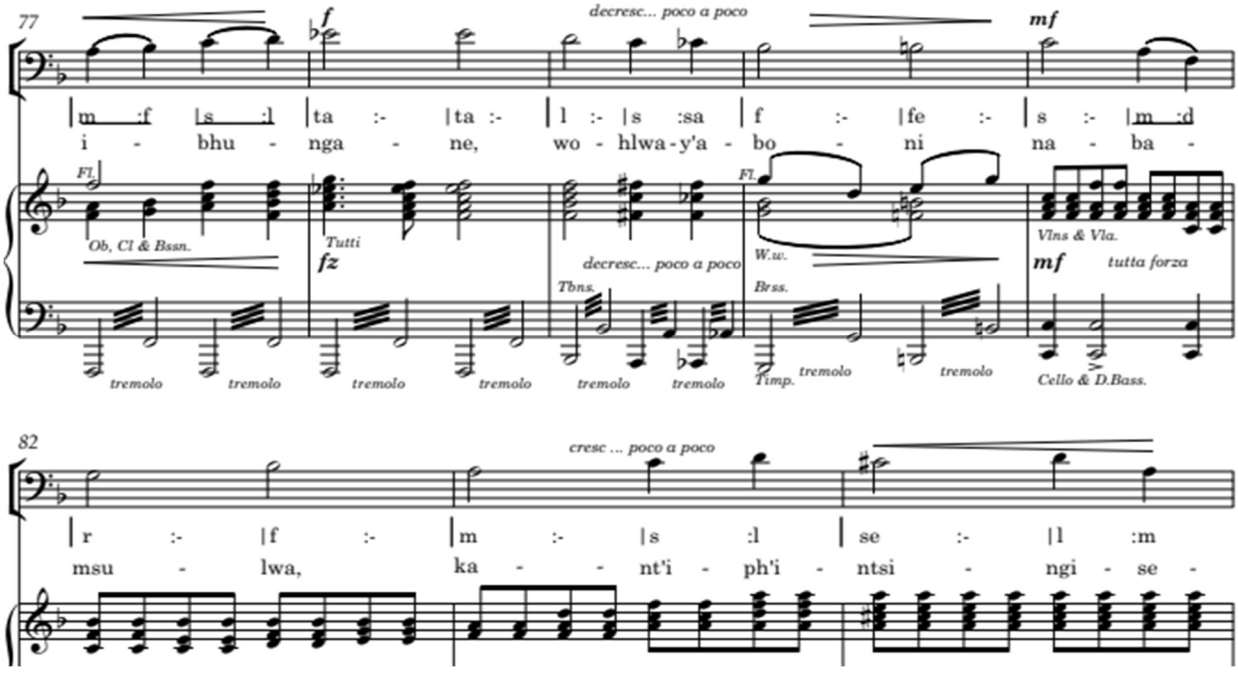
5. Uyingcungcuphela

Figure 26. Ngcu Click with Words and Music Notation from Measures 68-72



The melody in *Kufa ulutshaba* is deeply expressive and lyrical, capturing the duality of grief—its pain and the faint possibility of hope. The Xhosa lyrics convey a perspective of someone grappling with death's inevitability, while the interplay between instrumentation and vocal delivery mirrors the emotional journey described in the text. By exploring universal themes of loss and mortality, the piece resonates deeply, leaving listeners with a sense of unresolved emotion that reflects the ongoing struggle against death's finality. The composition's structure reinforces its thematic elements through strategic tempo and dynamic changes. Shifts in pace mirror the unpredictable nature of grief and the human fight against mortality. The alternation between soft pianissimo and powerful fortissimo passages effectively depicts emotional turbulence and resistance. As the volume builds, so does the tension, representing either mounting anguish or growing defiance in the face of death. These musical techniques work in harmony with the lyrics to create a profound and moving exploration of one of life's most challenging experiences.

Figure 27. Syllabic Depiction of Grief with Music from Measures 77-84



This example shows how the musical elements work cohesively with the lyrics to create a powerful and poignant exploration of loss and resistance.

Seventh Piece: Undishiyelani Na?

"Undishiyelani Na?" is a heartfelt composition written for tenor, piano, and cello by Nqobile Nkonzo in 2017. Dedicated to the memory of her aunt, Zodwa Pretty Nkonzo, the piece explores themes of loss and grief while incorporating Xhosa click consonants that add linguistic depth and vocal complexity. The clicks are carefully integrated into the musical structure, showcasing the composer's attention to both technical and emotional aspects of performance. The first click, "gqi," is an alveolar nasalized voiced palatal click notated as D above middle C. Its placement within the vocalist's range ensures authentic reproduction without compromising vocal mechanics. To execute this click, the singer must press their tongue firmly against the hard palate with consistent pressure, allowing for accurate sound production while maintaining pitch. This thoughtful integration reflects the composer's focus on blending speech and song techniques seamlessly.

The second click, "nxa," is an alveolar nasalized lateral click notated as B above middle C. This click introduces complexity due to the nasal "n" sound preceding the lateral "x." For singing, performers are advised to maintain light tongue contact with reduced pressure for easier articulation and projection. In speech, however, stronger tongue pressure is required to ensure precise pronunciation. The third click, "nkqwi," combines alveolar nasal and palatal elements and is notated as C above middle C. Rarely used in daily Xhosa conversation, this click demands careful vocal technique. Singers must maintain light tongue contact with minimal pressure while

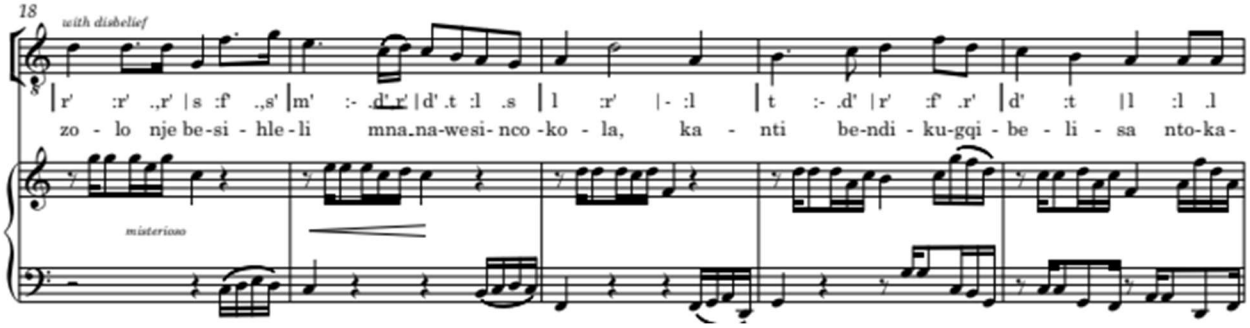
keeping the throat tension-free to preserve vocal fluidity. Modifications may be necessary to balance authenticity and ease of execution during performance.

The fourth click, "ngxa," is an alveolar nasalized voiced click found in the word "neengxaki" (problems) and notated as C above middle C. Its pronunciation involves holding the tongue lightly against the hard palate before releasing it to create the click sound. While spoken articulation requires firm tongue pressure for authenticity, singers may adapt their technique to prioritize vocal resonance and ease. This composition challenges performers to navigate between linguistic authenticity and vocal practicality while honoring the cultural significance of Xhosa clicks. Mastering these sounds requires a nuanced understanding of their phonetic intricacies, regular practice, and sensitivity to their emotional context within the music.

Click consonants featured in the music:

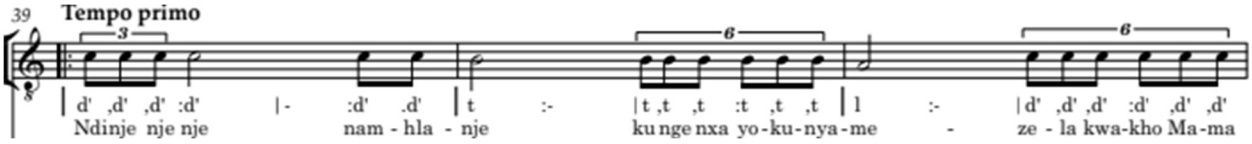
1. Kugqibelisa

Figure 28. Gqi Click with Words and Music Notation from Measures 18-22



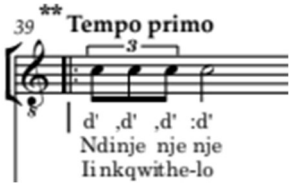
2. Ngenxa

Figure 29. Nxa Click with Words and Music Notation from Measures 39-41



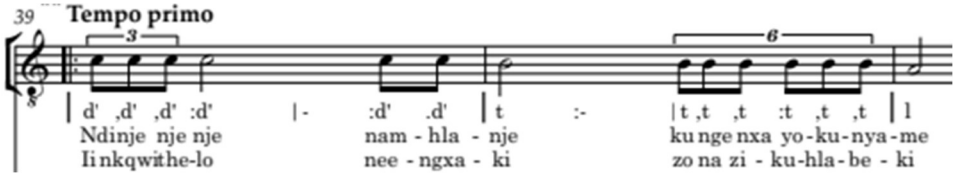
3. Iinkqwithelo

Figure 30. Nkqwi Click with Words and Music Notation from Measure 39



4. Neengxaki

Figure 31. Ngxa Click with Words and Music Notation from Measure 39-40



The integration of Xhosa clicks "Gqi," "Nxa," "Nkqwi," and "Ngxa" into "Undishiyelani Na?" showcases a rich phonetic tapestry, adding unique vocal elements to classical singing. This thoughtful incorporation demonstrates profound respect for linguistic heritage while expanding the boundaries of vocal technique. The composition's structure carefully mirrors Xhosa language patterns, with melodic lines and phrasing crafted to follow the natural rhythm and cadence of Xhosa sentences. This approach creates a seamless blend of music and linguistics, elevating the piece beyond mere song to a cultural narrative deeply rooted in Xhosa tradition. The rhythm of the piece highlights the inherent dramatic expression of the Xhosa language. Quick, staccato passages represent the sharp clicks, while flowing legato lines mirror the language's tonal qualities. The accompaniment echoes the rhythmic patterns of the clicks or provides a contrasting backdrop that accentuates the distinctive sounds of the language. Through this meticulous integration of language and music, "Undishiyelani Na?" becomes a powerful vehicle

for storytelling and emotional expression, honoring the Xhosa linguistic tradition while creating a unique and evocative musical experience.

Eighth Piece: Ndakuwubon' Umnqamlezo

"Ndakuwubon' Umnqamlezo" is a profound composition for mezzo-soprano from the oratorio "The Crucifixion," Opus 005, written in 2018. This piece explores themes of devotion and redemption, centering on Jesus's sacrifice for his followers. The composition uniquely incorporates Xhosa linguistic elements, particularly clicks, which add cultural depth and phonetic complexity to the music. The piece features seven distinct Xhosa clicks, each presenting unique vocal challenges and contributing to the rich linguistic tapestry of the work. The first click, "nqa," an alveolar nasalized palatal click, appears in the word "umnqamlezo" (the cross). Notated as C above middle C, it requires singers to hold their tongue firmly against the hard palate before release, maintaining consistency in both singing and speaking.

The second click, "xho," an alveolar aspirated lateral click, is found in "kwaxhonywa" (was hanged). Notated as F above middle C, it demands minimal pressure in aspiration when singing, allowing for relaxed vocal production while maintaining authenticity. The third click, "nca," a nasalized dental click in the word "ndancama" (give up), is notated as F above middle C. This click requires a firm tongue position against the hard palate and maintains consistency across singing and speaking. The fourth click, "xu," an alveolar lateral click in "luxubene" (mixed), is notated as a sixteenth note E below high F, allowing for manageable execution in fast rhythmic passages. The fifth click, "xo," another alveolar lateral click found in "thixo" (God), is notated as G above middle C, offering smooth transitions between vocal registers. The sixth click, "xhwa," an alveolar aspirated lateral click in "walixhwane" (a lamb), presents a unique

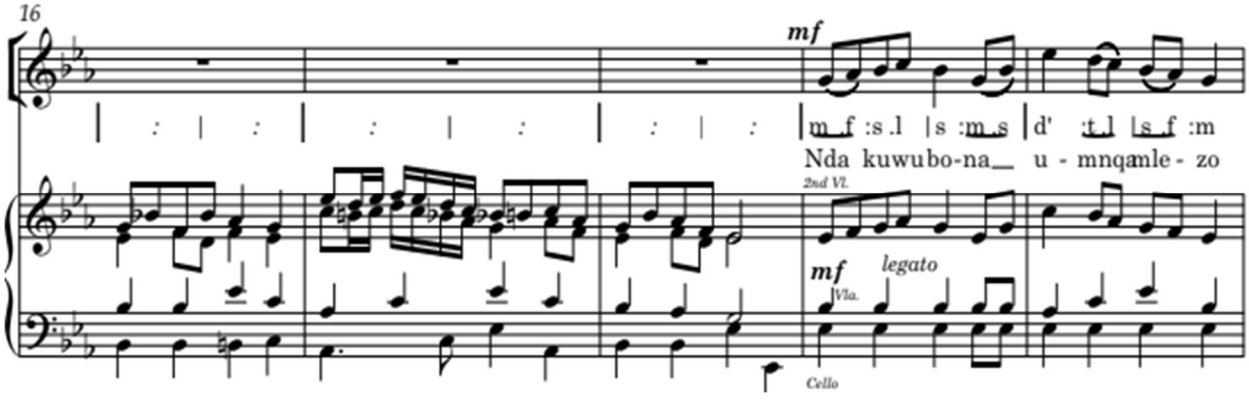
challenge with its rapid transition from click to "w" sound. Notated as G above middle C, it requires careful practice to execute smoothly.

The final click, "co," a dental click in "sicoce" (purify us), is notated as E above middle C. This click demands precise tongue placement and quick release, adding phonetic symbolism to the text. Each click is strategically placed within comfortable vocal ranges, allowing singers to balance authentic pronunciation with vocal ease. This thoughtful integration of Xhosa clicks into classical vocal music not only showcases the rich phonetic diversity of the language but also creates a unique musical experience that bridges cultural and linguistic traditions. Performers must navigate the complex interplay between linguistic accuracy and musical expression, resulting in a performance that is both technically challenging and emotionally resonant.

Click consonants featured in the music:

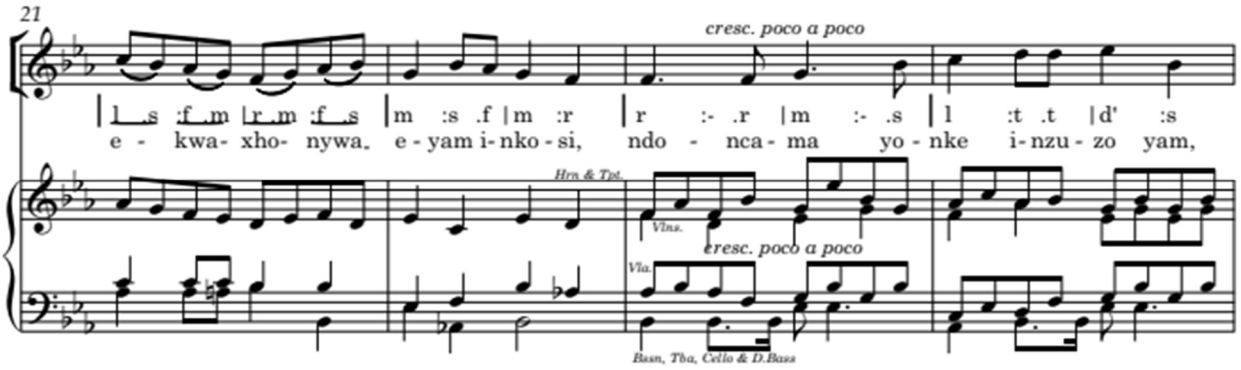
1. Umnqamlezo

Figure 32. Nqa Click with Words and Music Notation from Measures 16-20



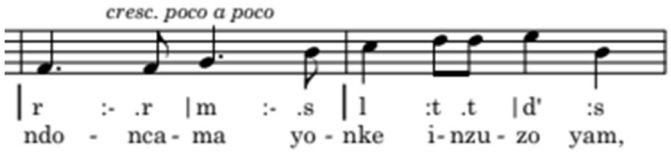
2. Kwaxhonywa

Figure 33. Xho Click with Words and Music Notation from Measures 21-24



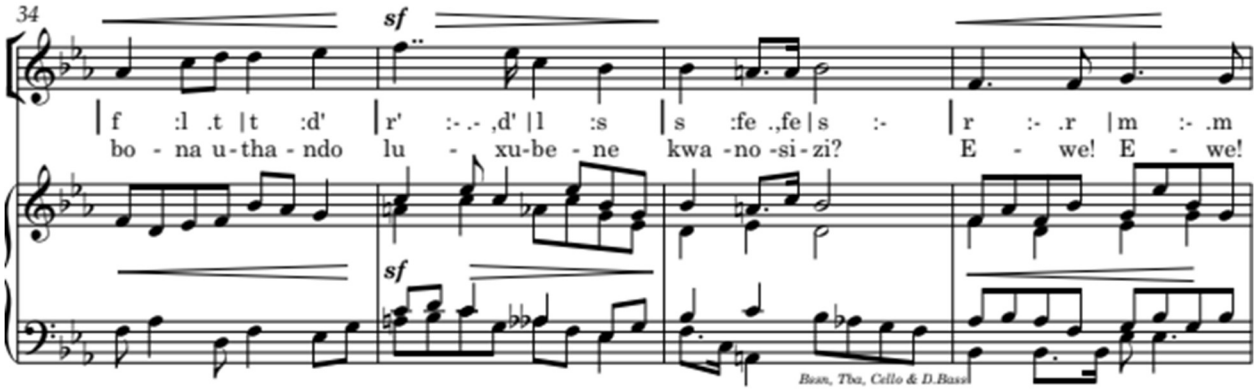
3. Nca-ndoncama

Figure 34. Nca Click with Words and Music Notation from Measures 23-24 (The Treble clef and measure number are not indicated in this example.)



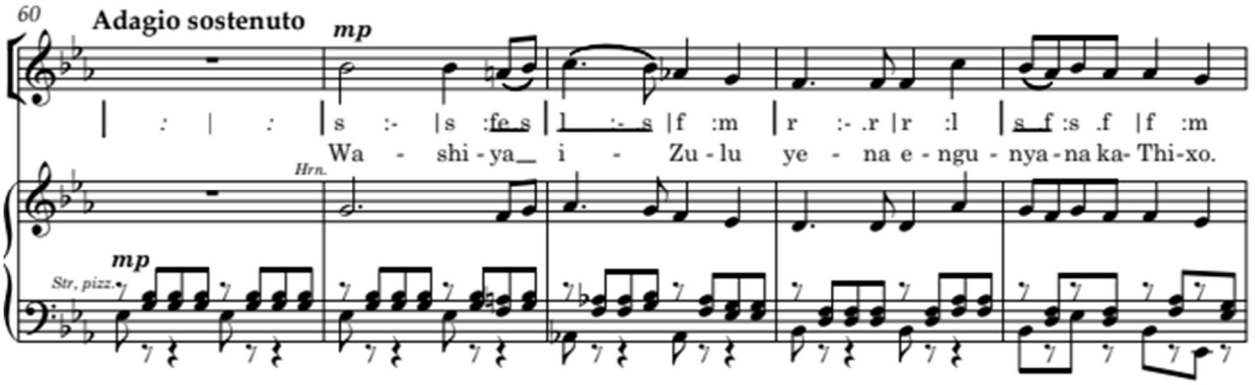
4. Luxubene

Figure 35. Xu Click with Words and Music Notation from Measures 34-37



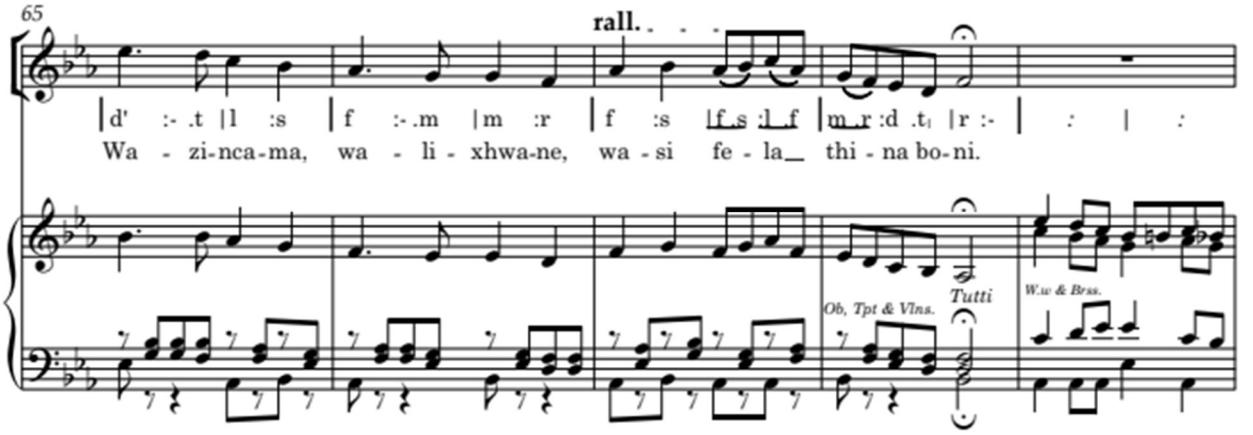
5. Thixo

Figure 36. Xo Click with Words and Music Notation from Measures 60-64



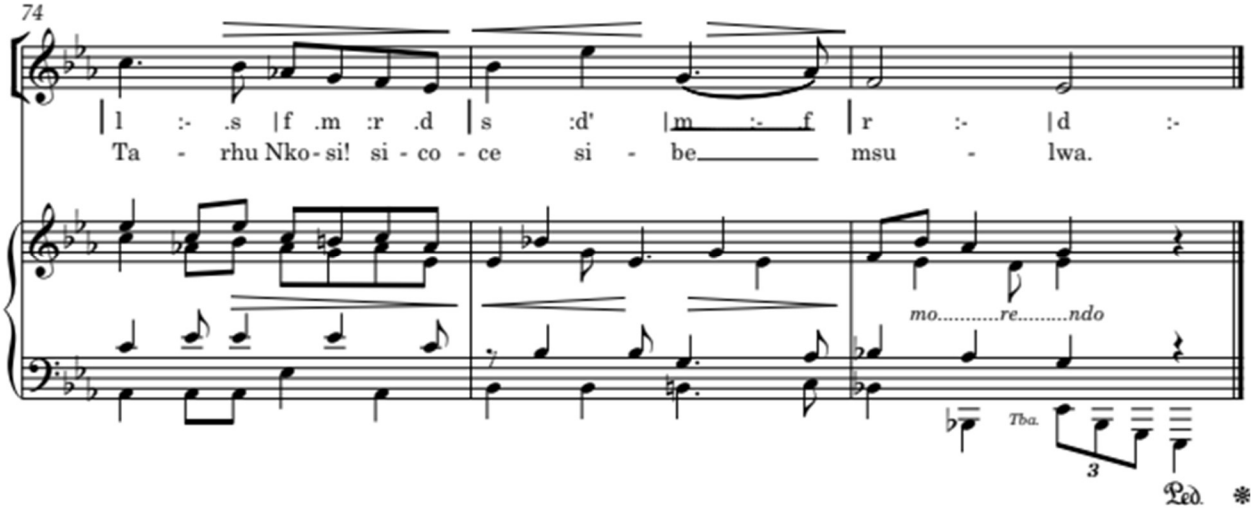
6. Walixhwane

Figure 37. Xhwa Click with Words and Music Notation from Measures 65-69



7. Sicoce

Figure 38. Coce Click with Words and Music Notation from Measures 74-76



The inclusion of Xhosa clicks, such as "nqa," enriches the piece by reflecting linguistic traditions tied to South African culture. The word *umnqamlezo* ("the cross") holds symbolic weight within both Christian theology and Xhosa expression, emphasizing themes of sacrifice and faith. The use of clicks not only challenges performers technically but also invites them to engage deeply with cultural authenticity. The "nqa" click in *Ndakuwubon' Umnqamlezo* exemplifies how linguistic elements can enhance musical storytelling. By mastering proper articulation techniques and understanding its cultural significance, singers can deliver a performance that is both technically proficient and emotionally resonant, honoring the intricate interplay between language and music in this powerful composition.

The inclusion of the aspirated lateral click "xho" not only adds linguistic authenticity but also deepens the connection between the music and its cultural roots.The incorporation of the "nca" click not only adds linguistic authenticity but also deepens the connection between the music, its cultural roots, and its spiritual message. It also exemplifies the intricate interplay between language, music, and storytelling. Its straightforward execution in both singing and speaking allows performers to focus on the emotional delivery of the text. By mastering this click, singers can provide a rendition that is linguistically accurate, technically sound, and emotionally resonant, honoring both the cultural heritage and the spiritual depth of the piece. The seamless integration of this click into the vocal line underscores the composer's skill in marrying complex linguistic elements with accessible vocal techniques, creating a powerful vehicle for musical and cultural expression. The inclusion of such a complex click in a word meaning "lamb" showcases the rich phonetic tapestry of the language. It demonstrates how intricate sounds are integrated into everyday vocabulary, reflecting the linguistic depth of the culture.

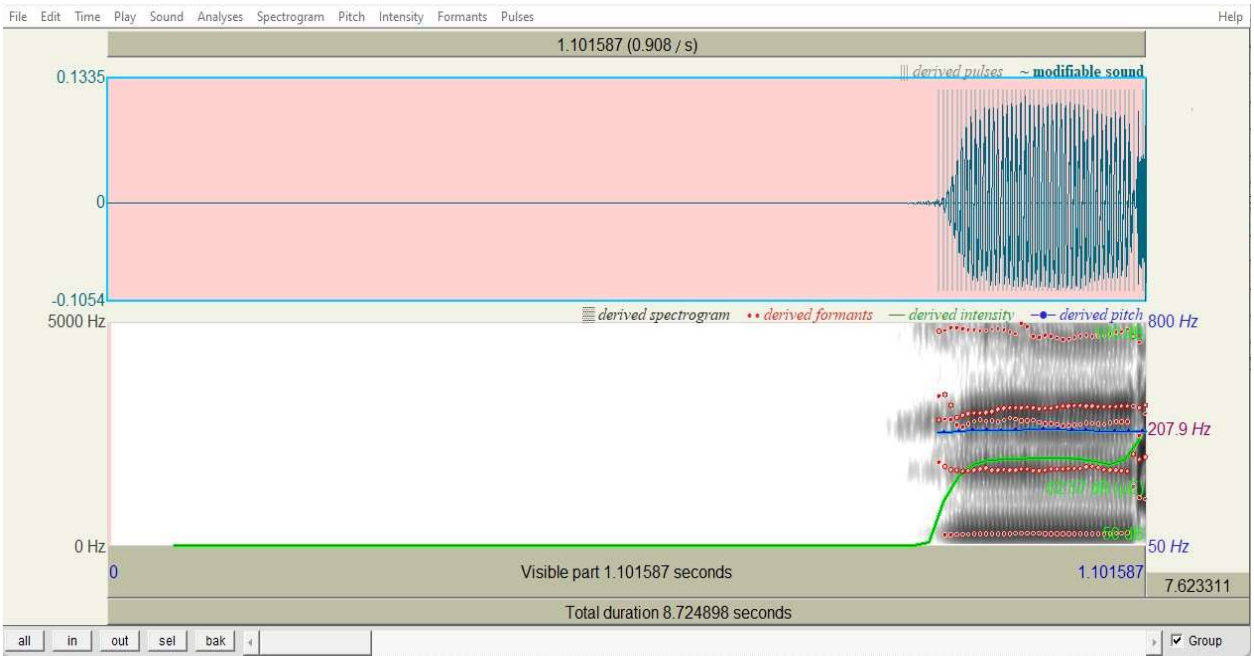
Spectrogram Analysis of Featured Click Consonants:

This study employs acoustic analysis to examine Xhosa click consonants in the complete vocal works of Nqobile Nkonzo, comprising seven compositions. The eight-piece titled 'Umsimelelo' is not included here because it incorporates clicks similar to those used in other pieces analyzed in this study. The analysis will commence with the aria "Wasithanda Mandela," and will then be applied systematically to the remaining pieces. This comprehensive approach shows the structure that logically presents the findings (spectrogram analyses, pitch, intensity, formants, and pulses). This allows for a broad investigation into the phonetic diversity of the Xhosa language within Nkonzo's vocal compositions. Each work incorporates distinct clicks: in "Wasithanda Mandela," these include "ngqo" in Ngqolomsila, "xhe" in Sixhenxe, "nci" in Ngcindezelo, "nx" in Kungenxa, and "ngxa" in Ngxatsho.

Spoken and sung Xhosa click consonants will be extracted from recordings of each aria and song for individual analysis, utilizing spectrogram and waveform analysis for visual inspection and valuable insights into acoustic properties. This methodology will provide a detailed understanding of the acoustic properties of Xhosa clicks across Nkonzo's entire vocal output, revealing patterns and nuances in the integration of these sounds into vocal music.

Spectrogram Analysis of Spoken Clicks

1. "Ngqo"- Nasalised Voiced Palatal Click



Spectrogram Analysis of "Ngqo" Click:

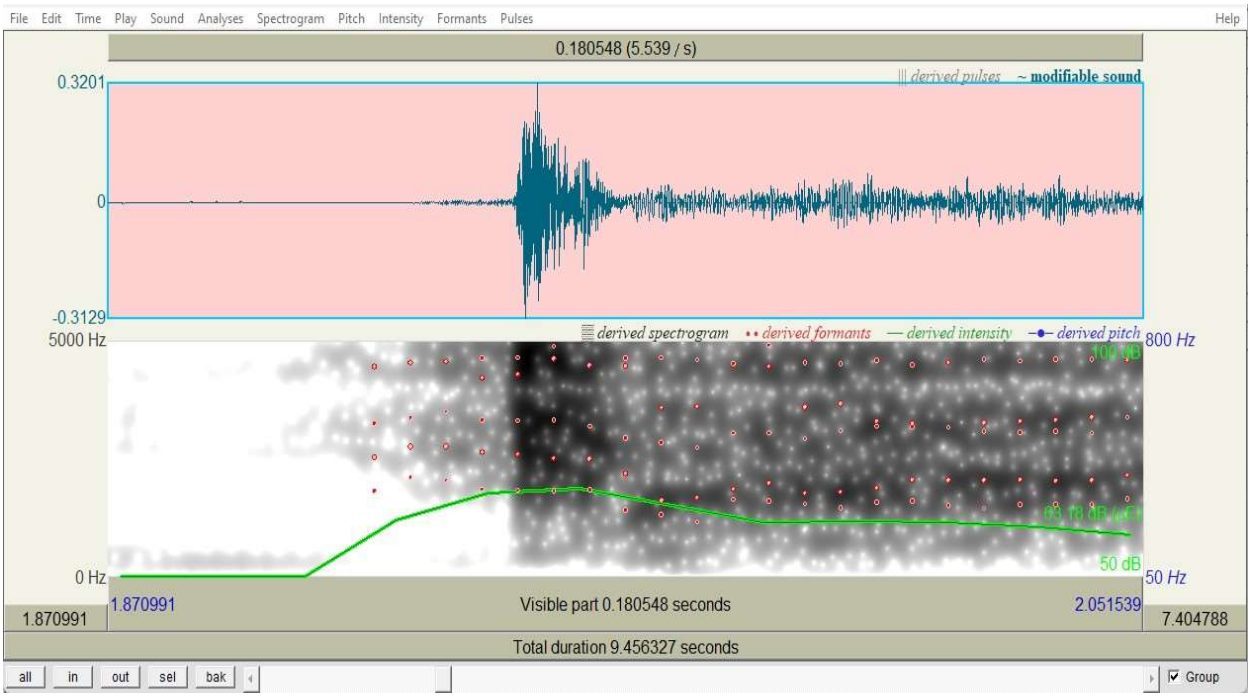
Spectrogram analysis (0-5000 Hz) of the "Ngqo" click reveals significant acoustic features. The non-uniform amplitude distribution of the following vowel "O" likely reflects the complex articulatory transition from the click release to the vowel. The spectral characteristics are influenced by vocal tract configuration, particularly tongue position, affecting formant frequency distribution. The pitch contour (50-800 Hz) yields a derived pitch of 207.9 Hz. Given that the click is notated at middle C, this corresponds to 261.63 Hz, which shows it may have been a challenge to sing the click in the correct pitch. As written in the document, this click is sung while pressing the tongue against the hard palate.

Intensity Analysis: Intensity measurements (50-100 dB) show the intensity contour intersecting the derived pitch at 207.9 Hz. The level of 50-100 dB may be a result of the pressing of the tongue against the hard palate for authentic pronunciation.

Formant Structure: Formant frequencies: F1: 550.46 Hz, F2: 1739.10 Hz, F3: 2695.71 Hz, F4: 3288.64 Hz reveal the configuration of the vocal tract as it provides. The results are the best way to create the “popping cork” click while maintaining vocal tone.

Glottal Pulse Analysis: Glottal pulse range: -0.4113 to 0.4626, reveals that the click is a nasalized voiced palatal click that is essential.

2. “Xhe”-Aspirated Lateral Click



Spectrogram Analysis of "Xhe" Click in "Sixhenxe":

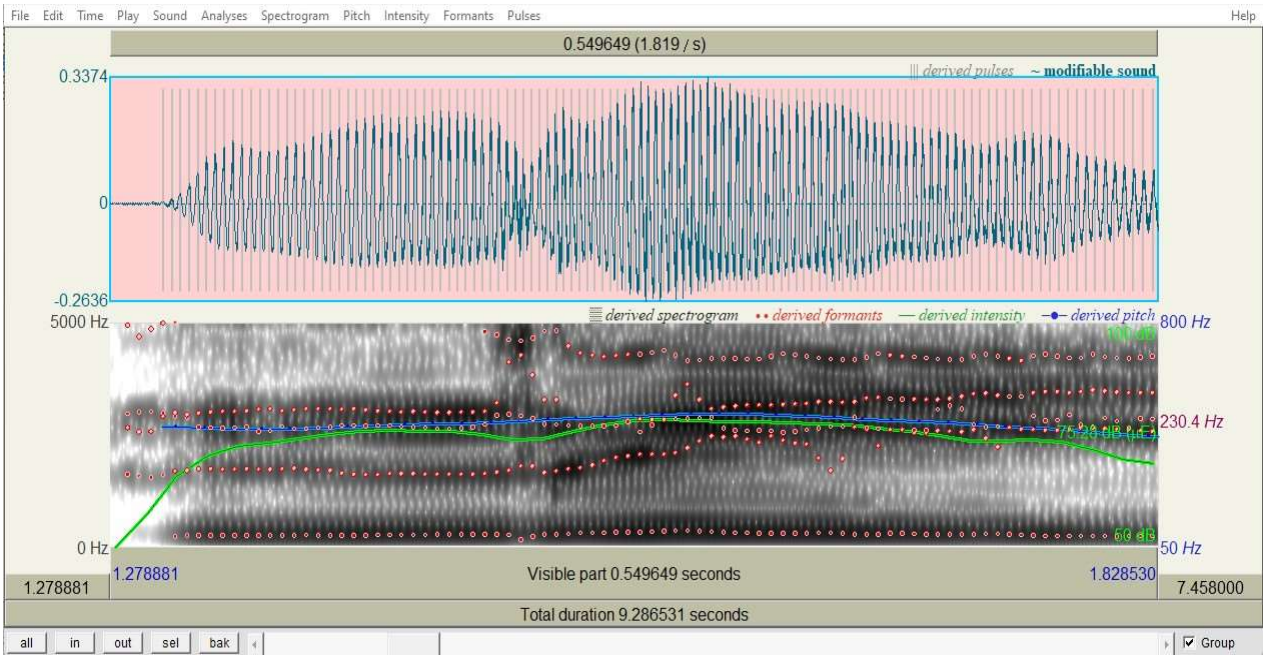
Spectrogram analysis of the aspirated click "Xhe" reveals significant acoustic features. The frequency range extends from 0 Hz to 5000 Hz, with the highest energy concentration observed in the lower frequencies. This is characteristic of aspirated sounds, where turbulence generates energy primarily in the lower part of the spectrum. The vowel "e" following the click exhibits the greatest amplitude, evidenced by dark regions in the spectrogram. This suggests a

strong vocalic component, transitioning smoothly after the click. The aspiration characteristic of this click notably influences the distribution of frequency components and their respective amplitudes, creating a distinct burst-like sound followed by the vowel.

The fundamental frequency (F0) analysis yields a pitch range of 50 Hz to 800 Hz, with a mean F0 of 227.7 Hz. Given that the click is notated as B below middle C (approximately 247 Hz), this F0 value aligns with the intended pitch, indicating that the singer is accurately producing the click at the specified note, in the middle register. This contributes to the overall melodic accuracy of the performance. Intensity measurements were conducted within a window of 50 dB to 100 dB. The observed intensity range for this click spans from 50 dB to approximately 63.5 dB, indicating a moderate level of acoustic energy. This moderate intensity is appropriate for the middle register, as it allows for clear articulation without excessive vocal strain.

Formant analysis reveals the following values: F1: 1320.87 Hz, F2: 2281.63 Hz, F3: 3198.34 Hz, F4: 4043.06 Hz. These formant frequencies provide insight into the vocal tract configuration during the production of this click sound, particularly the transition into the following vowel. Given the description of the tongue needing to be placed in two places on the hard palate during the performance, this can be confirmed using these formant values. Examination of the glottal pulses shows a range from -0.3129 to 0.3201. The click itself exhibits a movement of 0.001123, indicating the precise timing of the click release within the glottal cycle. These results showcase the coordination between the tongue movement and vibration.

3. Ngci Nasalized Voiced Dental Click

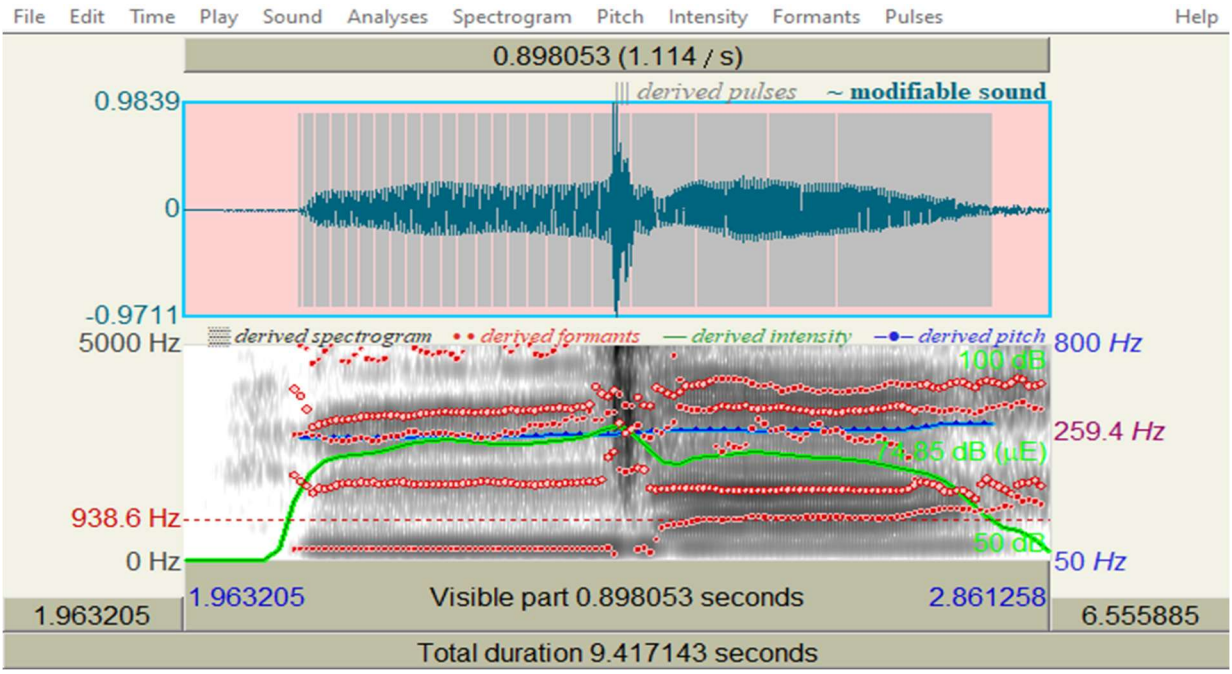


Spectrogram Analysis of "Ngci" Click:

Spectrogram analysis (0-5000 Hz) of the "ngci" click reveals significant acoustic features. The non-uniform amplitude distribution of the following vowel "i" likely reflects the complex articulatory transition from the click to the vowel, where the vocal tract rapidly reconfigures for the vowel articulation. The spectral characteristics are influenced by the vocal tract configuration during the production of the "ngci" click and subsequent vowel. The fundamental frequency (F0) contour (50-800 Hz) predominantly remaining below 230.4 Hz is consistent with typical values for human speech, further indicating a modal voice quality. This suggests that the speaker/singer maintains a stable and controlled vocal production throughout the click-vowel sequence. Intensity measurements (50-100 dB) revealing that the click's intensity falls below 74.78 dB suggest that the click, while distinct, is produced with a moderate level of acoustic energy within the overall utterance. This balanced intensity contributes to the click's seamless integration within the musical line.

Formant frequencies (F1: 340.53 Hz, F2: 2157.57 Hz, F3: 2803.48 Hz, F4: 3473.41 Hz) offer valuable information about vocal tract configuration. The relatively low F1 and high F2 are characteristic of the high front vowel "i," reflecting the tongue's high and forward position. Glottal pulse analysis reveals a range from -0.2636 to 0.3374. This provides insight into the vibratory patterns of the vocal folds during production. This data, combined with the tongue configuration from the vowel and click provides insight into the relationship between tongue behavior and vocal fold position.

4. Nxa Nasalised Lateral Click



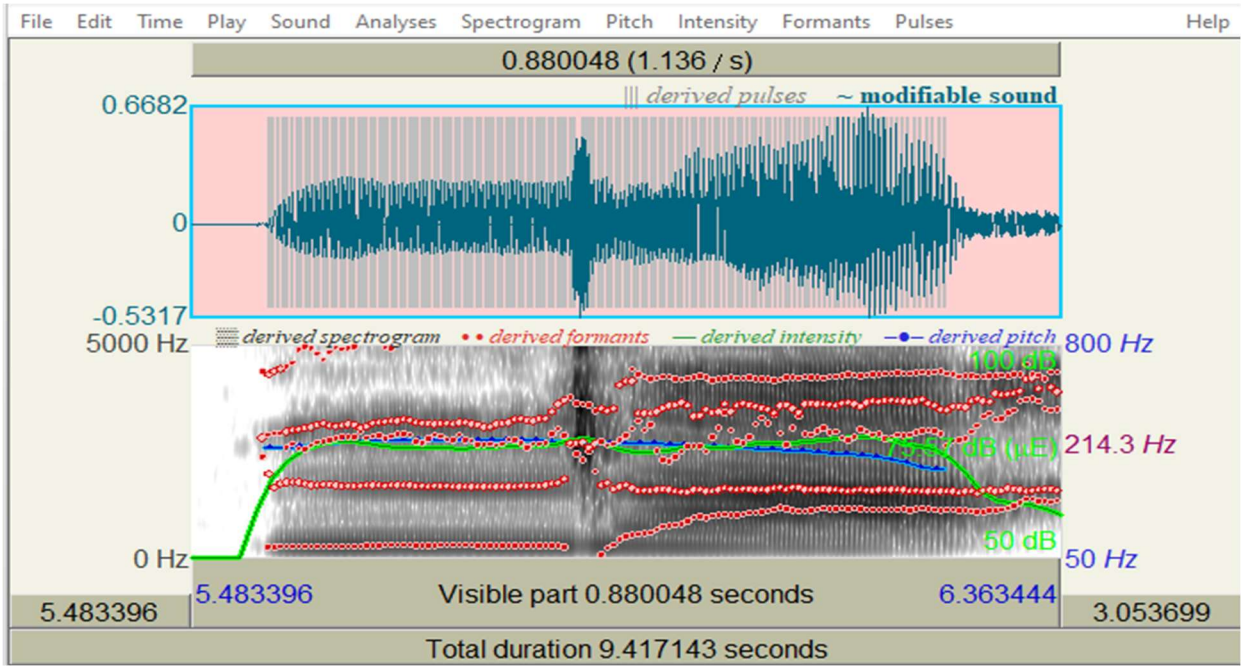
Spectrogram Analysis of "Nxa" Click:

The spectrogram analysis of the "Nxa" click reveals significant acoustic features within a broad frequency range of 0 Hz to 5000 Hz. This extensive spectral range allows for a detailed examination of both low and high-frequency components of the click and the following vowel "a." The amplitude distribution alternates between light grey and dark shades in the spectrogram,

indicating variations in acoustic energy across different frequency bands. This variability likely reflects the complex articulatory nature of the click-vowel sequence, as well as the unique resonance characteristics of the vocal tract during its production. The pitch analysis demonstrates fundamental frequency variations within a range of 50 Hz to 800 Hz, with a derived pitch of 259.633 Hz. This value aligns with the notation of A above high F, indicating that the click is sung in a high vocal register. The placement in this register complements the vowel "a," which is naturally easier to sing at higher pitches. The modal voice quality suggests efficient vocal fold vibration and controlled phonation during production.

Intensity measurements conducted within a window of 50 dB to 100 dB reveal a derived intensity of 74.94 dB for the click consonant. This moderate intensity level indicates that while the click is prominent, it does not overpower the surrounding musical elements. The syncopated rhythm written for this click adds excitement and attention-grabbing qualities, which are reflected in its acoustic energy. The formant analysis of "nxa" reveals the following values: F1 at 736.03 Hz, F2 at 1789.02 Hz, F3 at 3069.30 Hz, and F4 at 3705.76 Hz. These frequencies offer valuable insights into the vocal tract configuration during the production of this nasalized lateral click. The relatively high F2 value reflects the tongue's light contact with the hard palate, a technique emphasized for singing "nxa." This lighter tongue press enables smoother transitions between the click and the following vowel "a," promoting both clarity and ease in articulation while maintaining the phonetic integrity of the sound. Examination of glottal pulses reveals a range from -0.9711 to 0.9839, reflecting wide vibratory patterns of the vocal folds during production. This wide glottal pulse range suggests dynamic phonation characteristics, allowing for expressive delivery of the click consonant within its syncopated rhythmic context.

5. Ngxa Voiced Lateral Click



Spectrogram Analysis of "Ngxa" Click:

The spectrogram analysis of the click consonant "ngxa" reveals significant acoustic features within a broad frequency range of 0 Hz to 5000 Hz. This extensive spectral range allows for a comprehensive examination of both low and high-frequency components of the click and the following vowel. The amplitude distribution in the spectrogram exhibits a combination of black and light grey shades, indicating variations in acoustic energy across different frequency bands. This spectral variability likely reflects the complex articulatory nature of the click-vowel sequence and the unique resonance characteristics of the vocal tract during its production.

The pitch analysis demonstrates fundamental frequency variations within a range of 50 Hz to 800 Hz. The spectrogram analysis yields a derived pitch of 212.542 Hz for the click consonant. Given that the click is notated as B sharp (equivalent to middle C), which has a frequency of approximately 261.63 Hz, the singer may not have hit the precise F0. The "ng" before "x" may be a reason why the performer may not have performed correctly.

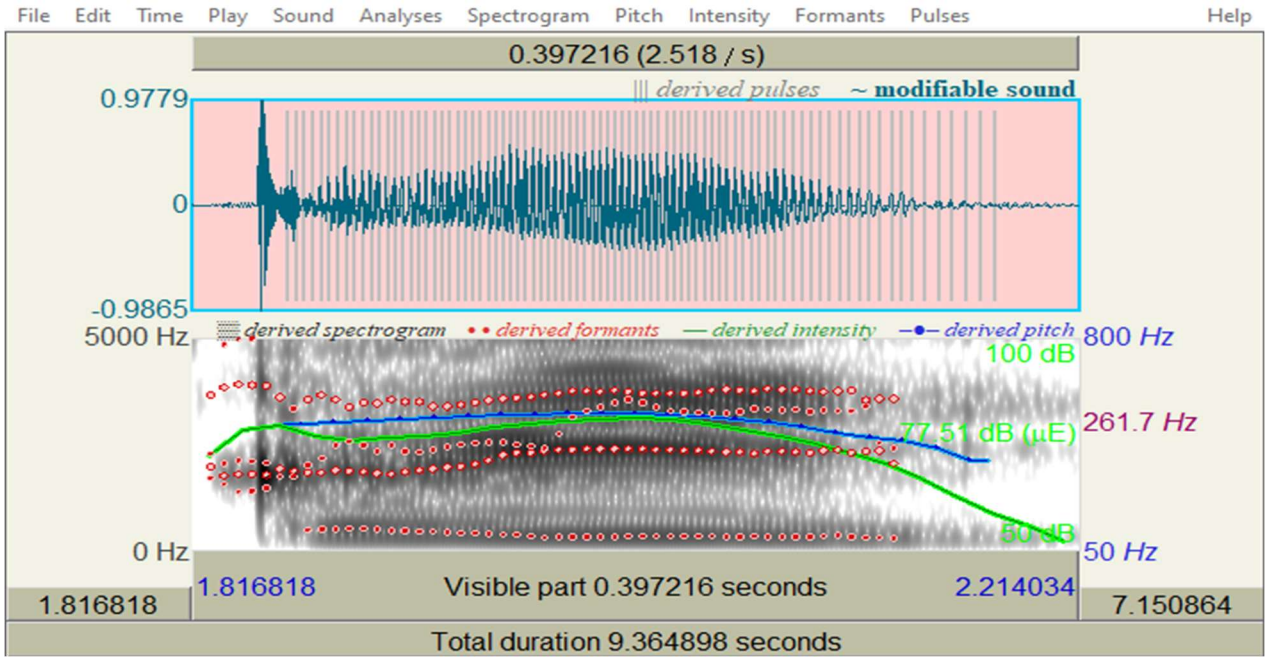
Intensity measurements conducted within a window of 50 dB to 100 dB reveal a derived intensity of 75.57 dB for the click consonant. This high intensity helps to project and allow people to know that the statement is an exclamation. The formant analysis of the "Ngxa" click reveals the following values: F1 at 790.27 Hz, F2 at 1699.59 Hz, F3 at 2914.66 Hz, and F4 at 3565.49 Hz. Given that the voice type is soprano, the high F1 value of 790.27 Hz is particularly noteworthy, as it suggests a relatively open vocal tract during production. This openness is likely necessary for sopranos to effectively produce the nasalized quality of the "Ngxa" sound, which requires more space in the oral cavity. However, this increased openness may have implications for the overall vocal timbre and production. The effort required to maintain this open configuration while executing the complex click consonant could potentially affect the voice's tonal quality and resonance. Examination of the glottal pulses indicates a range from -0.5317 to 0.6682. A glottal pulse range of -0.5317 to 0.6682 implies a relatively strong degree of vocal fold adduction, typical for the soprano voice. Soprano voices have a higher tone.

Second Piece: Uyehova nguMalusi, Opus. 014

Clicks incorporated in the music:

- Gqi
- Ngqi
- Gxe
- Nxa
- Ci

1. Gqi Voiced Palatal Click



Spectrogram Analysis of "Gqi" Click:

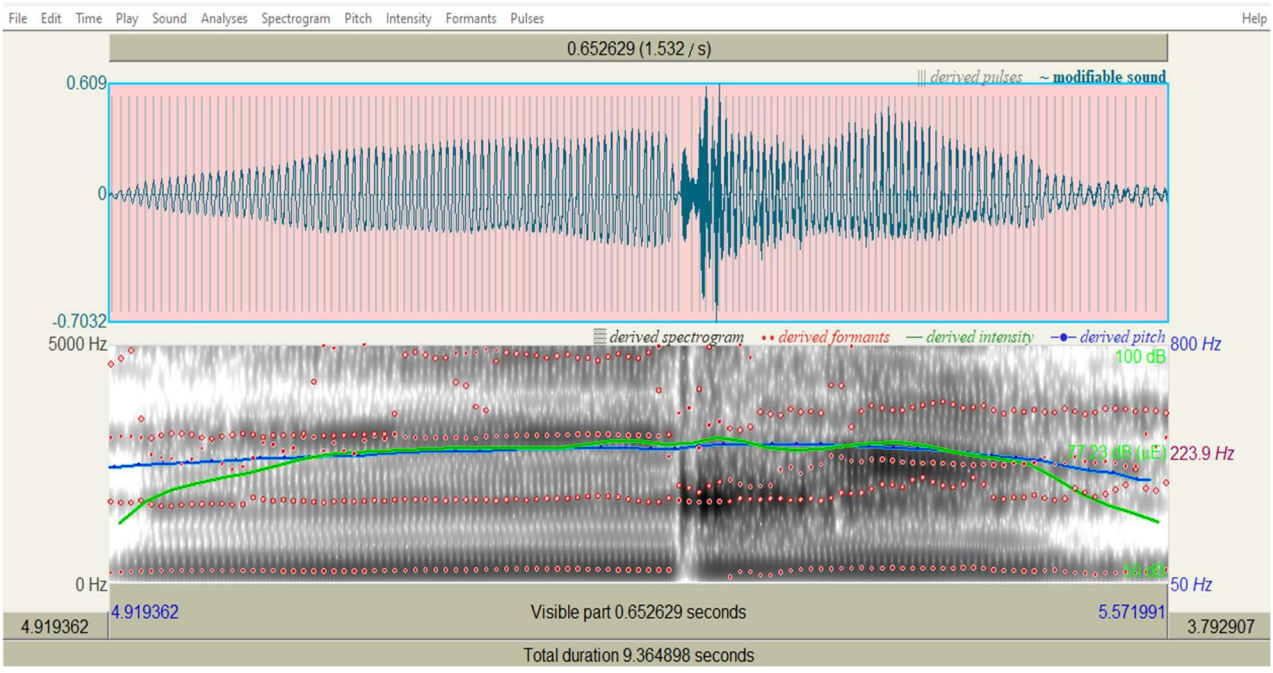
The acoustic examination of the click consonant "gqi" reveals a spectral content spanning from 0 Hz to 5000 Hz. The spectrogram displays a diverse amplitude profile, manifested as a mosaic, meaning it is manifested as a picture created of white, light grey, and black shades, which is indicative of the complex articulatory mechanisms involved in producing this distinctive click sound. Analysis of the fundamental frequency (F0) demonstrates oscillations within the 50 Hz to 800 Hz bandwidth. The spectrogram's pitch contour pinpoints a specific F0 of 261.66 Hz for this click consonant. Since the click is notated as B flat, the frequency (233.08 Hz) is a challenge. This may influence how vocal production is engaged. The click consonant exhibits an intensity level of 77.86 dB, indicating a robust acoustic presence. The level is influenced by where it is notated, B Flat.

The resonance characteristics of the "gqi" click reveal the following formant values: F1 at 510.68 Hz, F2 at 2144.57 Hz, F3 at 2858.83 Hz, and F4 at 3665.25 Hz. This formant

configuration provides essential insights into the shape and dimensions of the vocal tract during the articulation of the click and its transition to the subsequent vowel. The relatively low F1 value suggests a narrower vocal tract opening, while the high F2 reflects precise tongue positioning against the hard palate, which is critical for producing the lateral click sound. The elevated F3 and F4 frequencies contribute to the resonance and brightness of the sound, ensuring clarity and projection in performance.

Glottal Behavior: Examination of the glottal activity indicates pulse fluctuations ranging from -0.9865 to 0.9779, which could affect how vocal production is released because the tongue needs to be engaged and released.

2. Ngqi Nasalised Voiced Palatal Click



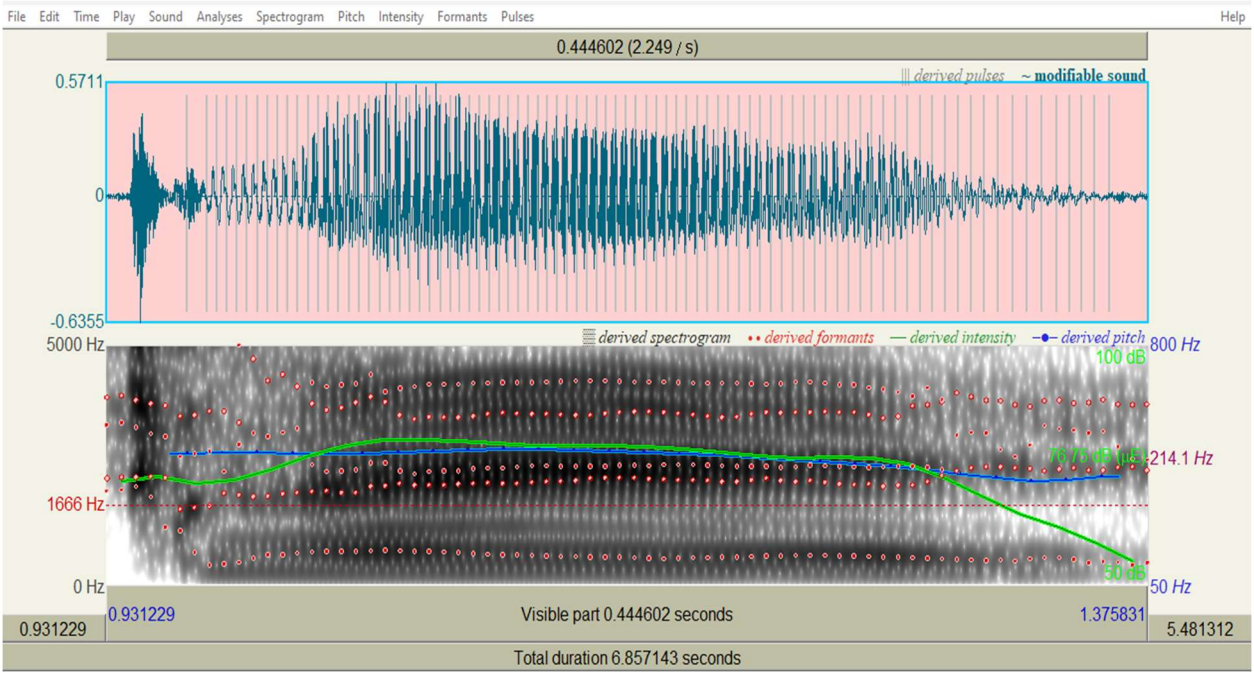
Spectrogram Analysis of "Ngqi" Click:

The acoustic examination of the click consonant "ngqi" reveals a comprehensive spectral profile spanning from 0 Hz to 5000 Hz. This extensive frequency range allows us to see both the

fundamental sound and higher tones of the click and the sounds around it. The spectrogram shows a range of amplitudes and frequencies in a detailed display, telling us about the many different tongue and mouth movements needed to make this click. The frequency investigation of the click reveals insightful data about its pitch characteristics and acoustic power. The fundamental frequency (F0), which represents the main pitch of the note, shows a mean value of 223.778 Hz, with a minimum of 166.26 Hz and a maximum of 252.23 Hz. This range underscores the complexity of vowel delivery in this context, highlighting the vocal agility required to navigate the pitch variations inherent in the click's production. The acoustic power evaluation indicates that the sound necessitates a delivery of 77.23 dB, which can be characterized as somewhat robust. This moderate intensity level suggests that while the click requires clear projection, it doesn't demand excessive vocal effort, allowing for a balance between audibility and vocal sustainability in performance.

The resonance characteristics of this click sound reveal a complex acoustic profile, with formant frequencies at F1: 328.70 Hz, F2: 1809.99 Hz, F3: 2766.31 Hz, and F4: 3834.01 Hz. This wide distribution of formants indicates significant engagement of the vocal tract, suggesting that the shape of the mouth plays a crucial role in the sound's production. The relatively low F1 value implies a more closed vocal tract configuration, while the higher F2, F3, and F4 values contribute to the sound's clarity and brightness. The vast range of these frequencies underscores the intricate shaping required in the oral cavity during articulation.

3. Gxe Voiced Lateral Click



Spectrogram Analysis of "Gxe" Click:

The spectral investigation of the "gxe" click consonant, an alveolar voiced lateral click, reveals a rich harmonic structure extending from 0 Hz to 5000 Hz. This broad range captures the complex articulation required for this unique sound in the word "ndagxekwa" (judged).

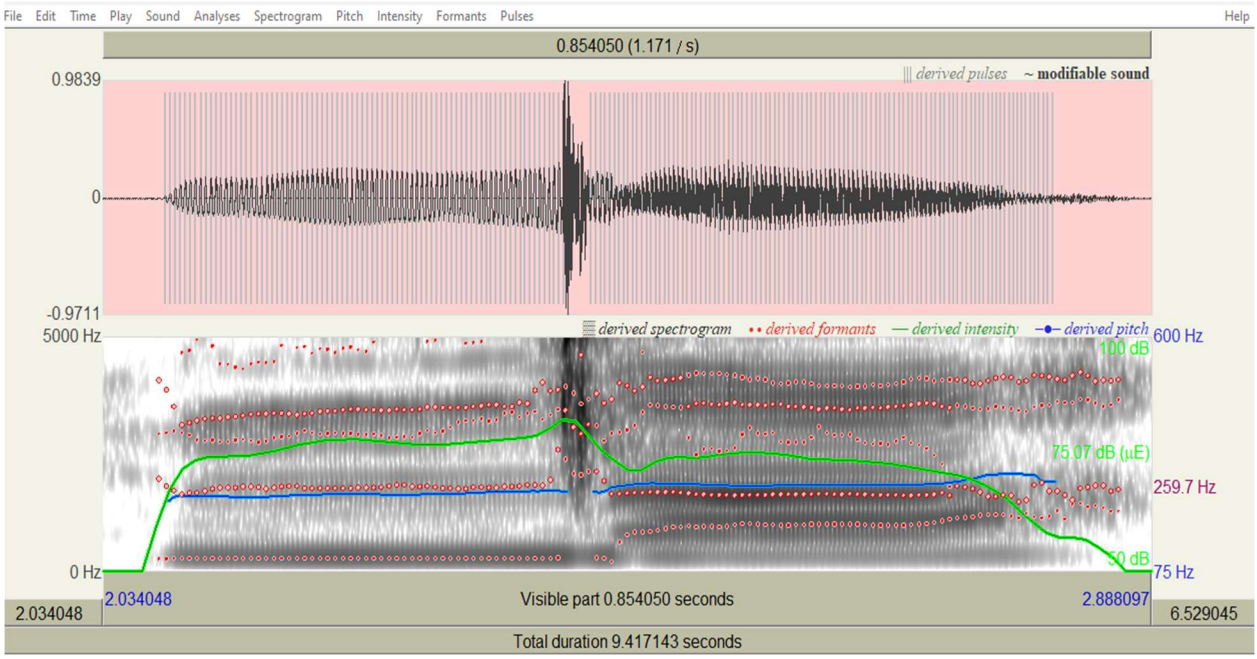
Fundamental Frequency Dynamics:

- Mean F0: 216.598 Hz
- Range: 148.436 Hz to 242.002 Hz

These values indicate that the click is produced within a typical speaking range, despite being notated on F two octaves above middle C. This suggests that singers may need to adjust their technique to hit the higher notated pitch while maintaining the click's integrity. The peak energy level of 76.75 dB indicates a strong, projectable sound, aligning with the description that this click placement allows for good vocal projection without compromising articulation. The formant structure (F1: 670.91 Hz, F2: 2143.36 Hz, F3: 2666.52 Hz, F4: 3689.17 Hz) reflects the

flat tongue position pressed against the hard palate. The high F2 and F3 values likely correspond to the firm pressing and quick release described for proper articulation. The glottal pulse range (-0.6355 to 0.5711) suggests significant vocal fold engagement, which may relate to the "g" sound preceding the "x" that makes the click firm.

3. Nxa Nasalised Lateral Click

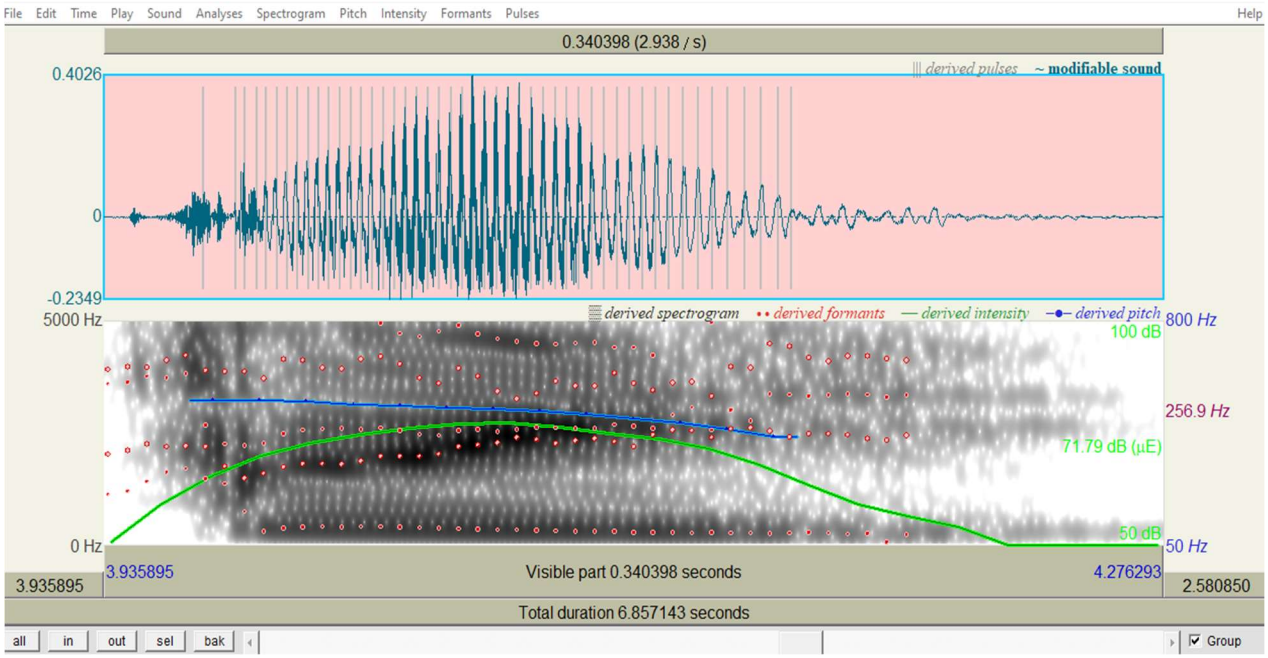


Spectrogram Analysis of "Nxa" Click:

The fourth click, "nxa," an alveolar nasalized lateral click, is part of "ngenxa" (because). It is notated as E below high F, and singing it requires a high-pitched tone, unlike the relaxed tone in speech. The average fundamental frequency is 259.68 Hz, ranging from a minimum of 232.28 Hz to a maximum of 293.14 Hz. This frequency range indicates the click is produced with variations in the vocal pitch. While it is high-pitched, the vowel is still key. The click has a peak energy level of 75.07 dB. This confirms that the click is delivered with significant power and the sound should be delivered. Vocal Fold behavior is important because the high and low

are key (the pattern of vocal cords as they open and close during speech ranging from -0.9711 to 0.9839). The tongue can properly be released to deliver a proper performance.

5. Ci Dental Click



Spectrogram Analysis of "Ci" Click:

The fifth click, "ci," is used in "ndacinga" and the data should explain why it is easy. The spectral investigation: 0 Hz to 5000 Hz helps to have the tone from start to finish while it is at the middle C. The action of vocal tone is able to be engaged at a variety of tone, range, and delivery (Mean F0: 258.006 Hz, Min F0: 187.169 Hz, Max F0: 319.252 Hz). The delivery has a base level for engaging the audience at a minimum of 71.79 dB. Tone and body gives the audience the sense of the note, so there is great delivery (F1: 432.91 Hz, F2: 2251.36 Hz, F3: 2906.33 Hz, F4: 3930.09 Hz).

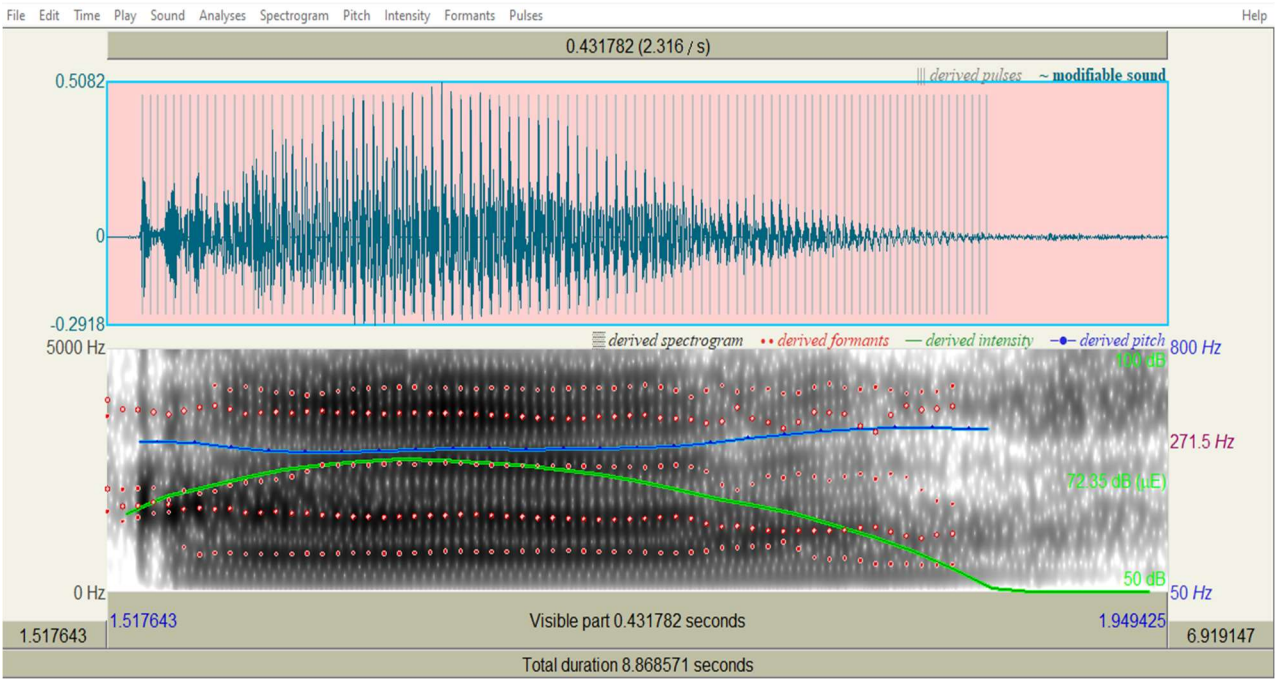
Glottal Behavior: The vocal cords connect space and vocal delivery in tone (-0.2349 to 0.4026).

Third Piece: Ihambo Yam, Opus. 015

Clicks incorporated in the music:

- Qa
- Qu
- Xa
- Xe
- Xo

1. Qa Palatal Click



Spectrogram Analysis of "Qa" Click:

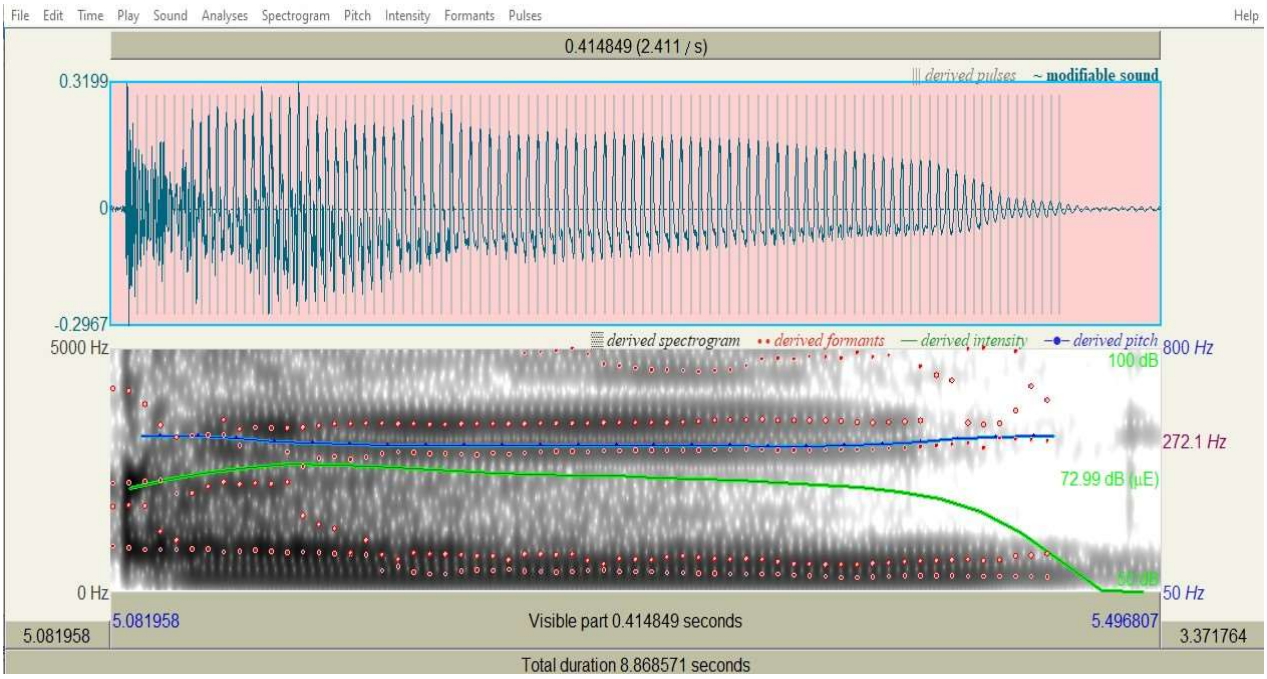
The spectrogram analysis of the "qa" click reveals a comprehensive spectral profile spanning from 0 Hz to 5000 Hz. This extensive frequency range encompasses both fundamental components and higher harmonics of the click and its accompanying phonetic environment. The spectrogram exhibits a diverse amplitude distribution, manifested as a combination of small white dots interspersed with black and light grey regions. A notable frequency component is

observed at 3244.42 Hz, potentially indicating a significant resonance in the vocal tract during the production of this click sound.

An examination of the fundamental frequency (F0) demonstrates variations within the 50 Hz to 800 Hz bandwidth. The spectrogram's pitch contour indicates a mean F0 of 271.47 Hz for this click consonant. Additional pitch metrics reveal a minimum F0 of 242.49 Hz and a maximum F0 of 324.05 Hz, illustrating the dynamic nature of pitch modulation during the production of this sound. These frequencies align with the typical vocal range of human speech, suggesting the employment of modal phonation in the articulation of this click. The acoustic intensity analysis was conducted within a 50 dB to 100 dB range, showing that the click consonant exhibits an intensity level of 72.35 dB. This measurement provides insight into the comparative loudness of the click within its phonetic context, indicating a moderate acoustic presence.

The formant structure analysis reveals resonant frequencies of F1: 890.71 Hz, F2: 1513.71 Hz, F3: 2526.63 Hz, and F4: 3683.13 Hz. This formant configuration offers crucial information about the vocal tract's shape and dimensions during the articulation of the "qa" click and its subsequent vowel, reflecting the intricate interplay between the click's production and the surrounding phonetic environment. Finally, an examination of the glottal activity indicates pulse fluctuations ranging from 0.2918 to 0.5082. This range in glottal pulse values suggests variations in vocal fold vibration patterns during the production of this click consonant and its adjacent sounds. Overall, the spectrogram analysis provides a detailed understanding of the acoustic properties of the "qa" click, highlighting its unique spectral characteristics and interaction with surrounding phonetic elements.

1. Qu Palatal Click



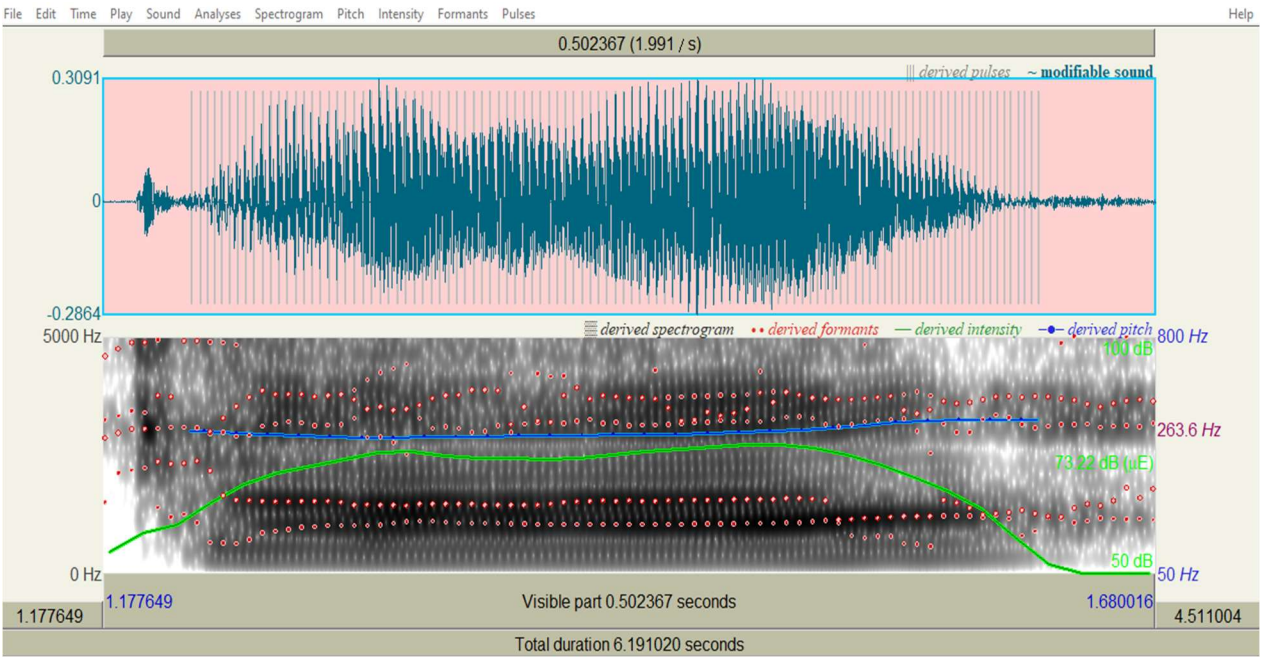
Spectrogram Analysis of "Qu" Click:

The spectrogram analysis of the "qu" click in "Ihambo Yam, Opus. 015" reveals fascinating acoustic properties that shed light on its unique characteristics. This alveolar palatal click, found in the word "ndabaqumbela," exhibits a rich spectral composition spanning from 0 Hz to 5000 Hz. The spectrogram displays a complex pattern of amplitude variations, with a notable peak at 3937.79 Hz, likely corresponding to a significant vocal tract resonance.

Examination of the fundamental frequency (F0) shows a relatively stable pitch production, with a mean F0 of 272.08 Hz and a narrow range between 262.53 Hz and 295.70 Hz. This stability aligns with the composer's intention of allowing free voice projection without tension. The click's acoustic intensity, measured at 73.00 dB, indicates a moderate prominence within its phonetic context. The formant structure analysis provides valuable insights into the vocal tract configuration during the click's production. With formants at 478.65 Hz, 1008.92 Hz,

2894.88 Hz, and 3671.72 Hz, the analysis reveals the intricate articulatory gestures involved in creating this distinctive sound. Additionally, the observed glottal behavior, oscillating between -0.2967 and 0.3199, points to complex patterns of vocal fold vibration associated with the click's articulation.

1. Xa Lateral Click



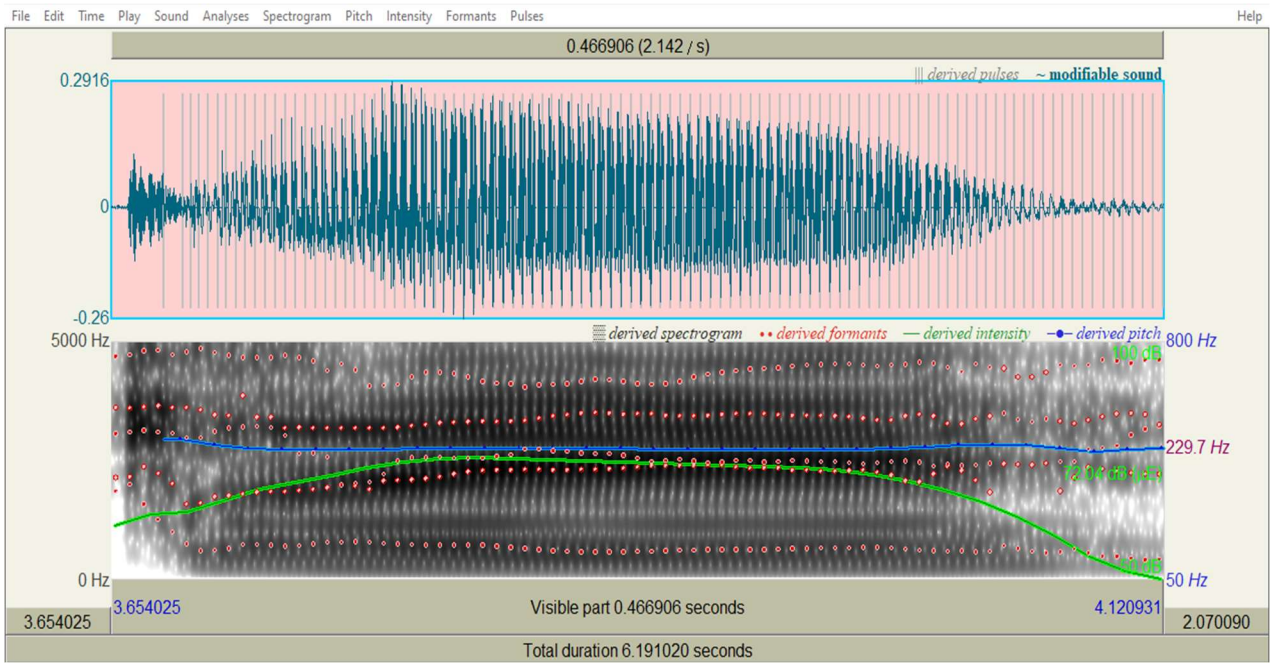
Spectrogram Analysis of "Xa" Click:

The spectrogram analysis of the alveolar lateral "xa" click reveals distinct acoustic properties that underscore its unique articulatory and musical characteristics. Spanning a broad frequency spectrum from 0 Hz to 5000 Hz, the click displays a notable spectral peak at 2742.32 Hz, likely reflecting resonant interactions within the vocal tract during production. This aligns with its notation on B above middle C—a mid-register pitch that facilitates comfortable articulation and projection in singing, as described in its musical context. Fundamental frequency (F0) analysis demonstrates stability within a 50–800 Hz range, with a mean F0 of 253.47 Hz and

extremes of 244.45 Hz (minimum) to 302.53 Hz (maximum). This narrow oscillation range suggests controlled vocal fold vibration, characteristic of modal voice production. The click's moderate acoustic intensity of 72.83 dB, measured within a 50–100 dB scale, highlights its balanced integration into the surrounding phonetic environment without overwhelming adjacent sounds.

Formant analysis identifies resonant frequencies at F1: 1051.81 Hz, F2: 1600.96 Hz, F3: 3103.92 Hz, and F4: 3720.92 Hz. These values provide critical insights into the vocal tract's configuration during articulation, indicating precise tongue placement and airflow dynamics required for the lateral click's execution. Glottal pulse oscillations (-0.2864 to 0.3091) further reveal nuanced vocal fold behavior, emphasizing the coordination between laryngeal activity and supralaryngeal articulation. The "xa" click's acoustic profile marked by its mid-register placement and stable F0 supports its functional role in the composition. The pairing of the click with the A vowel likely enhances melodic continuity and tonal color, as the vowel's formant structure complements the click's spectral properties.

2. Xe Lateral Click



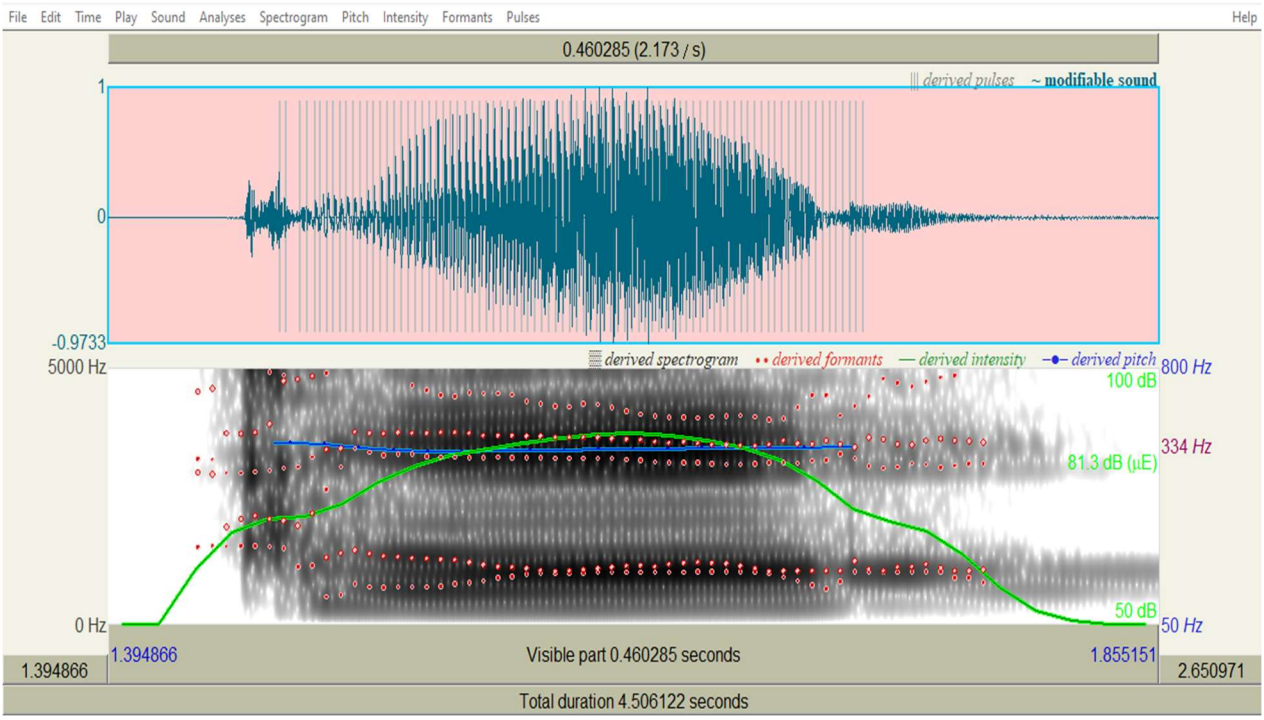
Spectrogram Analysis of "Xe" Click:

The spectrogram analysis of the alveolar lateral "xe" click reveals distinct acoustic features that reflect its linguistic significance. Spanning frequencies from 0 Hz to 5000 Hz, the click exhibits a prominent spectral component at 2527.14 Hz, likely tied to vocal tract resonance during articulation. This spectral profile provides insights into the click's production mechanisms.

Fundamental frequency (F0) analysis shows stability within a 50–800 Hz range, with a central F0 of 242.73 Hz and narrow boundaries between 221.76 Hz and 242.73 Hz. This consistency suggests controlled vocal fold vibration during the click's articulation, aligning with typical patterns of human vocalization. The click's moderate intensity of 71.84 dB (within a 50–100 dB scale) indicates a balanced acoustic presence, offering insights into its perceptual salience within its phonetic environment.

Formant analysis reveals resonant frequencies at F1: 643.14 Hz, F2: 2160.14 Hz, F3: 2687.39 Hz, and F4: 3464.02 Hz. These values map the vocal tract's configuration during sound production, highlighting the precise tongue-palate interaction required for the lateral click's execution. Glottal oscillations (-0.26 to 0.2916) further illustrate the coordination between vocal fold vibration and articulatory precision, critical for the click's distinctive sound. Overall, the spectrogram analysis provides a detailed understanding of the "xe" click's acoustic properties, reflecting its unique articulatory gestures and vocal tract configurations.

5. Xo Lateral Click



Spectrogram Analysis of "Xo" Click:

The spectrogram analysis of the alveolar lateral "xo" click reveals unique acoustic features that highlight its distinct articulatory and phonetic properties. The click spans a broad frequency spectrum from 0 Hz to 5000 Hz, with a prominent energy concentration at 2646.69

Hz. This peak likely corresponds to resonance patterns in the vocal tract during articulation, influenced by the dual constrictions typical of lateral clicks: an anterior alveolar closure and a posterior velar or uvular constriction. These spectral characteristics reflect the intricate airflow dynamics and lingual cavity adjustments required to produce this sound.

An examination of the fundamental frequency (F0) shows a relatively narrow range, with values fluctuating between 323.57 Hz and 354.52 Hz and a mean F0 of 333.59 Hz. This elevated F0 suggests a tense vocal fold configuration during articulation, which may result from increased subglottal pressure. The stability of the F0 contributes to the clarity of the click consonant, ensuring its distinctiveness within its phonetic environment. The acoustic intensity of the "xo" click peaks at 81.73 dB, indicating a forceful lingual release that enhances its perceptual prominence. This elevated intensity level suggests that the click is articulated with significant energy, which may serve to emphasize its role in linguistic contexts such as marking semantic distinctions or adding expressive weight to speech.

Formant analysis provides further insights into vocal tract configurations during the production of the "xo" click. The resonant frequencies are as follows: F1 at 903.43 Hz, F2 at 1204.71 Hz, F3 at 3150.06 Hz, and F4 at 3671.87 Hz. These values reflect the complex interplay between tongue position, airflow modulation, and pharyngeal constriction during articulation. The lower formants (F1 and F2) correspond to tongue placement and cavity resonance, while the higher formants (F3 and F4) capture the turbulent airflow associated with lateral release, which is characteristic of this type of click consonant.

Finally, an analysis of glottal dynamics reveals pulse fluctuations ranging from -0.9733 to 1.0000. This wide range indicates varying vocal fold contact patterns and air pressure during articulation. The negative values suggest ingressive airflow during the initiation of the click,

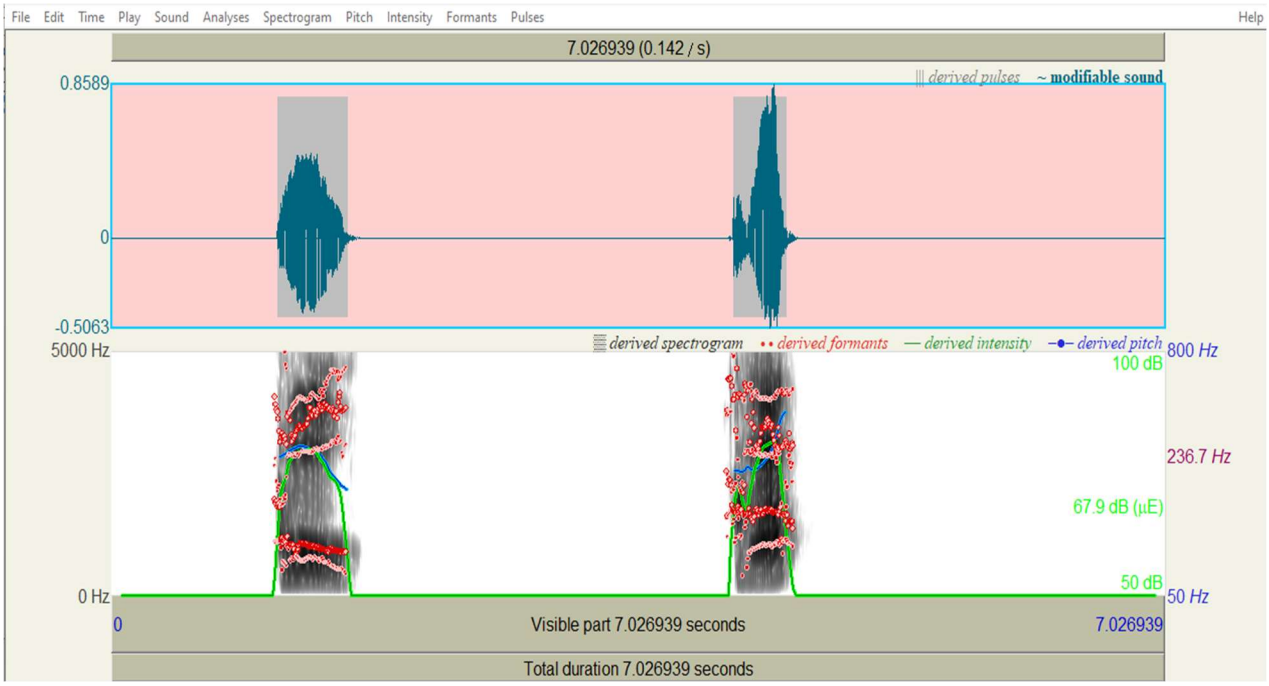
while positive values reflect egressive airflow following its release. This duality highlights the complex phonation patterns involved in producing clicks, which combine precise articulatory gestures with aerodynamic control to achieve their distinctive sound profile.

Fourth Piece: Ndakwenza Ntoni Na?

Clicks incorporated in the music:

- Gqo
- Gqa

1. Gqogqa Voiced Palatal Click



Spectrogram Analysis of "Gqo" and "Gqa" Click:

The spectrogram analysis of the "gqo" and "gqa" clicks reveals distinct acoustic signatures. Both clicks exhibit a broad frequency spectrogram spanning 0–5000 Hz, characteristic of alveolar voiced palatal clicks. The "gqo" click shows a higher amplitude peak at 4200.80 Hz, while "gqa" peaks at 3746.52 Hz, reflecting differences in vocal tract resonance

during articulation. These spectral disparities likely arise from variations in tongue placement and airflow dynamics between the two clicks, despite their shared classification as voiced palatal consonants. Pitch analysis highlights a critical divergence between the compositional notation and natural Xhosa prosody. The "gqo" click, notated on C (≈523 Hz), displays a derived pitch of 230.99 Hz (range: 165.51–272.97 Hz), whereas "gqa," notated on F (≈698 Hz), has a higher mean pitch of 241.85 Hz (range: 201.88–396.38 Hz). This inversion of spoken tonal patterns—where "gqo" is naturally higher-pitched than "gqa"—creates a performative tension. However, the spectrogram's pitch contours suggest singers can preserve linguistic authenticity through controlled F0 modulation, aligning with research showing that voiced clicks depress pitch in subsequent vowels (Jessen & Roux, 2002).

The "gqo" click registers a higher intensity (79.49 dB) compared to "gqa" (76.18 dB), indicating greater articulatory force during its production. This aligns with the dual-click structure of *ndizigqogqa* ("search"), where the initial "gqo" likely carries semantic emphasis. The moderate intensity levels ensure perceptual clarity without overwhelming adjacent vowels, a balance noted in studies of Xhosa click integration (Wheeler, 2025). The "gqo" click's formant structure reveals distinct articulatory features. The F1 value of 703.07 Hz indicates a posterior tongue position and smaller oral cavity, as the tongue is raised closer to the palate. The lower F2 (1045.33 Hz) reflects a retracted tongue body, elongating the pharyngeal cavity. Meanwhile, the elevated F3 (2861.08 Hz) and F4 (3700.24 Hz) suggest narrowed constrictions in the front oral cavity, amplifying high-frequency resonances caused by lateral airflow during the click's release.

In contrast, the "gqa" click exhibits different vocal tract dynamics. Its higher F1 (1096.32 Hz) points to a lowered tongue position and expanded oral cavity, with the mouth opened wider. The elevated F2 (1677.76 Hz) signals a more anterior tongue placement, shortening the front oral

cavity. The slightly reduced F3 (2777.11 Hz) and F4 (3582.18 Hz) compared to "gqo" imply less turbulence in the posterior vocal tract, resulting from a less restricted airflow after the click's release. For the "gqo" click, the posterior tongue constriction (evidenced by low F1 and F2) creates a smaller front cavity and longer back cavity. This configuration enhances resonance in higher frequencies (F3/F4), aligning with the sharp "pop" characteristic of alveolar palatal clicks. The rapid tongue release from the hard palate generates abrupt airflow, producing the click's percussive quality.

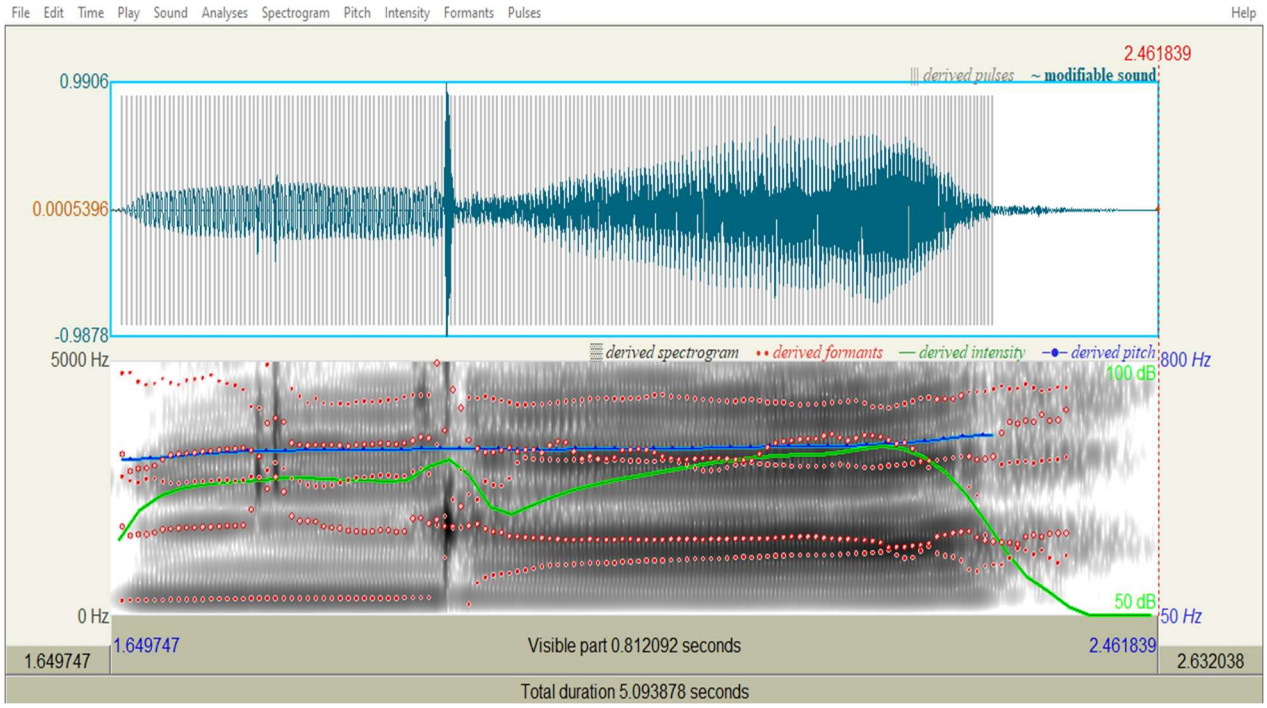
The "gqa" click, however, adopts a contrasting configuration. The anterior tongue position (higher F2) and expanded oral cavity (higher F1) result in a flatter tongue shape during articulation. This setup allows greater acoustic energy to concentrate in mid-frequency ranges, balancing the click's percussive release with smoother airflow. The reduced posterior constriction (lower F3/F4) facilitates a less turbulent sound, enabling clearer integration with adjacent vowels in the Xhosa word *ndizigqogqa*.

Fifth Piece: Kufa Ulutshaba, Opus.010

Clicks incorporated in the music:

- Nqa
- Qhe
- Ngcu

1. Nqa Nasalized Palatal Click



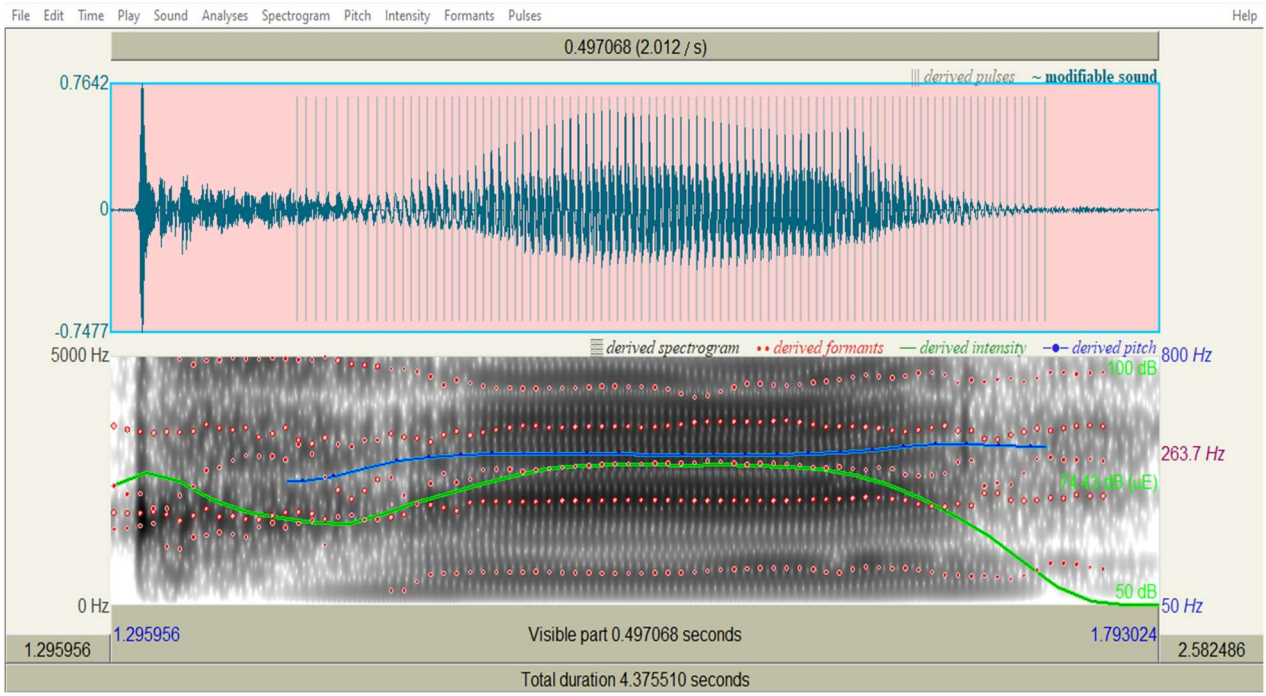
Spectrogram Analysis of "Nqa" Click:

The spectrogram analysis of the alveolar nasalized palatal click "nqa" reveals a broad frequency spectrum spanning from 0 Hz to 5000 Hz, with a notable peak at 5181.08 Hz. This wide range encompasses both the click's fundamental components and higher harmonics, indicating the click's rich acoustic profile. The spectrogram's visual representation, combining white, light grey, and black shades, illustrates the varying energy distribution across frequencies.

Pitch analysis shows the click's fundamental frequency (F0) ranging from 272.84 Hz to 353.38 Hz, with a mean of 307.29 Hz. This relatively high and narrow F0 range suggests a tense vocal fold configuration during articulation, consistent with typical patterns of human vocalization. The click's intensity of 77.66 dB indicates a moderately strong acoustic presence, providing insights into its perceptual salience within its phonetic environment.

The formant analysis of the "nqa" click reveals a distinctive structure that provides insights into its vocal tract configuration and acoustic properties. The first formant (F1) at 854.74 Hz and the second formant (F2) at 1609.14 Hz are relatively high, suggesting an open vocal tract configuration. This openness is likely attributable to the nasalization characteristic of this click. The third and fourth formants (F3 and F4) at 2836.50 Hz and 3434.33 Hz respectively, are notably elevated, indicating a complex resonance pattern within the vocal tract. These higher formants may reflect the intricate interaction between the click's release mechanism and the resonant properties of the nasal cavity. Together, this formant structure paints a picture of a sound that combines the sharp articulation of a click with the resonant qualities of nasalization.

2. Qhe Aspirated Palatal click



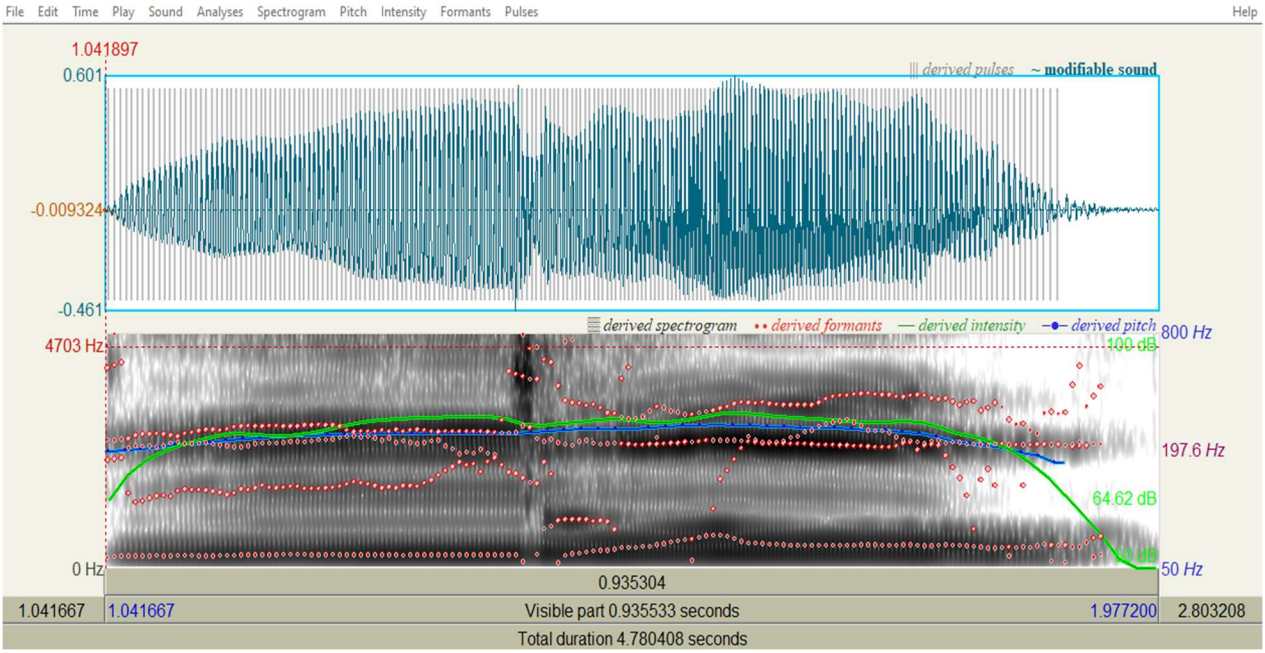
Spectrogram Analysis of "Qhe" Click:

The “qhe” click exhibits a broad frequency spectrum from 0 Hz to 5000 Hz, with a

notable peak at 3507.42 Hz. This wide range encompasses both the click's fundamental components and higher harmonics, indicating the click's rich acoustic profile. The pitch analysis shows the click's fundamental frequency (F0) ranging from 195.53 Hz to 298.38 Hz, with a mean of 262.05 Hz. This relatively wide F0 range suggests variability in vocal fold tension during articulation, possibly reflecting the challenges of producing this click at a high pitch.

The click's intensity of 74.19 dB indicates a moderate acoustic presence. Formant analysis reveals a structure with F1 at 852.05 Hz, F2 at 2025.21 Hz, F3 at 2738.01 Hz, and F4 at 3577.43 Hz. The relatively high F1 suggests an open vocal tract configuration, while the elevated F2 indicates frontal tongue positioning, typical of palatal articulations. The high F3 and F4 values likely reflect the complex resonance patterns created by the click's release and subsequent aspiration. The range of glottal pulses (-0.7477 to 0.7642) suggests moderate variations in vocal fold contact and air pressure during production, consistent with the aspirated nature of this click. This acoustic profile underscores the intricate balance between the click's sharp onset and its aspirated release, highlighting the articulatory precision required for its production.

3. Ngcu Nasalized Voiced Dental



Spectrogram Analysis of "Ngcu" Click:

The spectrogram analysis of the dental nasalized voiced click "ngcu" reveals distinctive acoustic features that reflect its complex articulation. The click exhibits a broad frequency spectrum from 0 Hz to 5000 Hz, with a notable peak at 4702.89 Hz. This wide range encompasses both the click's fundamental components and higher harmonics, indicating the click's rich acoustic profile, particularly in the higher frequencies. Pitch analysis shows the click's fundamental frequency (F0) ranging from 173.27 Hz to 270.03 Hz, with a mean of 238.57 Hz. This relatively wide F0 range suggests variability in vocal fold tension during articulation, likely due to the complex coordination required for this nasalized voiced click.

The click's intensity of 79.95 dB indicates a strong acoustic presence, which aligns with its voiced nature and the additional resonance provided by nasalization. Formant analysis reveals a structure with F1 at 382.75 Hz, F2 at 1990.09 Hz, F3 at 2808.78 Hz, and F4 at 3395.62 Hz. The low F1 suggests a closed vocal tract configuration, likely due to the dental articulation. The high

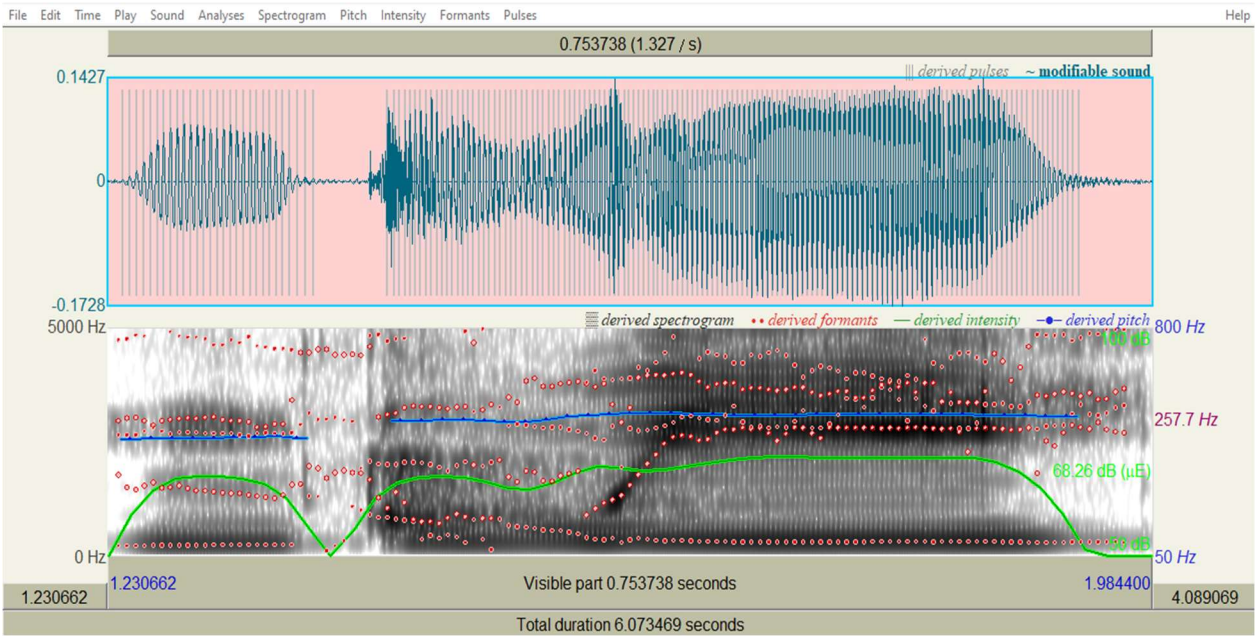
F2 indicates frontal tongue positioning, typical of dental articulations. The elevated F3 and F4 values likely reflect the complex resonance patterns created by the combination of the click's release, voicing, and nasalization. The range of glottal pulses (-0.461 to 0.601) suggests moderate variations in vocal fold contact and air pressure during production, consistent with the voiced nature of this click. This acoustic profile underscores the intricate articulatory gestures involved in producing the "ngcu" click, highlighting the coordination of voicing, nasalization, and the dental click release. The analysis supports the observation that modification of this click is challenging due to its voiced nature, as the acoustic features are integral to its distinctive sound.

Sixth Piece: Undishiyelani Na?

Click incorporated in the music:

- Nkqwi

1. Nkqwi Nasal & Palatal click combination



Spectrogram Analysis of "Nkqwi" Click:

The spectrogram analysis of the complex "nkqwi" click, combining alveolar nasal and palatal elements, reveals distinctive acoustic features. The click exhibits a broad frequency spectrum from 0 Hz to 5000 Hz, with a notable peak at 4870.26 Hz. This wide range encompasses both the click's fundamental components and higher harmonics, indicating a rich acoustic profile characteristic of complex click sounds. Pitch analysis shows the click's fundamental frequency (F0) ranging from 205.08 Hz to 283.73 Hz, with a mean of 257.69 Hz. This relatively narrow F0 range suggests controlled vocal fold tension during articulation. The click's intensity of 68.26 dB indicates a moderate acoustic presence, which may reflect the balance between maintaining the click's distinctive sound and its overall articulation.

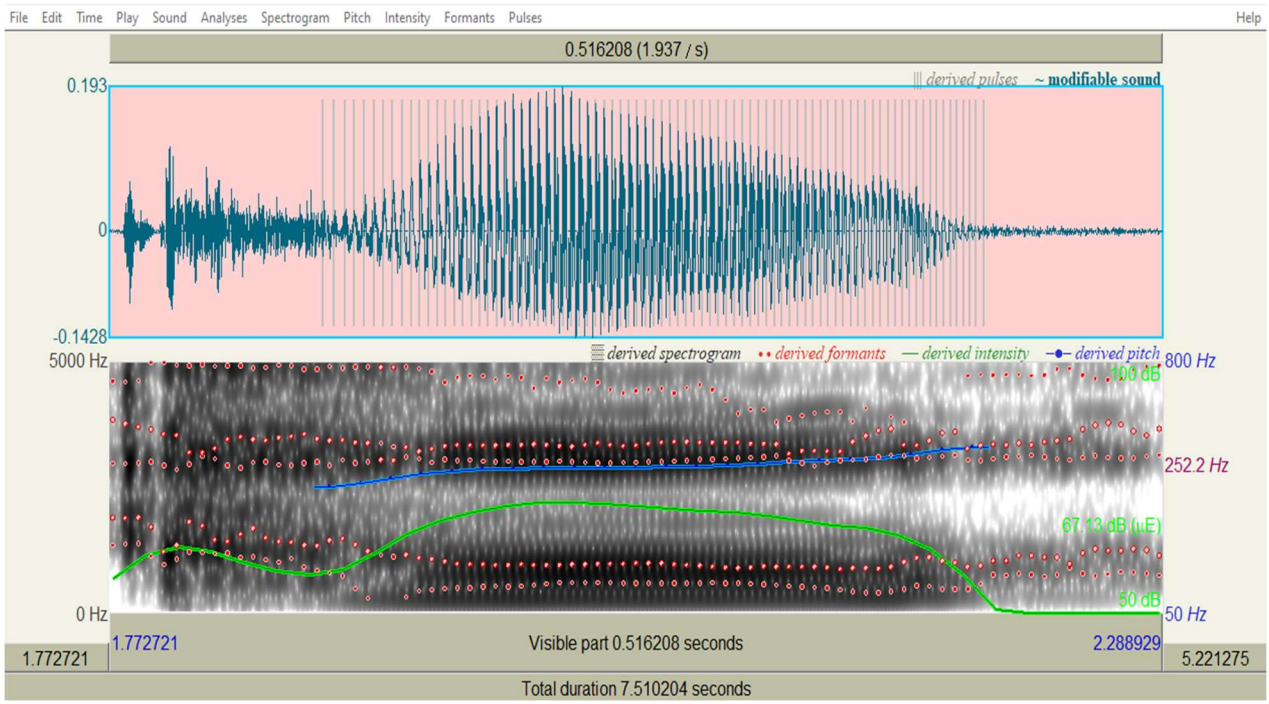
Formant analysis reveals a structure with F1 at 378.54 Hz, F2 at 2021.87 Hz, F3 at 2813.32 Hz, and F4 at 3553.93 Hz. The low F1 suggests a closed vocal tract configuration, likely due to the nasal component. The high F2 indicates frontal tongue positioning, typical of palatal articulations. The elevated F3 and F4 values likely reflect the complex resonance patterns created by the combination of nasal and palatal elements. The narrow range of glottal pulses (-0.1728 to 0.1427) suggests minimal variations in vocal fold contact and air pressure during production, consistent with the need for precise control in articulating this complex click.

Seventh Piece: Ndakuwubon’ Umnqamlezo

Clicks incorporated in the music:

- Xho
- Xhwa
- Co
- Nca

1. Xho Aspirated Lateral Click



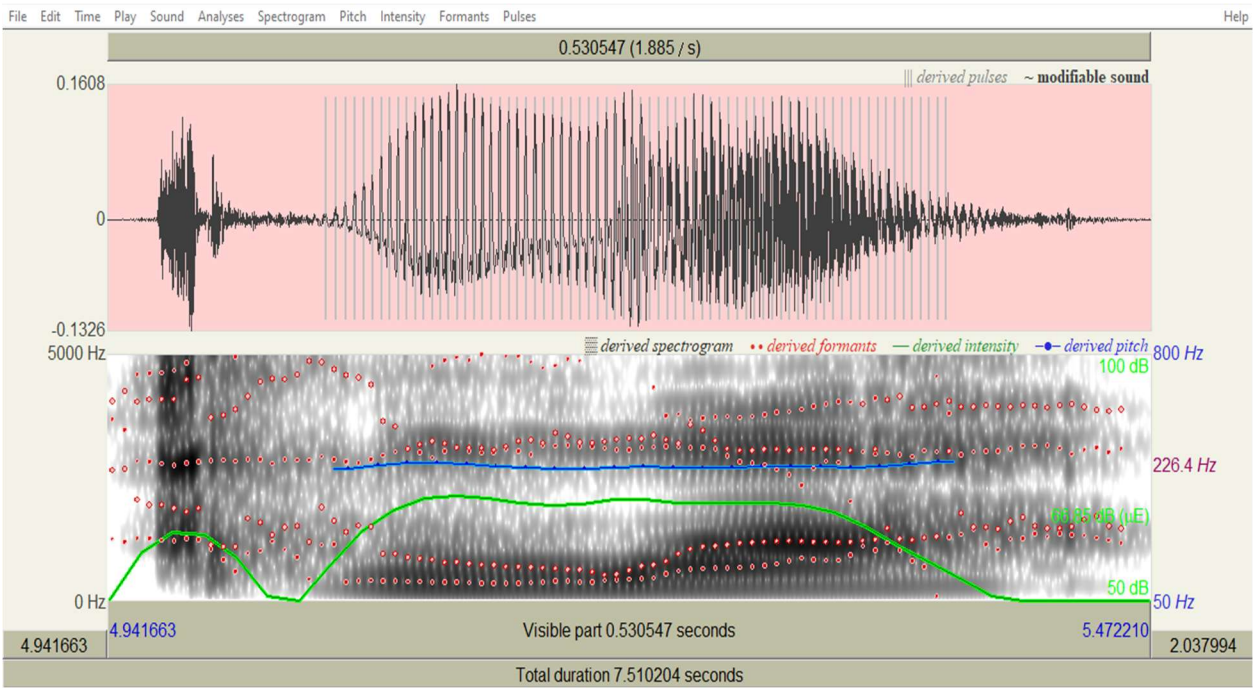
Spectrogram Analysis of "Xho" Click:

The spectrogram analysis of the alveolar aspirated lateral click "xho" reveals distinctive acoustic features that reflect its complex articulation. The click exhibits a broad frequency spectrum from 0 Hz to 5000 Hz, with a notable peak at 3507.42 Hz. This wide range encompasses both the click's fundamental components and higher harmonics, indicating a rich acoustic profile characteristic of complex click sounds. Pitch analysis shows the click's fundamental frequency (F0) ranging from 201.29 Hz to 308.76 Hz, with a mean of 252.21 Hz. This relatively narrow F0 range suggests controlled vocal fold tension during articulation, consistent with the click's placement in a comfortable middle vocal register.

The click's intensity of 67.13 dB indicates a moderate acoustic presence, which may reflect the balance between maintaining the click's distinctive sound and integrating it smoothly into vocal production. Formant analysis reveals a structure with F1 at 694.49 Hz, F2 at 1171.93

Hz, F3 at 3027.85 Hz, and F4 at 3439.85 Hz. The relatively low F1 and F2 suggest a somewhat closed and retracted vocal tract configuration, likely due to the lateral articulation. The elevated F3 and F4 values likely reflect the complex resonance patterns created by the click's release and subsequent aspiration. The narrow range of glottal pulses (-0.1428 to 0.193) suggests minimal variations in vocal fold contact and air pressure during production, consistent with the need for precise control in articulating this complex click.

2. Xhwa Aspirated Lateral Click



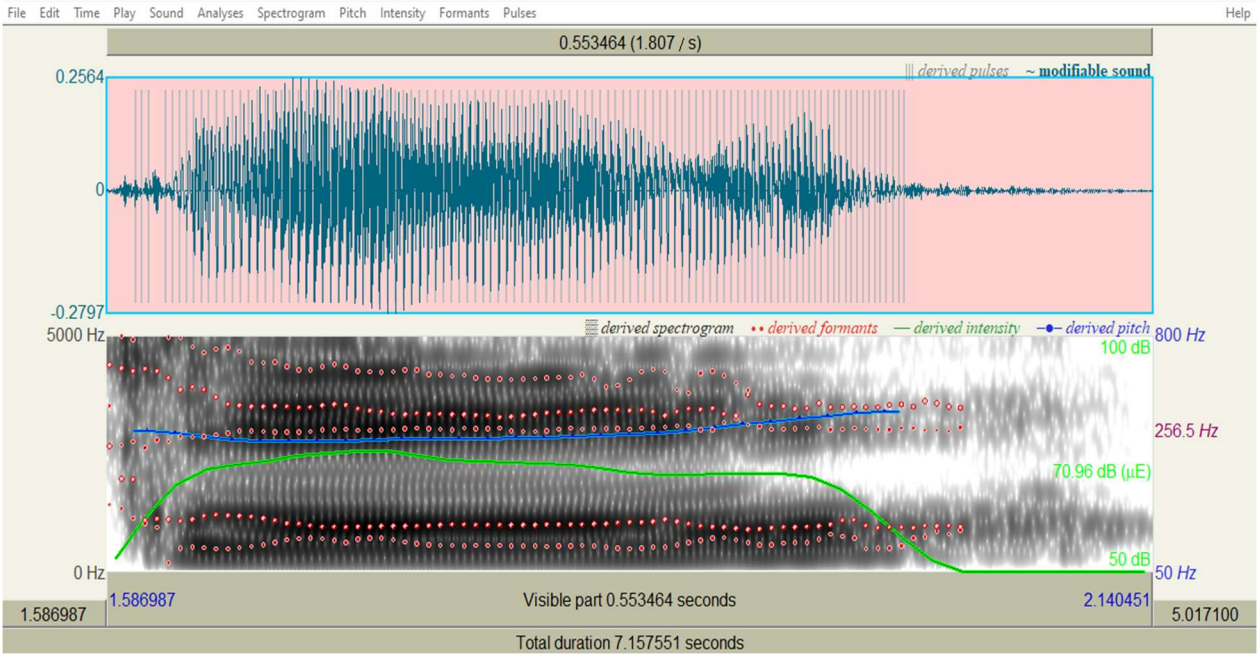
Spectrogram Analysis of "Xhwa" Click:

The spectrogram analysis of the alveolar aspirated lateral click "xhwa" reveals its intricate acoustic properties. The click exhibits a broad frequency spectrum ranging from 0 Hz to 5000 Hz, with a prominent peak at 4989.81 Hz. This wide range captures both the fundamental components and higher harmonics, highlighting the rich and complex nature of the click's acoustic profile. Pitch analysis shows the fundamental frequency (F0) of the click varying from

219.48 Hz to 239.33 Hz, with a mean of 226.39 Hz. This relatively narrow pitch range indicates controlled vocal fold tension during articulation, which is essential for producing this aspirated lateral click accurately.

The intensity of the click is measured at 66.85 dB, reflecting a moderate energy level. This intensity ensures that the click remains perceptually prominent while maintaining balance with surrounding sounds in speech or singing. Formant analysis reveals a structure with F1 at 800.94 Hz, F2 at 1255.80 Hz, F3 at 2956.89 Hz, and F4 at 3678.86 Hz. The relatively high F1 suggests an open vocal tract configuration during articulation, while the elevated F2 indicates lateral airflow and precise tongue placement against the molars. The high F3 and F4 values reflect the complex resonance patterns created by the aspirated release of this lateral click. The pulse analysis shows a range from -0.1326 to 0.1608, indicating minimal variation in glottal activity during production. This consistency aligns with the precise articulatory gestures required for this complex sound.

3. Co Dental Click



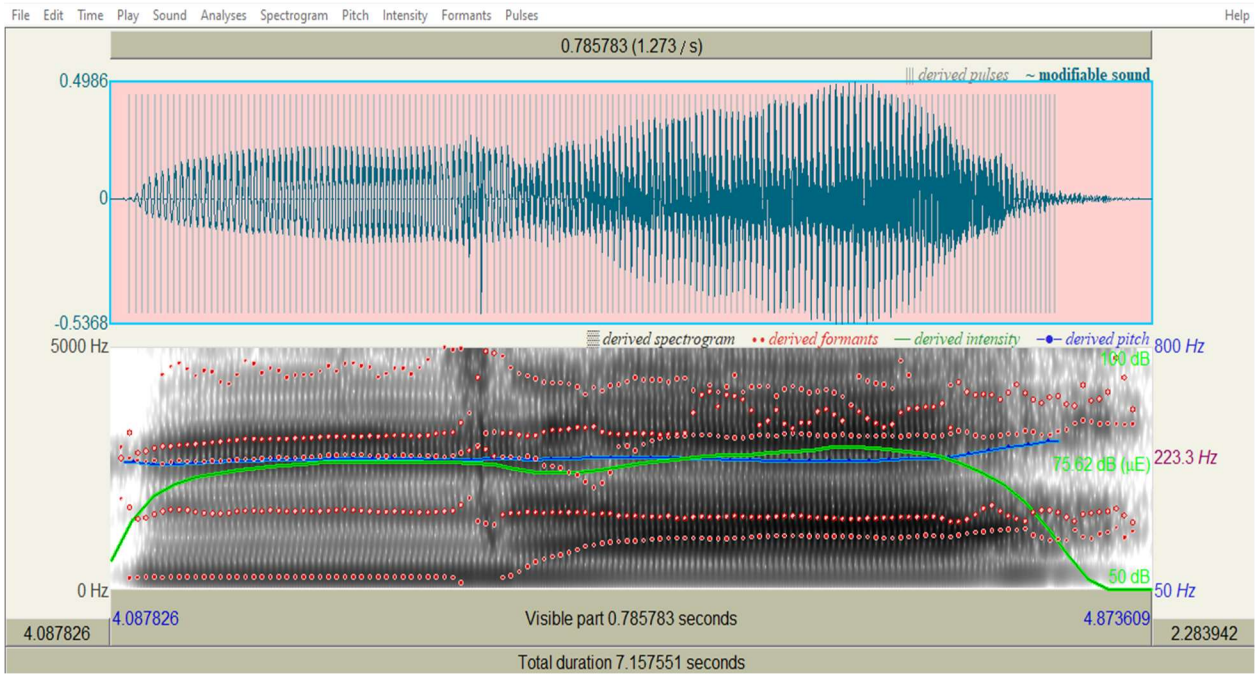
Spectrogram Analysis of "Co" Click:

The spectrogram analysis of the dental click "co" reveals distinctive acoustic features that reflect its unique articulation. The click exhibits a broad frequency spectrum from 0 Hz to 5000 Hz, with a notable peak at 4941.99 Hz. This wide range encompasses both the click's fundamental components and higher harmonics, indicating a rich acoustic profile characteristic of click sounds. Pitch analysis shows the click's fundamental frequency (F0) ranging from 230.58 Hz to 326.88 Hz, with a mean of 256.55 Hz. This relatively wide F0 range suggests some variability in vocal fold tension during articulation, which may reflect the complex coordination required for this dental click. The click's intensity of 70.96 dB indicates a moderately strong acoustic presence, which aligns with the clear and precise nature of dental clicks.

Formant analysis reveals a structure with F1 at 663.54 Hz, F2 at 1059.58 Hz, F3 at 2995.33 Hz, and F4 at 3540.13 Hz. The relatively low F1 and F2 suggest a somewhat closed and fronted vocal tract configuration, consistent with the dental articulation. The elevated F3 and F4

values likely reflect the complex resonance patterns created by the release of the click. The range of glottal pulses (-0.2797 to 0.2564) suggests moderate variations in vocal fold contact and air pressure during production, consistent with the precise control required for this click.

4. Nca Nasalized Dental Click



Spectrogram Analysis of "Nca" Click:

The spectrogram analysis of the nasalized dental click "nca" reveals its intricate acoustic properties, reflecting the complexity of its articulation. The click exhibits a broad frequency spectrum ranging from 0 Hz to 5000 Hz, with a prominent peak at 4989.81 Hz. This wide range captures both the fundamental components and higher harmonics, highlighting the rich acoustic profile of this nasalized click. Pitch analysis shows the fundamental frequency (F0) varying from 208.89 Hz to 272.11 Hz, with a mean of 223.34 Hz. This relatively narrow pitch range suggests controlled vocal fold tension during articulation, which is essential for producing this nasalized

dental click accurately. The intensity of the click measures 75.62 dB, indicating a strong acoustic presence that ensures clarity and prominence in both speech and singing contexts.

Formant analysis reveals a structure with F1 at 780.81 Hz, F2 at 1595.89 Hz, F3 at 2947.49 Hz, and F4 at 3497.13 Hz. The relatively high F1 reflects an open vocal tract configuration, while the elevated F2 suggests precise tongue placement against the upper front teeth, characteristic of dental clicks. The high F3 and F4 values highlight the complex resonance patterns created by the nasalization and release of this click. Pulse analysis shows a range from -0.5368 to 0.4986, indicating moderate variations in glottal activity during production. This consistency aligns with the precise control required for articulating this nasalized dental click.

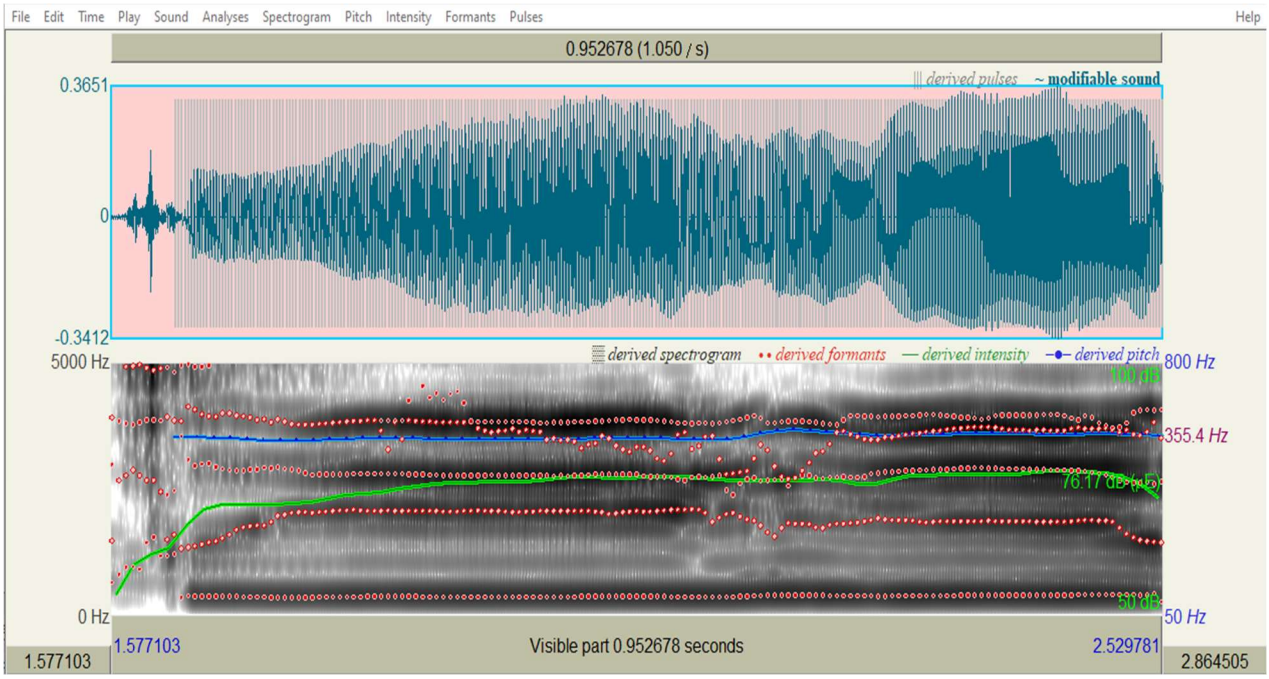
Spectrogram Analysis of Sung Clicks:

Nqobile Nkonzo used three types of click consonants in his music: dental clicks, alveolar palatal clicks, and alveolar lateral clicks. The singing acoustic analysis features 18 click consonants that represent dental, palatal, and lateral click sounds, demonstrating how these click consonants can be effectively utilized in singing.

Table 1

Dental	**Palatal**	**Lateral**
1. Ci	1.Qu	1.Xo
2. Nca	2.Nqa	2.Xe
3.Ngci	3.Qhe	3. Nxa
4. Ngcu	4. Gqogqa	4. Xhenxe
	5.Ngqi	5. Xhwa
	6. Ngqo	6. Gxe
	7.Nkqwi	7. Ngxa

1. Ci Dental Click



Spectrogram Analysis of "Ci" Click:

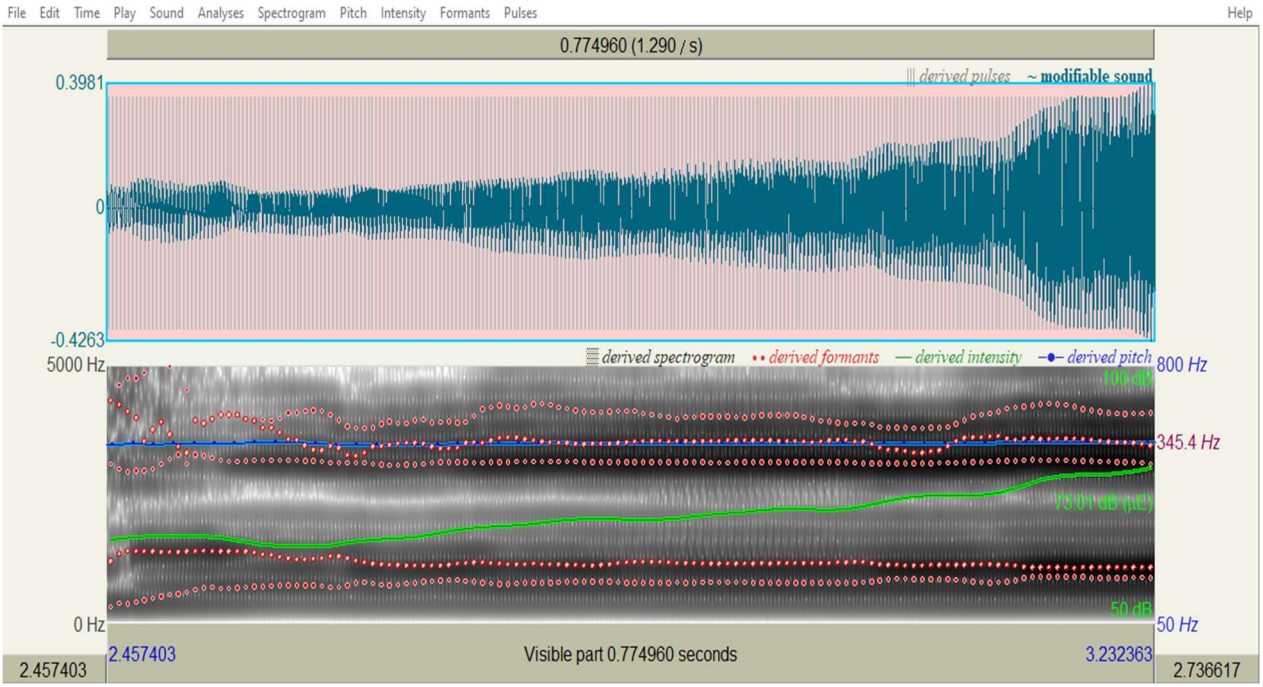
The spectrogram analysis of the dental click "ci" reveals its acoustic properties and significance for singing. The click exhibits a broad frequency spectrum ranging from 0 Hz to 5000 Hz, with a prominent peak at 4989.81 Hz. This wide range captures both the fundamental components and higher harmonics, highlighting the click's rich acoustic profile. Pitch analysis shows the fundamental frequency (F0) varying from 339.87 Hz to 382.44 Hz, with a mean of 355.45 Hz. This relatively high pitch range suggests that the click is articulated with controlled vocal fold tension, which aligns well with its placement in the middle vocal register. The vowel "i" following the click aids in projecting the sound and maintaining a smooth and controlled tone.

The intensity of the click measures 76.17 dB, indicating a strong acoustic presence that ensures clarity and prominence in singing contexts. This moderate intensity supports ease of articulation while maintaining the click's distinctiveness within melodic phrases. The formant

structure of the dental click "ci" provides valuable insights into its significance for singing. With F1 at 412.55 Hz, F2 at 1914.79 Hz, F3 at 2829.78 Hz, and F4 at 3632.33 Hz, the acoustic profile highlights several features beneficial for vocal performance. The relatively low F1 reflects a closed vocal tract configuration, which helps maintain a focused and controlled tone during articulation. The elevated F2 suggests precise frontal tongue positioning against the hard palate, a key element for clear and accurate articulation of dental clicks in singing. Additionally, the high F3 and F4 values contribute to the resonance patterns associated with the "singer's formant cluster," a feature that enhances vocal projection.

The pulse analysis, showing a range from -0.3412 to 0.3651, further underscores the click's suitability for singing. This moderate variation in glottal activity indicates controlled vocal fold vibration, which is essential for maintaining pitch stability while articulating the click. It also reflects a balance between clear click production and smooth vocal phrasing, ensuring that the click integrates seamlessly into melodic lines without disrupting tonal quality or flow.

2. Nca Nasalized Dental Click



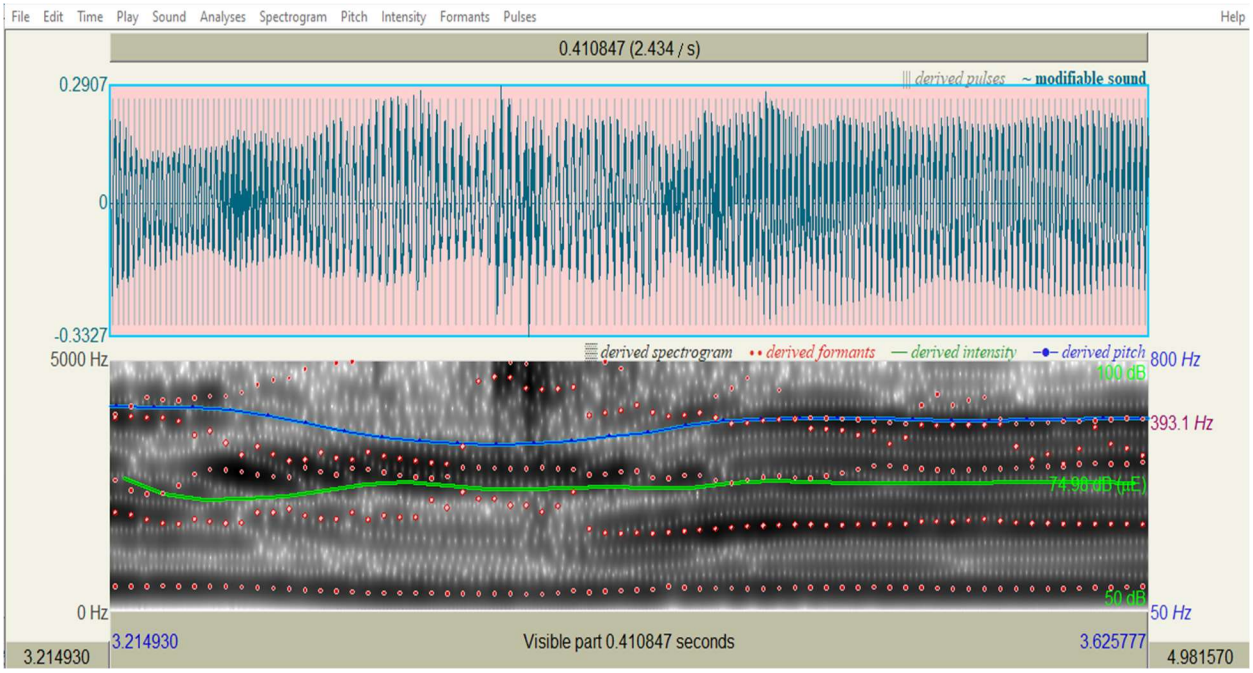
Spectrogram Analysis of "Nca" Click:

The spectrogram analysis of the nasalized dental click "nca" reveals acoustic properties that hold significant implications for vocal performance. The click exhibits a broad frequency spectrum spanning 0 Hz to 5000 Hz, with a pronounced harmonic peak at 5013.72 Hz, reflecting its rich high-frequency resonance—a critical feature for vocal projection in classical singing. Pitch analysis shows a remarkably narrow fundamental frequency range (339.29 Hz to 349.71 Hz, mean 345.42 Hz), indicating stable vocal fold control during articulation. This precision aligns with the demands of melodic accuracy in the middle register (notated as F above middle C), where the click's placement ensures vocal comfort and clarity. The stability of pitch is crucial for maintaining a smooth vocal line, especially when integrating clicks into melodic phrases, as it allows singers to focus on articulation without compromising pitch accuracy.

The intensity of the click measures 73.01 dB, striking a balance between perceptual prominence and vocal ease. This moderate energy level allows the click to remain distinct while

minimizing strain, essential for sustaining the emotional weight of the word *ndancama* (“give up”) in the crucifixion narrative. The balance of intensity is vital for singers, as it enables them to project the click clearly without overexerting their voices, thereby maintaining vocal health when singing. The formant structure (F1: 757.10 Hz, F2: 1172.11 Hz, F3: 3111.16 Hz, F4: 3547.71 Hz) highlights key articulatory and resonant traits. The elevated F3 and F4 values surpass the typical 2700–3000 Hz singer’s formant range, creating a complementary resonance cluster that enhances vocal projection. This resonance pattern is particularly advantageous for singers, as it amplifies the click’s presence above orchestral or piano accompaniment. The relatively low F1 suggests nasal airflow, consistent with the click’s nasalization, while the mid-range F2 reflects precise dental articulation (tongue pressed against the hard palate). The pulse analysis of the "nca" click shows a relatively narrow range (-0.4263 to 0.3981), indicating minimal fluctuation in vocal fold activity during its production. This stability is significant for singers, as it facilitates seamless incorporation of the click into smooth, connected (legato) vocal lines. The controlled glottal behavior aligns with the linguistic principle of maintaining consistent click articulation across both spoken and sung contexts, ensuring phonetic accuracy without compromising vocal technique.

3. Ngci Nasalized Voiced Dental



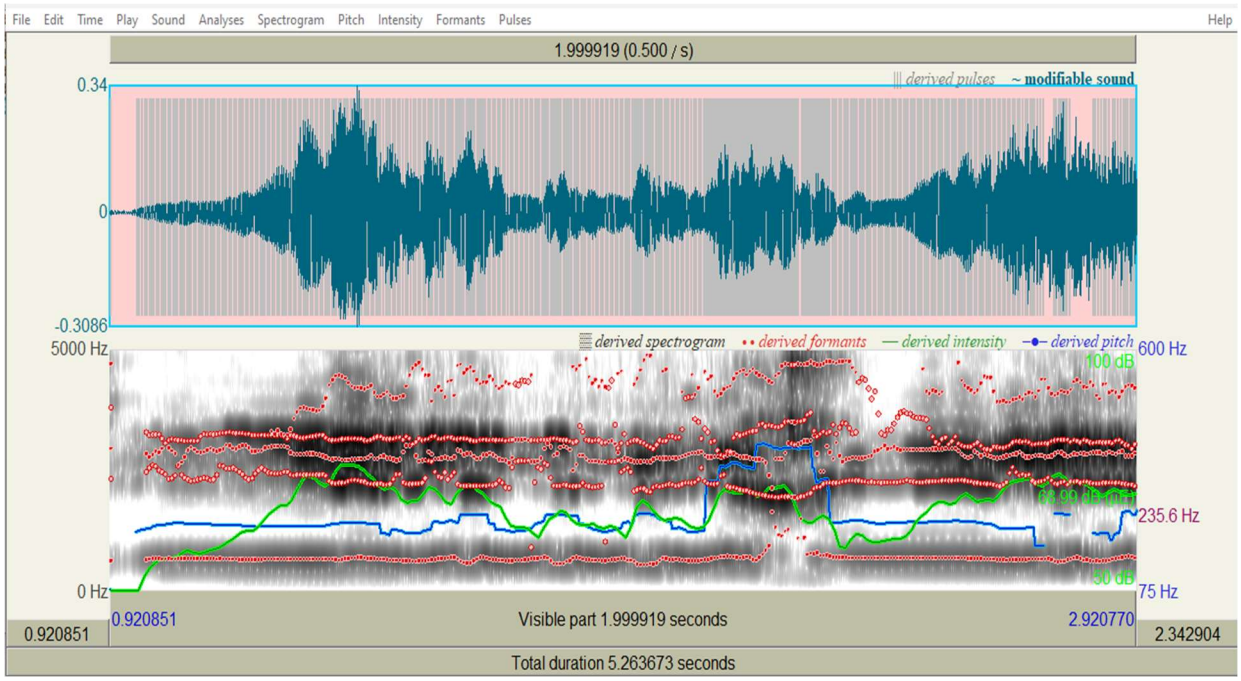
Spectrogram Analysis of "Ngci" Click:

The spectrogram analysis of the nasalized voiced dental click "ngci" reveals acoustic properties that significantly enhance its performance in vocal contexts. The click exhibits a broad frequency range (0 Hz–5000 Hz), with a dominant peak at 4965.90 Hz, ensuring clarity and projection even when sung below middle C. The fundamental frequency (F0) ranges from 314.68 Hz to 478.81 Hz (mean 478.81 Hz), aligning with the lower-middle vocal register and allowing singers to articulate the click without compromising tonal control. At 74.98 dB, the click's intensity strikes a balance between percussive sharpness and vocal sustainability, supporting its role as the stressed syllable in "ngcindezelo" ("oppression") without causing vocal strain.

The formant structure (F1: 425.28 Hz, F2: 1813.19 Hz, F3: 2744.26 Hz, F4: 3592.66 Hz) provides insights into the click's articulation and resonance. The low F1 reflects nasal airflow and raised tongue position, while the high F2 indicates precise dental articulation and the brightening effect of the vowel "i." The elevated F3 and F4 create a resonance cluster that

amplifies the click's presence, helping it project. The narrow pulse range (-0.3327 to 0.2907) suggests minimal glottal disruption, enabling smooth integration into legato phrasing.

4. Ngcu-ngcu Nasalized Voiced Dental



Spectrogram Analysis of "Ngcu" Click:

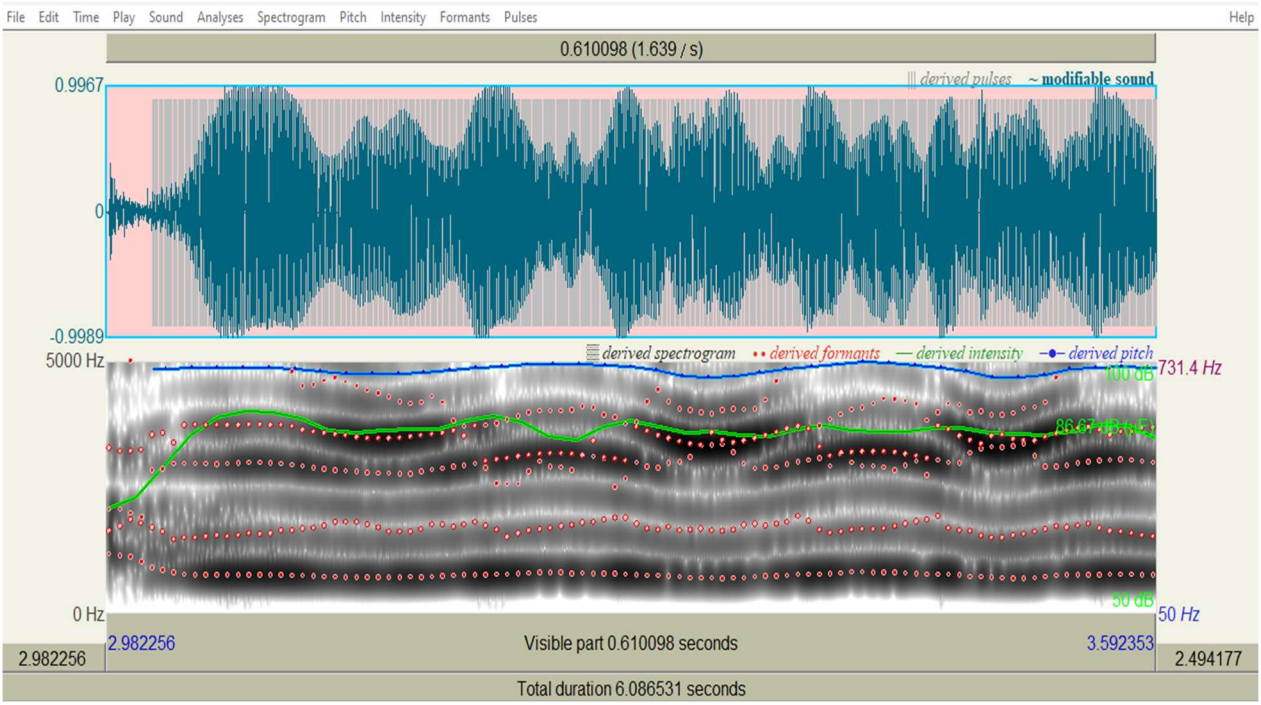
The spectrogram analysis of the nasalized voiced dental click "ngcu" reveals unique acoustic characteristics that are highly relevant for vocal performance. The click spans a frequency range of 0 Hz to 5000 Hz, with its waveform showing a gradual build-up, expanding as the sound projects and tapering off with vibrato. The spectrogram itself appears dense, with white-shaded areas and prominent dotted lines representing formant frequencies. Additionally, the intensity and pitch lines intersect multiple times, reflecting the dynamic nature of the click's articulation. A notable frequency value of -78.99 Hz is observed, emphasizing the complexity of its acoustic profile.

The pitch analysis indicates a frequency range from 75 Hz to 600 Hz, with a mean pitch of 235.57 Hz. The minimum pitch is 76.68 Hz, while the maximum reaches 394.68 Hz. This wide pitch range supports the click's flexibility in vocal execution, particularly when sung as high A in the musical notation. The presence of vibrato in the waveform adds tonal depth and expressiveness, enhancing its suitability for dramatic storytelling within the aria *Kufa Ulutshaba*. The intensity analysis shows a range between 50 dB and 100 dB, with a mean energy intensity of 68.99 dB. This moderate intensity ensures that the click maintains clarity and prominence without overpowering the vocal line, allowing singers to manage breath control and phrasing effectively during faster rhythmic sections.

The formant structure provides further insight into the articulatory precision required for this click. F1 at 663.12 Hz reflects nasal airflow and tongue elevation, while F2 at 2259.93 Hz highlights the dental articulation achieved by pressing the tongue firmly against the hard palate. F3 (2816.84 Hz) and F4 (3242.11 Hz) contribute to resonance patterns that enhance vocal projection, aligning with frequencies typically associated with the singer's formant cluster. Pulse analysis reveals a range from -0.3086 to 0.34, indicating stable glottal activity during production. This stability allows singers to incorporate the click seamlessly into legato phrases while maintaining tonal consistency and smoothness in their vocal delivery.

Palatal Click Consonants:

1. Qu Palatal Click



Spectrogram Analysis of "Qu" Click:

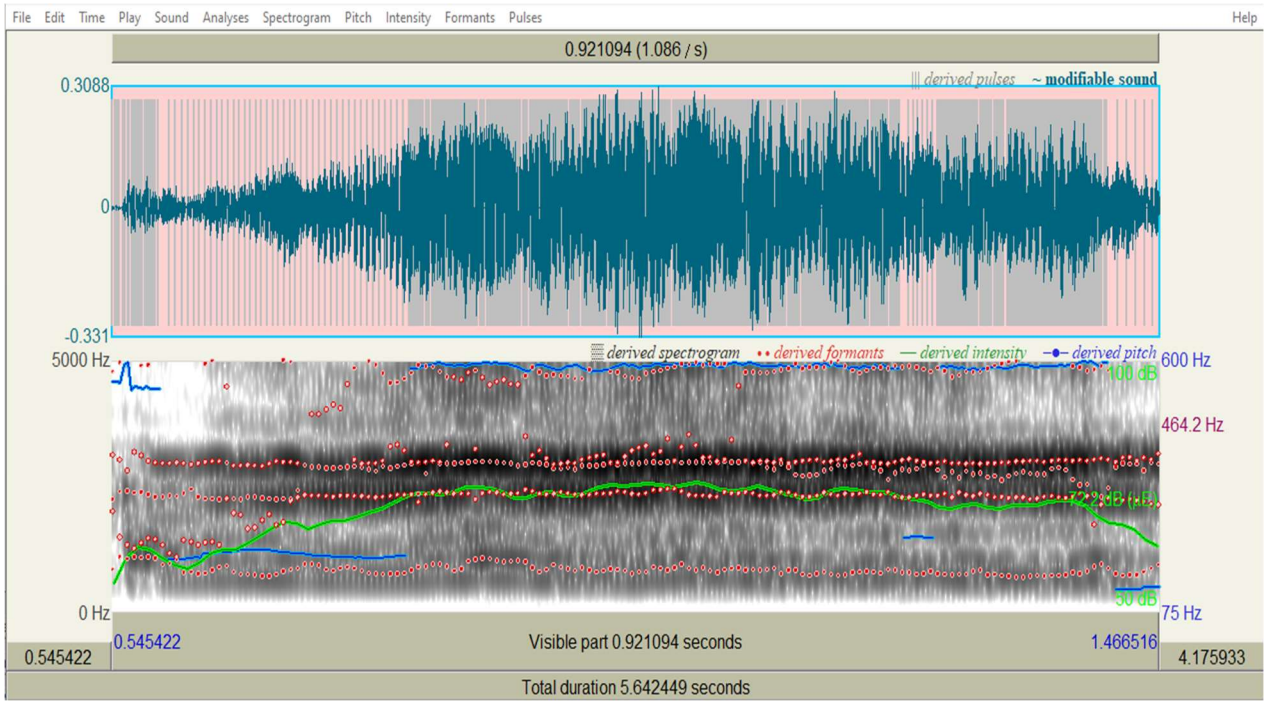
The spectrogram analysis of the alveolar palatal click "qu" in "Ihambo Yam" reveals acoustic properties that are significant for its vocal performance. The click exhibits a broad frequency spectrum from 0 Hz to 5000 Hz, with a prominent peak at 4965.90 Hz. This wide range captures both fundamental components and higher harmonics, contributing to the click's distinctive "popping" sound. The pitch analysis shows a frequency range of 50 Hz to 800 Hz, with a mean pitch of 731.39 Hz. The minimum pitch is 661.20 Hz, while the maximum reaches 796.32 Hz. This relatively high pitch range aligns well with the click's notation on E below high F, allowing for clear articulation and projection without vocal tension.

The intensity analysis reveals a range of 50 dB to 100 dB, with a mean energy intensity of 86.67 dB. This high intensity ensures the click remains audible and distinct, supporting its role in expressing anger within the word "ndabaqumbela" (anger at them). The formant structure provides insights into the click's articulation:

- F1 (755.93 Hz) and F2 (1670.69 Hz) reflect the tongue's position against the hard palate.
- F3 (2911.03 Hz) and F4 (3442.52 Hz) contribute to the click's resonance and projection.

The pulse range (-0.9989 to 0.9967) indicates significant vocal fold activity during production, which supports the integration of the click into the overall vocal line.

2. Nqa Nasalized Palatal Click



Spectrogram Analysis of "Nqa" Click:

The spectrogram analysis of the alveolar nasalized palatal click "nqa" in the aria "Kufa Ulutshaba" reveals acoustic properties that are significant for its vocal performance, particularly for a baritone voice. The click exhibits a broad frequency spectrum from 0 Hz to 5,000 Hz, with

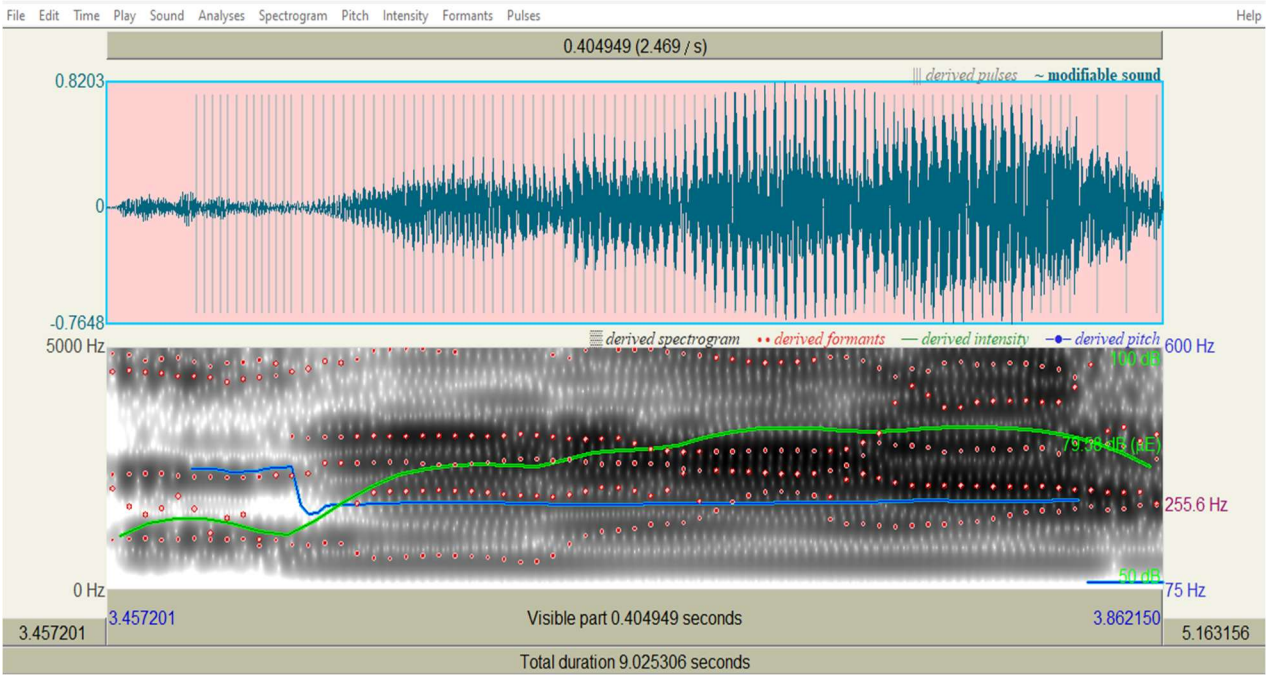
a prominent peak at 4941.99 Hz. This wide range captures both fundamental components and higher harmonics, contributing to the click's distinctive sound and projection. The pitch analysis shows a frequency range of 75 Hz to 600 Hz, with a mean pitch of 464.17 Hz. The minimum pitch is 120.67 Hz, while the maximum reaches 602.35 Hz. This range aligns well with the click's notation as a high A, which is typically manageable for most baritones. The broad pitch range allows for expressive variation while maintaining the character of the click.

The intensity analysis reveals a range of 50 dB to 100 dB, with a mean energy intensity of 72.20 dB. This moderate intensity ensures the click remains audible and distinct without overpowering the vocal line, supporting its role in expressing "hope" within the word "umnqantsa". The formant structure provides insights into the click's articulation:

- F1 (823.42 Hz) reflects the openness of the vocal tract, likely due to the "a" vowel.
- F2 (2175.15 Hz) indicates the tongue's position for the palatal articulation.
- F3 (2751.13 Hz) and F4 (3186.25 Hz) contribute to the click's resonance and projection.

The pulse range (-0.331 to 0.3088) suggests moderate vocal fold activity during production, which supports the integration of the click into the sustained note.

3. Qhe Aspirated Palatal Click



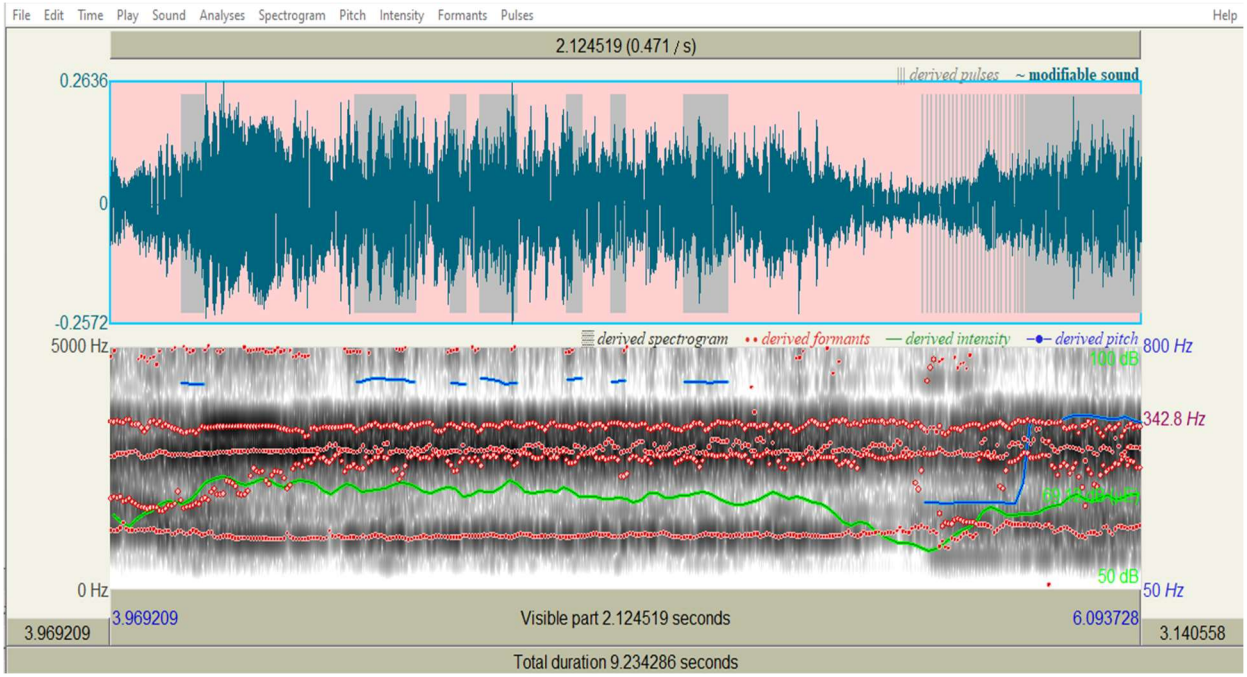
Spectrogram Analysis of "Qhe" Click:

The spectrogram analysis of the aspirated palatal click "qhe" provides valuable insights into its acoustic properties and implications for vocal performance. The click spans a frequency range of 0 Hz to 5000 Hz, with a spectrogram that appears darker in shade. This broad spectrum captures both the fundamental components and higher harmonics, contributing to the click's distinctive "popping" sound. Pitch analysis reveals a range from 75 Hz to 600 Hz, with a mean pitch of 255.558 Hz. The minimum pitch is 88.832 Hz, while the maximum reaches 349.942 Hz. Although this range is lower than the notated high D-flat, it suggests that the click's core acoustic properties are maintained even when sung at higher pitches. This adaptability is crucial for singers navigating challenging vocal registers.

The intensity analysis shows a range of 50 dB to 100 dB, with a mean energy intensity of 79.57894 dB. This moderate intensity aligns well with the mezzo-piano (mp) dynamic marking, allowing for clear articulation without excessive volume. This balance is essential for

maintaining vocal control while conveying the emotional depth of the word "kuqhekeke" (broken apart). The formant structure of the "qhe" click offers valuable insights into its articulation and acoustic properties. The notably high F1 at 1204.39 Hz reflects the open vowel "e" that follows the click, contributing to its clarity and projection. The F2, positioned at 2029.73 Hz, indicates the precise palatal articulation required for this click, highlighting the specific tongue placement against the roof of the mouth. Meanwhile, the higher formants, F3 at 2722.36 Hz and F4 at 3745.55 Hz, play crucial roles in shaping the click's overall resonance and projection. The pulse range (-0.7648 to 0.8203) suggests significant vocal fold activity during production, which may pose challenges when singing at high pitches.

4. Gqogqa Voiced Palatal Click Combination



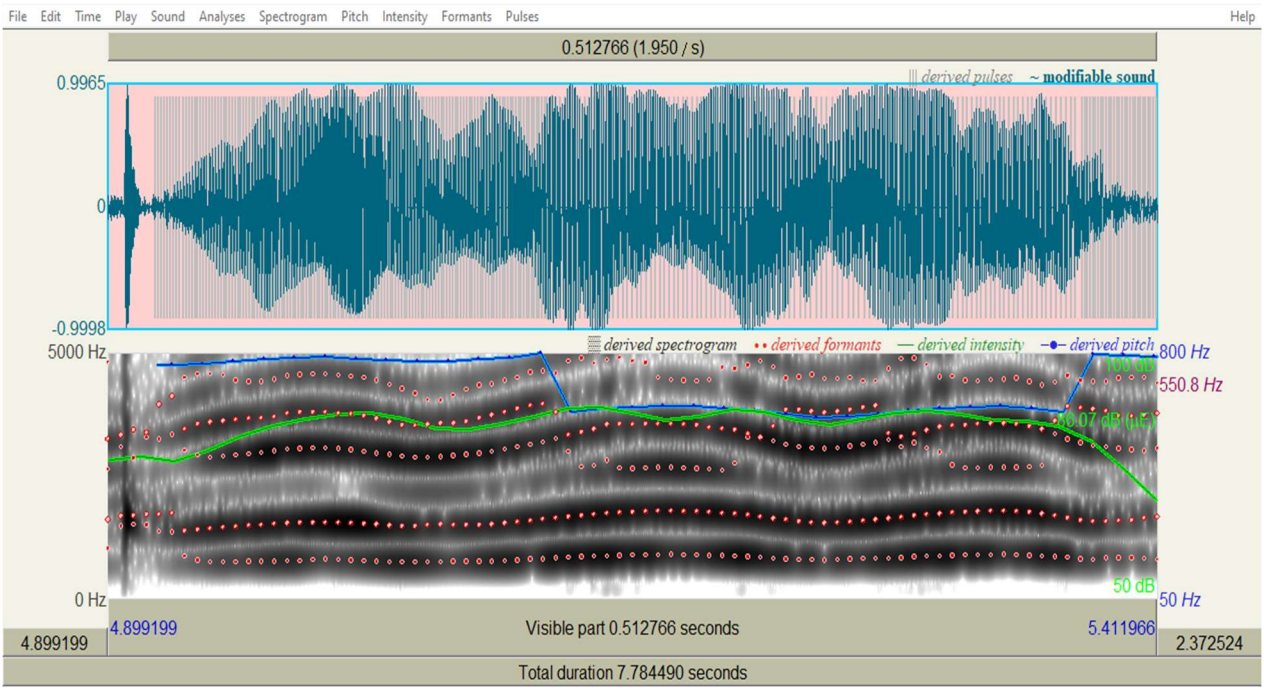
Spectrogram Analysis of "Gqo-gqa" Click:

The spectrogram analysis of the alveolar voiced palatal click combination "gqo-gqa" in "ndizigqogqa" reveals acoustic properties that are significant for its vocal performance in the aria

"Ndakwenza Ntoni Na?". The clicks span a frequency range of 0 Hz to 5000 Hz, with a peak at 4918.08 Hz, indicating a rich harmonic structure that contributes to their distinctive sound. The pitch analysis shows a range from 50 Hz to 800 Hz, with a mean pitch of 342.84 Hz. The minimum pitch is 129.43 Hz, while the maximum reaches 560.08 Hz. This wide range reflects the complex tonal nature of the clicks, especially considering their musical notation on C and F above middle C. The chopped appearance of the pitch in the spectrogram suggests rapid variations in frequency, which aligns with the challenging nature of producing these clicks in sung form.

The intensity analysis reveals a range of 50 dB to 100 dB, with a mean energy intensity of 69.12 dB. This moderate intensity allows for clear articulation without overpowering the vocal line, crucial for maintaining the balance between linguistic authenticity and musical expression. The formant structure of the "gqo-gqa" click combination offers valuable insights into its articulation and acoustic properties. The first formant (F1) at 1115.48 Hz is notably high, reflecting the open nature of the vowels "o" and "a" that follow each click. This elevated F1 contributes to the clarity and resonance of these vowels, enhancing the overall sonority of the word "ndizigqogqa". The second formant (F2), positioned at 2463.99 Hz, indicates the precise palatal articulation required for these clicks. This high F2 underscores the importance of accurate tongue placement against the hard palate, a crucial aspect of producing authentic Xhosa clicks in singing. The third and fourth formants, F3 at 2868.64 Hz and F4 at 3361.01 Hz respectively, play significant roles in shaping the clicks' overall resonance and projection. The pulse range (-0.2572 to 0.2636) suggests moderate vocal fold activity during production, which supports the integration of the clicks into the melodic line.

5. Ngqi Nasalised Voiced Palatal Click



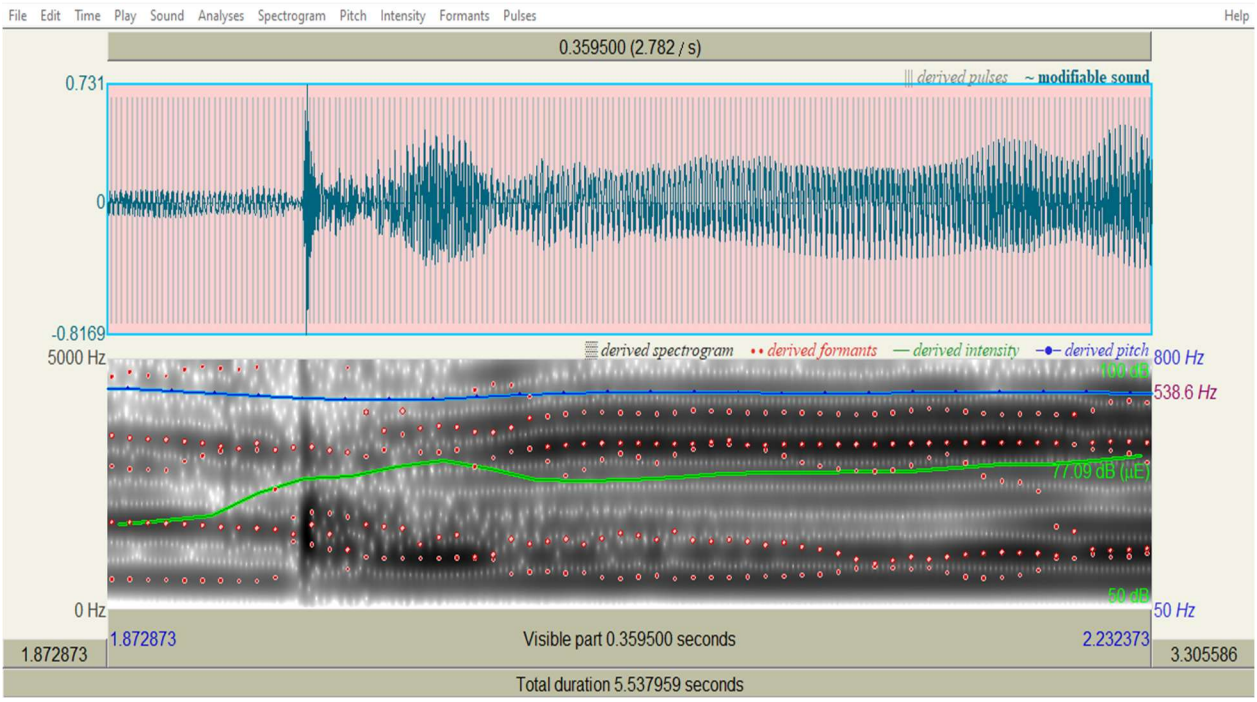
Spectrogram Analysis of "Ngqi" Click:

The spectrogram analysis of the alveolar nasalized voiced palatal click "ngqi" in the word "bungqina" reveals acoustic properties that are significant for its vocal performance in the soprano aria "Uyehova nguMalusi". The click spans a frequency range of 0 Hz to 5000 Hz, with a peak at 5109.35 Hz, indicating a rich harmonic structure that contributes to its distinctive sound. The pitch analysis shows a range from 50 Hz to 800 Hz, with a mean pitch of 550.79 Hz. The minimum pitch is 383.47 Hz, while the maximum reaches 844.65 Hz. This wide range reflects the complex tonal nature of the click, especially considering its musical notation on high A. The broad pitch range presents a significant challenge for singers, particularly when articulating the click at higher registers.

The intensity analysis reveals a range of 50 dB to 100 dB, with a mean energy intensity of 86.07 dB. This relatively high intensity contributes to the click's prominence in the vocal line, which can be both an advantage for clarity and a challenge for seamless integration into the

melodic flow. The formant structure of the "ngqi" click offers valuable insights into its articulation and acoustic properties. The first formant (F1) at 846.48 Hz is relatively high, reflecting the open nature of the vowel "i" that follows the click. This elevated F1 contributes to the clarity and resonance of the vowel, enhancing the overall sonority of the word "bungqina". The second formant (F2), positioned at 1609.26 Hz, indicates the precise palatal articulation required for this click, underscoring the importance of accurate tongue placement against the hard palate. The third and fourth formants, F3 at 2950.19 Hz and F4 at 3617.25 Hz respectively, play significant roles in shaping the click's overall resonance and projection. Notably, these higher formants fall within the range typically associated with the singer's formant (2700-3000 Hz). The pulse range (-0.9998 to 0.9965) suggests significant vocal fold activity during production, which underscores the complexity of integrating this click into the sung line.

6. Ngqo Nasalised Voiced Palatal Click



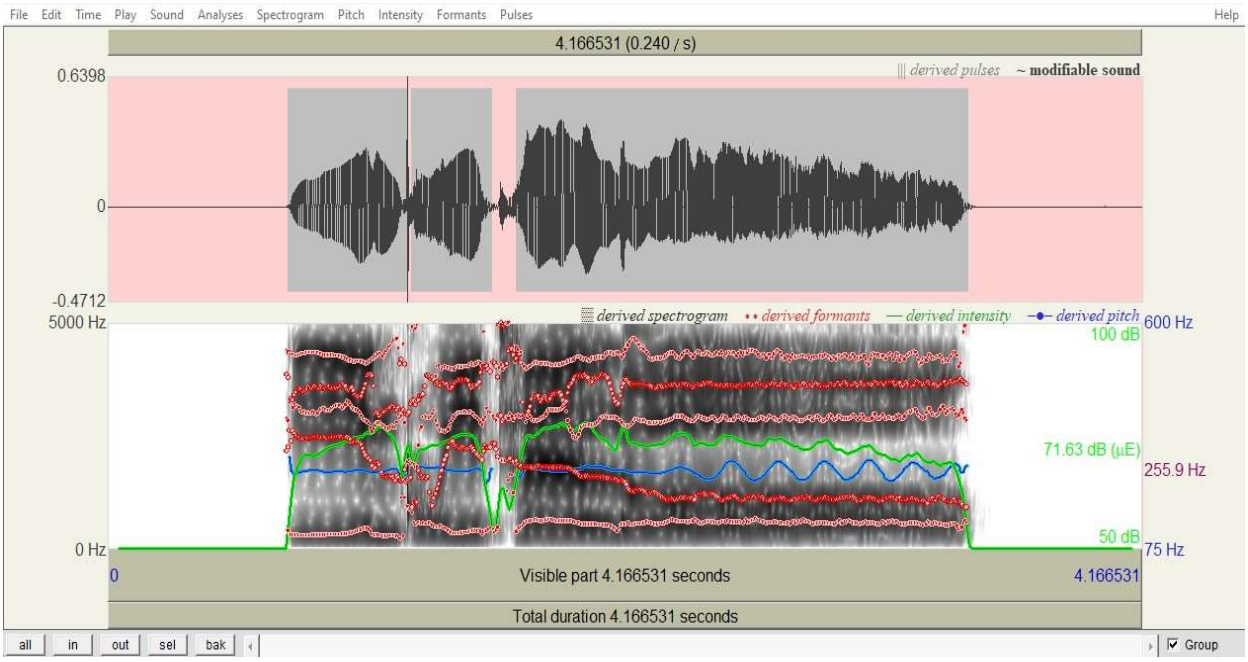
Spectrogram Analysis of "Ngq" Click:

The spectrogram analysis of the alveolar nasalized voiced palatal click "ngqo," as featured in the word "ngqolomsila" in *Wasithanda Mandela*, reveals significant acoustic properties relevant for its vocal performance. The click spans a frequency range of 0 Hz to 5000 Hz, with a prominent peak at 5037.63 Hz. Unlike the "ngqi" click, the spectrogram of "ngqo" appears less wavy and lighter in shade, reflecting differences in its acoustic profile and articulation. The pitch analysis indicates a frequency range between 50 Hz and 800 Hz, with a mean pitch of 538.64 Hz. The minimum pitch is 504.29 Hz, while the maximum reaches 570.08 Hz. This relatively narrow pitch range aligns well with the click's placement on middle C, which facilitates its projection and articulation in the middle vocal register.

The intensity analysis reveals a range from 50 dB to 100 dB, with a mean energy intensity of 77.09 dB. This moderate intensity ensures that the click is both audible and balanced within the vocal line, making it easier to integrate into the overall melodic structure without overpowering surrounding notes. The formant structure of the "ngqo" click offers valuable insights into its articulation and acoustic properties. The first formant (F1) at 773.14 Hz reflects the open vowel quality that follows the click, contributing to its resonance and clarity. The second formant (F2), positioned at 1333.18 Hz, indicates the precise palatal articulation required for this click, underscoring the importance of accurate tongue placement against the hard palate. The third and fourth formants, F3 at 2861.33 Hz and F4 at 3358.38 Hz respectively, play significant roles in shaping the click's overall resonance and projection. Notably, F3 aligns closely with the singer's formant range (2700–3000 Hz), potentially enhancing the click's clarity and audibility, especially when performed against musical accompaniment. The pulse analysis reveals a range spanning from -0.8169 to 0.731, suggesting consistent and controlled vocal fold

vibration during the production of the "ngqo" click. This relatively narrow range indicates that singers can articulate the click with minimal disruption to their overall vocal technique.

7. Nkqwi Nasal & Palatal Click Combination



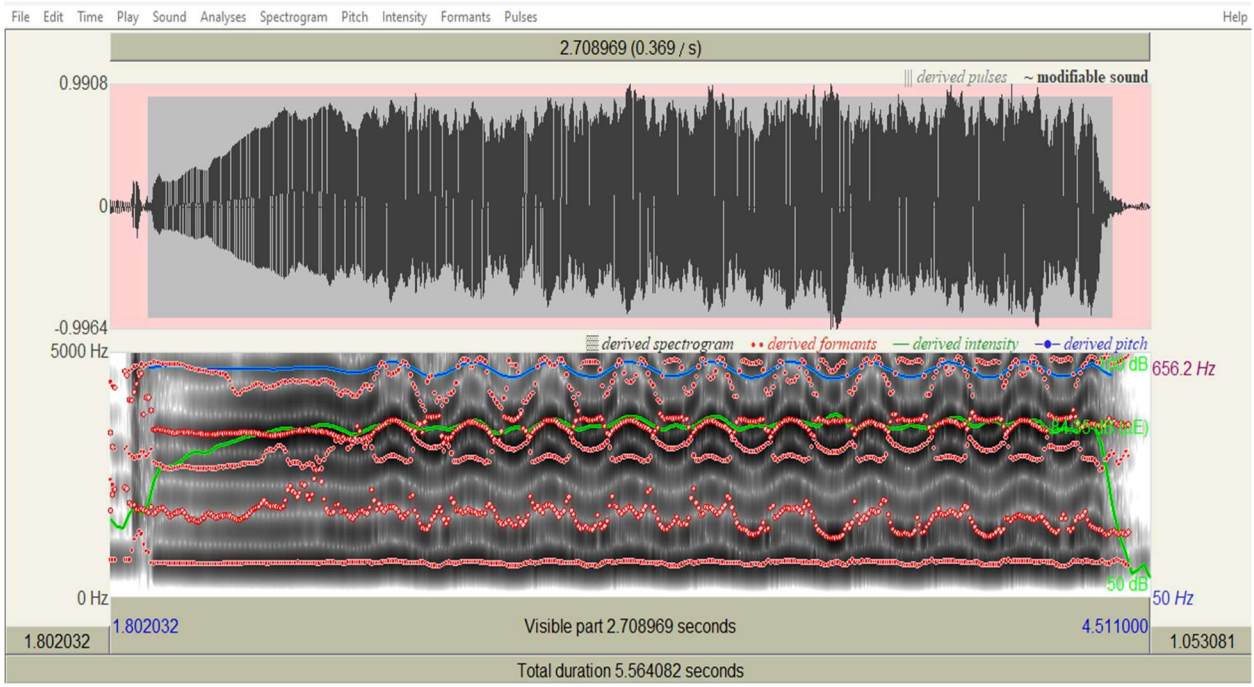
Spectrogram Analysis of "Nkqwi" Click:

The spectrogram analysis of the complex "nkqwi" click in "Undishiyelani Na?" reveals fascinating acoustic properties relevant to its vocal performance. This rare dual-nature click merges alveolar nasal and palatal clicks spanning a frequency range of 0 Hz to 5000 Hz, with a notable peak at 4200.80 Hz, reflecting its unique articulation. The click's pitch characteristics, ranging from 226.72 Hz to 286.65 Hz with a mean of 255.88 Hz, align well with its notation on C above middle C, making it accessible yet challenging for tenors. Its moderate mean intensity of 71.63 dB allows for clear articulation without overpowering the vocal line. The formant structure provides further insights: F1 at 618.51 Hz is lower than typical palatal clicks, likely due to the nasal component. F2 at 1634.33 Hz indicates precise palatal articulation, while F3

(2930.27 Hz) and F4 (3788.73 Hz) enhance resonance and projection, falling within the singer's formant range. This structure supports both linguistic authenticity and vocal practicality. The pulse range of -0.4712 to 0.6398 suggests stable vocal fold activity, crucial for integrating this complex sound into legato phrases.

Lateral Click Consonants

1. Xo Click



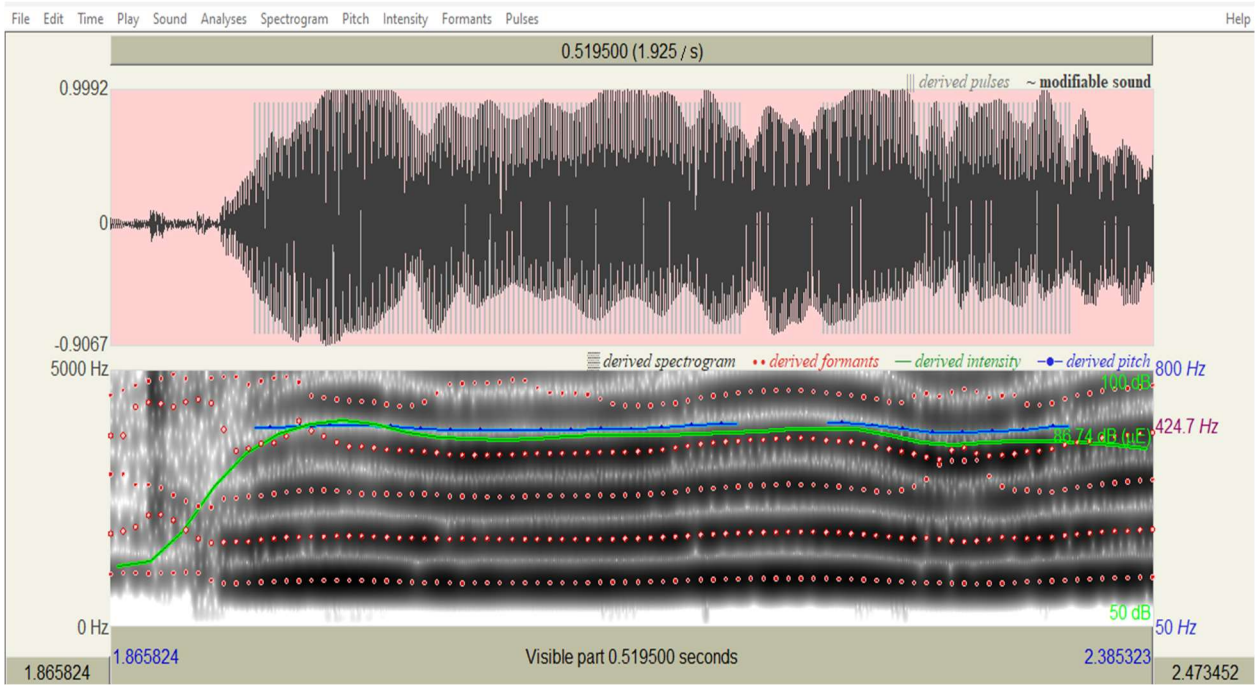
Spectrogram Analysis of "Xo" Click:

The spectrogram analysis of the alveolar lateral click "xo" in "Thixo" reveals fascinating acoustic properties relevant to its performance in "Ihambo Yam". This click exhibits a broad frequency spectrum from 0 Hz to 5000 Hz, peaking at 4965.90 Hz, which captures its unique timbral qualities. The pitch characteristics of "xo" are particularly interesting. With a mean pitch of 656.23 Hz and a range from 590.93 Hz to 718.82 Hz, the click aligns well with its musical notation on E below high F. This placement makes it accessible to singers while still presenting a

technical challenge, reflecting the composer's thoughtful integration of Xhosa phonetics into the vocal line. Intensity analysis shows a range of 50 dB to 100 dB, averaging 84.35 dB. This moderately high intensity ensures the click's audibility within the musical texture, crucial for conveying the word "Thixo" (God) and its thematic significance in the piece.

The formant structure of the "xo" click provides valuable insights into its articulation and acoustic properties. The first formant (F1) at 694.40 Hz suggests an open vowel quality immediately following the click, contributing to its clarity and resonance. The second formant (F2), positioned at 1636.93 Hz, reflects the lateral articulation characteristic of this type of click, highlighting the precise tongue positioning required for its production. The third and fourth formants, F3 at 2899.98 Hz and F4 at 3492.30 Hz, play a significant role in shaping the click's resonance and projection. Notably, F3 falls within the singer's formant range (2700–3000 Hz), which is known to enhance carrying power and audibility in vocal performance. The wide pulse range (-0.9964 to 0.9908) implies significant vocal fold engagement, highlighting the complex nature of producing this click in a sung context.

2. Xe Click

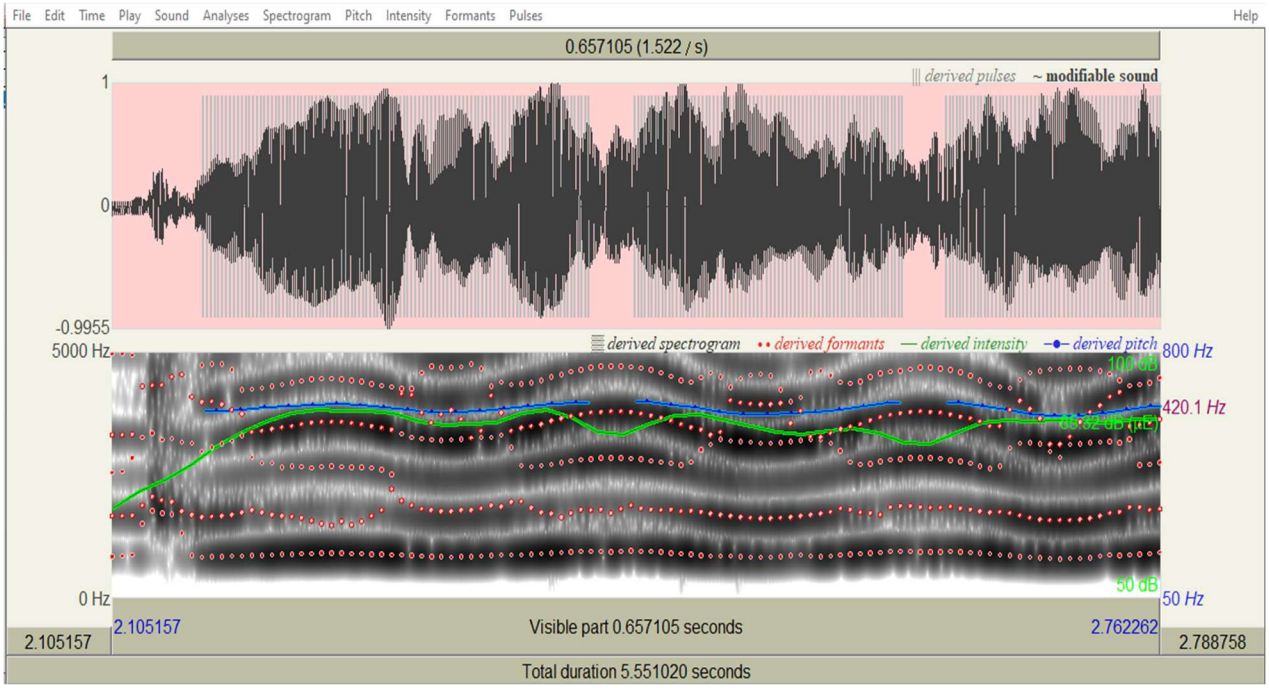


Spectrogram Analysis of "Xe" Click:

The spectrogram analysis of the alveolar lateral click "xe," featured in the word "xesha" from *Ihambo Yam, Opus.015*, highlights key acoustic properties that are significant for its integration into vocal performance. The click spans a frequency range of 0 Hz to 5000 Hz, with a peak at 4989.81 Hz, capturing both its fundamental and harmonic components. The spectrogram displays dark, wavy patterns similar to the "xo" click but features dotted red lines, distinguishing its visual representation. The pitch analysis reveals a frequency range from 404.05 Hz to 450.44 Hz, with a mean pitch of 424.65 Hz. This relatively narrow pitch range aligns well with the notation of the click on high A, two octaves above middle C. Its placement within this register ensures accessibility for singers while supporting the lyrical and legato singing style required by the composer.

The intensity analysis shows a range from 50 dB to 100 dB, with a mean energy intensity of 86.74 dB. This moderately high intensity allows for clear articulation and projection of the click while maintaining the gentle tone specified in the performance instructions. The formant structure provides further insights into the click's articulation. F1 at 876.40 Hz reflects the open vowel quality following the click, contributing to its clarity and resonance. F2 at 1743.06 Hz indicates the lateral articulation characteristic of this type of click, requiring precise tongue placement against the hard palate. F3 at 2650.02 Hz and F4 at 3558.35 Hz enhance resonance and projection, with F3 falling close to the singer's formant range (2700–3000 Hz), which aids in audibility and carrying power for singing. The pulse range (-0.9067 to 0.9992) suggests stable vocal fold activity during production, allowing singers to integrate this complex sound smoothly into melodic passages without disrupting vocal technique.

3. Nxa Nasalised Lateral Click

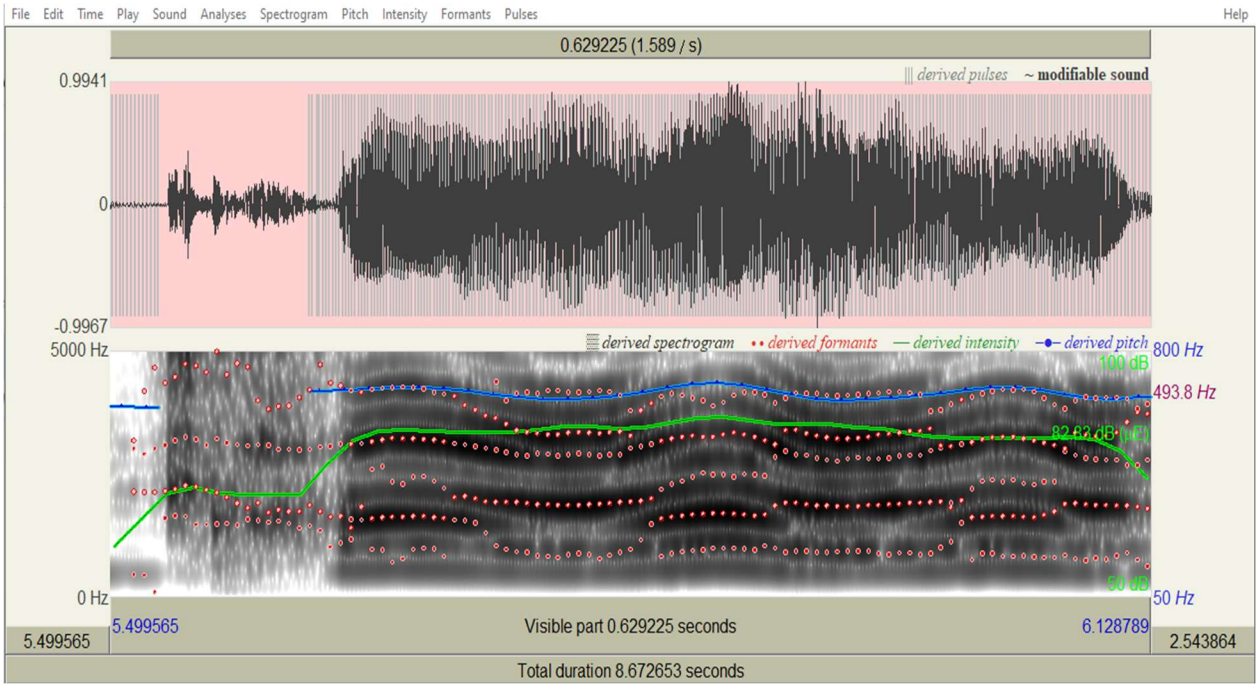


Spectrogram Analysis of "Nxa" Click:

The spectrogram analysis of the alveolar nasalized lateral click "nxa" in "Undishiyelani Na?" reveals fascinating acoustic properties that shed light on its performance challenges and opportunities. This complex click, spanning 0 Hz to 5000 Hz with a peak at 4989.81 Hz, exhibits a unique spectral signature characterized by a wavy waveform with dark shades and a lighter spectrogram featuring white wave-like patterns interspersed with red dotted lines representing formants. The pitch characteristics of "nxa" are particularly intriguing, ranging from 386.69 Hz to 454.40 Hz, with a mean of 420.13 Hz. This relatively narrow range aligns well with its musical notation on B, a major seventh above middle C, suggesting the composer's thoughtful integration of this Xhosa phoneme into the tenor vocal line.

Intensity analysis shows a range of 50 dB to 100 dB, averaging 85.32 dB. This moderately high intensity ensures the click's audibility within the musical texture while allowing for nuanced expression of the piece's themes of loss and grief. The formant structure of the "nxa" click provides valuable insights into its articulation and acoustic properties. The first formant (F1) at 893.16 Hz suggests an open vowel quality immediately following the click, contributing to its clarity and resonance. The second formant (F2), positioned at 1721.63 Hz, reflects the lateral articulation characteristic of this type of click, highlighting the precise tongue positioning required for its production. The third and fourth formants, F3 at 2926.57 Hz and F4 at 3660.77 Hz, play a significant role in shaping the click's resonance and projection. Notably, F3 falls within the singer's formant range (2700-3000 Hz). The wide pulse range (-0.9955 to 1) implies significant vocal fold engagement, highlighting the complex nature of producing this click in a sung context.

4a. Xhe Aspirated Lateral Click Form Part of the Word Xhenxe



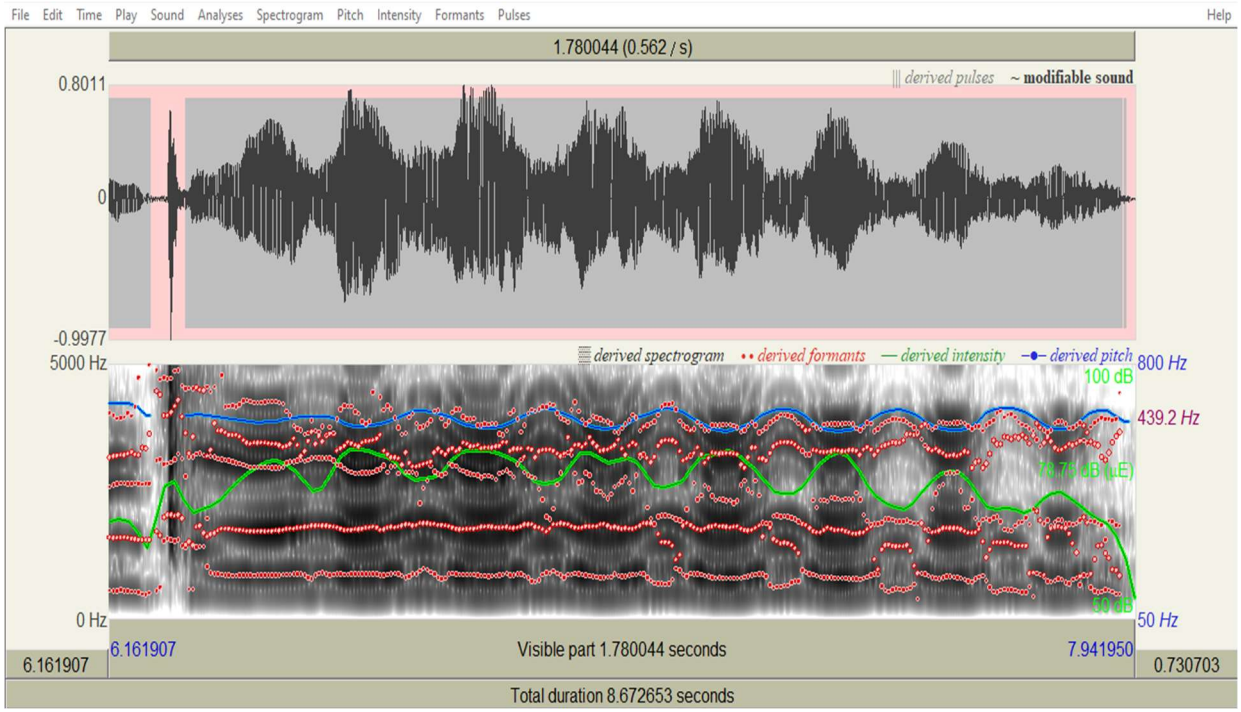
Spectrogram Analysis of "Xhe" Click:

The spectrogram analysis of the "xhe" click in "Wasithanda Mandela" reveals fascinating acoustic properties that illuminate its role in vocal performance. This aspirated lateral click, part of the word "sixhenxe," exhibits a frequency range from 0 Hz to 5000 Hz, peaking at 4941.99 Hz. The waveform's dark, wavy pattern, starting small and expanding, reflects its unique articulation without sustained vibrato. Pitch characteristics span from 423.56 Hz to 558.20 Hz, averaging 493.79 Hz. This range complements its notation on B below middle C, facilitating the percussive melody created by the interplay of aspirated and nasalized lateral clicks in "xhenxe."

The intensity, ranging from 50 dB to 100 dB with a mean of 82.83 dB, ensures clear projection while maintaining balance within the vocal line. The formant structure of the "xhe" click provides valuable insights into its articulation and acoustic properties. The first formant (F1) at 994.14 Hz suggests an open vowel quality immediately following the click, contributing to its clarity and resonance. The second formant (F2), positioned at 1815.04 Hz, indicates the

precise lateral articulation required for this click type, highlighting the specific tongue placement necessary for its production. The third and fourth formants, F3 at 2756.12 Hz and F4 at 3536.02 Hz, play significant roles in shaping the click's resonance and projection. The pulse range (0.9967 to 0.9941) implies stable vocal fold activity, crucial for seamless integration into melodic passages.

4b. Nxe Nasalised Lateral Click Forms Part the Word “Xhenxe”



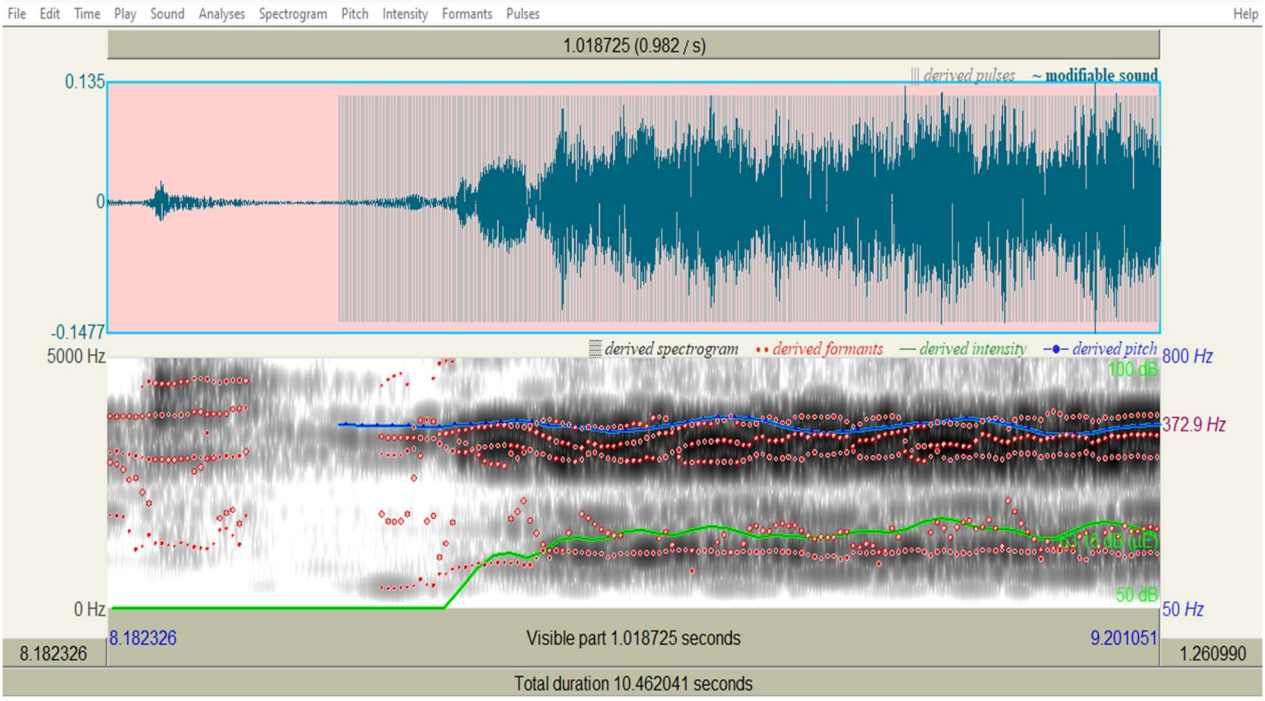
Spectrogram Analysis of "Nxe" Click:

The spectrogram analysis of the alveolar nasalized lateral click "nxe," as found in the word "xhenxe" from *Wasithanda Mandela*, highlights its unique acoustic properties and significance for vocal performance. This click spans a frequency range of 0 Hz to 5000 Hz, with a peak at 4965.90 Hz. Unlike the "xhe" click, the waveform of "nxe" begins with a tall sound wave, indicating a high initial volume, followed by sustained vibrato that increases in amplitude.

The spectrogram also features numerous red dotted lines representing derived formants, showcasing its complex resonance structure. The pitch analysis reveals a range from 383.30 Hz to 523.20 Hz, with a mean pitch of 439.22 Hz. The placement of this pitch on B below middle C ensures accessibility for singers while supporting the composer's intention for the click to be sung in the middle register, which facilitates vocal comfort and clarity. The intensity analysis shows a range from 50 dB to 100 dB, with a mean energy intensity of 78.75 dB, allowing for clear projection without overwhelming the surrounding melodic line.

The formant structure of the "nxe" click offers valuable insights into its acoustic properties and articulation. The first formant (F1), positioned at 790.06 Hz, suggests a relatively open vowel quality immediately following the click, contributing to its clarity and resonance. The second formant (F2) at 1665.95 Hz reflects the lateral articulation characteristic of this click type, highlighting the specific tongue placement required for its production. The third and fourth formants, F3 at 2555.27 Hz and F4 at 3392.67 Hz, play crucial roles in shaping the click's overall clarity and acoustic amplification. The pulse range (-0.9977 to 0.8011) suggests stable and significant vocal fold activity during production, underscoring the complexity of executing this nasalized lateral click in a sung context.

5. Xhwa Aspirated Lateral Click



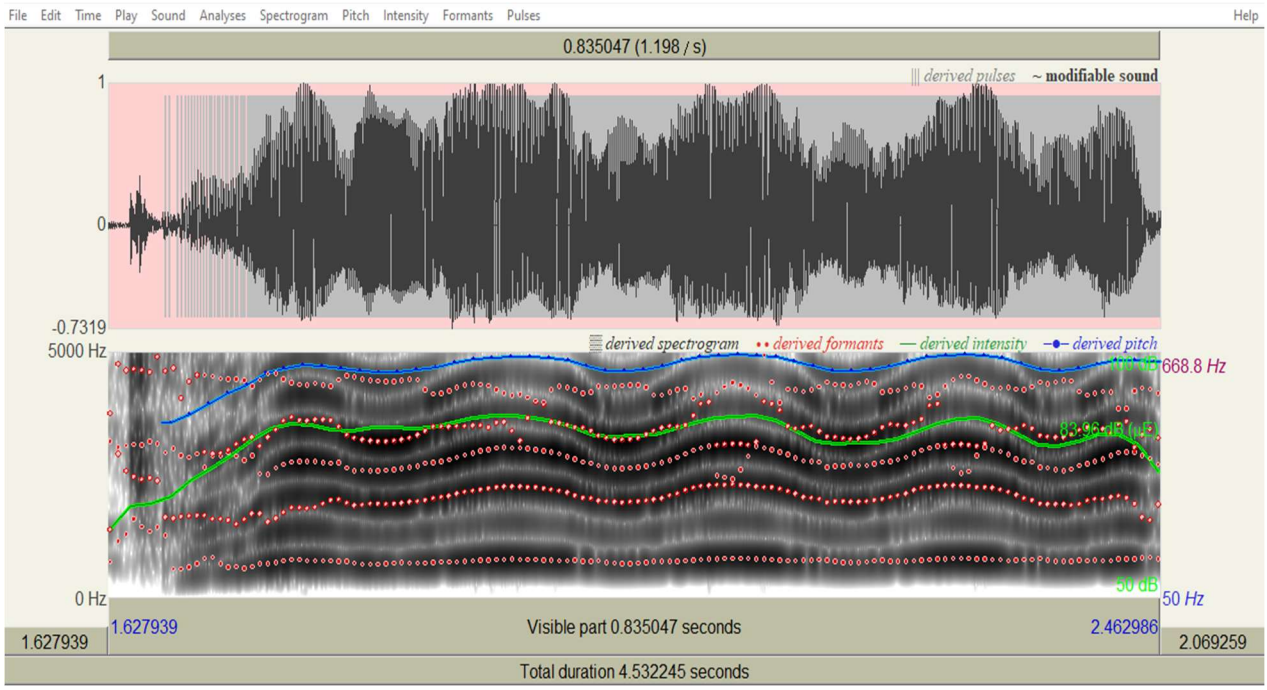
Spectrogram Analysis of "Xhwa" Click:

The spectrogram analysis of the "xhwa" click in *Ndakuwubon' Umnqamlezo* reveals a complex acoustic profile that is significant for its vocal performance. This alveolar aspirated lateral click spans a frequency range of 0 Hz to 5000 Hz, with a dominant peak at 4941.99 Hz, reflecting its unique articulation combining lateral airflow and aspiration. The waveform begins with a sustained, expanding vibrato, visible as a white-to-dark gradient in the spectrogram, indicating gradual amplification of the sound. The mean pitch of 372.92 Hz and narrow range of 338.35 Hz to 409.66 Hz align with its notation on G (a perfect fifth above middle C), creating a balance between technical accessibility and linguistic authenticity in the mezzo-soprano register.

The formant structure provides further insights into the click's articulation. F1 at 1015.91 Hz suggests an open vocal tract post-click, supporting the vowel transition to "w." F2 at 1922.42 Hz indicates precise lateral articulation, consistent with the tongue-molar contact required. F3 at 3107.05 Hz and F4 at 3514.93 Hz enhance resonance, with F3 overlapping the singer's formant

range (2700–3000 Hz), aiding projection over accompaniment. The parallel motion of formants reflects the rapid transition from click to "w," a key challenge noted in performance guidelines. For singers, these acoustic properties present both challenges and opportunities. The moderate intensity (63.17 dB mean) and controlled pitch range reduce strain, critical for executing the aspirated click followed by the labial "w." The pulse range (-0.9977 to 0.135) suggests stable glottal coordination, essential for maintaining legato phrasing amid rapid articulatory shifts. The vibrato expansion demands precise breath control to balance the click's percussive attack with sustained resonance.

6. Gxe Voiced Lateral Click



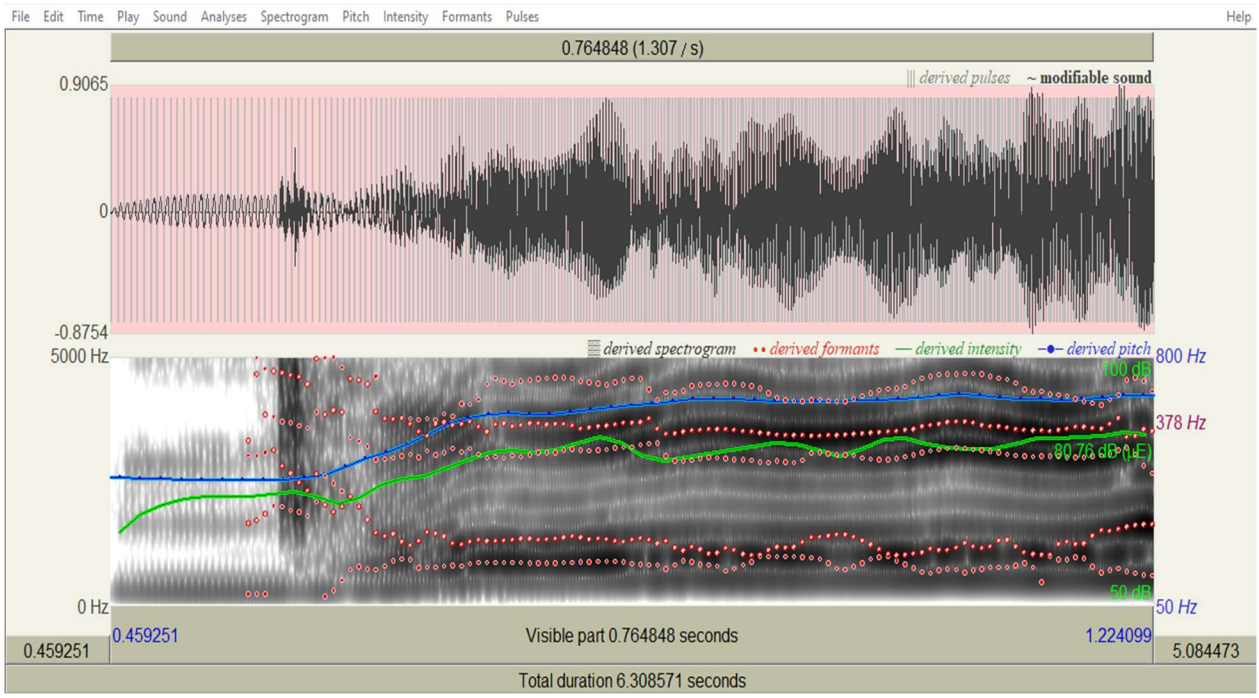
Spectrogram Analysis of "Gxe" Click:

The spectrogram analysis of the alveolar voiced lateral click "gxe" in *Uyehova nguMalusi, Opus. 014* reveals fascinating acoustic properties that illuminate its role in vocal performance. This complex sound spans a frequency range of 0 Hz to 5000 Hz, with a notable

peak at 3459.60 Hz, reflecting its unique voiced lateral articulation. The waveform begins with a small sound wave that expands as vibrato develops, visible in the spectrogram as dark, wavy patterns. This click's acoustic profile is particularly intriguing given its high mean pitch of 668.75 Hz and wide range from 357.13 Hz to 773.68 Hz, aligning with its notation on F6, two octaves above middle C.

The formant structure provides further insights into the click's articulation and resonance. F1 at 759.68 Hz indicates a moderately open vocal tract, supporting vowel clarity after the click. F2 at 2010.89 Hz reflects the lateral articulation, consistent with the tongue's firm contact against the hard palate. F3 (2799.53 Hz) falls within the singer's formant range, enhancing projection, while F4 (3478.83 Hz) contributes to the overall brightness of the sound. This structure ensures that the click's linguistic authenticity remains clear even in the soprano's upper register. The high pitch placement demands precise breath support to balance vibrato expansion with tonal clarity. The pulse range (-0.7319 to 1) suggests stable glottal coordination, essential for maintaining pitch stability during the click's rapid articulation. The mean intensity of 83.96 dB ensures audibility without compromising vocal comfort, crucial for sustaining this high-frequency sound. In the context of *Uyehova nguMalusi*, where the click forms part of the word "ndagxekwa" (meaning "judged"), its acoustic profile takes on added significance. The inherent sonority of this voiced lateral click, evident in its intensity and F3 resonance, aligns well with the emotional weight of the text.

7. Ngxa Nasalised Voiced Click



Spectrogram Analysis of "Ngxa" Click:

The spectrogram analysis of the alveolar nasalized voiced click "ngxa" in Nqobile Nkonzo's *Wasithanda Mandela* highlights its unique acoustic features and significance in vocal performance and cultural representation. This click spans a frequency range of 0 Hz to 5000 Hz, with a peak at 5061.53 Hz, showcasing its intricate articulation that combines nasalization, voicing, and lateral airflow. The waveform begins with a sustained, small sound that gradually expands through vibrato, as reflected in the spectrogram's light-dark gradients and intersecting formant lines. The pitch analysis reveals a mean pitch of 378.02 Hz, with a range from 202.10 Hz to 526.01 Hz, aligning with its notation on B♯ (middle C). This placement is ideal for facilitating clear articulation and projection while maintaining the linguistic authenticity of the click. The formant structure further illustrates the click's acoustic complexity: F1 at 764.58 Hz suggests a moderately open vocal tract post-click, F2 at 1420.42 Hz reflects the lateral articulation required for tongue placement against the hard palate, and F3 at 3019.14 Hz

enhances projection by falling within the singer's formant range (2700–3000 Hz). F4 at 3590.73 Hz adds brightness to the sound, ensuring audibility in a chromatic harmonic context.

The acoustic analysis reveals a pulse range of -0.8754 to 0.9065, suggesting consistent vocal fold activity during the production of the "ngxa" click. This stability is crucial for singers to navigate the complex articulation, particularly the delayed release necessitated by the preceding "ng" consonants. The click's intensity, averaging 80.76 dB, strikes a careful balance between clear projection and vocal endurance. This moderate energy level ensures the click remains audible within the musical texture without requiring excessive vocal effort, allowing performers to maintain sound quality and technique throughout the piece.

Glossary

This section details the terms used in the Methodology and Results of this study**.** The first terms describe the key acoustic parameters for spectrogram analysis for spoken and sung clicks. [66,67]

- ***Spectrogram Analysis:*** A visual representation of sound that shows how frequency and amplitude change over time. It is widely used in speech analysis to study features like formants and noise patterns.
- ***Pitch Contours:*** The variation in fundamental frequency (F0) over time, often used to analyze intonation patterns and emotional expression in speech.
- ***Intensity Profiles:*** A depiction of changes in sound energy (amplitude) over time, useful for tracking loudness variations during speech production.

[66] Suphattharachai Chomphan, "Analysis of Fundamental Frequency Contour of Coded Speech Based on Multi-Pulse Based Code Excited Linear Prediction Algorithm." *Journal of Computer Science* 7, no. 6 (2011): 865-870.
[67] Suphattharachai Chomphan, *Analysis of Fundamental Frequency Contour*, Kasetsart University Press, 2020.

- ***Pulse Patterns:*** Periodic waveforms with alternating active and silent phases, analyzed to study harmonic content and sound quality.
- ***Formant Structures:*** Resonant frequencies (F1, F2, F3, F4) of the vocal tract that define vowel sounds. These are influenced by tongue position and lip shape.

The next set of terms is used in explaining the Voice Report Acoustic Analysis.[68,69]

- ***Pitch:*** the perceived highness or lowness of a sound, determined by the frequency (F0) of vibration in the sound waves. In speech and music, pitch plays a crucial role in conveying intonation, melody, and emotional expression.
    - Median pitch: The middle F0 value in a sample.
    - Mean pitch: The average F0 value.
    - Minimum pitch: The lowest F0 value.
    - Maximum pitch: The highest F0 value.
- ***Hertz (Hz):*** a unit of frequency that measures how many cycles a sound wave completes in one second. It is used to describe pitch, with human hearing typically ranging from 20 Hz to 20,000 Hz.
- ***Decibel (dB):*** a unit for measuring sound intensity or power on a logarithmic scale. They represent loudness, where higher dB values indicate louder sounds.
- ***Jitter:*** Local, absolute, usec: Measures the variability in vocal fold vibration cycle durations, expressed in microseconds (usec).

[68] Joana Fernandes, Felipe Teixeira, Vitor Guedes, Arnaldo Junior, and João Paulo Teixeira, "Harmonic to Noise Ratio Measurement - Selection of Window and Length," *Procedia Technology* 1, no. 1 (2018): 1-10.
[69] John Stonham, *Phonetics and Phonology Lecture Notes,* Accessed March 28, 2025.

    - DDP (%): The relative cycle-to-cycle variation in pitch, expressed as a percentage.
- ***Shimmer (dda, %):*** Measures the variability in vocal fold vibration amplitude, expressed as a percentage. Higher shimmer indicates voice instability.
- ***NHR (Noise-to-Harmonic Ratio):*** The ratio of noise energy to harmonic energy in a voice signal. Higher values suggest breathiness; lower values indicate clearer voicing.
    - Mean Noise-to-Harmonic Ratio: The average noise-to-harmonic ratio across a sample.
    - Mean Harmonics-to-Noise Ratio (dB): The inverse decibel measure, showing harmonic dominance.
- ***Dot Plot:*** Local, dB: A graph showing amplitude variations (in decibels) over time.
    - DDA,%: A graph displaying shimmer values as percentages over multiple cycles.
- ***Box Plot:*** A statistical graph summarizing data distribution through medians, quartiles, and ranges, often used to compare voice parameters like jitter or shimmer.

CHAPTER FOUR: RESULTS

Method of Data Collection:

1. I collaborated with Mr. Gopichandh Danala, a research scientist at the Data Institute for Societal Challenges at the University of Oklahoma, on the data analysis for this section. We reformatted the initial data in Excel, creating multiple tabs to separate spoken and sung click consonants.
2. Color-coding was implemented to distinguish between data types:
    - Orange: Spoken clicks only
    - Green: Both spoken and sung clicks
3. We addressed formatting issues in the figures obtained from Praat voice reports:
    - Converted "E-3 seconds" to milliseconds for the number of periods and standard deviation in pitch
    - Adjusted "E-6 seconds" to microseconds for Jitter (local, absolute) measurements

Data Analysis:

This analysis investigated acoustic properties of thirteen spoken and sung Xhosa click consonants. Pitch distribution was visualized using Excel. Jitter, shimmer, and harmonics-to-noise ratio (NHR) were analyzed using Praat voice reports and custom calculations. Due to the sparse and subjective nature of frame counts, the number of frames from Praat reports were excluded from the Jitter analysis. Instead, local jitter (microseconds) and Jitter DDP (ratio/percentage) were calculated, representing the average absolute difference between consecutive periods. Shimmer was assessed using local dB, reflecting amplitude variations. NHR was calculated to determine the relative prominence of harmonics (characteristic voice tones)

versus noise (distorted sounds). Data was visualized using Google Colab to generate dot plots and boxplots for comparative analysis.

Results:

Jitter

- Dot Plot Analysis: The dot plot comparing jitter in sung and spoken clicks revealed that "nca" and "nxa" clicks exhibited similar jitter values between spoken and sung versions. The "ngcu" click showed higher jitter in the sung version, whereas most other clicks showed higher jitter in the spoken versions, contrary to initial expectations. The most significant differences were observed in the "nqa" and "ngcu" clicks, with the singing version showing high values (120 and 80 microseconds, respectively).
- General Trend: Overall, spoken clicks tended to have higher jitter values than sung clicks, except for the "ngcu" and "nqa" clicks.

Shimmer

- Dot Plot Analysis: Shimmer analysis (dda/%) indicated higher shimmer values in the sung version of the clicks.
- Interpretation: This suggests greater amplitude variation in sung clicks compared to spoken clicks, likely due to the more monotone nature of speech. The "nca" click showed little difference in shimmer between spoken and sung versions. Conversely, the "xo" click exhibited a higher shimmer in the spoken version.

Harmonics-to-Noise Ratio (NHR)

- Dot Plot Analysis: The dot plot of the mean harmonic-to-noise ratio (dB) showed that spoken click consonants generally had higher harmonic values than sung clicks, with the exception of the "xe" click, where the sung version was higher.
- Interpretation: The results showing higher harmonic values for spoken click version than sung clicks was unexpected, as singing was hypothesized to have richer harmonic content.

Pitch Analysis (Box Plots)

- Classification-Based Comparison: Boxplots comparing pitch by click classification (dental, lateral, palatal) showed minimal overall difference, with the primary distinction being the pitch range. Dental clicks exhibited a lower pitch range, while lateral and palatal clicks were slightly higher. The median pitch was lowest for dental clicks and highest for lateral clicks.
- Spoken vs. Sung Comparison: Boxplots comparing pitch between spoken and sung clicks revealed that the "nca" click had similar pitch variation in both conditions. The "ngcu" click had a similar median pitch, but greater variation in the sung version. The "xe" click showed a tight distribution in the spoken version and greater variation in the sung version. Lateral clicks ("xe, xhe, nxa, gxe, and ngxa") generally showed large pitch variations, except for "xo". The "nkqwi" click was the only exception to this trend, with the spoken version showing greater variation than the sung version.

Summary of Pitch Analysis

The “nca” click showed consistent behavior across spoken and sung versions. The “ngcu” click showed a slight increase in pitch variation when sung. All other clicks, excluding "nkqwi," displayed substantial differences in pitch variation between spoken and sung versions. The “nkqwi” click was unique in that the spoken version showed greater variation.

Overall Conclusion of the Entire Dataset

Across jitter, shimmer, NHR, and pitch analyses, the "nca" click exhibited relatively consistent behavior. The other clicks displayed varied changes across spoken and sung versions. Based on these findings, dental clicks appear to be the easiest to sing due to their lower pitch range and smaller variation, while lateral clicks are the most challenging due to their high variability, although this does not preclude their singability.

Figure 1: Jitter (ddp) Dot Plot

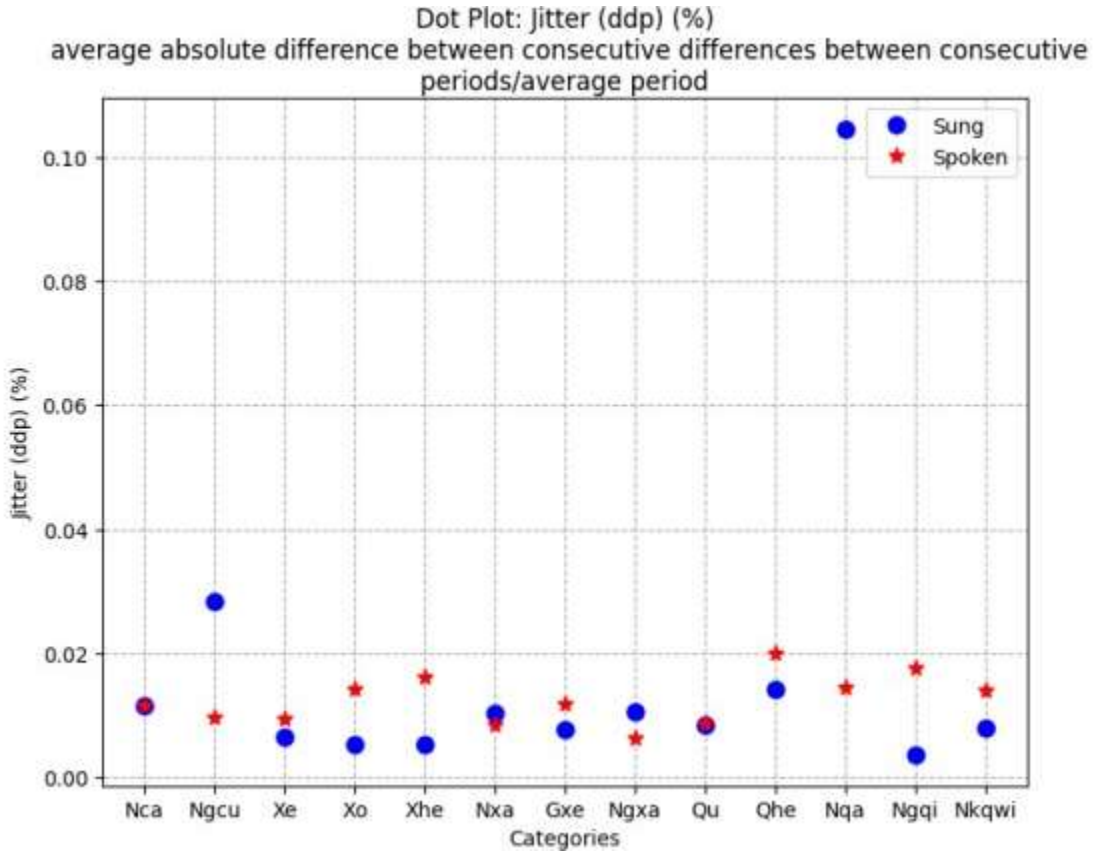


Figure 2: Shimmer (dda%) Dot Plot

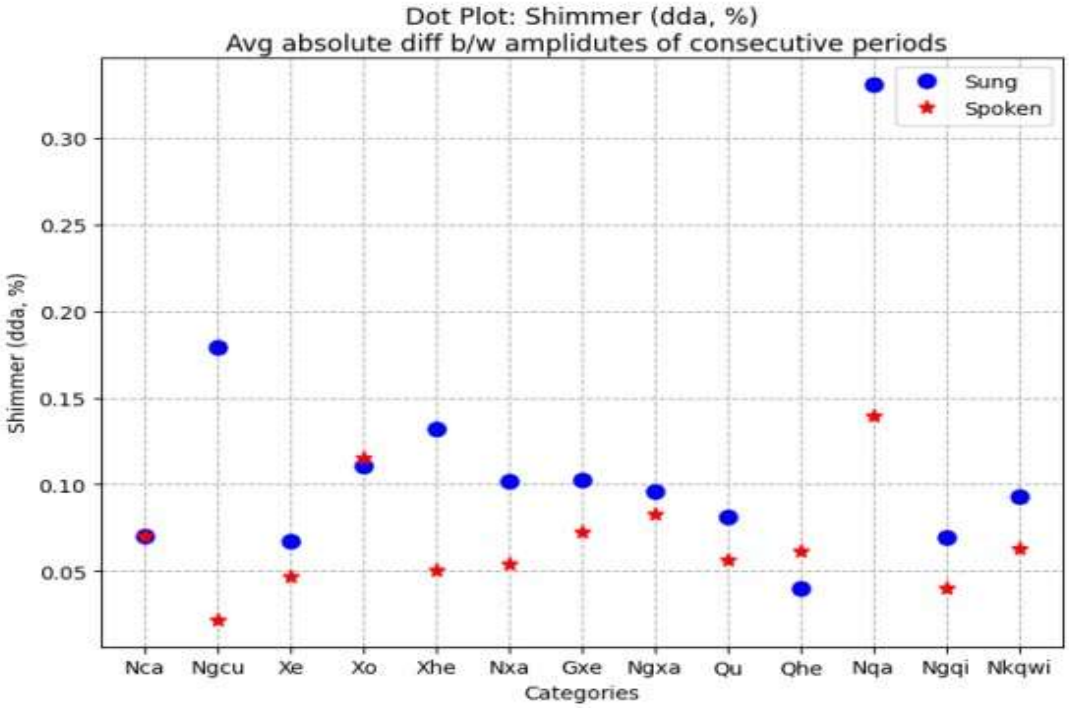


Figure 3: NHR (dB) Dot Plot

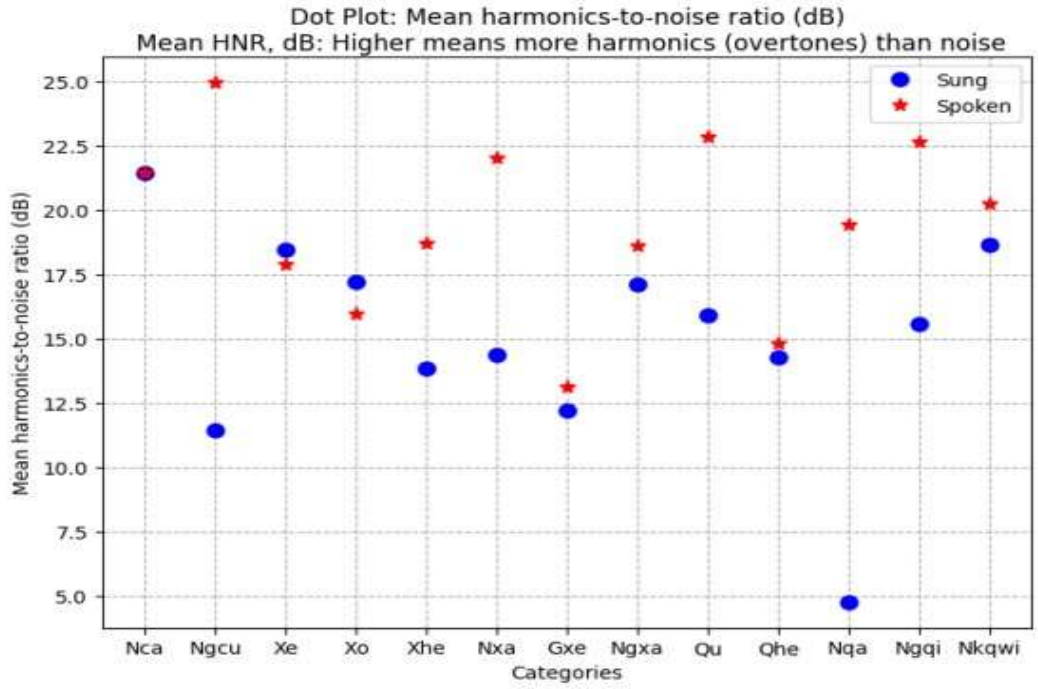
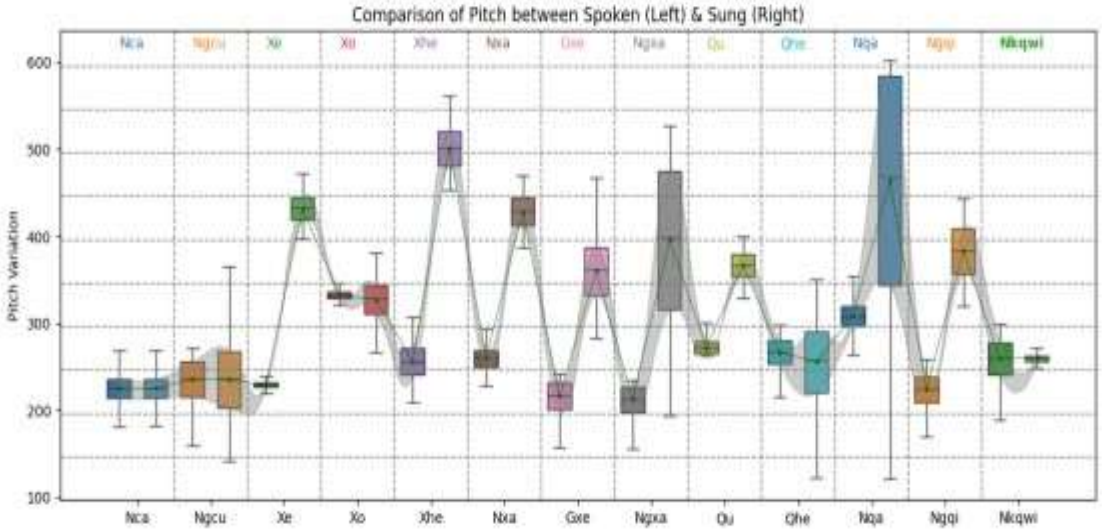
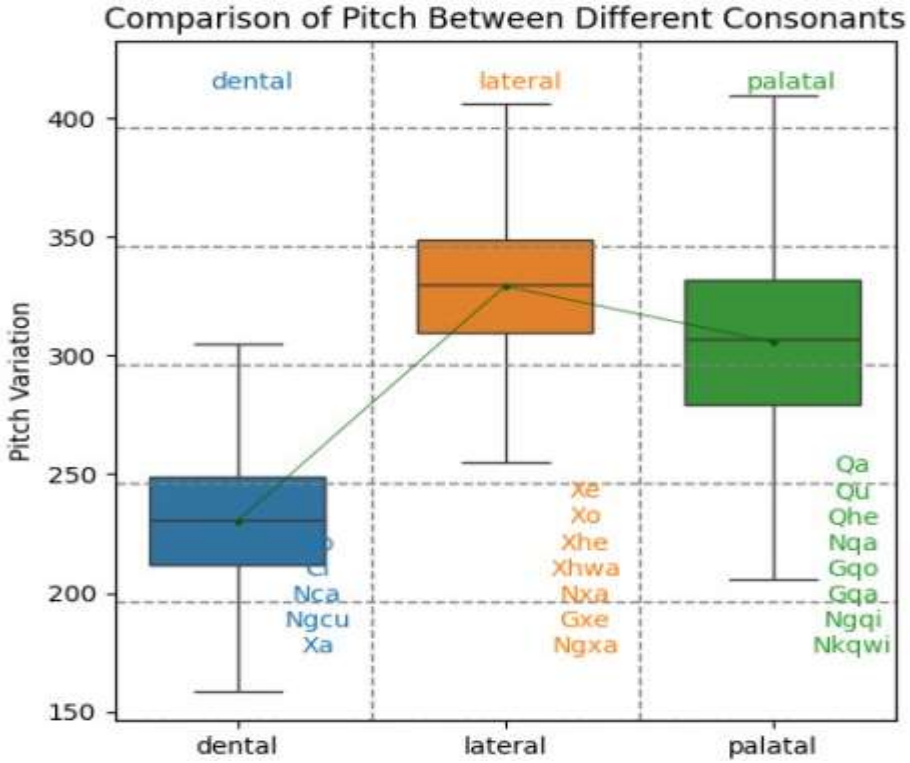


Figure 4: Pitch Analysis Box Plots

4.1: Comparison of Pitch for Spoken and Sung Clicks



4.2: Comparison of Pitch Between Different Consonants Click Classifications



BEST PRACTICES FOR SINGING XHOSA CLICK CONSONANTS

Introduction

This chapter outlines best practices for singing Xhosa click consonants, drawing on practical insights gained from the analysis of Nqobile Nkonzo's music. Mastering Xhosa click consonants in vocal performance presents both unique opportunities and distinct challenges for singers. Based on the results of this study, it is clear that the articulation of click consonants, whether spoken or sung, can significantly impact vocal clarity, musical expression, and linguistic authenticity. In addition to highlighting effective techniques, this section addresses common challenges singers may encounter when integrating clicks into their repertoire. Recommended vocal exercises tailored for both high and low voices are provided in Appendix H to support the development of these specialized skills.

Nca Dental Click

Mastering the "nca" click in Nkonzo's "Ndakuwubon' Umnqamlezo" requires a multifaceted approach to practice and performance. Singers should begin by isolating the click sound, practicing it with various vowel combinations like "nca-a," "nca-e," and "nca-o" to ensure smooth transitions. Proper tongue placement is crucial, with the tip pressing firmly against the upper teeth while maintaining nasal airflow. Diaphragmatic breathing exercises are essential for sustaining airflow during the click's suction phase, and using a metronome can help achieve rhythmic precision, especially when the click aligns with complex musical patterns.

In performance, linguistic authenticity should take precedence, even if it occasionally compromises tonal perfection. The middle register placement (F above middle C) allows for effective projection of the click's acoustic energy, while forward articulation enhances brightness

without vocal strain. Singers can emphasize the emotional weight of "ndancama" ("give up") by slightly elongating the click's duration where appropriate and experimenting with dynamic contrasts to highlight the text's themes. Several challenges must be addressed when performing this click. Achieving articulatory precision, balancing nasal and oral resonance, and maintaining phrasing continuity are key concerns. Quick repetitions of the click can improve tongue agility, while alternating between humming and open vowels helps balance resonance. Additionally, subtle portamento or rubato can maintain phrase momentum despite the click's percussive nature.

Ngcu Dental Nasalized Voiced Click

Mastering the "ngcu" click in Nkonzo's "Kufa Ulutshaba" requires a focused approach to practice and performance. This dental nasalized voiced click, occurring twice in the word "uyingcungcuphela" (meaning "bothersome"), presents unique challenges for baritone singers. In practice, singers should isolate the "ngcu" sound, concentrating on its dental placement and nasalization. Tongue control exercises, such as rapid repetitions of "ngcu-ngcu-ngcu" at varying speeds, can improve agility. To develop proper nasalization, alternating between humming and the "ngcu" sound is beneficial. Rhythmic precision is crucial, especially for the double click in "uyingcungcuphela"; using a metronome at different tempos can help. Recording oneself and comparing it to native Xhosa speakers can ensure authenticity.

For performance, maintaining linguistic integrity should be the priority, even if it occasionally compromises tonal perfection. Adequate breath support is essential, particularly for executing the double click on a high A. Singers should strive to convey the "bothersome" nature of the word through appropriate vocal color and expression. Clear articulation of surrounding

consonants will help highlight the clicks. Practicing the word at various dynamic levels while maintaining click clarity can enhance performance versatility.

Several challenges arise when performing this click. Pitch accuracy may be affected when executing the double click on a high A, necessitating slow, deliberate practice to build muscle memory. The held "n" before the clicks can cause breath tension, requiring focus on maintaining a relaxed throat and steady airflow. Vocal fatigue from repeated performances of this challenging word is a concern, so it should be incorporated judiciously into practice sessions. Balancing the nasalization of "ng" with the clarity of the "cu" clicks requires careful attention. Lastly, ensuring both clicks in "uyingcungcuphela" are equally pronounced and maintain their strength throughout the performance is crucial.

Xe Lateral Click

Practice Recommendations:

Incorporate tongue placement exercises, focusing on a firm press against the hard palate with a quick release, gradually increasing speed for agility. Practice pitch isolation, working on the high A (two octaves above middle C) without the click before introducing the click sound. Use legato exercises, performing scales with smooth transitions, and weaving the "xe" click in to maintain that quality.

Performance Recommendations:

Deliver the click with a gentle approach, emphasizing a soft, lyrical quality supported by consistent breath control to ensure clarity. Modify the following vowel slightly to ease production in the high register, experimenting with mouth shapes for optimal comfort and

resonance. Connect emotionally to the meaning of "xesha" (time) within the song's theme of childhood hardships, allowing that context to inform the click's delivery.

Performance Challenges:

The high A placement may cause vocal strain if not approached with care, requiring a relaxed throat and proper breath support. Balancing authenticity with vocal ease means achieving an authentic click sound without compromising the line's lyrical flow, finding equilibrium between tongue placement and relaxation. Rhythmic integration necessitates seamless incorporation of the click into the legato line, maintaining consistent energy and articulation throughout. Proper Projection must occur, so the click must be clear, and it can't be a strain to the throat. Overall, it requires precision to avoid vocal strain.

Xo Lateral Click

Practice Recommendations for "xo" Click:

Isolate the "xo" click as a standalone sound before integrating it into the word "Thixo," focusing on tongue placement (sucking sides of the tongue against upper molars) and a clean release. Vocalize on the note E below high F, using a neutral vowel to become comfortable with the pitch. Combine the click and note, starting slowly and gradually increasing speed, ensuring clarity and accuracy. Finally, incorporate the word "Thixo," integrating the click with surrounding sounds.

Performance Recommendations:

When singing, strive for authentic pronunciation of the "xo" click. Focus on smooth transitions between the click and vowels/consonants. Leverage the comfortable middle register for expressive delivery and a balanced sound. Consider the emotional and spiritual weight of "Thixo" (God) to inform the delivery of the click and phrase.

Performance Challenges:

Maintaining an authentic and musically pleasing click can be challenging; avoid over-exaggeration. Seamlessly incorporate the click into the vocal line without disrupting flow or rhythm. Achieve a balanced sound in the middle register, especially when transitioning from other registers. Convey the word's emotional and spiritual weight through the click and phrase.

Xhe Aspirated Lateral Click and Nxe Nasalized Lateral Click

To effectively practice and perform the "xhe" and "nxe" clicks in "Wasithanda Mandela," singers should begin by mastering each click in isolation. For the "xhe" (alveolar aspirated lateral click), place the tongue tip against the alveolar ridge, create suction, and release with a slight aspiration. The "nxe" (alveolar nasalized lateral click) requires the same tongue position but with added nasalization by lowering the velum. Practice transitioning between these clicks, gradually increasing speed while maintaining clarity. Incorporate them into the word "xhenxe," emphasizing the stress on the second syllable and adhering to the percussive melody with its short note value for "xhe" and longer for "nxe."

When performing, proper tongue placement is crucial: high on the hard palate for "xhe" and lower for "nxe." Maintain clear distinction between the aspirated and nasalized clicks, even

at performance speed. Pay close attention to the notated rhythm and sing the clicks in the middle register as indicated (B below middle C) to aid vocal production. Emphasize the stressed syllable "nxe" in "xhenxe" to preserve the word's natural rhythm. Performers may face several challenges, including maintaining consistent click sounds across multiple repetitions, executing quick transitions between clicks while preserving clarity, and balancing the percussive nature of the clicks with the overall melodic line. Additionally, coordinating click sounds with proper breath support and vocal technique, ensuring audibility without overpowering other vocal elements, and maintaining proper intonation on the notated pitch while executing the clicks are important considerations.

Nxa Nasalized Lateral Click

To effectively practice and perform the "nxa" click in Nqobile Nkonzo's *Wasithanda Mandela,* singers should begin by isolating the click and practicing it separately before incorporating it into the word "ngenxa." Proper tongue placement is essential, with a light touch of the tongue to the hard palate for the "n" sound, transitioning smoothly to the "x" without excessive pressure. To refine nasal resonance, singers should practice controlling nasal airflow by alternating between nasalized and non-nasalized sounds. Since the click is notated as A above high F, exercises targeting this high vocal register are recommended to build familiarity and ease. Additionally, practicing the syncopated rhythm of the click within its musical context is crucial, starting slowly and gradually increasing tempo to achieve rhythmic precision.

When performing, singers should modify their articulation by using a lighter tongue touch compared to speaking the click. The "a" vowel in "nxa" should be utilized to maintain vocal comfort and ease in the high register. As the stressed syllable in "ngenxa," the "nxa" click

should be emphasized to bring out its rhythmic and melodic significance. Performers should connect emotionally to the celebratory nature of the syncopated rhythm, which symbolizes Mandela's release from prison, while ensuring that the nasalized quality of the click is balanced and not overpowering.

Several challenges may arise when performing the "nxa" click. Maintaining clarity in the high register can be difficult, as can preserving rhythmic precision while executing the syncopated pattern. Vocal fatigue is another potential issue due to repeated performance of the click in a high range, requiring careful management of breath support and vocal technique. Achieving consistency in click quality across multiple repetitions is critical, as is honoring the cultural authenticity of the click and its role in celebrating Nelson Mandela’s legacy.

Gxe Voiced Lateral Click

To master the "gxe" click in "Uyehova nguMalusi, Opus. 014," singers should begin by practicing the click in isolation before incorporating it into the word "ndagxekwa." Proper tongue placement is crucial, focusing on flattening the tongue and pressing it firmly against both sides of the hard palate. A swift, strong release of the tongue is necessary to produce a firm sound, due to the "g" preceding the "x." Given the click's high placement on F two octaves above middle C, incorporating exercises targeting this vocal range is essential. Contextual practice within the word and phrase is also important for seamless integration.

When performing, singers should utilize the high placement of the click to project the sound clearly while maintaining clear articulation without modifying surrounding vowels. Connecting the click sound with the word's meaning ("judged") can enhance emotional delivery. It's crucial to balance the click with other musical elements and strive for consistent quality

throughout the performance. Several challenges may arise during performance or practice. Maintaining click clarity and proper technique in the high register without strain is paramount. Rhythmic precision within the song's context and effective breath control are also crucial for sustaining the high note while producing the click. Balancing technical aspects with emotional conveyance presents another challenge, as does managing potential vocal fatigue from repeated high-register performances. Lastly, striving for linguistic authenticity honors the cultural significance of the click within the song cycle.

Ngxa Lateral Nasalized Voiced Click

To master the "ngxa" click in Nqobile Nkonzo's "Wasithanda Mandela," singers should begin by isolating the click before incorporating it into the word "ngxatsho." Proper tongue placement is crucial, focusing on a strong press against the hard palate and briefly holding to acknowledge the "ng" before the "x." Initially practicing the click in slow motion ensures proper tongue movement and placement. Incorporating chromatic exercises around B-sharp (C natural) helps familiarize singers with the tonal context. Gradual integration of the click into the word, phrase, and full musical context is recommended for comprehensive practice.

When performing, clear articulation of the click is essential, emphasizing the stressed "ngxa" syllable. Singers should utilize the middle C placement to project the click sound effectively and pay attention to the chromatic nature of the B-sharp to enhance the approaching climax. Conveying the exclamation of approval that "ngxatsho" represents within the piece's context adds emotional depth. Balancing the click with surrounding musical elements and vowels is crucial for a cohesive performance.

Several challenges may arise during performance. Executing the click with precise timing within the rhythmic structure, considering the slight delay caused by the "ng" consonants, requires careful attention. Maintaining consistent click quality throughout multiple repetitions and managing breath support to produce the click effectively while sustaining the musical line are also critical. Navigating the chromatic B-sharp accurately while producing the click presents a tonal challenge. Lastly, honoring the linguistic and cultural significance of the click within the celebration of Nelson Mandela's legacy is most important.

Qu Palata Click

To master the "qu" alveolar palatal click in Nqobile Nkonzo's "Ihambo Yam, Opus. 015," singers should begin by isolating the click before incorporating it into the word "ndabaqumbela." Proper tongue placement is crucial, focusing on pressing the tongue against the hard palate, holding briefly, then quickly releasing to create the characteristic popping sound.Gradual integration of the click into the word, phrase, and full musical context is recommended, along with vocal exercises around the note E below high F to familiarize singers with the tonal context. Experimenting with a softer touch on the hard palate when releasing the tongue can help maintain proper vocal technique.

When performing, singers should utilize the E below high F placement to project the click sound effectively without tension, ensuring clear articulation while maintaining the flow of vibrato. Conveying the anger expressed in "ndabaqumbela" within the context of young South African children's hardships adds emotional depth to the performance. Balancing the click with surrounding musical elements and vowels, and striving for consistent click quality throughout the performance is essential.

Performers may encounter various challenges when executing the "qu" click in "Ihambo Yam, Opus. 015." A primary concern is preserving proper vocal technique while producing the click, which may necessitate a gentler approach to tongue release.The intricate task of harmonizing technical precision with emotional expression—particularly in conveying the anger and resilience inherent in the piece—demands meticulous attention. Breath control poses another significant challenge, as singers must effectively produce the click while maintaining the musical line's integrity. Additionally, ensuring that vibrato flows seamlessly through the click articulation requires careful management.

Qhe Aspirated Palatal Click

To effectively execute the "qhe" aspirated palatal click in *Kufa Ulutshaba, Opus.010,* singers should start by isolating the click and practicing it separately before incorporating it into the word "kuqhekeke".Given the challenge of singing the click on high D-flat, it is important to modify the sound by emphasizing the "q" with the vowel "e" while minimizing or omitting the aspiration of the "h." Practicing the click at the mp (mezzo-piano) dynamic marking is crucial to mastering its subtlety, and gradually integrating it into the musical context ensures a seamless performance.

During performance, singers should employ the modified version of the click when singing on high D-flat, concentrating on the "q" and "e" sounds. In more comfortable vocal ranges, a clearer popping sound should be pursued. Maintaining the mp dynamic while ensuring the click remains audible is crucial, as is conveying the meaning of "broken apart" within the aria's theme of death and devastation. Consistency in click quality throughout the performance, with appropriate adaptations for different vocal registers, is key to a successful execution.

Performers face several challenges, including maintaining click clarity on the high D-flat while preserving vocal technique, effectively producing the click at the mp dynamic level without losing its distinctive sound, and coordinating breath support for both the high note and click production. Balancing the technical aspects of the click with the emotional conveyance of the aria's themes requires careful attention. Finally, honoring the click's cultural significance while adapting it for Western classical performance presents a unique challenge that demands both technical skill and cultural sensitivity.

Nqa Nasalized Palatal Click

When practicing the "nqa" alveolar nasalized palatal click in *Kufa Ulutshaba, Opus.010*, focus on developing precise tongue control and coordination. Start by isolating the click sound itself, practicing it slowly and deliberately to ensure accurate placement and release of the tongue. Gradually increase speed and combine it with the vowel sound. For breath support, work on sustaining long notes on the high A, focusing on steady, controlled exhalation. This will help maintain the necessary air pressure for both the click and the following sustained vowel. Practice transitioning smoothly from the click into the vowel, ensuring that the sound remains consistent and well-supported throughout.

To improve overall performance, concentrate on the emotional context of the word "umnqantsa" (hope) within the aria. Practice delivering the click with varying intensities to match the emotional nuances of the piece. Work on integrating the click seamlessly into the melodic line, ensuring it doesn't disrupt the overall flow of the phrase. When addressing challenges, pay attention to any tension in the jaw or tongue. Use gentle massage and relaxation techniques to keep these areas loose. To manage breath control, practice breaking down the

phrase into smaller segments, gradually building up to the full length. For balancing the click with the vowel, experiment with different emphases, finding a balance that highlights both elements effectively.

Ngqi Nasalized Voiced Palatal Click

When practicing the "ngqi" click in Uyehova nguMalusi, Opus. 014, several strategies can enhance both technical proficiency and emotional delivery. It's advisable to isolate the "ngqi" click and practice it separately from the word "bungqina" to develop muscle memory. Gradually increase the pitch, starting from a comfortable mid-range and working up to the high A notation. Since the click is challenging, especially on high notes, focus on the "i" vowel sound following the click, as this can help maintain clarity and articulation. Additionally, practice breath support exercises to ensure steady airflow, which is crucial for executing the click on a high note. Relaxation techniques are also important; keep your jaw and tongue relaxed while producing the click to avoid tension.

In performance, prioritize clarity and emotional context. Focus on clear articulation of the "i" vowel following the click and consider the meaning of "bungqina" (evidence) within the song's narrative about life experience to inform your interpretation. Strive for a balance between the click sound and the vowel, ensuring neither overpowers the other. Maintain consistent breath support and vocal placement throughout the phrase containing the click. If using amplification, be mindful of potential plosive sounds from the click and adjust the microphone placement accordingly.

However, several challenges may arise during the performance. One of the main difficulties is executing the click on a high A, which can be challenging even for native Xhosa

speakers. Maintaining vocal quality is also crucial; ensure the click doesn't disrupt the overall vocal line or tone quality. Breath control is another challenge; managing breath support for both the click and the sustained high note requires careful practice. Additionally, articulation speed is important; execute the click quickly enough to maintain the musical rhythm without sacrificing clarity. Finally, reproducing the click consistently in each performance can be a challenge, given its technical difficulty.

Nkqwi Combined Alveolar Nasal and Palatal Click

To master the "nkqwi" click, singers should focus on developing precise tongue control and minimizing tension. Begin by practicing light tongue contact with the hard palate, followed by a quick release to achieve the popping sound characteristic of the click.
Gradually integrate this articulation into melodic phrases while maintaining a smooth vocal line. Breath support is essential; singers should practice sustaining notes on C while articulating the click with minimal tongue pressure. Modifications to the authenticity of the click may be necessary to prevent vocal strain and ensure ease of integration into the musical line.

During performance, prioritize maintaining a tension-free throat and smooth vocal transitions between the click and surrounding notes. Focus on balancing authenticity with practicality by slightly modifying the click to fit within the melodic context without losing its essential character. Emphasize emotional delivery by connecting the meaning of "bungqina" (evidence) to the themes of loss and grief in the piece. Ensure that breath support is consistent throughout to sustain both the note and the click articulation effectively.

The "nkqwi" click presents significant difficulties due to its unusual combination of nasal and palatal elements, requiring precise tongue control and positioning. Achieving a balance

between authenticity and vocal practicality can be challenging, especially when integrating it into melodic phrases at higher pitches. Maintaining vocal health while articulating this complex sound requires careful attention to minimizing tension in both the tongue and throat. Additionally, reproducing the click consistently across performances demands an understanding of Xhosa phonetics and deliberate practice to refine technique while preserving emotional expression.

CHAPTER V: CONCLUSION

Nqobile Nkonzo's integration of Xhosa clicks into classical vocal music enriches the Western classical repertoire by blending cultural heritage with vocal artistry. This approach transforms the voice into a more versatile instrument, adding rhythmic and percussive qualities that deepen both emotional expression and linguistic authenticity. The study demonstrates that click consonants, whether spoken or sung, can be systematically learned through language acquisition. Here, 'language acquisition' refers to the process by which both native speakers and learners develop the ability to produce click consonants, either through natural exposure in childhood or through structured vocal training as adults. As Saville-Troike notes, "Language is not something we are born with but rather something we absorb and learn as we grow."[70] Incorporating Xhosa clicks into Western classical singing offers singers new insights into vocal technique and a deeper understanding of the phonetic features of click production. This practice bridges cultural divides, broadens the scope of vocal art music, and provides actionable recommendations for performance, highlighting the beauty and complexity of Xhosa language and music.

This research is intended for a diverse audience: vocal performers, voice teachers, linguists, musicologists, composers, and scholars in African and cultural studies. It delivers practical tools and perspectives to each field. Vocalists and educators gain innovative methods for expanding technique and repertoire, while linguists and language teachers benefit from detailed analysis of the teachability and acoustic properties of click consonants. Musicologists and theorists are offered a framework for exploring cross-cultural influences and integrating

[70] Muriel Saville-Troike, *Introducing Second Language Acquisition*, Cambridge: Cambridge University Press, 2006.

indigenous sounds into Western art music. Composers receive guidance for writing with Xhosa clicks, particularly starting with the dental click, to ensure accessibility and effectiveness.

For scholars in African and cultural studies, this work models how indigenous linguistic and musical traditions can be celebrated and sustained within global classical music. By demonstrating the expressive and pedagogical value of Xhosa clicks, this research supports broader efforts in cultural preservation and social empowerment. Ultimately, integrating Xhosa clicks into Western classical music bridges disciplines and cultures. It affirms the voice as a powerful tool for connection, education, and artistic innovation, and highlights the importance of cultural plurality in shaping the future of vocal performance.

BIBLIOGRAPHY

"A Brief History of African Click Words." *The Week* online. January 11, 2015. https://theweek.com/articles/457951/brief-history-african-click-words.

Berliner, Paul F. *The Soul of Mbira: Music and Traditions of the Shona People of Zimbabwe. Chicago*: University of Chicago Press, 1993.

Burnett, Charles. "Resonating Across an Anglican-Xhosa Mission Soundscape: A Case Study." *Journal of Mission Studies* 28, no. 3 (2023): 307-325.

Burnett, Philip. "Resonating Across an Anglican-Xhosa Mission Soundscape: A Case Study of Instruments, Bells, and Processions." *Postcolonial Studies* 26, no. 3 (2023): 406-432. DOI: 10.1080/13688790.2023.2243073.

Cilliers, Johan. *Timing Grace: Reflections on the Temporality of Preaching*. Stellenbosch University, 2014: 125-142.

Chomphan, Suphattharachai. "Analysis of Fundamental Frequency Contour of Coded Speech Based on Multi-Pulse Based Code Excited Linear Prediction Algorithm." *Journal of Computer Science* 7, no. 6 (2011): 865-870.

Suphattharachai Chomphan, *Analysis of Fundamental Frequency Contour*, Kasetsart University Press, 2020.

Coplan, David B. "Basotho and the Experience of Death, Dying, and Mourning in the South African Mining Compounds." *Journal of Southern African Studies* 24, no. 2 (1998): 197-213.

Coplan, David B. *In Township Tonight!: South Africa's Black City Music and Theatre*. Chicago: University of Chicago Press, 2008.

“Constitution of the Republic of South Africa. 1996.” *South African Government* online. March 20, 2025. http://www.gov.za/documents/constitution-republic-south-africa-1996.

Dargie, David J. *Techniques of Xhosa Music: A Study Based on the Music of the Lumko District*. (PhD diss., Rhodes University, 1986), 105-106.

Dowling, Tessa, Somikazi Deyi, and Anele Gobodwana. "When Culturally Significant Songs Are Decontextualised: The Initiation Song Somagwaza, A Case Study." *Southern African*

Journal for Folklore Studies 28, no. 2 (2018): 1-19. https://doi.org/10.25159/1016-8427/3919.

Erlmann, Veit. “Miriam Makeba.” In *Oxford Bibliographies in Music*. Oxford University Press, 2021. https://www.oxfordbibliographies.com/abstract/document/obo-9780199757824/obo-9780199757824-0298.xml

Fernandes, Joana, Felipe Teixeira, Vitor Guedes, Arnaldo Junior, and João Paulo Teixeira. "Harmonic to Noise Ratio Measurement - Selection of Window and Length." *Procedia Technology* 1, no. 1 (2018): 1-10.

Finlayson, Rosalie. "Linguistic and Cultural Aspects of Identity: A Case Study of Xhosa Male Initiation." In *Democratically Speaking: International Perspectives on Language Planning,* 107-116. Edited by Nigel Crawhall. Salt River: National Language Project, 1998.

Finnegan, Ruth. *Oral Literature in Africa. Oxford*: Oxford University Press, 1970. Journal of Literature, Languages and Linguistics. "Literary Analysis of 'Kpaa' Songs: A Didactic Legacy of Oral Tradition." *Journal of Literature, Languages and Linguistics* 36 (2017): 21-22.

Kim, Hye-Jung, Chong, Hyun Ju, and Lee, Min. "Music Listening in Foreign Language Learning: Perceptions, Attitudes, and Its Impact on Language Anxiety." *Frontiers in Education* 9 (2024): Article 1372786. https://doi.org/10.3389/feduc.2024.1372786.

Gunnink, Hilde, Bonny Sands, Brigitte Pakendorf, and Koen Bostoen. "Prehistoric Language Contact in the Kavango-Zambezi Transfrontier Area: Khoisan Influence on Southwestern Bantu Languages." *Journal of African Languages and Linguistics* 36, no. 2 (2015): 193-232.

Gunnink, Hilde. *Click Adoption and Insertion in Xhosa: Revisiting the Role of Hlonipha*. Unpublished manuscript, 2020.

Guthrie, Malcolm. *Comparative Bantu: An Introduction to the Comparative Linguistics and Prehistory of the Bantu Languages*. 4 vols. Farnborough: Gregg Press, 1967-1971.

Gxilishe, Sandile. "The Acquisition of Clicks by Xhosa-Speaking Children." *Per Linguam* 20, no. 2 (2004): 1-12.

Hawn, Michael. *Singing Freedom: David Dargie and South African Church Music*. Nashville: Abingdon Press, 2003.

Henderson, Anne T., and Nancy Berla, eds. *A New Generation of Evidence: The Family Is Critical to Student Achievement.* Washington, DC: National Committee for Citizens in Education, 1994.

Herbert, Robert K. "The Relative Markedness of Click Sounds: Evidence from Language Change, Acquisition, and Avoidance." *Anthropological Linguistics* 32, no. 1-2 (1990): 120-138.

"How Can Integrating Music into Your Classroom Benefit Students?" *Safe Supportive Learning*, January 1, 2011.

Izu, Benjamin, and Alethea DeVilliers. "The Societal Value of Music in the Xhosa Culture." *Nelson Mandela University*, July 19, 2021.

Jessen, Michael, and Justus C. Roux. "Voice Quality Differences Associated with Stops and Clicks in Xhosa." *Journal of Phonetics* 30, no. 1 (2002): 1-52.

Jiang, Wenying. "The Relationship Between Culture and Language." *ELT Journal* 54, no. 4 (October 2000): 328-334. https://doi.org/10.1093/elt/54.4.328.

Knight, Jonathan T. "Sing On, Ntsikana: The Story of Christian Music among the Xhosa People of South Africa." *Musical Offerings* 1, no. 1 (2010): 26-32.

Kramsch, Claire. *Language and Culture*. Oxford: Oxford University Press, 1998.

Ladefoged, Peter, & Anthony Traill. Clicks and their accompaniments. *Journal of Phonetics* 22, no. 1 (1994): 33-64.

Lanham, L. W. *The Comparative Phonology of Nguni*. Rhodes University, 1960.

“Makeba, Miriam.” *Oxford Research Encyclopedia of African History*. Oxford University Press, 2021.https://oxfordre.com/africanhistory/display/10.1093/acrefore/9780190277734.001.0001/acrefore-9780190277734-e-774

Matsumoto, David. *Culture and Psychology*. Pacific Grove, CA: Brooks/Cole, 1996. Matsumoto, quoted in Spencer-Oatey and Franklin, *Intercultural Interaction: A Multidisciplinary Approach to Intercultural Communication*, 1.

Mbaegbu, Celestine Chukwuemeka. "The Effective Power of Music in Africa." *Open Journal of Philosophy* 5, no. 3 (2015): 176-183. https://doi.org/10.4236/ojpp.2015.53021.

Miller, Lisa. “Interview: Miriam Makeba.” Bomb, Summer 2000. https://bombmagazine.org/articles/2000/07/01/miriam-makeba/.

Miller, Amanda L., Johanna Brugman, Bonny Sands, Levi Namaseb, Mats Exter, and Chris Collins. Differences in airstream and posterior place of articulation among N|uu clicks. *Journal of the International Phonetic Association* 40, no. 1 (2010): 22-35.

Mkizwana, Viwe. The Influence of Xhosa Traditional Music and Culture on Modern South African Jazz. *University of Pretoria*, 2023.

Motinyane-Masoko, Mantoa, and Aquilina Mawadza. *Introduction to Xhosa, Xhosa Dictionary & Phrasebook*. Cape Town: Phambili Agencies cc, 2017.

Nnamani, Sunday N. "The Role of Music Therapy in the Healing Process of Traditional African Society: A Case Study of Igbo Area of Nigeria." *Proceedings of INTCESS14 - International Conference on Education and Social Sciences* (2014): 453-460.

Obaje, Ojochogwu. "Aesthetics in African Cultural Performance: A Critical Study of Ote'gwu Festival among the Igala People in Nigeria." PhD diss., University of KwaZulu-Natal, 2018.

Olwage, Grant, ed. *Composing Apartheid: Music For and Against Apartheid*. Johannesburg: Witwatersrand University Press, 2008.

Patel, Aniruddh D. "Why Would Musical Training Benefit the Neural Encoding of Speech? The OPERA Hypothesis." *Frontiers in Psychology* 2 (2011): Article 142.

Pinnock, Don. *The Brotherhoods: A Sociological Study of South African Gang Culture*. Cape Town: David Philip Publishers, 1998.

Qosi, Lubabalo. "Expressing the Sacred: Music in Xhosa Culture." *Young Anglican Theology Blog*, July 8, 2024.

Sandlana, Nonkululeko. "A Review of the Sociocultural Roles of Traditional Musical Arts in Xhosa Society." *Mediterranean Journal of Social Sciences* 5, no. 3 (2014): 544-550.

Saville-Troike, Muriel. *Introducing Second Language Acquisition*. Cambridge: Cambridge University Press, 2006.

Sibani, Clifford. "The Role of Westernization in the Changing African Family Structures." *Humanities, Society, and Community* 62 (2018): 17-23.

Stevens, Robin. "Tonic Sol-fa in Contemporary Choral Music Practice: A South African Case Study." *Conference Contribution*, 2005.

Stonham, John. *Phonetics and Phonology Lecture Notes.* Accessed March 28, 2025.

Suphattharachai Chomphan. *Analysis of Fundamental Frequency Contour*. Kasetsart University Press, 2020.

Traill, Anthony. *Phonetic and Phonological Studies of !Xóõ Bushman*. Hamburg: Helmut Buske Verlag, 1985.

Van Heerden, Gary Paul. "Holding on or Letting Go? The Resolution of Grief in Relation to Two Xhosa Rituals in South Africa." Master's thesis, Rhodes University, 2002.

"Why Music is a Must-Have Resource for Language Learning", *Lindsay Does Languages* (blog). March 10, 2022. https://www.lindsaydoeslanguages.com/why-music-is-a-must-have-resource-for-language-learning/

Zamela, Zandile. *The Role of Westernisation in Xhosa Women's Beauty Ideals, Everyday Dress Practices and Acculturation Strategies*. University of Pretoria, 2023.

Appendix A:

Female Xhosa singers

1. Dr. Latozi Madosini Mphahleni



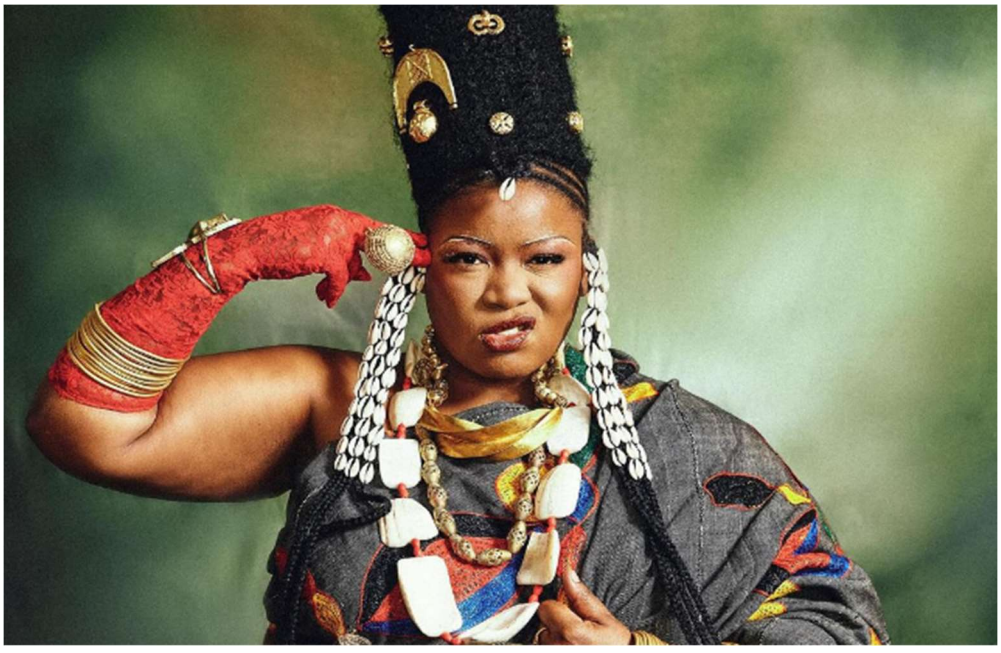
2. Miriam Makeba



3. Simphiwe Dana



4. Thandiswa Mazwai



Appendix B:

Journey to Manhood (Ulwaluko)



When the boys come back from initiation school they wear traditional attire. They are called "Amakrwala".



Appendix C:

Xhosa Traditional Clothing for Women and Men



A more contemporary Xhosa attire for men. Nelson Mandela wearing traditional Xhosa attire.





Appendix D:

Map of the Eastern Cape Province



Appendix E:

Miriam Makeba's Biography and Song Text and Translations

Miriam Makeba's Biography:

Miriam Makeba (March 4, 1932 – November 9, 2008), affectionately known as "Mama Africa," was a trailblazing South African singer whose journey from humble beginnings to international stardom is nothing short of inspiring.[71] Born in Prospect Township near Johannesburg to a Xhosa father and a Swazi mother, Makeba's musical odyssey began with the Cuban Brothers, an amateur group led by her cousin. Her talent soon caught the attention of the renowned Manhattan Brothers in the 1950s, marking a pivotal moment that set the stage for her remarkable career.

In 1956, Makeba formed The Skylarks, an all-female group that further showcased her vocal abilities. However, it was her role in the film *Come Back Africa* that propelled her onto the global stage. Following the film's premiere in Venice in 1959, Makeba relocated to the United States, where she would reside for nearly two decades. Under the mentorship of Harry Belafonte, Makeba's career flourished in America. She captivated audiences worldwide with her distinctive voice and became a powerful advocate against apartheid. Her 1963 address to the United Nations Special Committee on Apartheid marked a defining moment, solidifying her dual legacy as both musician and activist.

Makeba's personal life also influenced her journey; after marrying political activist Stokely Carmichael in 1968, she moved to Guinea. Despite the upheaval, her musical output remained prolific, releasing approximately 30 albums between 1960 and 2008 that reflected her

[71] Veit Erlmann, "Miriam Makeba," In *Oxford Bibliographies in Music*, Oxford University Press, 2021, https://www.oxfordbibliographies.com/abstract/document/obo-9780199757824/obo-9780199757824-0298.xml

evolving artistic vision and circumstances. Revered as 'Mama Africa,' Makeba received numerous accolades, including the prestigious Dag Hammarskjöld Peace Prize, recognizing her contributions to music and social justice. Her influence extended beyond her own generation, inspiring countless artists and activists. After returning to South Africa in 1990, she balanced her international career with family life and philanthropy, notably supporting initiatives like the Miriam Makeba Centre for Girls.[72] Tragically, Makeba passed away on November 9, 2008, during a performance in Castel Volturno, Italy, while singing "Pata Pata," one of her most beloved hits. Although South Africa lost a national treasure that day, Miriam Makeba's enduring impact as a musician, activist, and humanitarian continues to resonate, inspiring new generations to use their voices for change.

Qongqothwane-Click Song Text and Translation

Xhosa	English
Igqirha Lendlela Nguqongqothwane Igqirha lendlela nguqongqothwane Sele qabel' egqithapha nguqongqothwane Sele Qubul' egqithapha nguqongqothwane	The road's witch doctor is the knocking beetle The road's witch doctor is the knocking beetle He passed by up the steep hill, knocking He passed by up the steep hill, the knocking beetle.

Pata Pata Text and Translation

Xhosa	English
Pata Pata Saguquka sathi bheka Nantsi pata pata Iyhooo pata pata Hayi yiyo mama yiyo mama Nants' iPata Pata	Dance Every Friday and Saturday Night It's Pata Pata time! The dance keeps going all night long Til' the morning sun begins to shine! It's Pata Pata time.

[72] "Makeba, Miriam," *Oxford Research Encyclopedia of African History*. Oxford University Press, 2021, https://oxfordre.com/africanhistory/display/10.1093/acrefore/9780190277734. 001.0001/acrefore-9780190277734-e-774

Appendix F:

Nqobile Nkonzo's Biography and Text and Translations



Nqobile Nkonzo is a South African composer and music educator born on January 7, 1997, in Ibisi, uMzimkhulu. His musical journey began in the church, where he was exposed to choral music from an early age. Nkonzo's formal music education started at Ibisi Junior Secondary School, where he joined the school choir and later community choirs. He went on to pursue a music degree in singing at the University of KwaZulu-Natal, Howard College Campus. During his undergraduate years, he explored various singing styles and techniques, growing as both a singer and performer. His first stage appearance was as Cord Elam in the 2017 production of "Oklahoma," which helped him overcome his fear of performing for large audiences.

Although initially focused on performance, Nkonzo developed a strong interest in music theory and composition during his undergraduate studies. He began transcribing music for church choirs, which led to his first original composition dedicated to political figure O.R. Tambo. His compositional style blends Western classical traditions with African elements, reflecting his diverse musical background. Nkonzo's academic journey expanded to include musicology, ethnomusicology, and music education. He holds a Postgraduate Certificate in Education and has worked as an English and Creative Arts teacher. Despite facing financial challenges in completing his master's degree, Nkonzo remains committed to furthering his education and aspires to pursue doctoral studies in music composition and education. As a

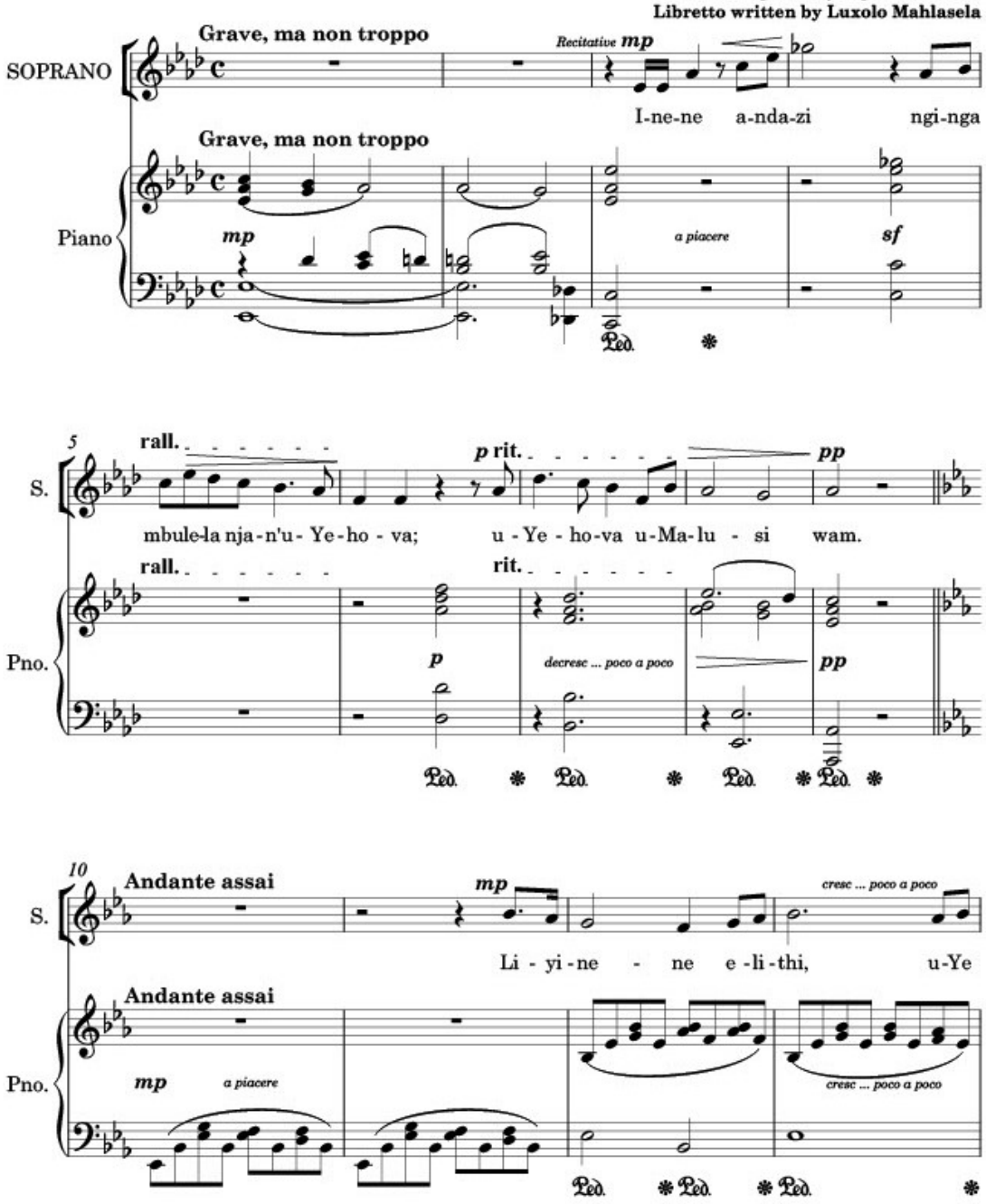
composer of Xhosa art music, Nkonzo's work is particularly relevant for acoustic and linguistic analysis of Xhosa click consonants, making it valuable for research in the intersection of language and music in South African classical compositions.

It is important to note that Nqobile is still very young and at the beginning stages of his career as a composer. At this early point in his professional journey, he does not yet have a personal website or extensive digital presence. I have a personal connection to Nqobile; we met in 2015 as voice students at the University of KwaZulu-Natal's Opera School and Choral Academy, and our shared passion for music has continued since then. I have chosen to use his music in my study because it serves as an excellent example for teaching Xhosa click consonants and demonstrates the exciting potential of emerging South African composers. Nqobile Nkonzo's music begins on the next page.

UYEHOVA NGUMALUSI

for Amanda Kosi

Music composed by Nqobile Nkonzo
Libretto written by Luxolo Mahlasela



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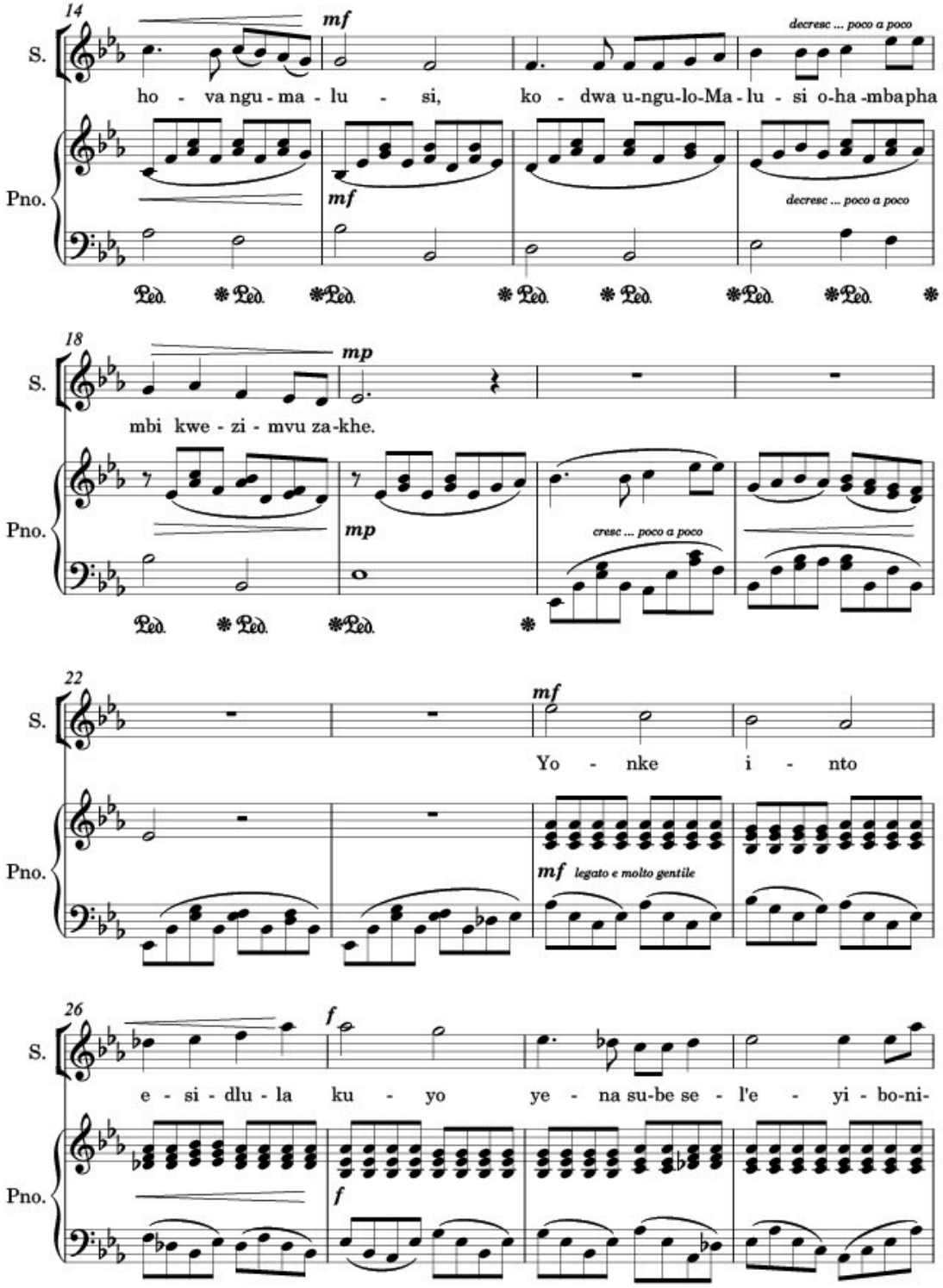
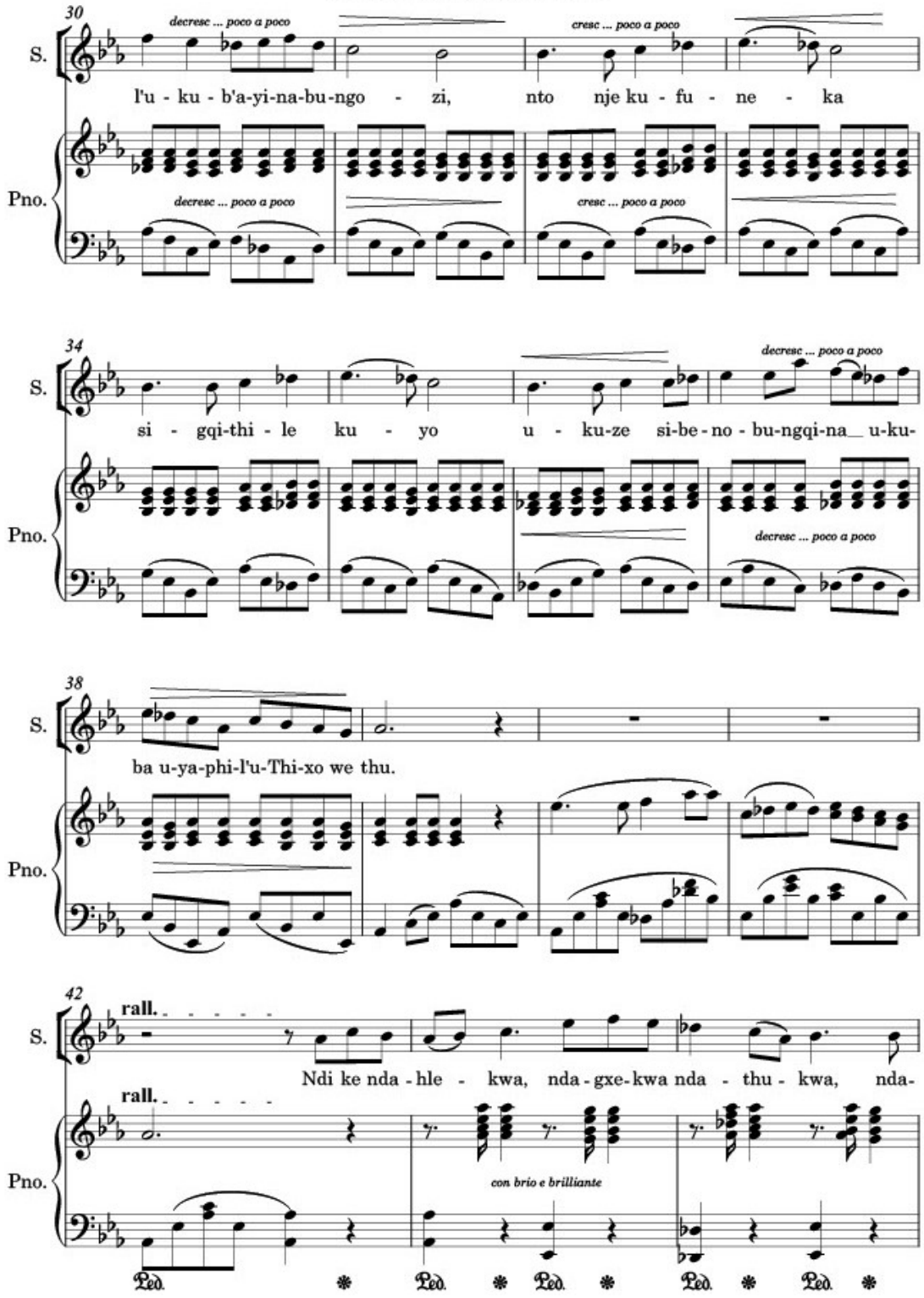
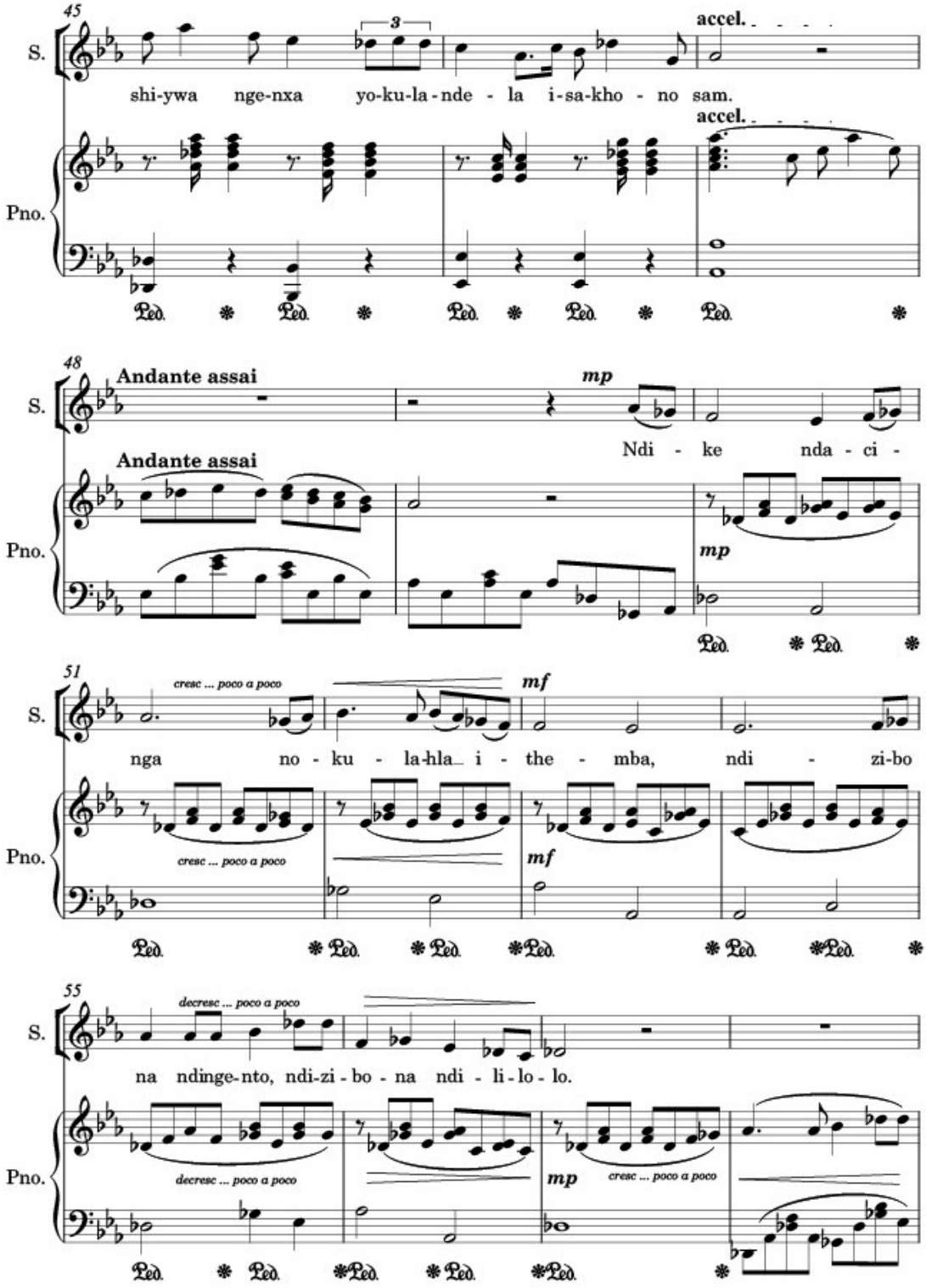
uYehova ngumalusi, Opus.014

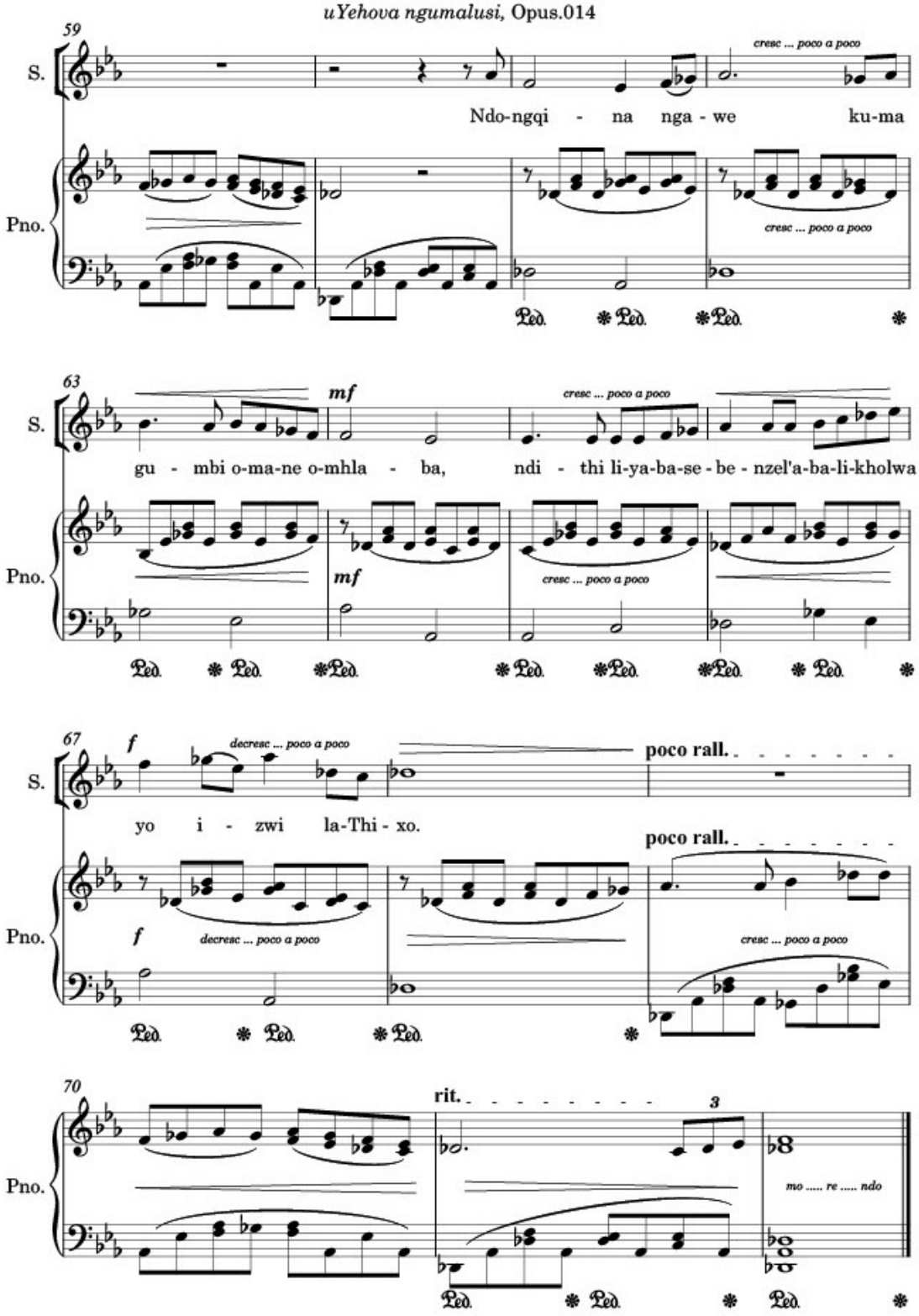


uYehova ngumalusi, Opus.014




45
S.
Pno.
3
accel.
shi-ywa nge-nxa yo-ku-la-nde - la i-sa-kho - no sam.
48
Andante assai
mp
Ndi - ke nda - ci -
51
cresc ... poco a poco
mf
nga no - ku - la-hla_ i - the - mba, ndi - zi-bo
55
decresc ... poco a poco
na ndinge-nto, ndi-zi - bo - na ndi - li - lo - lo.

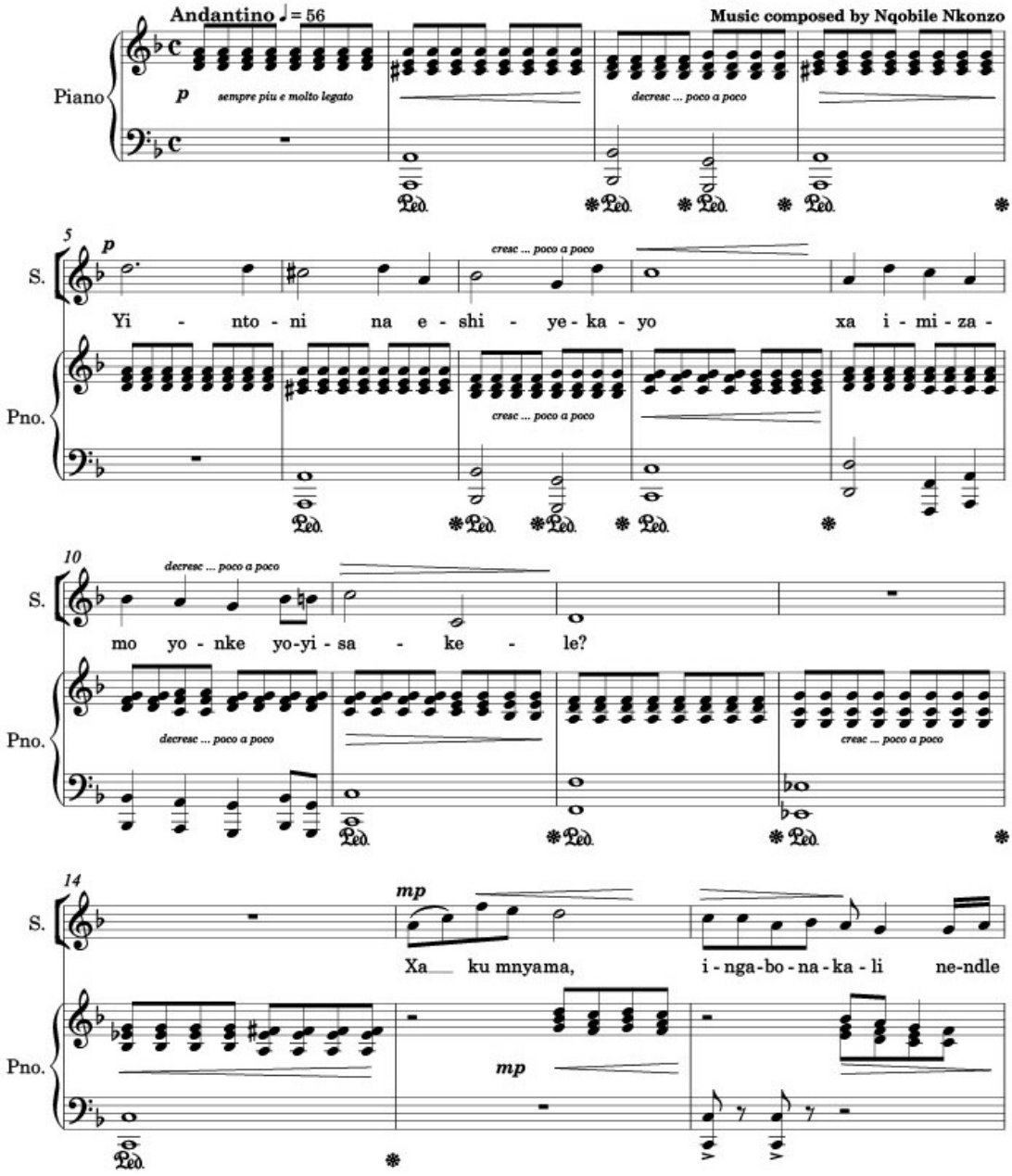
uYehova ngumalusi, Opus.014



Text	Translation
1. Uyehova NguMalusi	***1. The Lord is my shepherd***
Inene andazi ndingambulela njan' uYehova; uYehova uMalusi wam. Liyinene elithi, uYehova ngumalusi, kodwa unguloMalusi ohamba phambi kwezimvuzakhe.	I truly don't know how to thank God; The Lord is my shepherd. It is true, The Lord is my shepherd, but he is a shepherd that leads his flock.
Yonke into esidlula kuyo, yena subesele yibonilukubayinabungozi, Nto nje kufuneka sigqithile kuyo ukuze sibenobungqina ukuba uyaphil'uThixo wethu.	Everything we go through in life, he already sees there's no danger, but we go through trials so we can witness that there is God.
Ndike ndahlekwa, ndagxekwa ndathukwa, Ndashiywa ngenxa yokulandela isakhono sam. Ndike ndacinga nokulahla ithemba, Ndizibona ndingento, ndizibona ndililolo.	People laughed, blamed, and swore at me, friends left me because I chose to follow my path. I even thought of giving up hope, I saw myself worthless and alone.
Ndongqina ngawe kumagumbi omane omhlaba, Ndithi liyabasebenzela abalikholwayo izwi lika Thixo.	I will proclaim your name on all corners of the earth, I will say God's word works for those who believe in God.

UMSIMELELO

for Amanda Kosi



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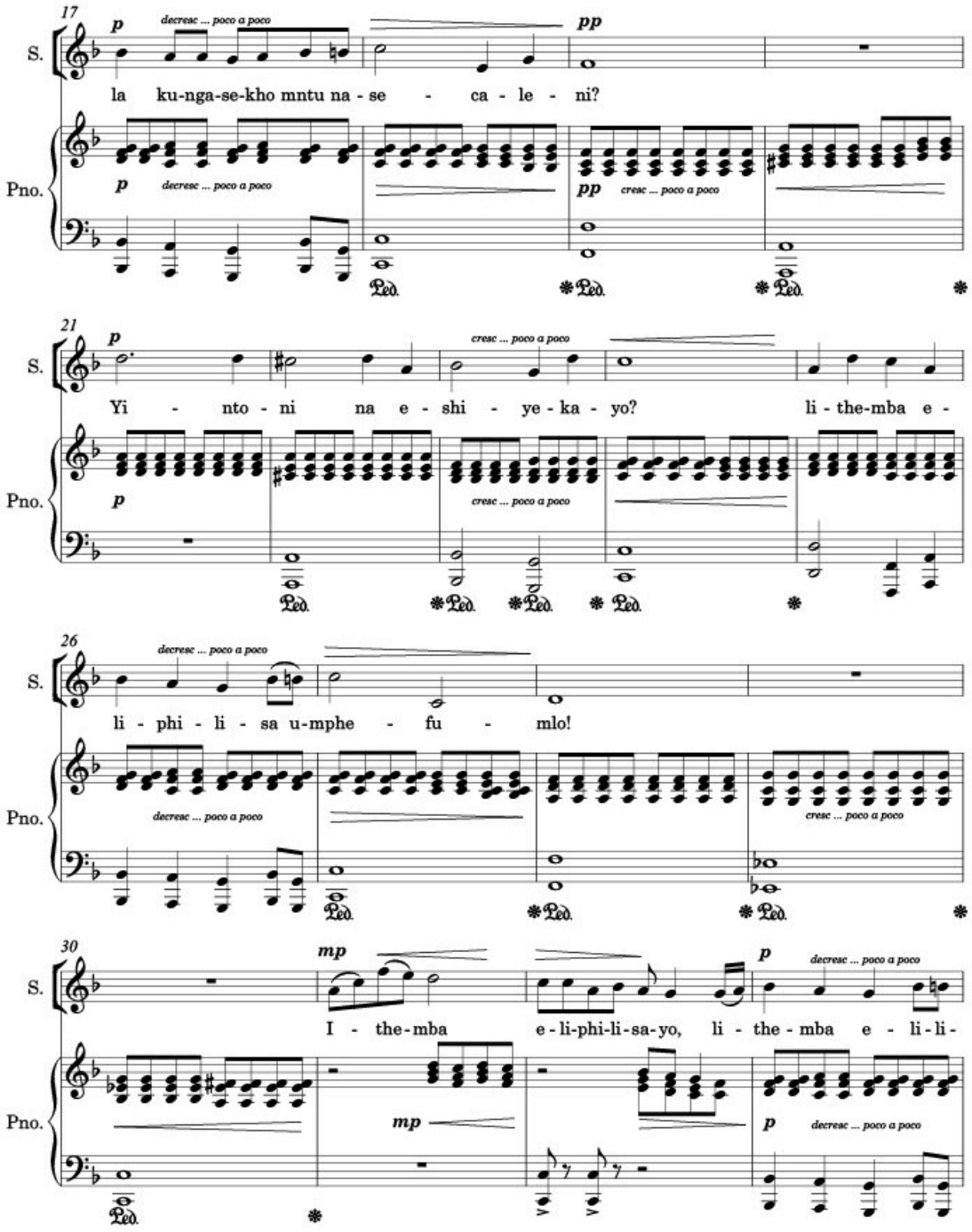
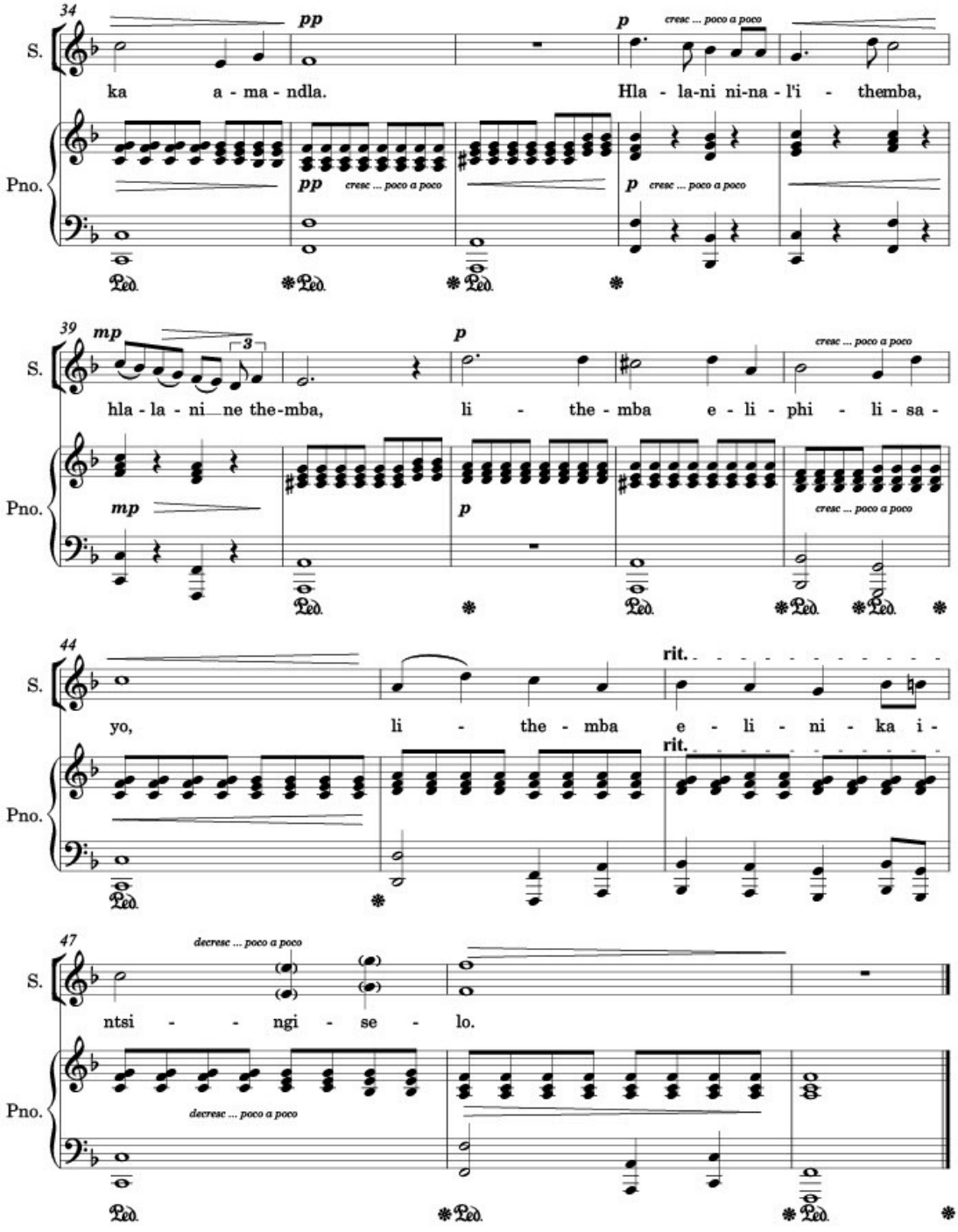
Umsimelelo, Opus. 016



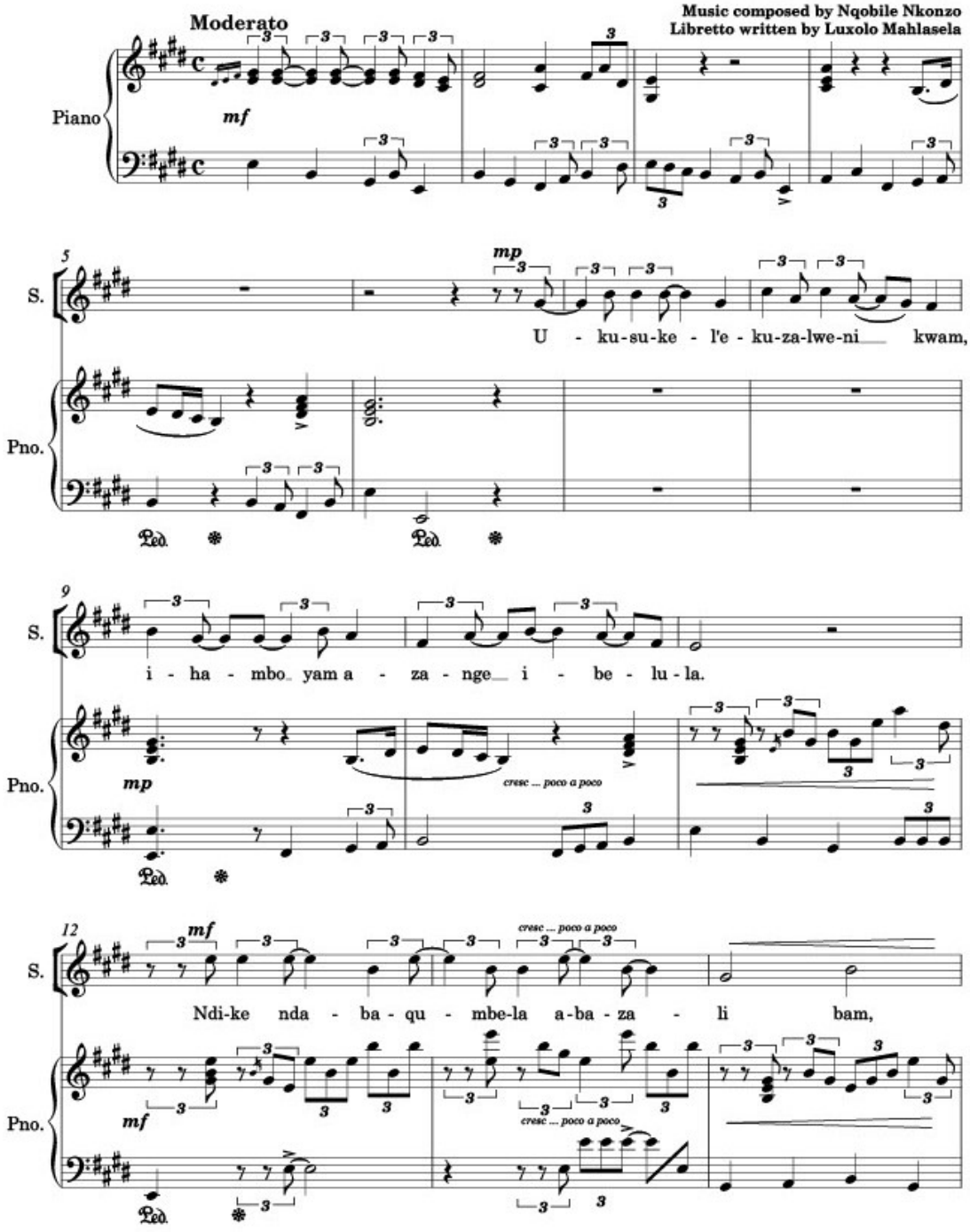
Umsimelelo, Opus. 016



Text	Translation
2. UMsimelelo	***2. Representative***
Yintoni na eshiyekayo xa imizamo yonke yoyisakele? Xa kumnyama ingabonakali, nendlela kungasekho mntu nasecaleni? Lithemba eliphilisa umphefumlo! Lithemba elinika amandla. Hlalani ninal' ithemba, Lithemba elinika intsingiselo.	What can you do when all your efforts seem to fail? When it's dark and you don't see, is there no one besides you? Only hope gives us life! It is hope that gives us power. Have hope all the time, Hope gives meaning to Life.

IHAMBO YAM

for Amanda Kosi



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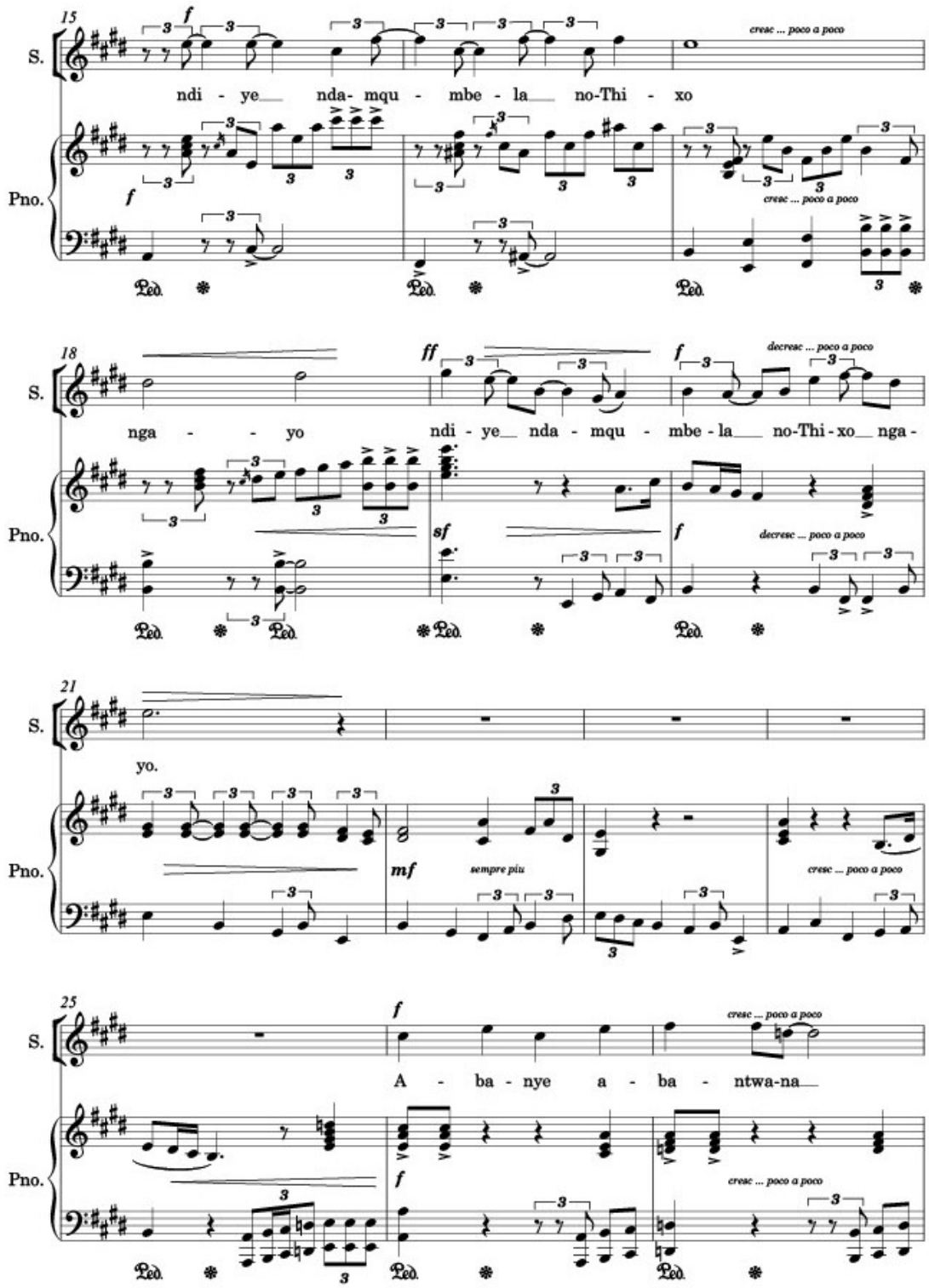
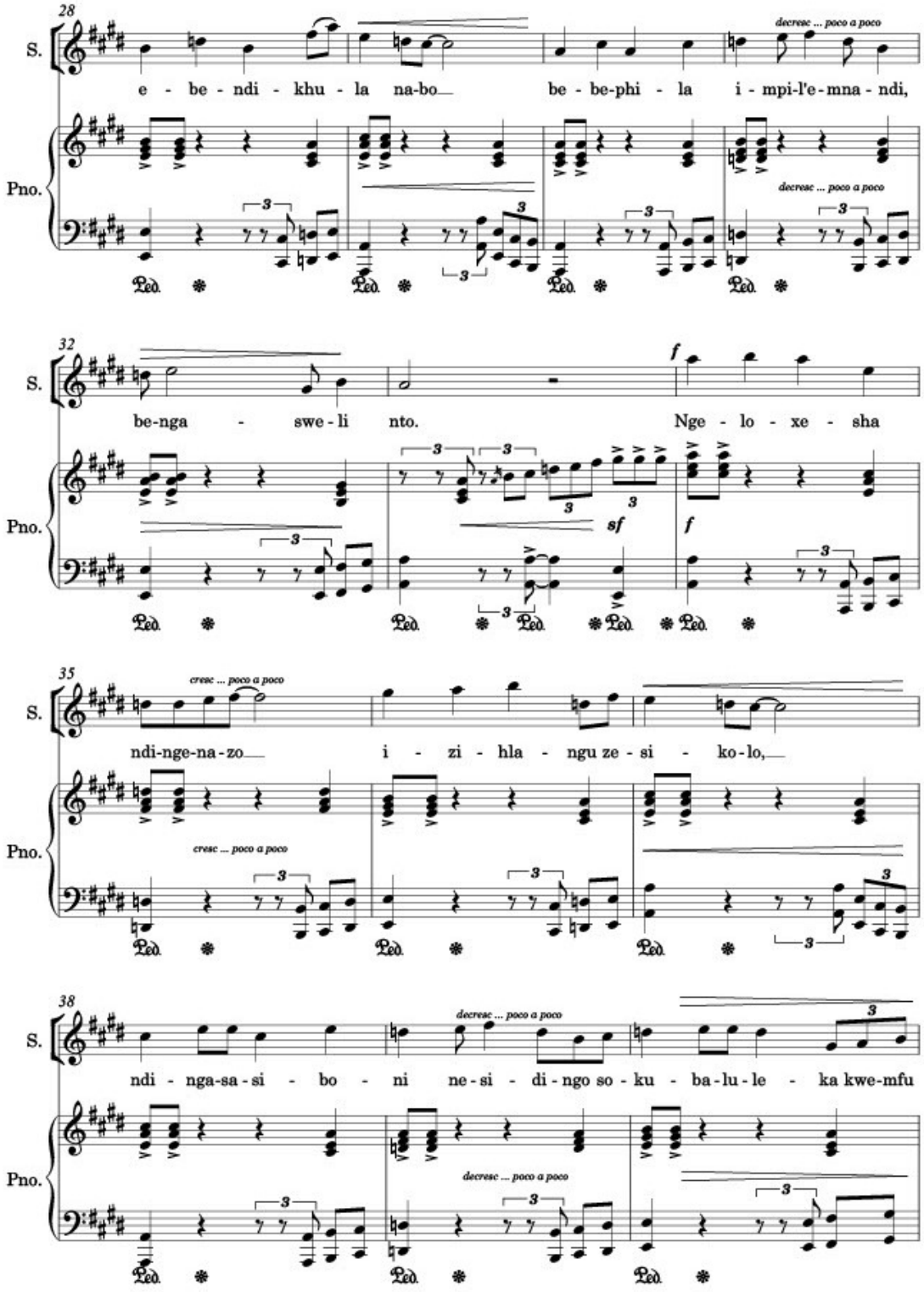
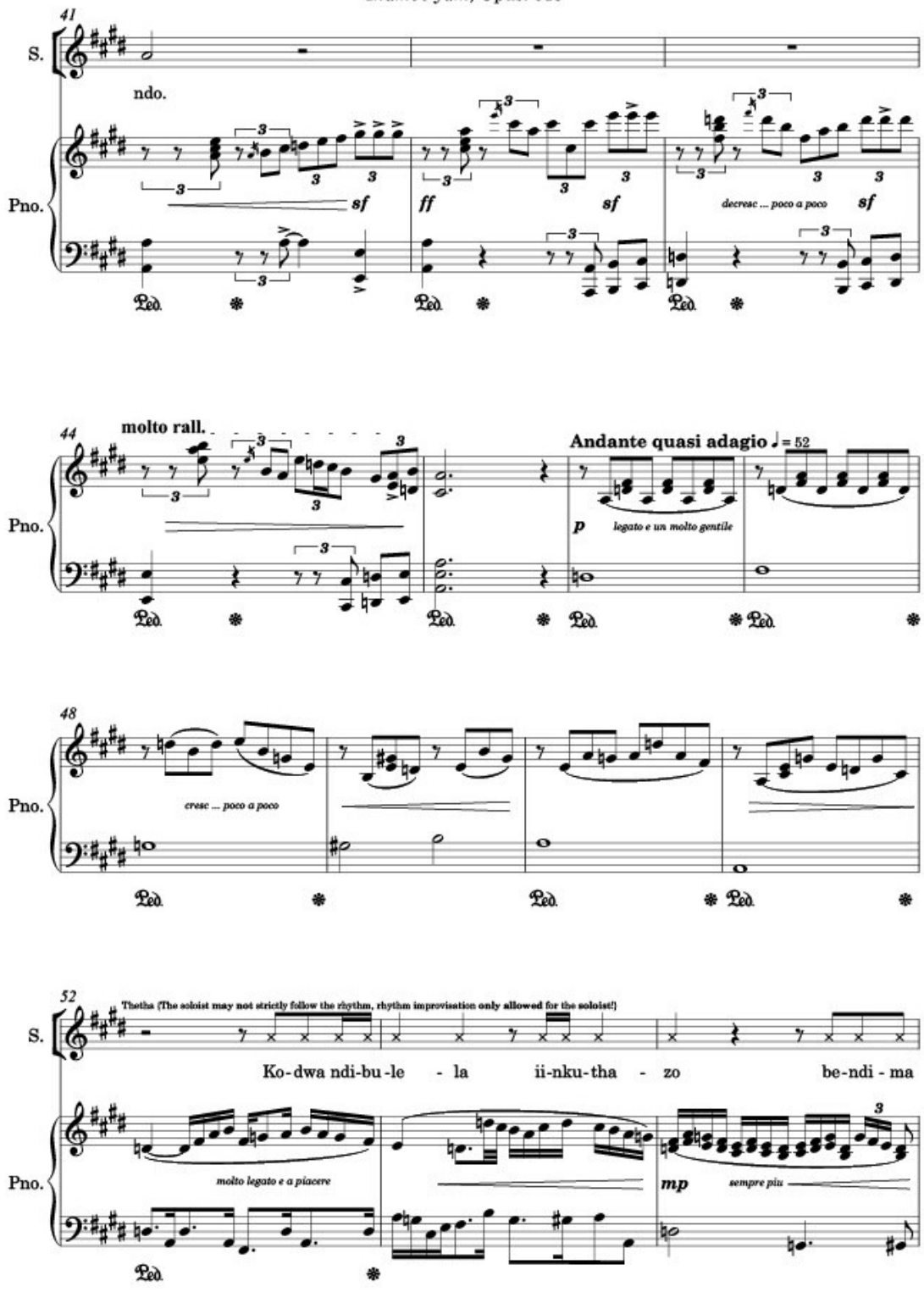
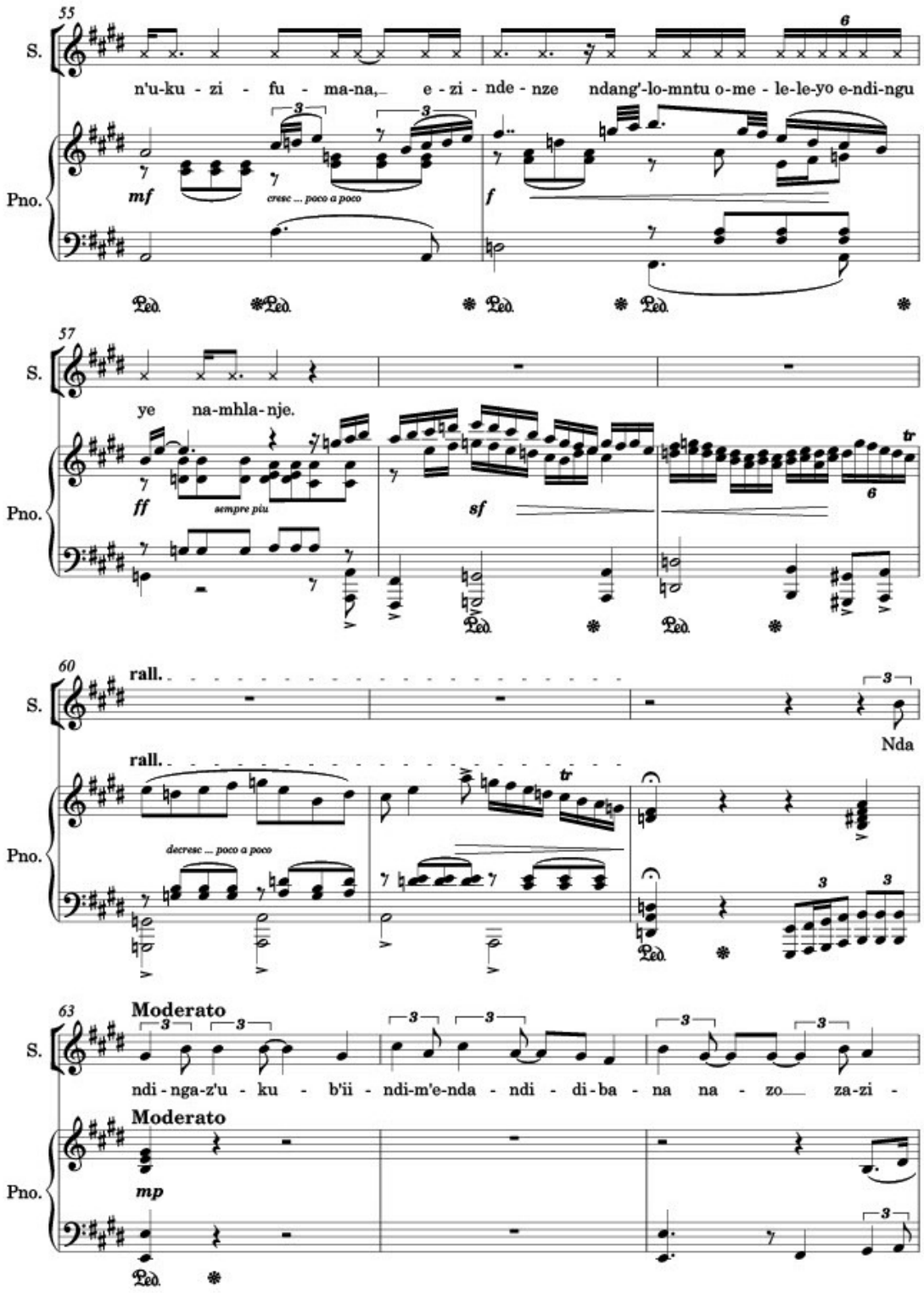
Ihambo yam, Opus. 015



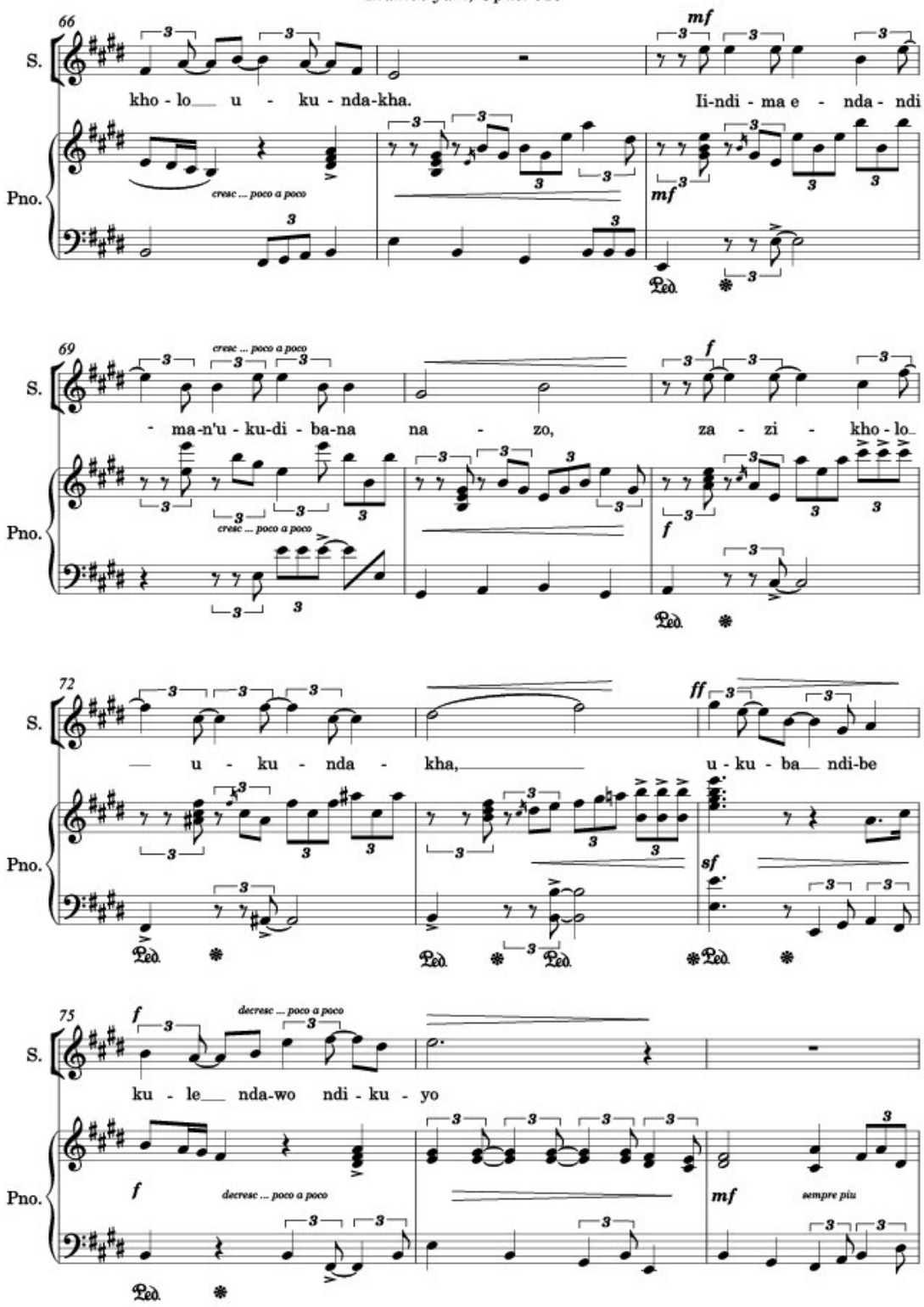

28
S.
Pno.
e - be - ndi - khu - la na-bo
be - be-phi - la i - mpi-l'e-mna - ndi,
decresc ... poco a poco
32
be-nga - swe - li nto.
Nge - lo - xe - sha
f
sf
35
ndi-nge-na-zo
i - zi - hla - ngu ze - si - ko-lo,
cresc ... poco a poco
38
ndi - nga-sa - si - bo - ni ne - si - di - ngo so - ku - ba-lu-le - ka kwe-mfu

Ihambo yam, Opus. 015

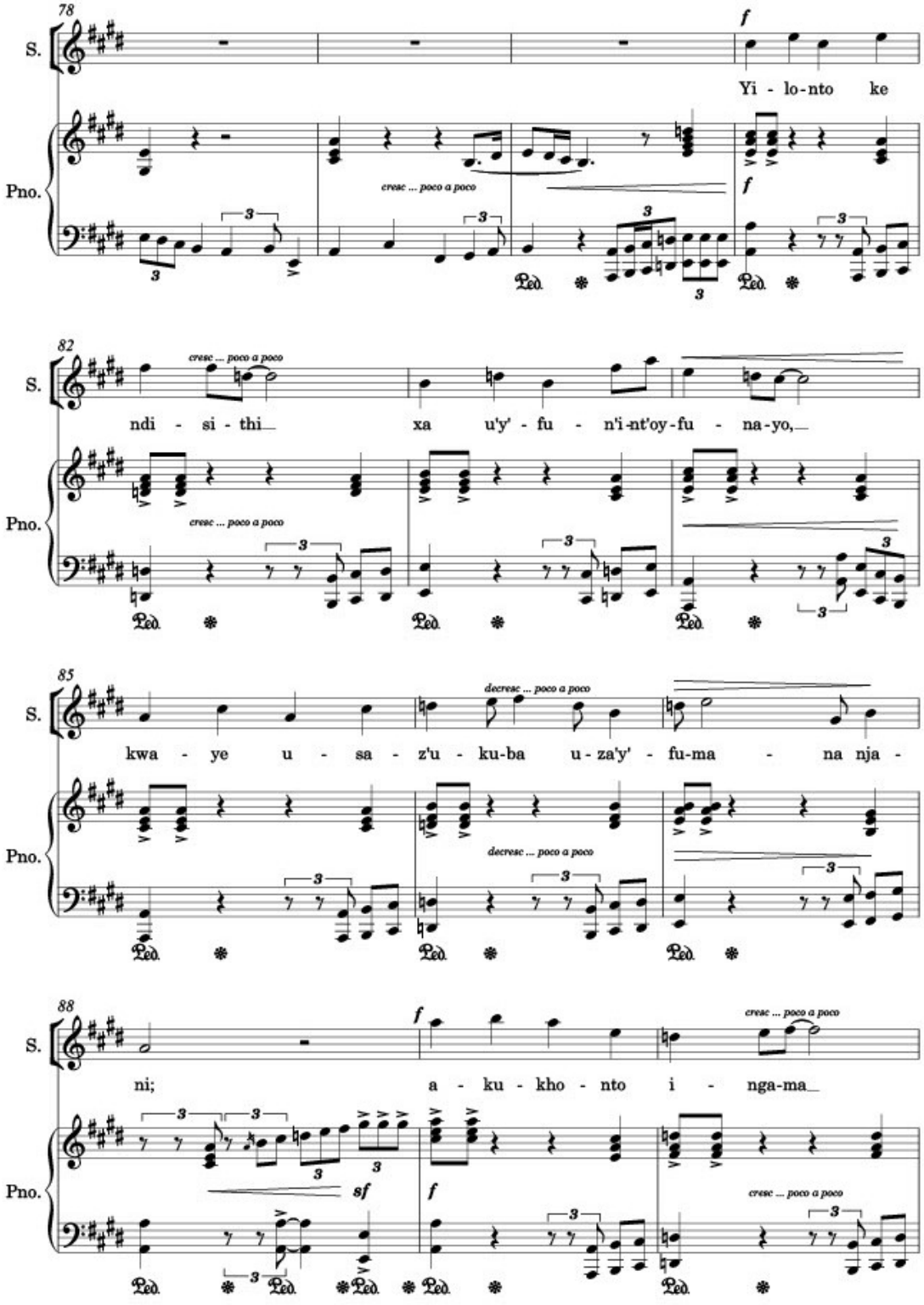



55
S.
n'u-ku - zi - fu - ma-na, e - zi - nde - nze ndang'-lo-mntu o-me - le-le-yo e-ndi-ngu
Pno.
mf
cresc ... poco a poco
f
Ped.
57
S.
ye na-mhla-nje.
Pno.
ff
sempre più
sf
Ped.
60
rall.
S.
Nda
rall.
Pno.
decresc ... poco a poco
Ped.
63
Moderato
S.
ndi-nga-z'u-ku - b'ii - ndi-m'e-nda - ndi - di-ba - na na - zo za-zi -
Moderato
Pno.
mp
Ped.

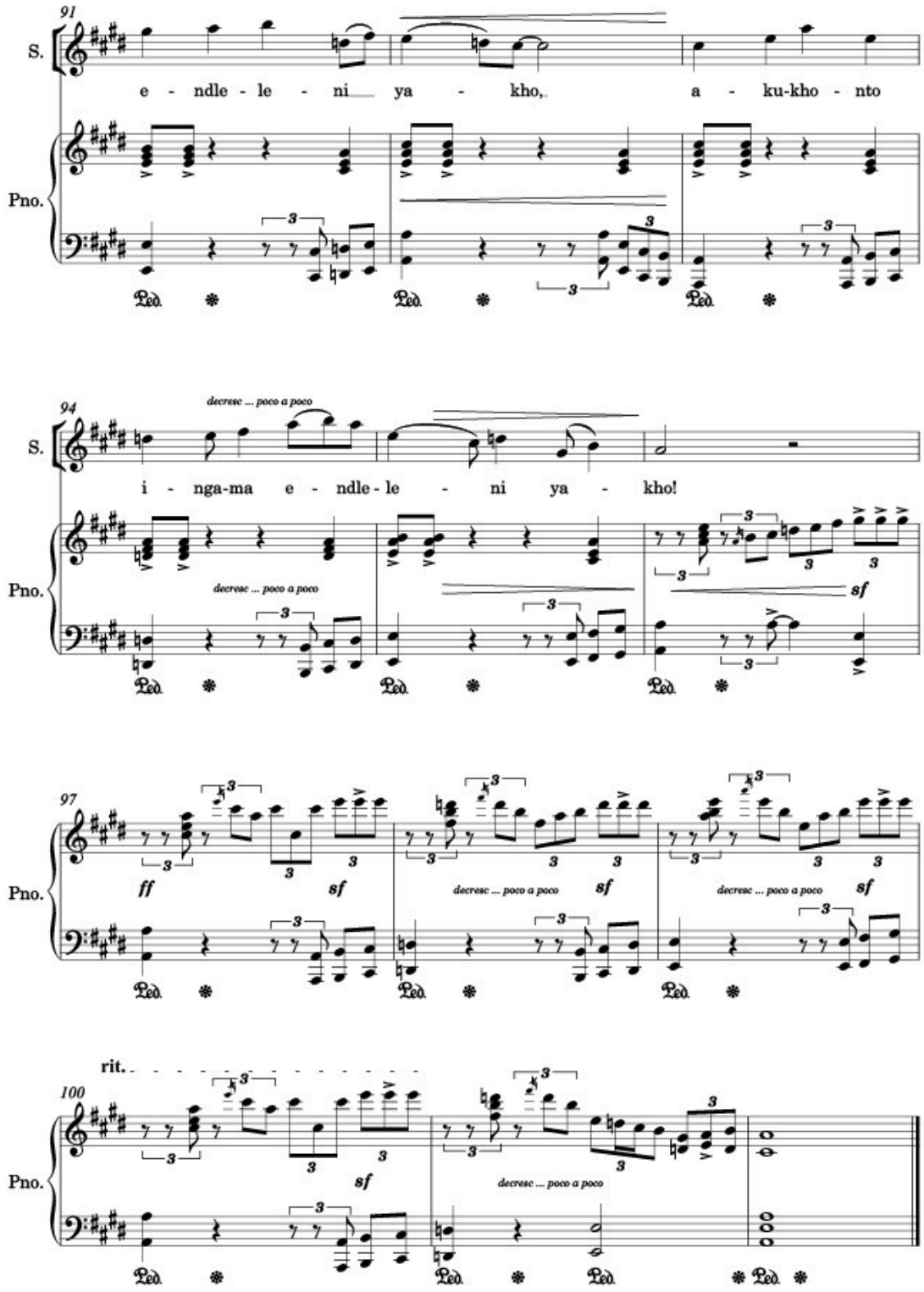
Ihambo yam, Opus. 015



Ihambo yam, Opus. 015



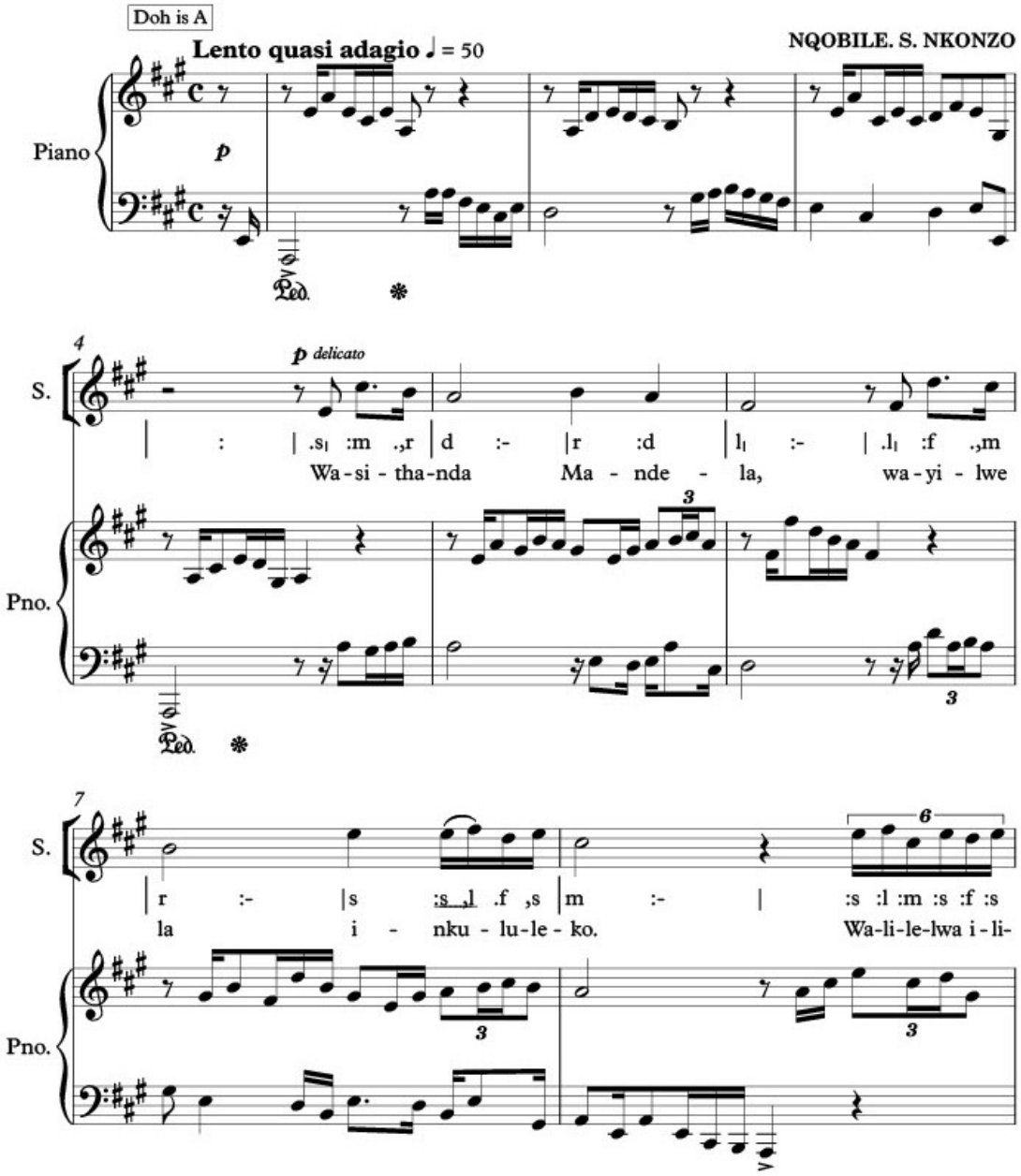
Ihambo yam, Opus. 015



Text	Translation
3. Ihambo Yam	***3. My Journey***
Ukusukel' ekuzalweni kwam, Ihambo yam azange ibelula. Ndike ndabaqumbela abazali bam, Ndiye ndamqumbela noThixo ngayo. Abanye abantwana ebendikhula nabo, bebephila impilo emnandi, Bengasweli nto. Ngeloxesha ndingenazo izihlangu zesikolo, ndingasasiboni nesidingo sokubaluleka kwemfundo.	From the moment I was born, my journey hasn't been easy. I was angry at my parents, I was also angry at God. Friends from my childhood, had a great life, they had everything they needed. At the time I didn't have shoes, I also didn't see the need for education.
Kodwa ndibulela iinkuthazo bendimana ukuzifumana, ezindenze ndang' ulomntu womeleleyo endinguye namhlanje.	But I would like to thank everyone who encouraged me, your contributions helped me to become a strong person.
Ndandingazi ukuba indima, endandidibana nazo zazikholo ukundakha. Ukuba ndibe kulendawo ndikuyo. Yilonto ke ndisithi, xa uyifuna into oyifunayo, Kwaye usazi ukuba uzayifumana njani, Akukho nto ingama endleleni yakho!	I didn't know the challenges I faced prepared me to be strong. And to be where I need to be today. That is why I'm saying, when you want something, and you have a plan on how to get it, Nothing can stand in your way!

3. WASITHANDA MANDELA

Celebrating the centenary of Nelson Rholihlahla Mandela through Music



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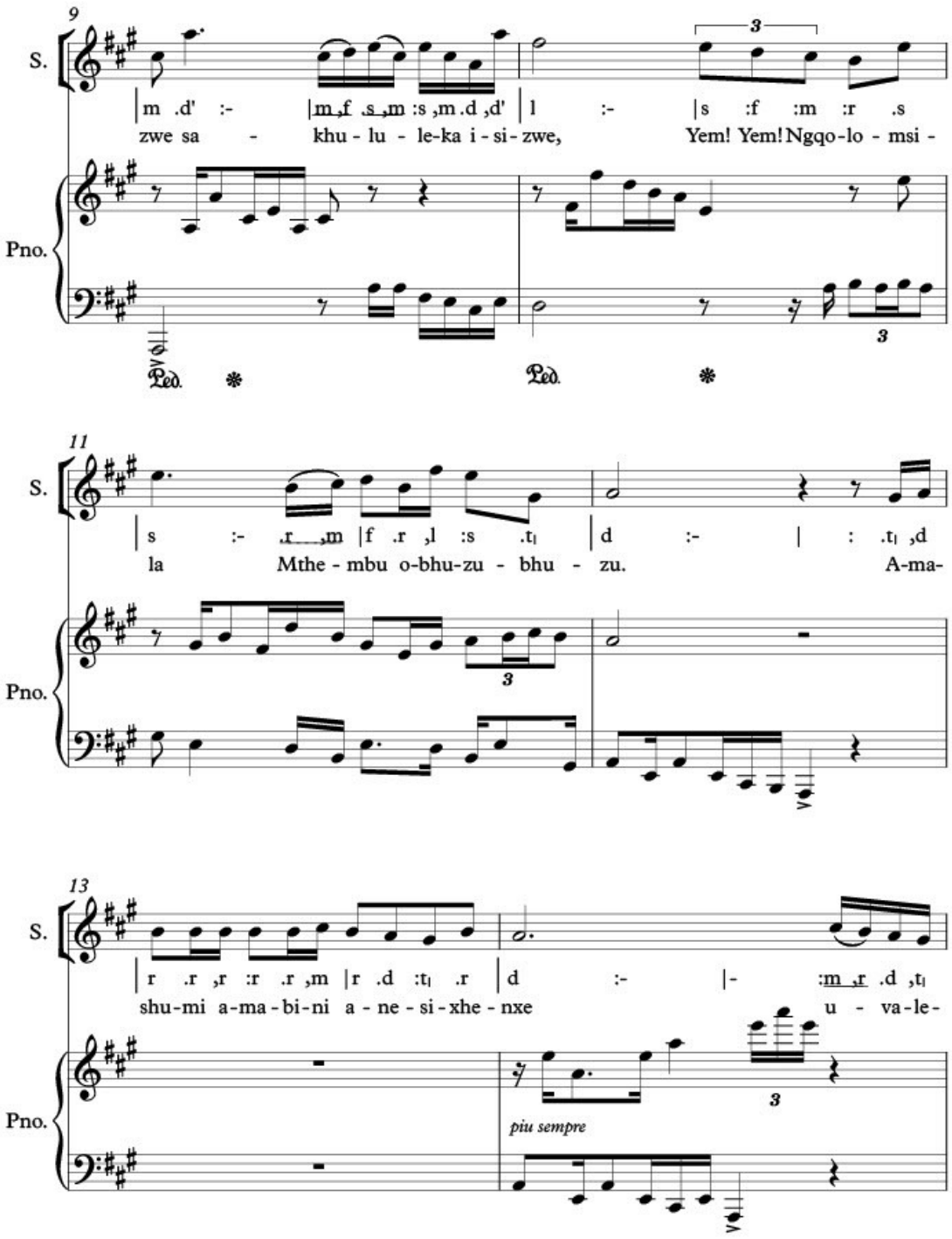
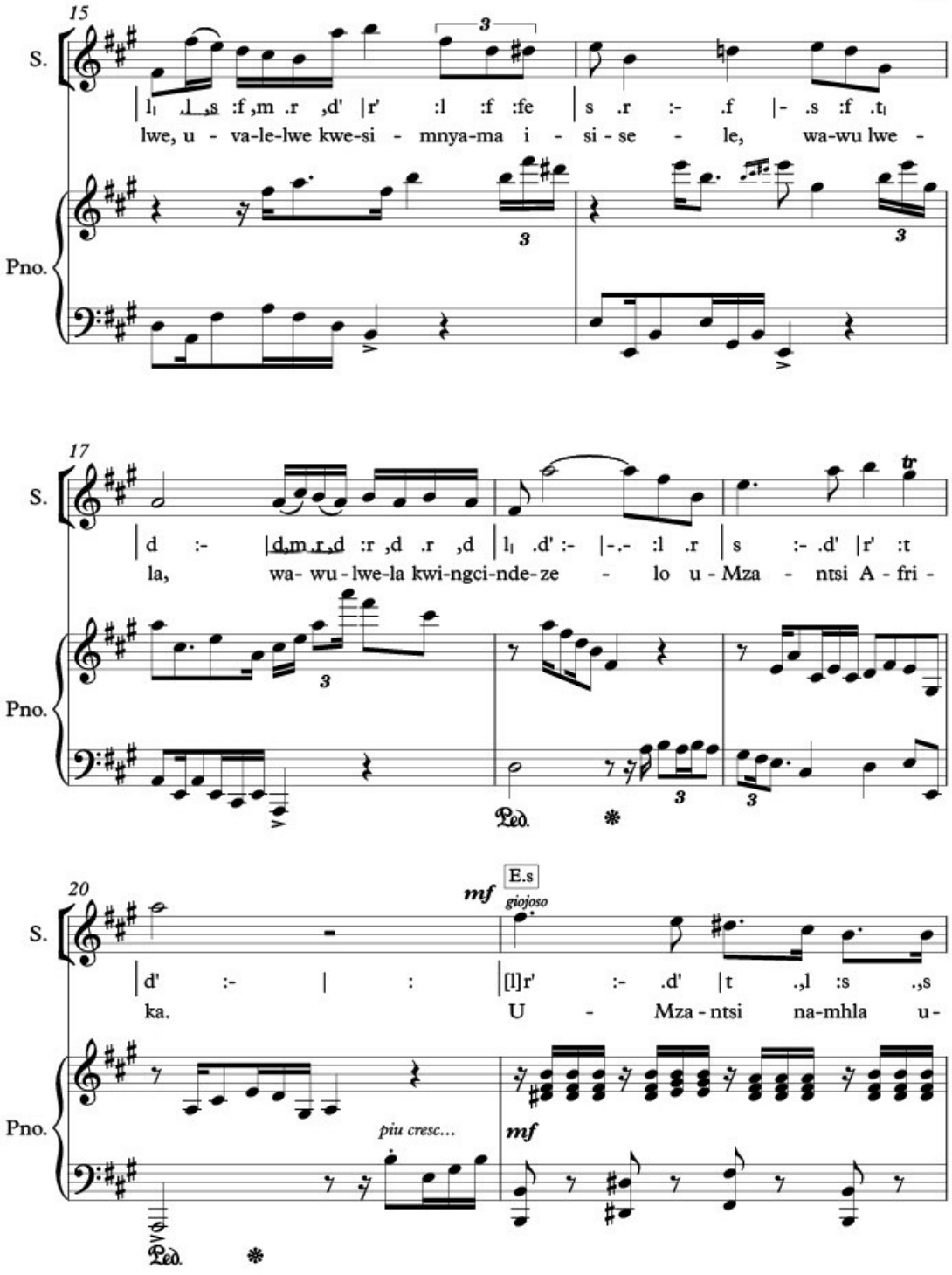
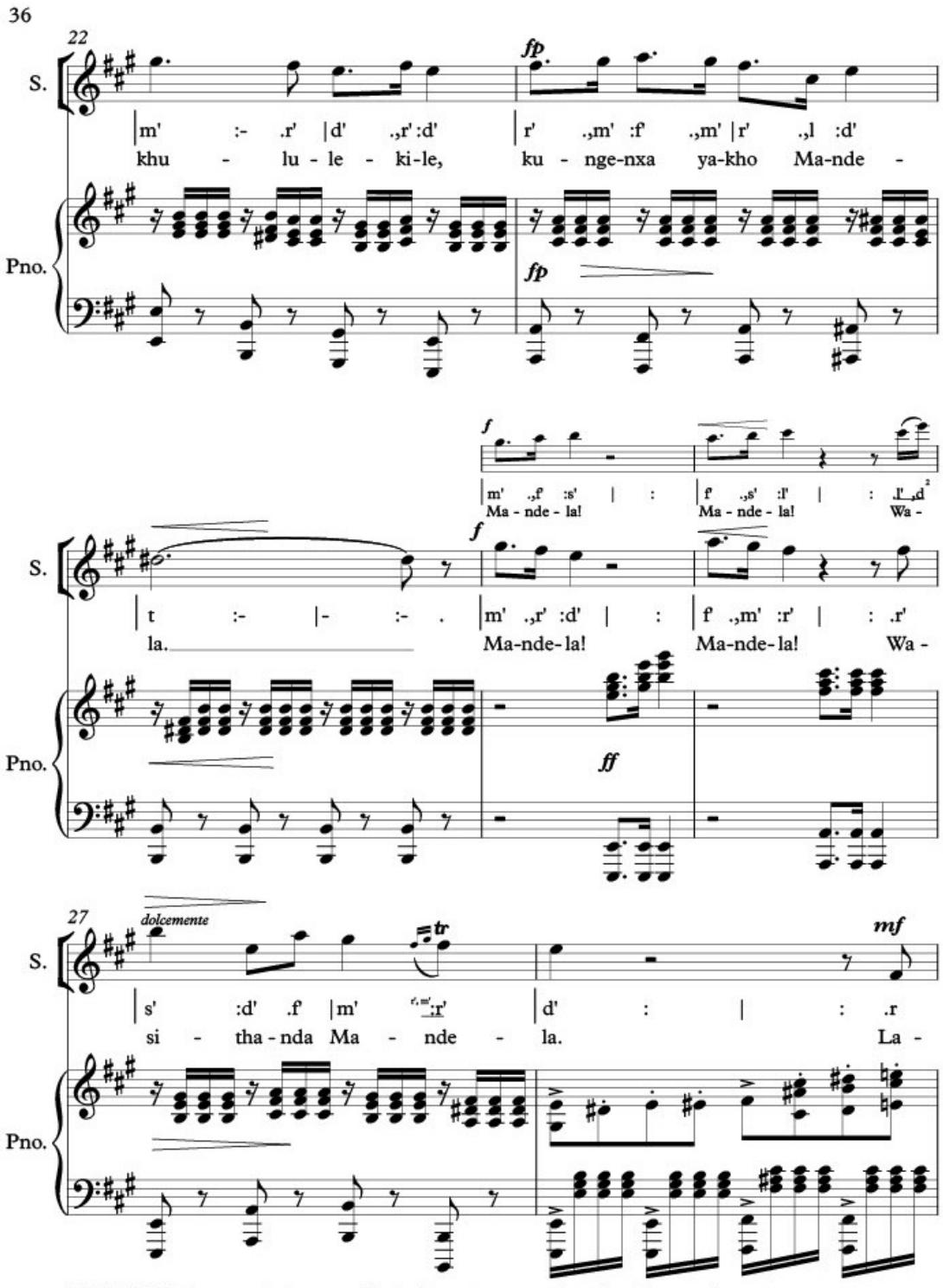
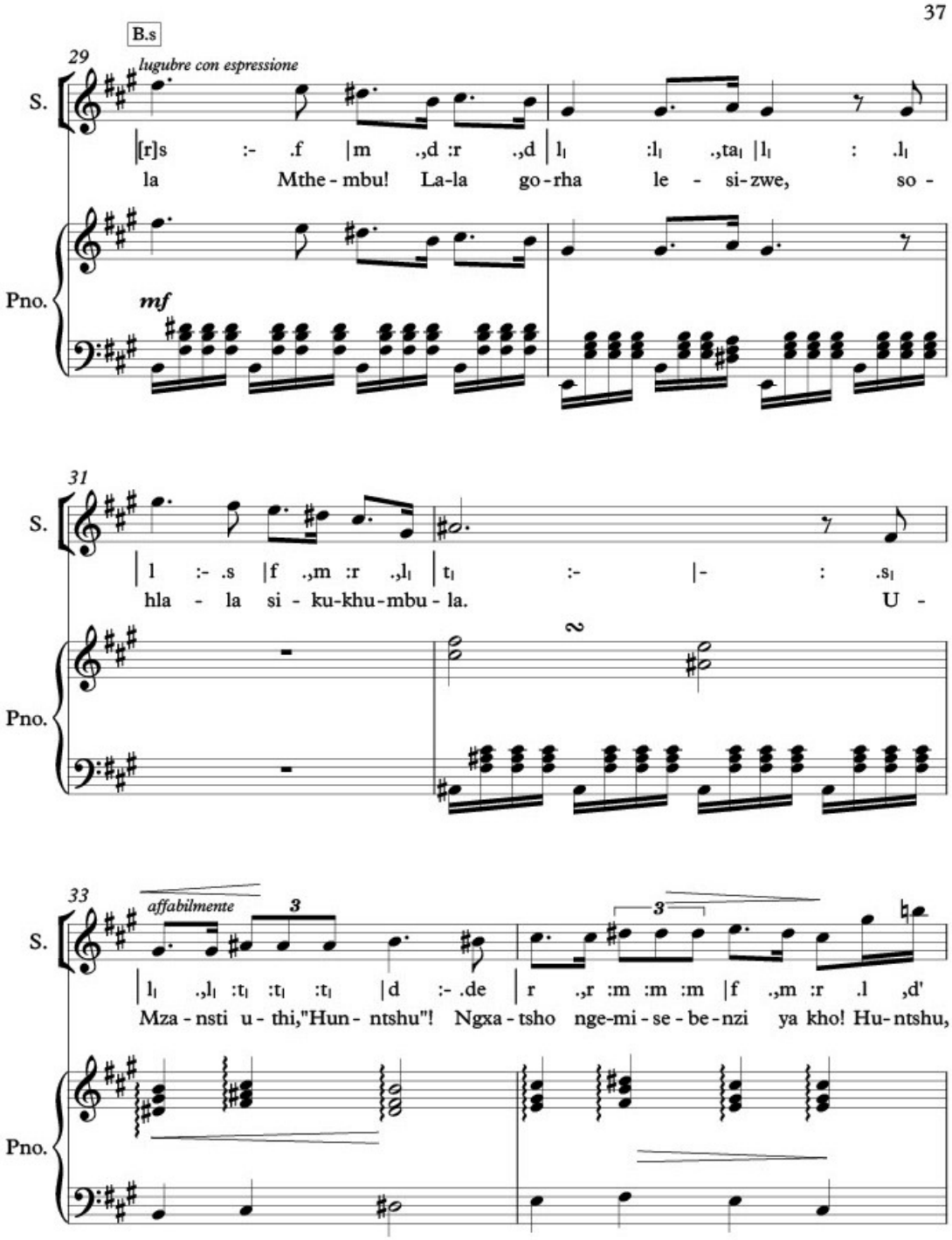
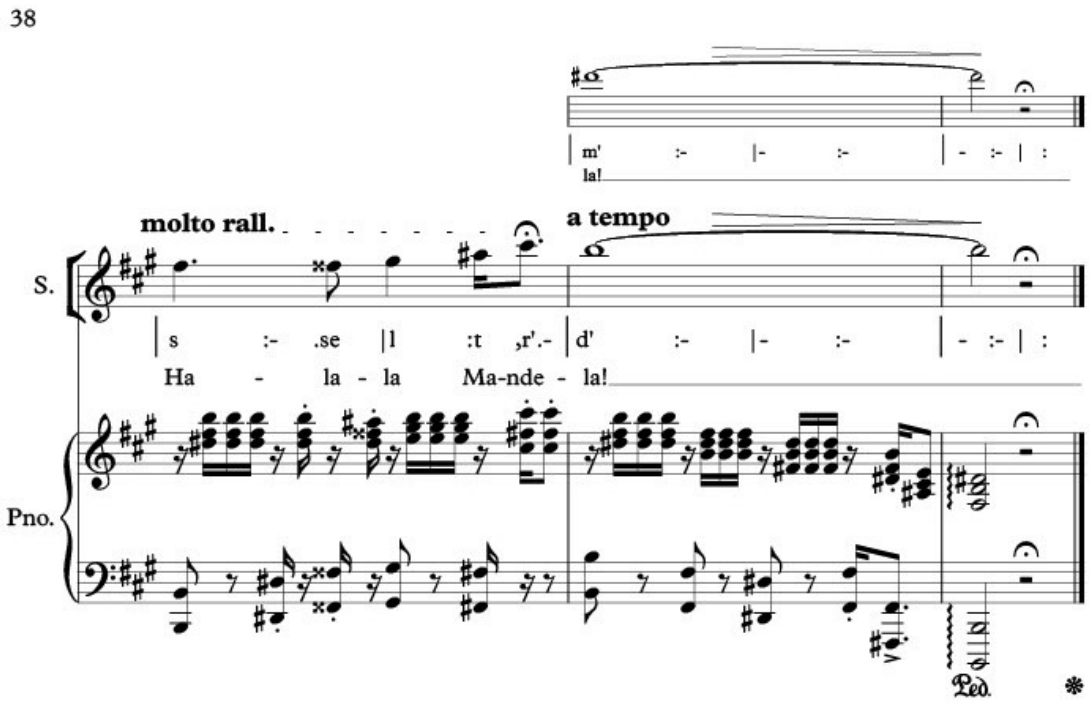

9
S.
Pno.
m .d' :- |m ,f .s ,m :s ,m .d ,d' | l :- |s :f :m :r .s
zwe sa - khu - lu - le-ka i - si - zwe, Yem! Yem! Ngqo-lo - msi -
3
Ped. * Ped. *
11
S.
Pno.
s :- ,r ,m |f .r ,l :s .tl | d :- | : .tl ,d
la Mthe - mbu o-bhu-zu - bhu - zu. A-ma-
3
13
S.
Pno.
r .r ,r :r .r ,m |r .d :tl .r | d :- |- :m ,r .d ,tl
shu-mi a-ma-bi-ni a - ne - si-xhe - nxe u - va-le-
3
piu sempre


15
S.
Pno.
lwe, u - va-le-lwe kwe-si - mnya-ma i - si - se - le, wa-wu lwe -
17
la, wa- wu - lwe-la kwi-ngci-nde-ze - lo u - Mza - ntsi A - fri -
Ped.
20
mf
giojoso
E.s
ka. U - Mza - ntsi na-mhla u -
piu cresc...
mf
Ped.



** **N.B:** Soloist may apply **tempo rubato** then **a tempo** as from bar 27 onwards.

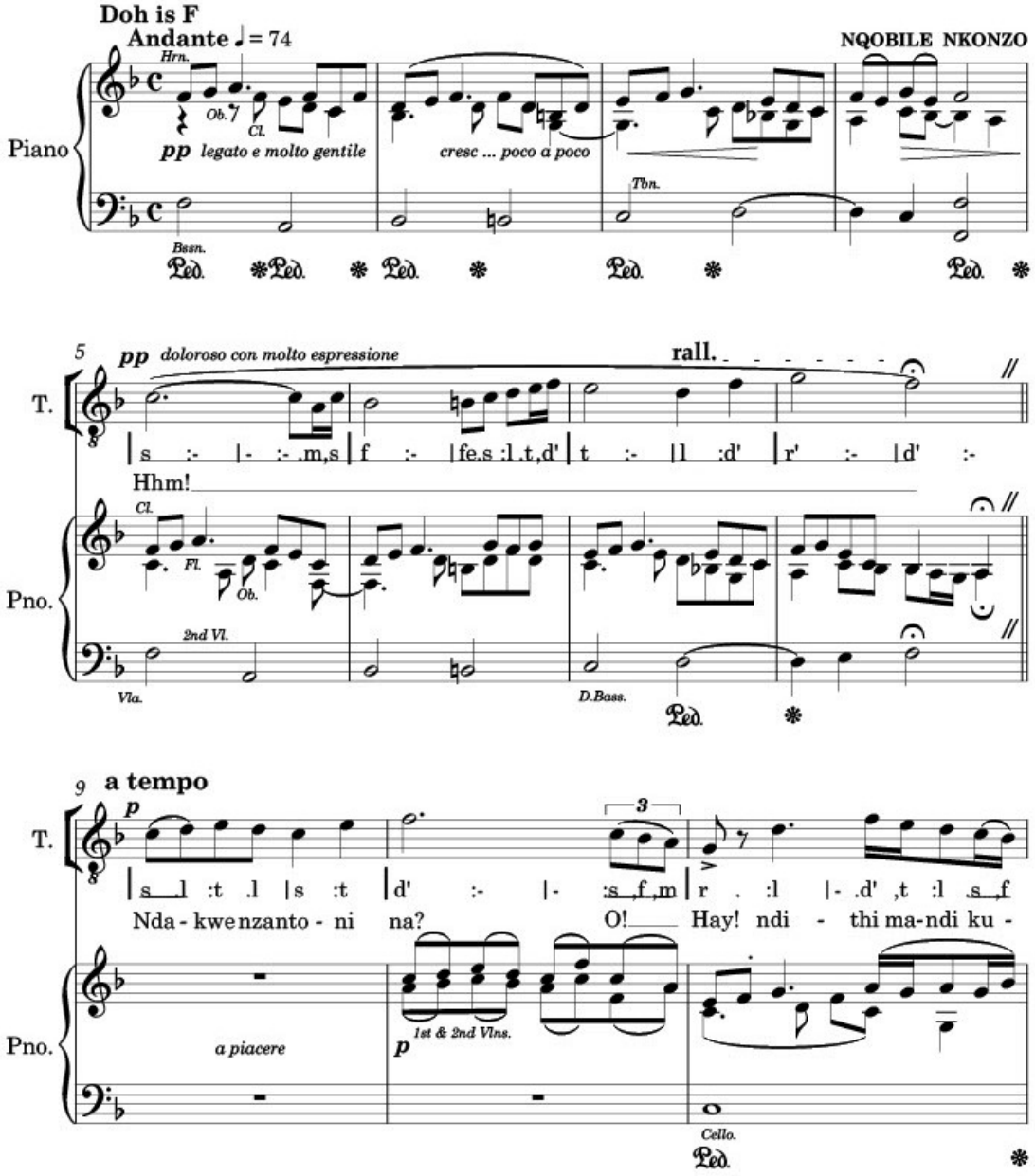

B.s
29
lugubre con espressione
S.
Pno.
mf
[r]s :- .f |m .,d :r .,d | l, :l, .,ta, |l, : .l,
la Mthe - mbu! La-la go - rha le - si - zwe, so -
31
S.
Pno.
2
l :- .s |f .,m :r .,l, | t, :- |- : .s,
hla - la si - ku-khu-mbu - la. U -
33
affabilmente
3
3
S.
Pno.
l, .,l, :t, :t, :t, |d :- .de | r .,r :m :m :m |f .,m :r .l ,d'
Mza - nsti u - thi,"Hun - ntshu"! Ngxa - tsho nge-mi - se - be - nzi ya kho! Hu - ntshu,



Text	Translation
4. ***Wasithanda Mandela***	**4**. ***You loved us Mandela***
Wasithanda Mandela Wayilwela inkululeko. Walilwela ilizwe sakhululeka isizwe, Yem-Yem! Ngqolomsila Mthembu obhuzubhuzu. Amashumi amabini anesixhenxe, uvalelwe kwesimnyama isisele. Wawulwela kwingcindezelo uMzantsi Afrika. UMzantsi namhla ukhululekile, kungenxa yakho Mandela. Lala mthembu! lala gorha lesizwe, Sohlala sikukhumbula. Umzantsi uthi huntshu, ngxatsho ngemisebenzi yakho! Huntshu halala Mandela.	You loved us Mandela You fought for freedom. You fought for the country and we are free, Clan names Clan names. For twenty seven years, you were in a dark cell. You fought oppression in South Africa. South Africa today is free, it's all because of you Mandela. Rest in peace! South African hero, you will always be in our hearts. South Africans salute you, congratulations for your amazing work! Congratulations Mandela.

2. Aria: NDAKWENZA NTONI NA?

from the *Song Cycle no. 1 - Ubomi,* Opus. 010



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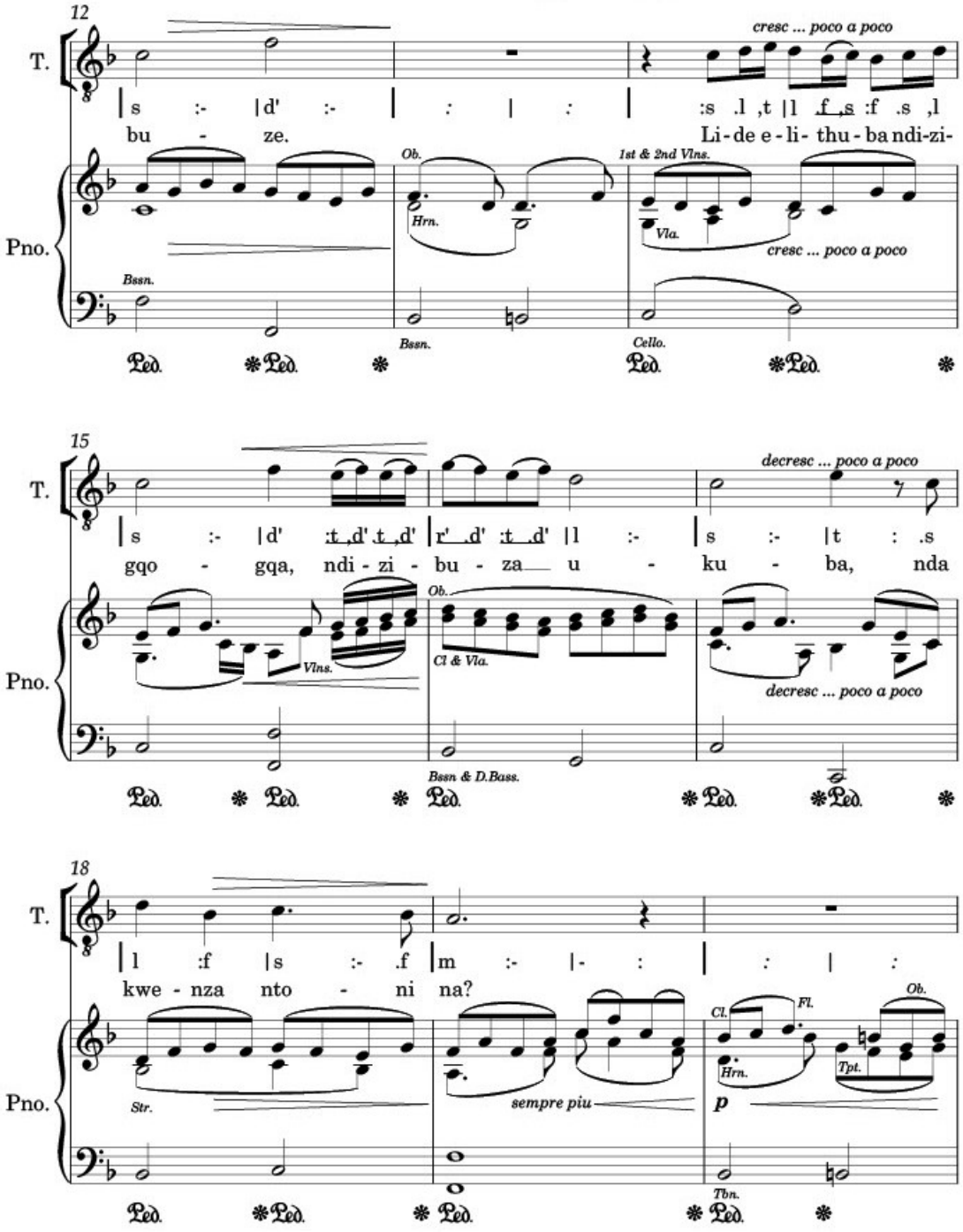
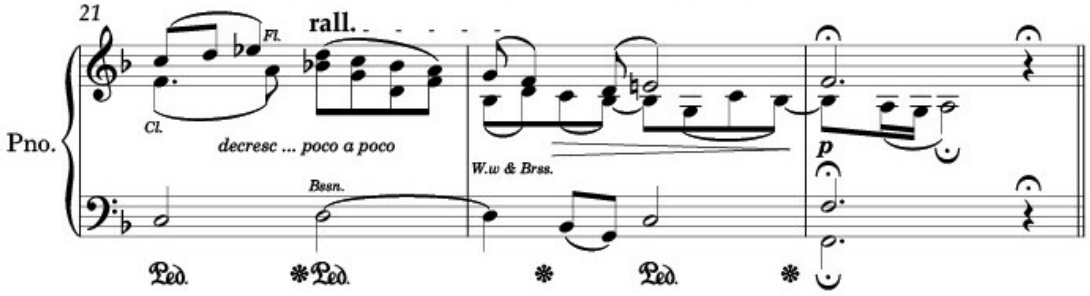
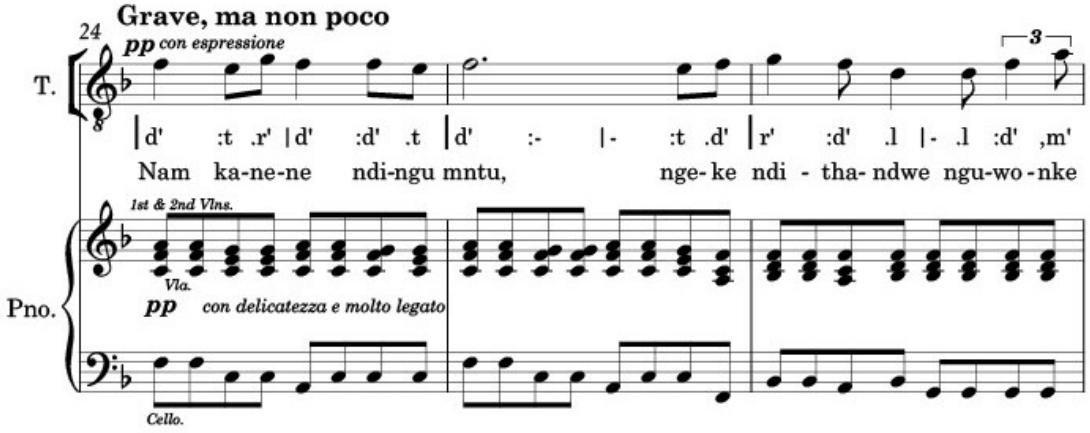
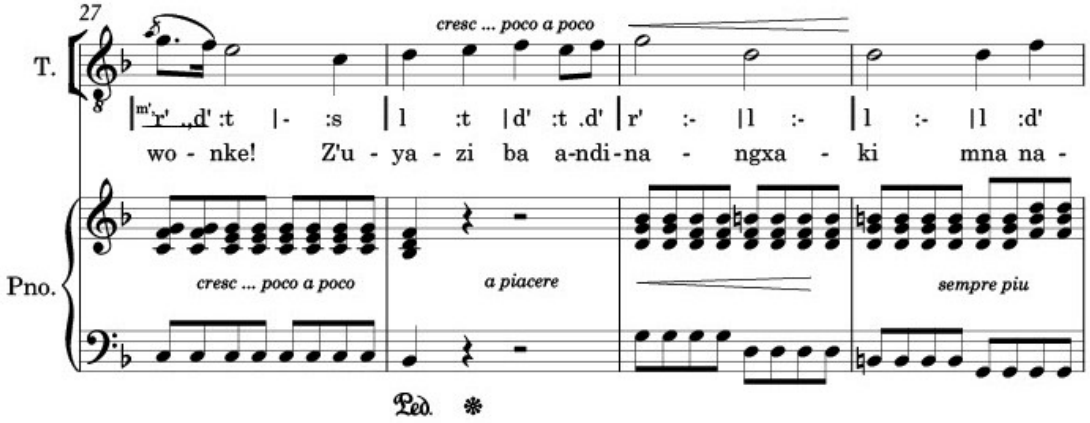
Ndakwenza ntoni na? from the song cycle no.1, Opus. 010

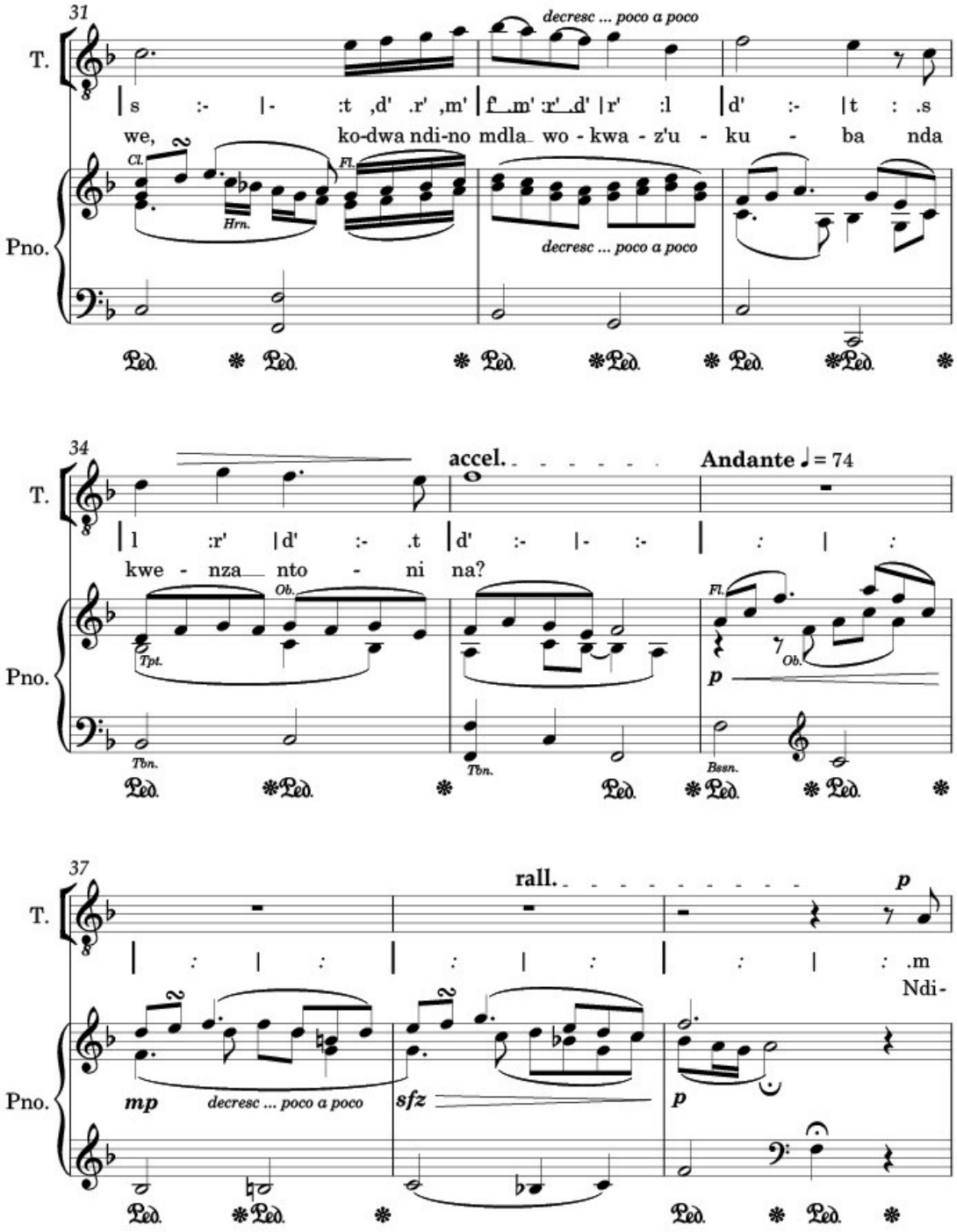


Ndakwenza ntoni na? from the song cycle no.1, Opus. 010

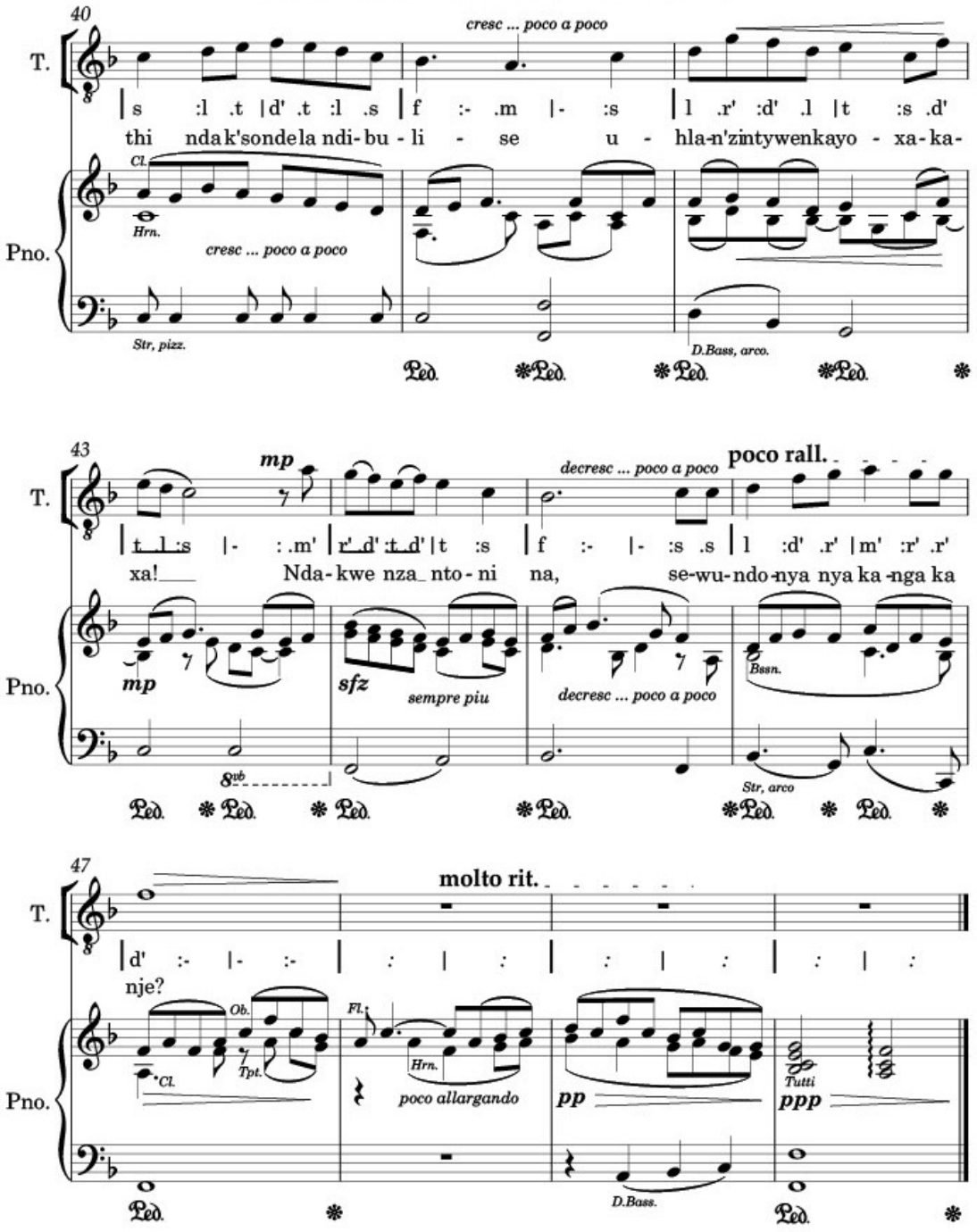







31
T.
Pno.
decresc ... poco a poco
s :- |- :t ,d' .r' ,m' | f .m' :r' .d' | r' :l | d' :- |t : .s
we, ko-dwa ndi-no mdla wo - kwa - z'u - ku - ba nda
Cl.
Fl.
Hrn.
decresc ... poco a poco
34
accel.
Andante ♩= 74
l :r' | d' :- .t | d' :- |- :- | : | :
kwe - nza nto - ni na?
Ob.
Tpt.
Fl.
Ob.
p
Tbn.
Tbn.
Bssn.
37
rall.
p
: | : | : | : | : .m
Ndi-
mp
decresc ... poco a poco
sfz
p

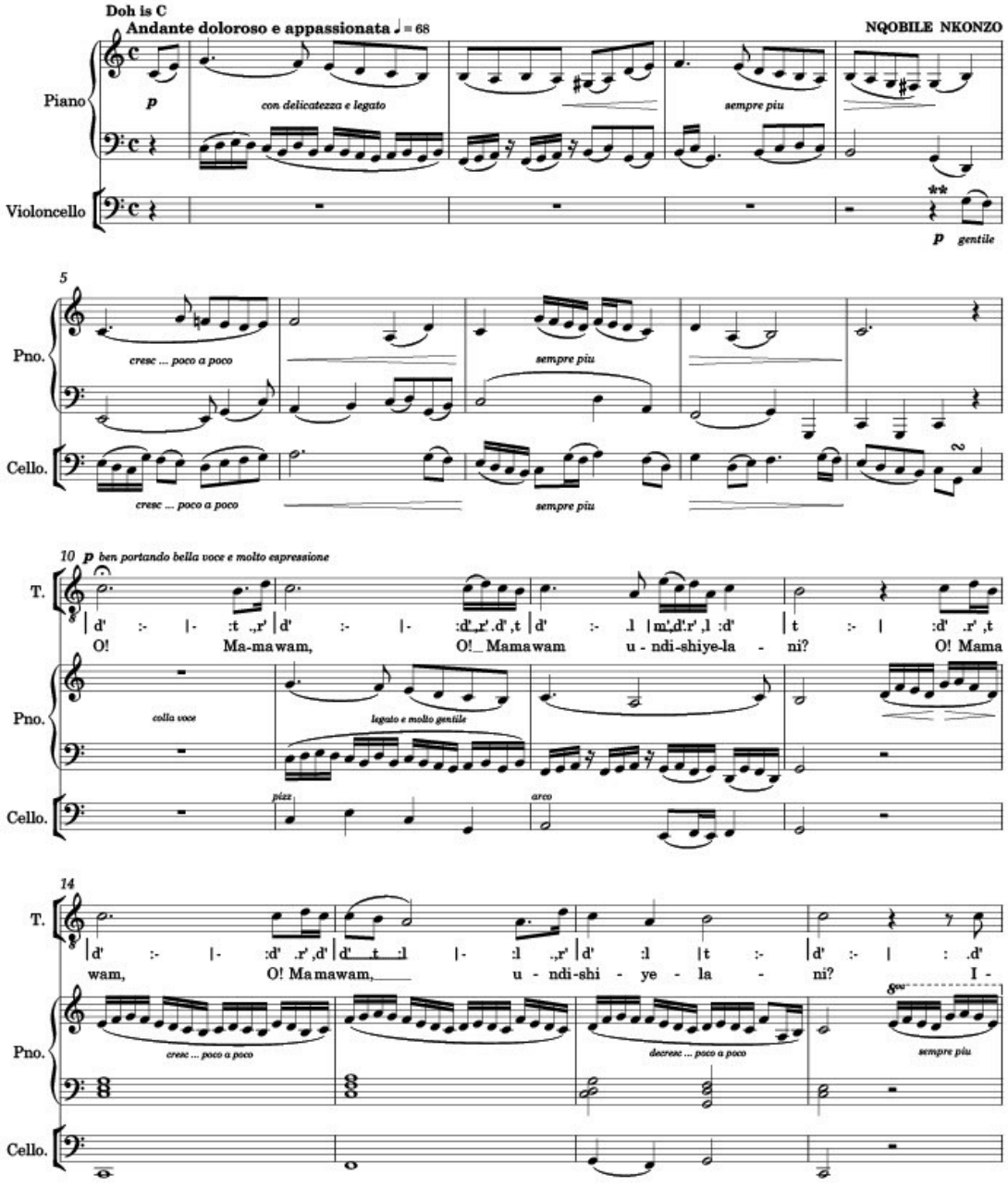
Ndakwenza ntoni na? from the song cycle no.1, Opus. 010



Text	Translation
5. ***Ndakwenza Ntoni Na?***	**5.** ***What have I done to you?***
Ndakwenzantoni na? O! Hay! ndithi mandikubuze. Lide elithuba ndizi gqogqa, ndizibuza ukuba, ndakwenza ntoni na? Namkanene ndingu mntu, ngeke ndithandwe nguwonke-wonke!	What have I done to you? Oh! No! I just wanna know. I've been wondering for a long time, questioning myself, what have I done wrong? I am also human, Not everyone will like me!
Zuyazi ukuba andinangxaki mna nawe, kodwa ndino mdla wokwaz' ukuba ndakwenza ntoni na? Ndithi ndak'sondela ndibulise uhlan'zintywenkayo xakaxa! Ndakwenza ntoni na, sewundonyanya kangaka nje?	Know that I don't have a problem with you, I'm really curious to know what have I done to you? When I pass by and greet you you become disgusted! What have I done to you, that make you so disgusted?

UNDISHIYELANI NA?

In a loving memory of my late aunt, Judua Pretty Nkonzo - Nsimbi



** **N.B:** The violoncello is part of the music and in the absence of the violoncello, it's music **may be played** on the piano (left - hand) **where possible**.

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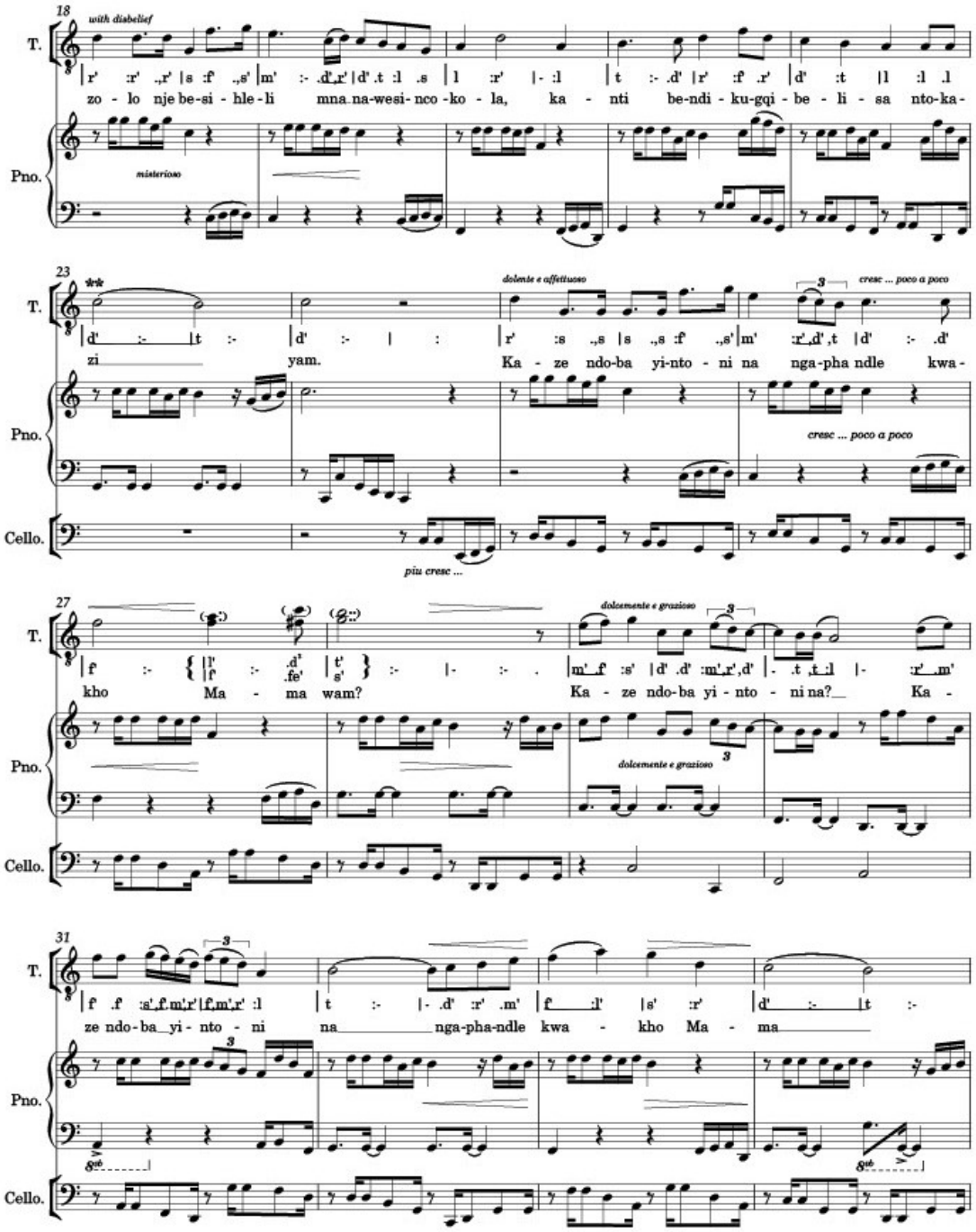
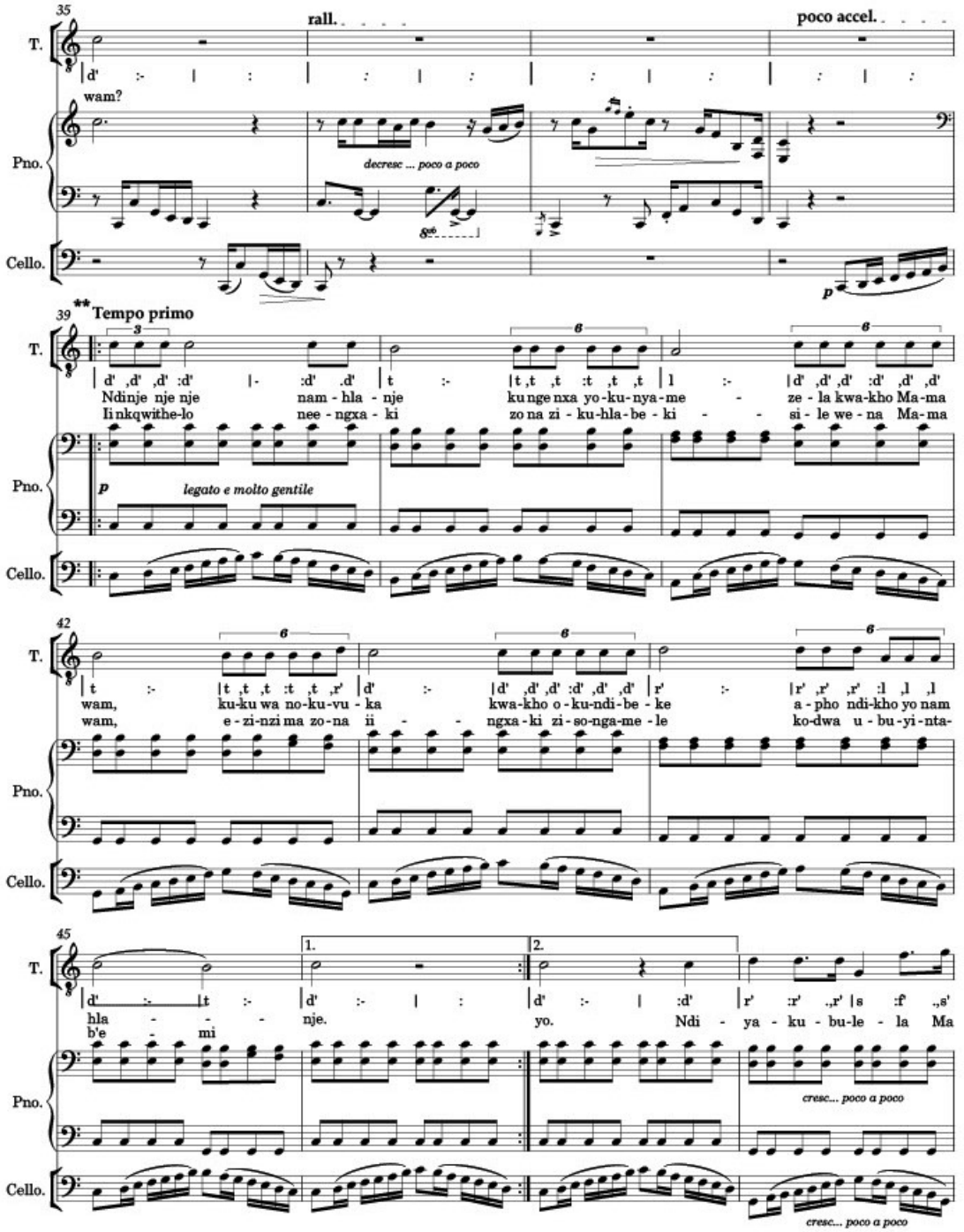
Undishiyelani na?, Opus. 002

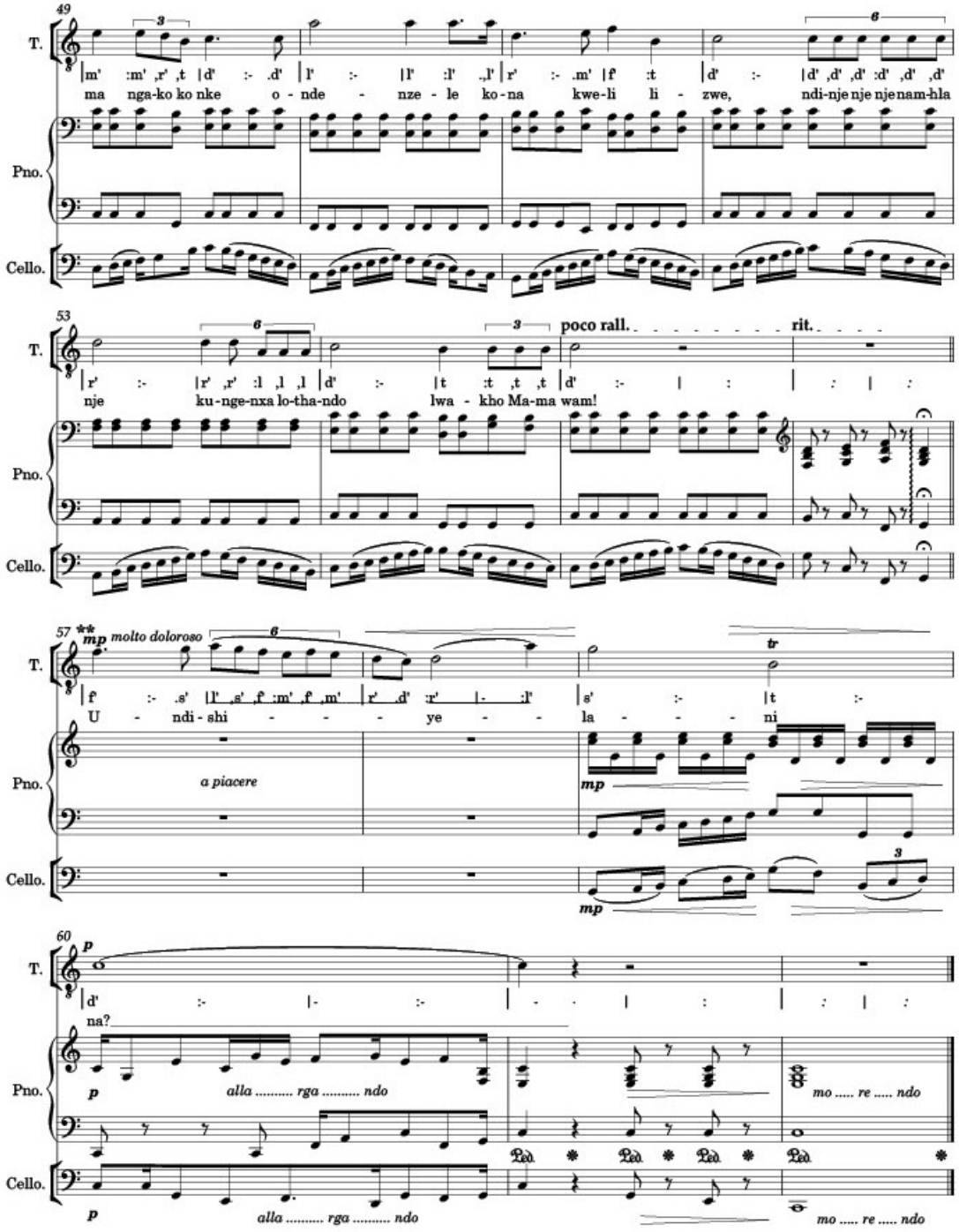


**** N.B (Not compulsory):** On bar 23, the soloist **may apply** a *rallentando* and the cello will *accel.* on bar 24 then the soloist will return to the **initial tempo** on bar 25.



** **N.B:** From bar 39 to bar 55, there are no dynamics and the soloist **may interpret** the aria based on how the music appeals to him and based on his own emotions. The cellist is **allowed to improvise** from bar 39 until bar 55.

Undishiyelani na?, Opus. 002

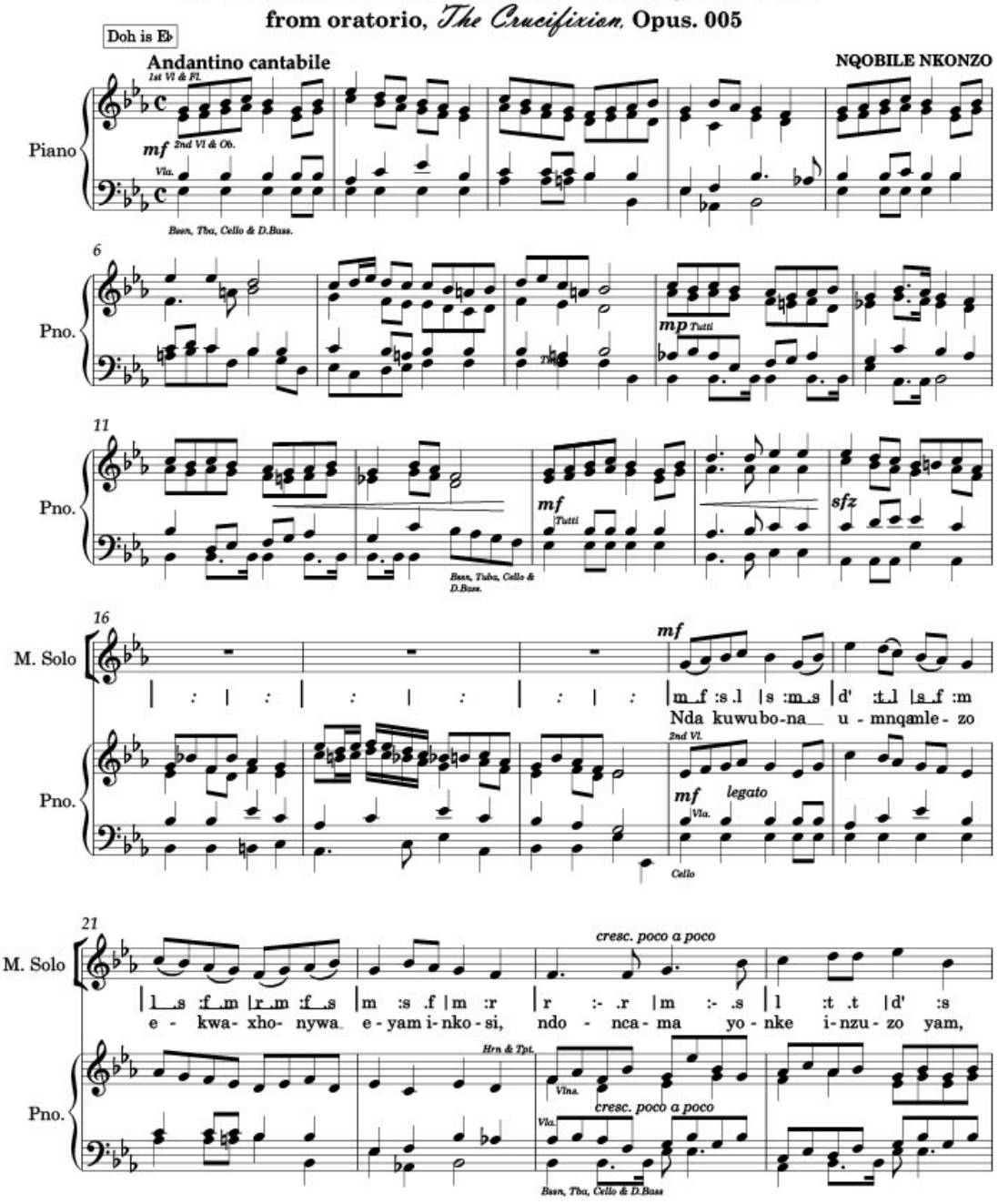


** **N.B:** The soloist is **permitted to improvise** the cadenza in bar 57 & bar 58 up to bar 59, and the improvisation on bar 59 is **only applicable for the soloist!**

Text	Translation
6. Undishiyelani Na?	***6. Why did you leave me?***
O! Mama wam, Undishiyelani? Izolo njengokuba besihleli mna nawe, sincokola kanti bedikugqibelisa ntokazi yam. Kaze ndoba yintoni na? Ngapha ndlekwakho Mama wam.	Oh! My mother, Why did you leave me? As we were sitting together yesterday, that was the last time I was seeing you my dear. I wonder what I will be? Without you my mother.
Ndinje nje nje namhlanje kungenxa yokunyamezela kwakho mama. Kukuwa nokuvuka kwakho okundibeke apho ndikhoyo namhlanje. Iinkqwithelo neengxaki zona zikuhlabekisile wena mama wam. Ezinzima zona iingxaki zisongamele kodwa ubuyintab' emiyo.	I am where I am today because of your hard work my mother. It's your endurance that put me where I am today. Challenges and problems affected you my dearest mother. Big unsolvable problems overpowered us you stood like a mountain.
Ndiyakubulela mama ngako konke ondenzele kona kwelilizwe, ndinje nje nje namhlanje. Kungenxa yothando lwakho Mama wam!	I thank you mother for everything you have done in this earth, today I'm grateful. It's all because of your love my Mother!

1. Aria: NDAKUWUBON' UMNQAMLEZO

from oratorio, *The Crucifixion*, Opus. 005



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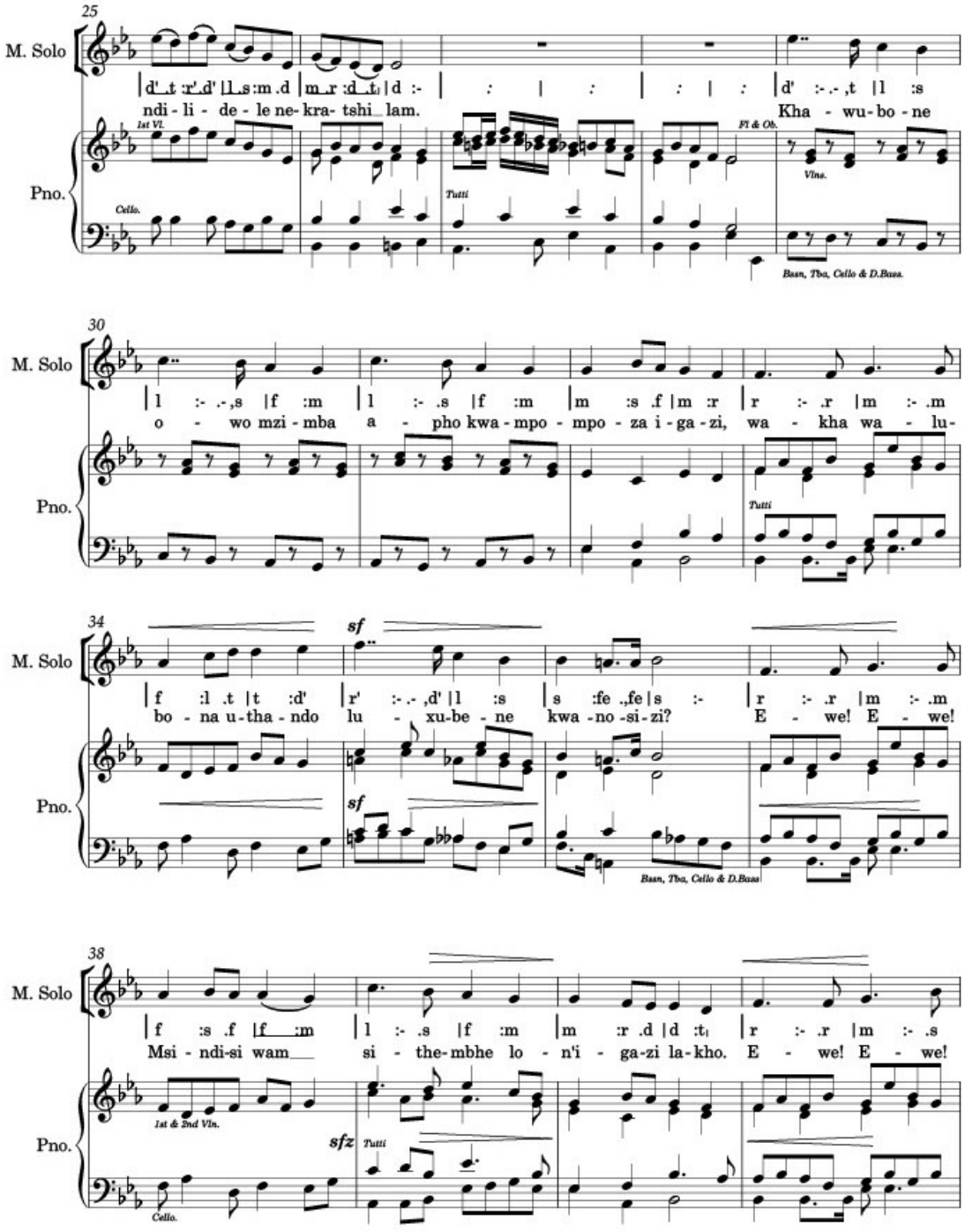
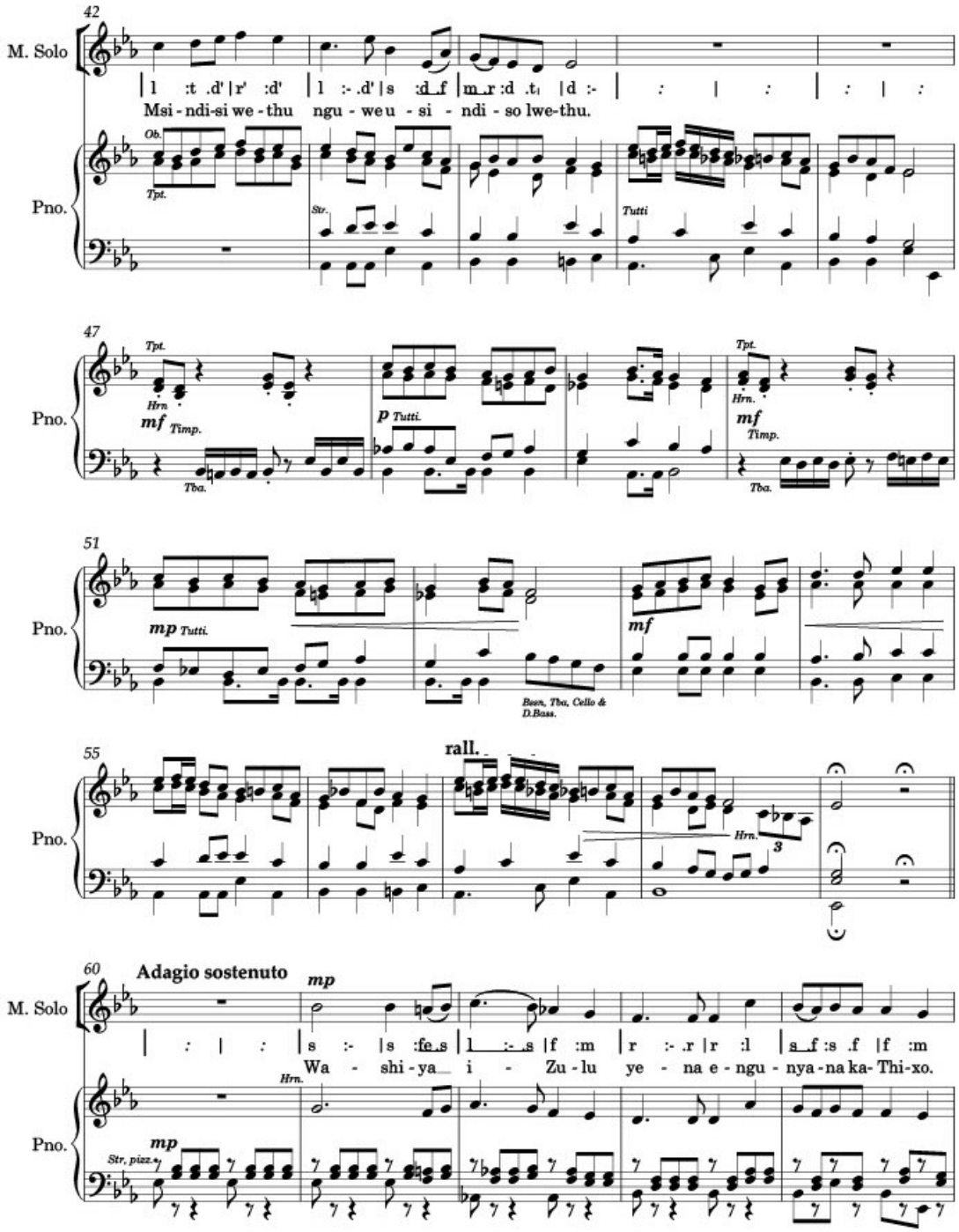
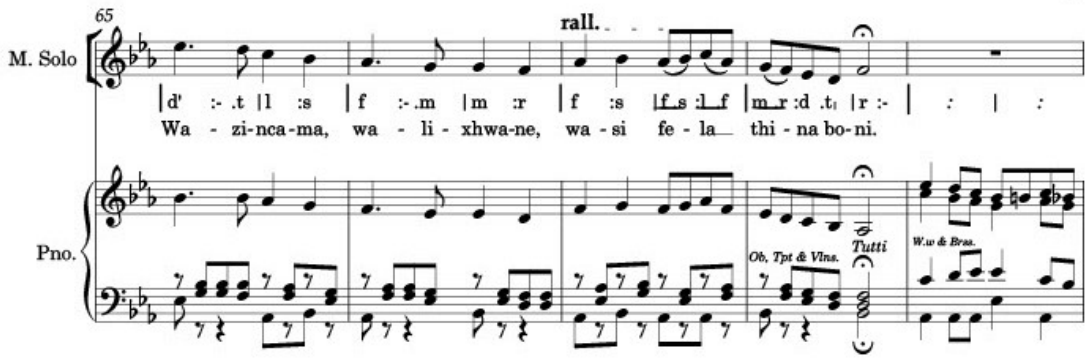
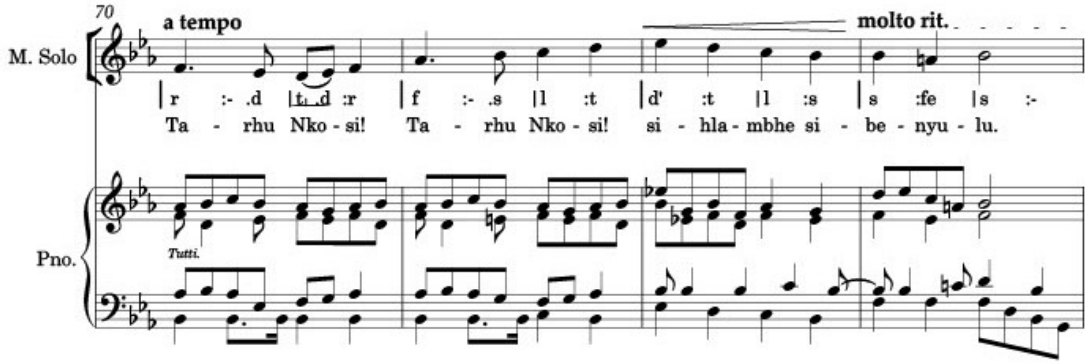
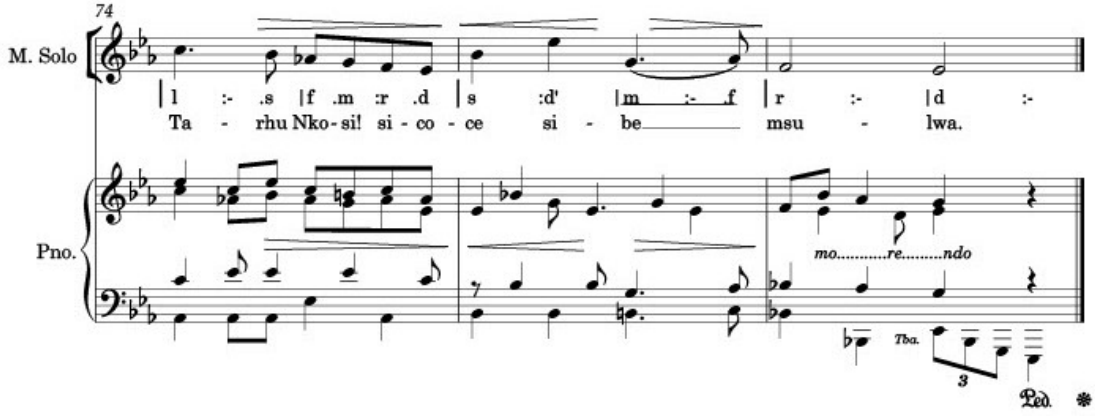

25
M. Solo
d' :t :r' d' | l :s :m .d | m :r :d :t | d :-
ndi - li - de - le ne- kra- tshi lam.
: | : | : | :
d' :- .- ,t | l :s
Kha - wu- bo - ne
1st Vl.
Fl & Ob.
Vlns.
Pno.
Cello.
Tutti
Bass, Tba, Cello & D.Bass.
30
M. Solo
l :- .- ,s | f :m | l :- .s | f :m | m :s .f | m :r | r :- .r | m :- .m
o - wo mzi - mba a - pho kwa - mpo - mpo - za i - ga - zi, wa - kha wa - lu-
Pno.
Tutti
34
M. Solo
sf
f :l .t | t :d' | r' :- .- ,d' | l :s | s :fe .,fe | s :- | r :- .r | m :- .m
bo - na u - tha - ndo lu - xu-be - ne kwa - no - si - zi? E - we! E - we!
Pno.
sf
Bass, Tba, Cello & D.Bass
38
M. Solo
f :s .f | f :m | l :- .s | f :m | m :r .d | d :t | r :- .r | m :- .s
Msi - ndi-si wam si - the-mbhe lo - n'i - ga-zi la-kho. E - we! E - we!
Pno.
1st & 2nd Vln.
sfz
Tutti
Cello.


42
M. Solo
Msi - ndi-si we - thu ngu - we u - si - ndi - so lwe-thu.
Pno.
Ob.
Tpt.
Str.
Tutti
47
Tpt.
Hrn
mf Timp.
Tba.
p Tutti.
Tpt.
Hrn.
mf Timp.
Tba.
51
Pno.
mp Tutti.
mf
Bsns, Tbn, Cello & D.Bass.
55
rall.
Pno.
Hrn.
3
60
Adagio sostenuto
mp
M. Solo
Wa - shi - ya i - Zu - lu ye - na e - ngu - nya - na ka- Thi-xo.
Pno.
Hrn.
mp
Str, pizz.


65
rall.
M. Solo
Wa - zi-nca-ma, wa - li - xhwa-ne, wa - si fe - la thi - na bo-ni.
Pno.
Ob, Tpt & Vlns.
Tutti
W.w & Brss.

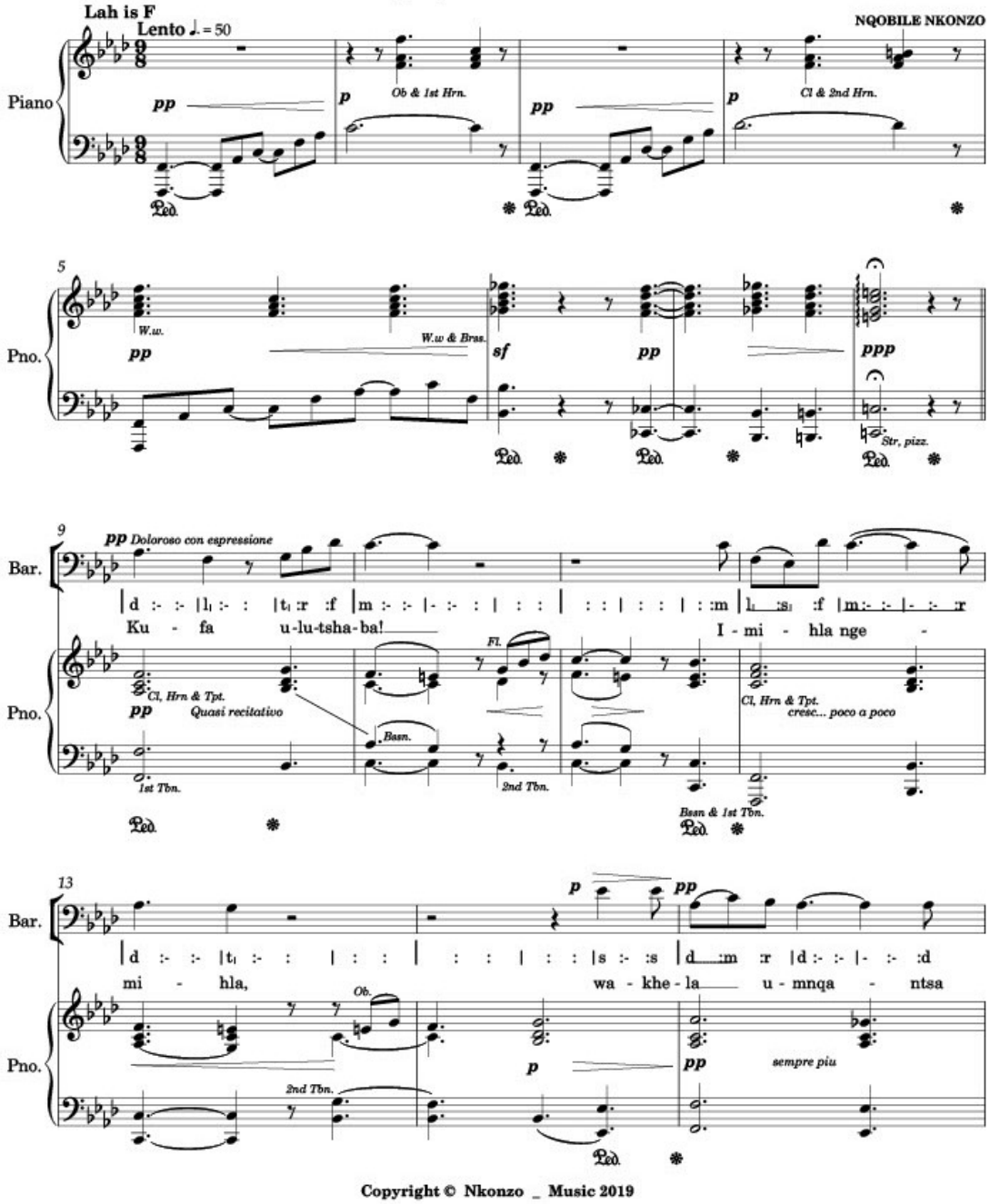

70
a tempo
molto rit.
M. Solo
Ta - rhu Nko - si! Ta - rhu Nko - si! si - hla - mbhe si - be - nyu - lu.
Pno.
Tutti.


74
M. Solo
Ta - rhu Nko-si! si - co - ce si - be msu - lwa.
Pno.
mo.....re.....ndo
Tba.
3
Ped.

Text	Translation
7. Ndakuwubon' umnqamlezo	***7. When I see the cross***
Ndakuwubon' umnqamlezo ekwaxhonywa eyam inkosi, ndoncama yonke inzuzo yam. Ndilidele nekratshi lam. Khawubone owomzimba Aphokwampompoza igazi, wakhe walubona uthando luxubene nosizi?	When I see the cross where my Jesus was hanged, I'll give up all my earnings. I'll give up my pride. Just look at the body where the blood was flowing, have you ever seen love and sorrow?
Ewe! Msindisi wam sithembe lon' igazi lakho. Ewe! Msindisi wethu nguwe usindiso lwethu. Washiya iZulu yena engunyana ka Thixo. Wazincama, walixhwane, wasifela thina boni. Tarhu Nkosi! sihlambe sibenyulu. Tarhu Nkosi! sicoce sibemsulwa.	Yes! My Savior, we trust your blood. Yes! our Savior you are our salvation. He left heaven as God's son. He sacrificed himself, and died for us all. Good Lord! wash us pure. Good Lord! clean us and make us innocent.

5. Aria: KUFA ULUTSHABA

from the *Song Cycle no.1 - Ukumi,* Opus. 010



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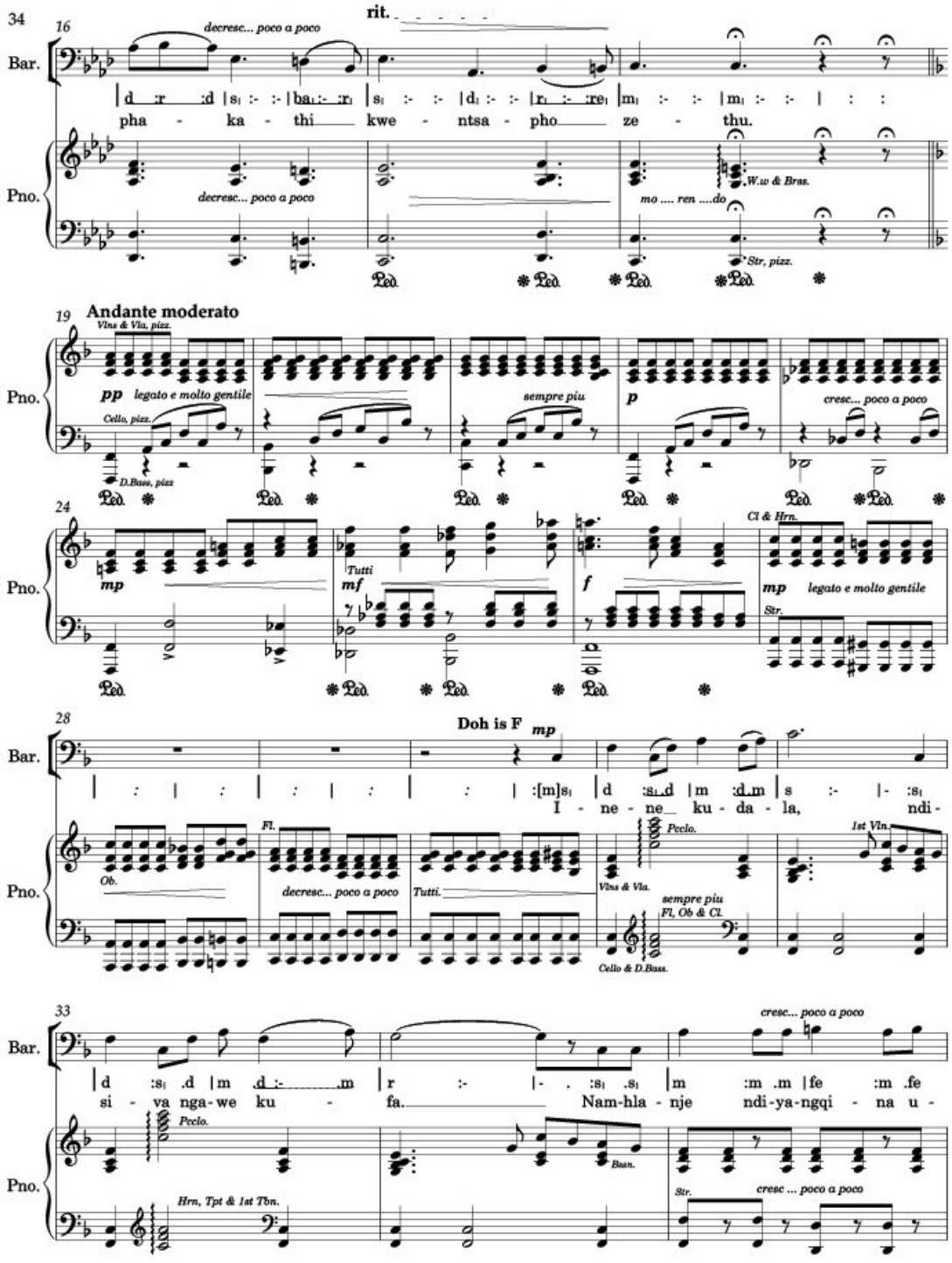
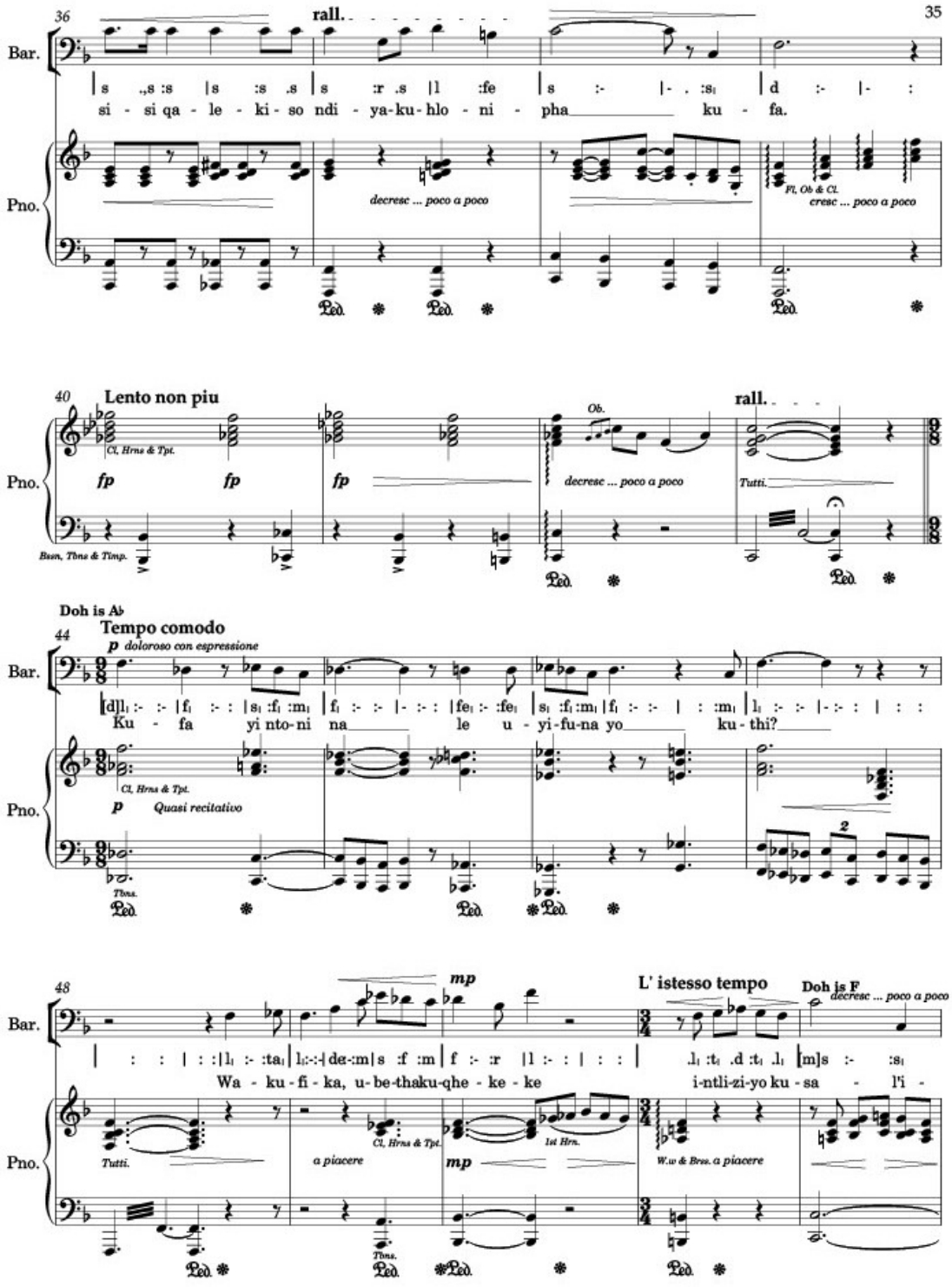
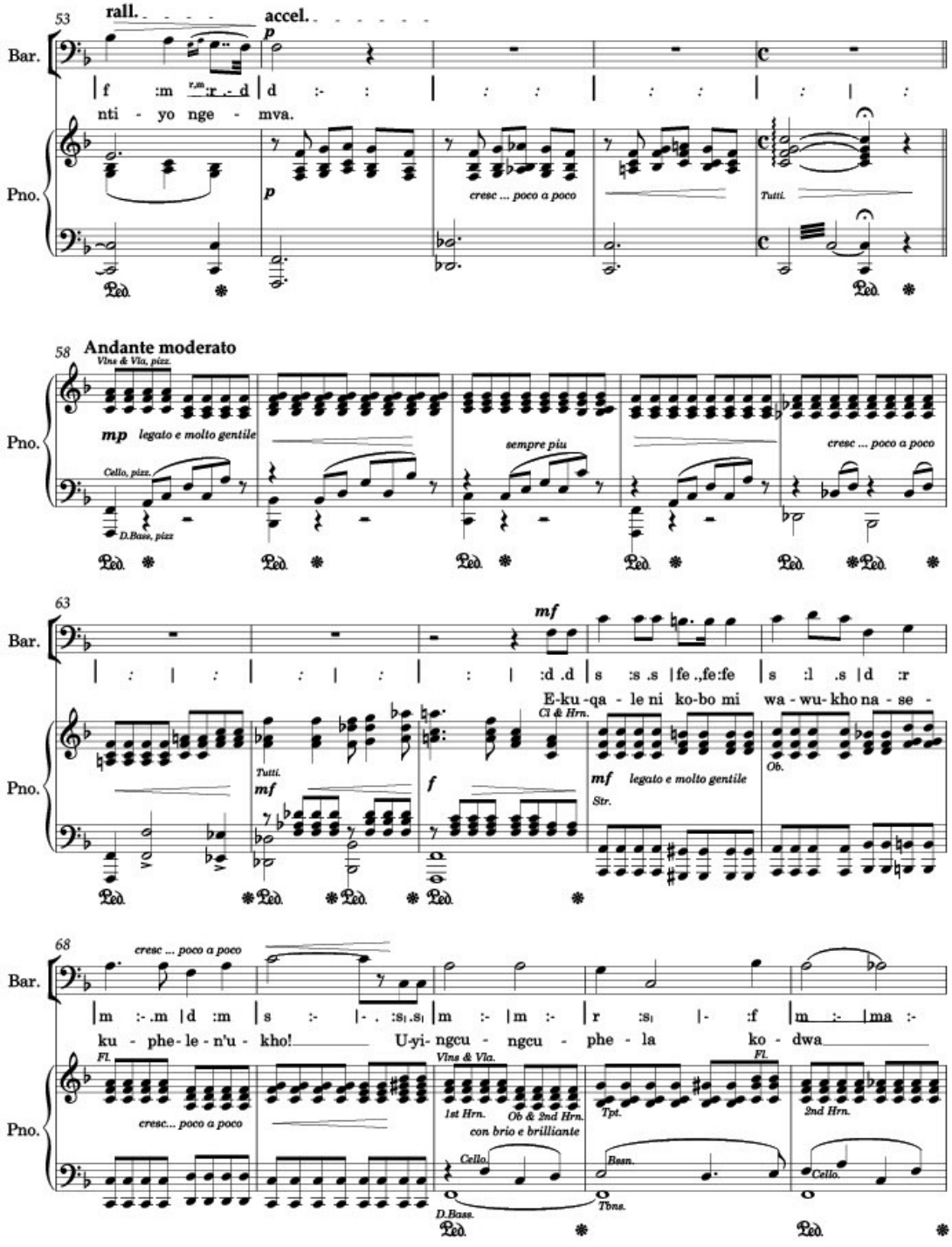
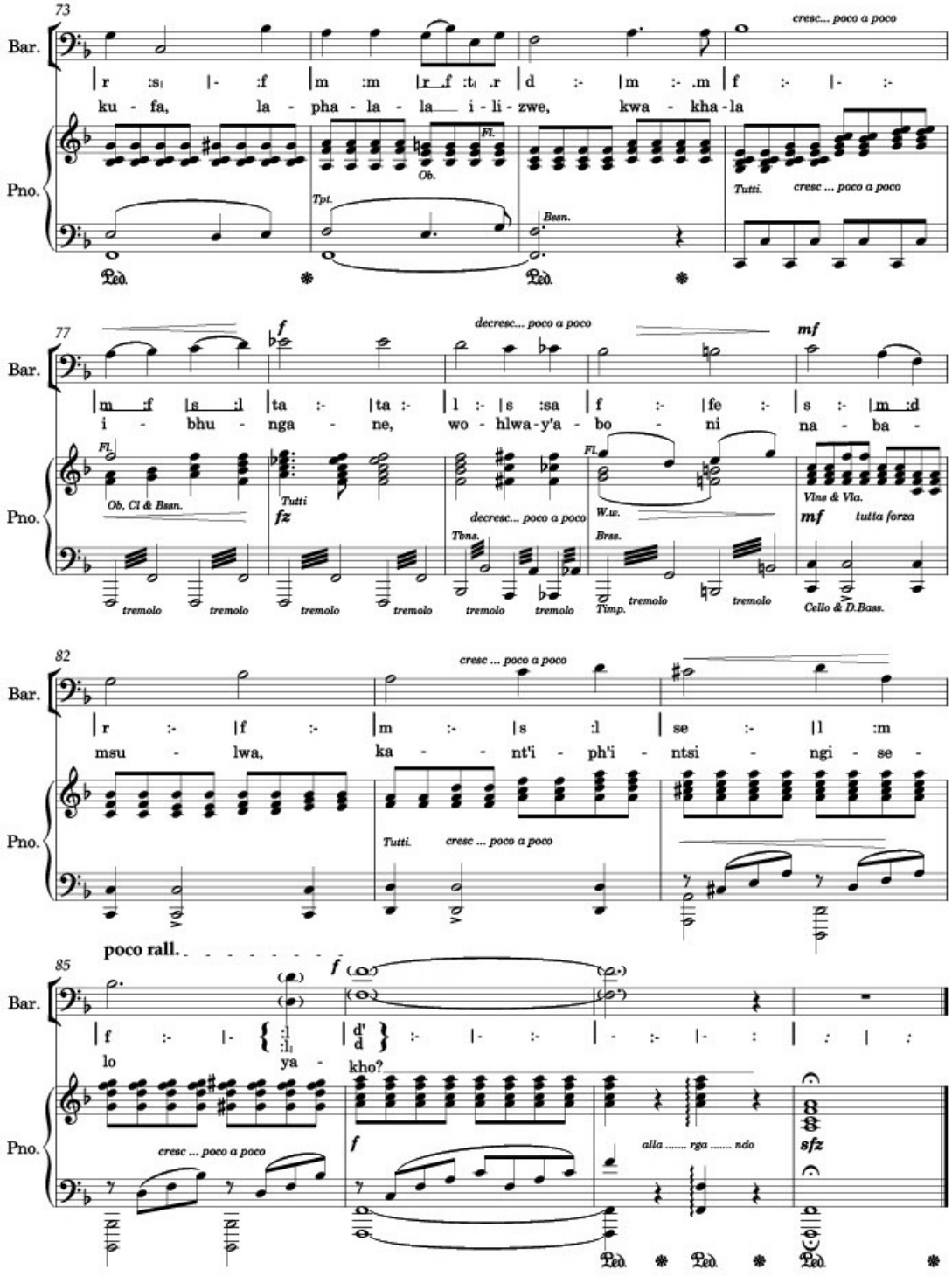

34
16
rit.
decresc... poco a poco
Bar.
pha - ka - thi kwe - ntsa - pho ze - thu.
Pno.
decresc... poco a poco
W.w & Brss.
mo .... ren ....do
Str, pizz.
19
Andante moderato
Vlns & Vla, pizz.
pp legato e molto gentile
Cello, pizz.
D.Bass, pizz
sempre piu
p
cresc... poco a poco
24
mp
Tutti
mf
f
Cl & Hrn.
mp legato e molto gentile
Str.
28
Doh is F
mp
I - ne - ne ku - da - la, ndi-
Fl.
Ob.
decresc... poco a poco
Tutti.
Pcclo.
Vlns & Vla.
sempre piu
Fl, Ob & Cl.
Cello & D.Bass.
1st Vln.
33
cresc... poco a poco
si - va nga - we ku - fa. Nam-hla - nje ndi-ya-ngqi - na u -
Pcclo.
Hrn, Tpt & 1st Tbn.
Bsn.
Str.
cresc ... poco a poco


36
rall.
35
Bar.
si - si qa - le - ki - so ndi - ya-ku-hlo - ni - pha ku - fa.
Pno.
decresc ... poco a poco
Fl, Ob & Cl.
cresc ... poco a poco
40
Lento non piu
Cl, Hrns & Tpt.
fp fp fp
Ob.
decresc ... poco a poco
rall.
Tutti.
Bsns, Tbns & Timp.
Doh is A♭
44
Tempo comodo
p doloroso con espressione
Ku - fa yi nto-ni na le u - yi-fu-na yo ku - thi?
Cl, Hrns & Tpt.
p Quasi recitativo
Tbns.
48
mp
L' istesso tempo
Doh is F
decresc ... poco a poco
Wa - ku - fi - ka, u- be-thaku-qhe - ke - ke i-ntli-zi-yo ku - sa - l'i -
Tutti.
a piacere
Cl, Hrns & Tpt.
1st Hrn.
mp
W.w & Brss. a piacere
Tbns.


53
rall.
accel.
Bar.
Pno.
nti - yo nge - mva.
cresc ... poco a poco
Tutti.
58
Andante moderato
Vlns & Vla, pizz.
mp legato e molto gentile
Cello, pizz.
D.Bass, pizz
sempre più
cresc ... poco a poco
63
mf
E-ku-qa - le ni ko-bo mi wa - wu- kho na - se -
Cl & Hrn.
Tutti.
Ob.
Str.
68
cresc ... poco a poco
ku - phe - le - n'u - kho! U-yi- ngcu - ngcu - phe - la ko - dwa
Fl.
Vlns & Vla.
1st Hrn.
Ob & 2nd Hrn.
con brio e brilliante
Tpt.
2nd Hrn.
Cello.
Basn.
D.Bass.
Tbns.


73
Bar.
Pno.
cresc... poco a poco
r :s, |- :f |m :m |r :t, .r |d :- |m :- .m |f :- |- :-
ku - fa, la - pha - la - la i - li - zwe, kwa - kha - la
Fl.
Ob.
Tpt.
Bsn.
Tutti.
cresc ... poco a poco
77
f
decresc... poco a poco
mf
m :f |s :l |ta :- |ta :- |l :- |s :sa |f :- |fe :- |s :- |m :d
i - bhu - nga - ne, wo - hlwa - y'a - bo - ni na - ba -
Fl.
Ob, Cl & Bsn.
Tutti
fz
decresc... poco a poco
Tbns.
W.w.
Brss.
Timp.
Vlns & Vla.
mf
tutta forza
Cello & D.Bass.
tremolo
82
cresc ... poco a poco
r :- |f :- |m :- |s :l |se :- |l :m
msu - lwa, ka - - nt'i - ph'i - ntsi - ngi - se -
Tutti.
cresc ... poco a poco
poco rall.
85
f
f :- |- :l :l, |d' d :- |- :- |- :- |- : |: |:
lo ya - kho?
cresc ... poco a poco
f
alla ..... rga ..... ndo
sfz

Text	Translation
8. Kufa Ulutshaba	***8. Death you are an enemy***
Kufa ulutshaba! Imihla ngemihla, wakhela umnqantsa, phakathi kwentsapho zethu. Inene kudala, ndisiva ngawe kufa. Namhlanje ndiyangqina usisiqalekiso, ndiyakuhlonipha kufa. Kufa, yintoni nale uyifunayo kuthi? Wakufika ubetha kuqhekeke intliziyo, kusal' intiyo ngemva. Ekuqaleni kobomi wawukhona, sekuphelen'ukho! Uyingcungcuphela kodwa kufa, laphalala ilizwe, kwakhala ibhungane, wohlway'aboni nabamsulwa. Kanti iph' intsingiselo yakho?	Death, you are an enemy! Everyday you leave, a gap between our families. I've heard about you death. Today I agree you are a curse, I respect death. Death, what do you want from us? When you come you break hearts, you leave hatred behind. In the beginning you were there, even in the end you are still here! Death you torment us, you destroy the world, a beetle cried, you punish sinners and saints. What is your meaning?

Recording of arias and songs used for Praat analysis were sung by:

1. Soprano: Amanda Kosi.
2. Mezzo Soprano: Thembeka Khaba
3. Tenor: Zazi Nongalo
4. Baritone: Musa Ngqungwana

The recordings of the music can be requested from the composer. Amanda Kosi has recordings of the soprano pieces and will share upon request.

Appendix G:

IPA Phonetic Representation of three Xhosa Clicks: C, Q, and X

Dental Click IPA symbol: ⟨ǀ⟩

DENTAL CLICKS	PHONETICS REPRESENTATION	XHOSA WORD
C Dental Click	[-]	Cela (Ask)
Nc Nasalized Dental Click	[-&]	Ncuma (Smile)
Ch Aspirated Dental Click	[-î]	Chola (Pick it up)
Gc Voiced Dental Click	[-3]	Gcina (Keep)
Ngc Nasalized Voiced Dental	[-&3]	Ingca (Grass)
Nkc Nasal+Dental Click	[N -]	nkcenkceshela (irrigate)

Alveolar Palatal Click IPA symbol: [!]

ALVEO PALATAL CLICKS	PHONETICS REPRESENTATION	XHOSA WORD
q Palatal Click	[<]	Qala (Start)
nq Nasalized Palatal click	[<&]	Umnqamlezo (The cross)
qh Aspirated Palatal click	[<î]	Iqhiya (Headwrap)

gq Voiced Palatal click	[<3]	Gqiba (Finish)
ngq Nasalised Voiced Palatal click	[<&3]	Ndiyangqina (I agree)
nkq Nasal & Palatal click combination	[N<]	Inkqayi (Bald)

Alveolar Lateral Click IPA symbol: [ǁ]

ALVEOLAR LATERAL CLICKS	PHONETICS REPRESENTATION	XHOSA WORD
x Lateral click	[„]	Ixelegu (Untidy person)
nx Nasalised Lateral click	[„)]	Inxeba (Wound)
xh Aspirated Lateral click	[„î]	Xhela (Slaughter)
gx Voiced Lateral click	[„3]	Gxuma (Jump)
ngx Nasalised Voiced click	[„3)]	Ngxatsho (That's right)
nkx Nasal & Lateral click combination	[N „]	Inkxaso (support)

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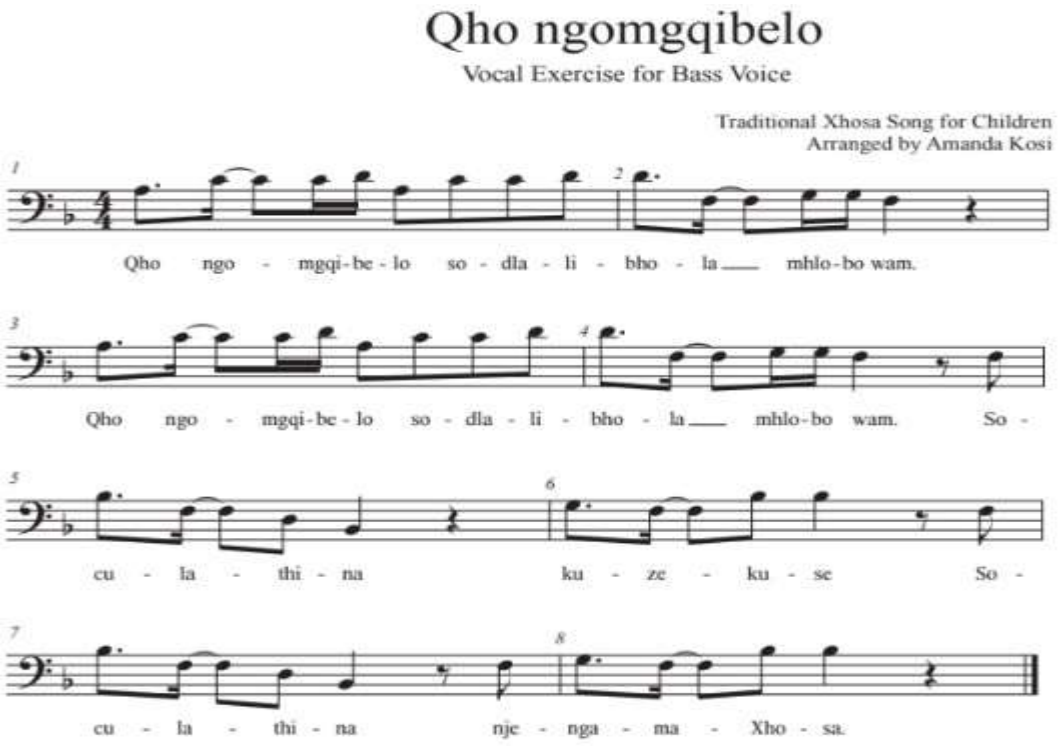
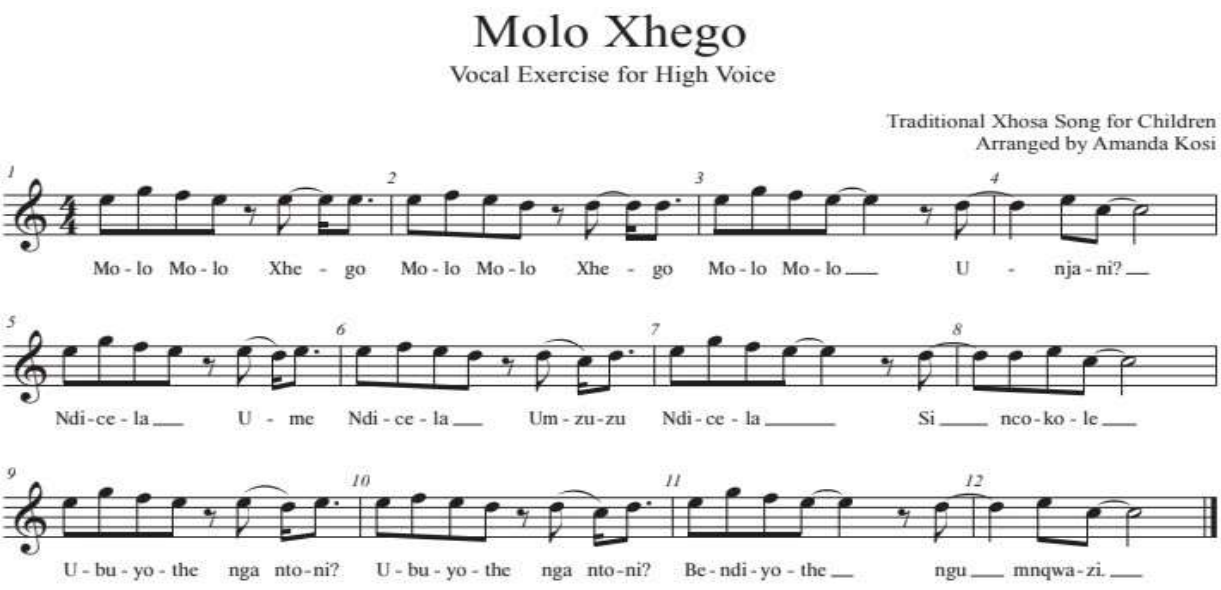
© Ladefoged & Traill (1994:46)

Appendix H:

Recommended Vocal Exercises for High and Low Voices





Appendix I:

Acoustic Analysis

March 19, 2025

1 Acoustic Analysis –

https://www.fon.hum.uva.nl/praat/ to compare the sung and spoken consonents from praat voice reports

- Pitch – perceived highness or lowness of a sound, determined by the frequency of its vibrations
- Jitter – unpleasant distortion or artifact in the sound
- Shimmer – tones of various instruments playing the same note are slightly out of tune
- NHR – measure of the relative energy of noise compared to harmonic components

[1]:
```
from google.colab import drive
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
import numpy as np
from matplotlib import cbook
from scipy.interpolate import make_interp_spline, BSpline
from textwrap import wrap
import os

drive.mount('/content/drive')
%cd "/content/drive/MyDrive/Colab Notebooks (1)/DISC OU/Acoustic Analysis"

# settings
current_dir = os.getcwd()
save_dir = os.path.join(current_dir, r'figs')
save_flg = False
bars_dot = 1 # 0 = bar plots, 1 = dot plots
```

```
Drive already mounted at /content/drive; to attempt to forcibly remount, call
drive.mount("/content/drive", force_remount=True).
/content/drive/MyDrive/Colab Notebooks (1)/DISC OU/acoustic analysis
```

2 Load Dataset

[2]:
```
df = pd.read_excel('praat reports.xlsx', sheet_name='Praat reports - combined')
# df = df.iloc[1:]
df = df.set_index(df['Component'])
df.drop(columns=['Component','Type'], inplace=True)

df.drop(index=['Click consonants','Number of pulses', 'Number of␣
 ↪periods','Number of voice breaks','voice brak duration (sec)'], inplace=True)

components = df.index
# df.head()
print(components)

df.head()
```

```
Index(['Median pitch', 'Mean pitch', 'Standard deviation', 'Minimum pitch',
       'Maximum pitch', 'Mean period (msec)',
       'Standard deviation of period (msec)', 'Total frames',
       'unvoiced frames', 'Fraction of locally unvoiced frames (%)',
       'voice duration (sec)', 'Degree of voice breaks (%)',
       'Jitter (local) (%)', 'Jitter (local, absolute, usec)',
       'Jitter (rap) (%)', 'Jitter (ppq5) (%)', 'Jitter (ddp) (%)',
       'Shimmer (local) (%)', 'Shimmer (local, dB)', 'Shimmer (apq3, %)',
       'Shimmer (apq5, %)', 'Shimmer (apq11, %)', 'Shimmer (dda, %)',
       'Mean autocorrelation', 'Mean noise-to-harmonics ratio',
       'Mean harmonics-to-noise ratio (dB)'],
      dtype='object', name='Component')
```

[2]:

Component	Co SP	Ci SP	Nca SP	Nca SG	Ngcu SP	Ngcu SG	\
Median pitch	243.668	267.917	221.253	221.286	243.259	221.013	
Mean pitch	257.204	258.006	224.938	225.009	235.765	235.342	
Standard deviation	27.86	36.291	17.076	17.172	30.875	50.69	
Minimum pitch	230.276	187.169	180.78	181.784	109.844	141.141	
Maximum pitch	324.121	319.252	311.383	311.341	270.78	394.597	

Component	Xa SP	Xe SP	Xe SG	Xo SP	…	Qhe SP	Qhe SG	\
Median pitch	254.717	228.077	429.343	333.383	…	266.956	261.527	
Mean pitch	263.565	229.069	432.063	332.449	…	266.778	255.558	
Standard deviation	18.497	3.859	20.016	5.52	…	20.963	54.116	
Minimum pitch	243.378	219.02	397.666	321.451	…	200.272	88.832	
Maximum pitch	301.595	241.136	473.121	346.886	…	298.759	349.942	

Component	Nqa SP	Nqa SG	Gqo SP	Gqa SP	Ngqi SP	Ngqi SG	\

```
Median pitch        306.337  585.853  246.621  222.384  230.526  381.963
Mean pitch          307.938  464.167  234.781  246.171  223.778  382.849
Standard deviation   18.01   185.145   33.662   73.607   21.934    39.89
Minimum pitch       256.782   120.67  168.953   103.29  162.165  319.829
Maximum pitch       360.006  602.352  274.234  402.068  258.524  443.844

                  Nkqwi SP Nkqwi SG
Component
Median pitch        273.546  260.159
Mean pitch          259.421  259.604
Standard deviation   28.844     4.76
Minimum pitch       176.684  243.797
Maximum pitch       298.963  276.821

[5 rows x 33 columns]
```

3 Create dictionary for different sounds

[3]:
```
unique_sounds = [col.split()[0] for col in df.columns if "SP" in col]
# print(unique_sounds)

sound_dict = {}

dental_consonants = ["Co", "Ci", "Nca", "Ngcu", "Xa"]
lateral_consonants = ["Xe", "Xo", "Xhe", "Xhwa", "Nxa", "Gxe", "Ngxa"]
palatal_consonants = ["Qa", "Qu", "Qhe", "Nqa", "Gqo", "Gqa", "Ngqi", "Nkqwi"]

for sound in unique_sounds:
  if sound in dental_consonants:
    consonent = "dental"
  elif sound in lateral_consonants:
    consonent = "lateral"
  elif sound in palatal_consonants:
    consonent = "palatal"
  else:
    consonent = " "

  spoken_col = sound + " SP"
  sung_col = sound + " SG"
  if spoken_col in df.columns and sung_col in df.columns:
    sound_dict[sound] = {"spoken": True, "sung": True, "consonent": consonent}
  elif spoken_col in df.columns:
    sound_dict[sound] = {"spoken": True, "sung": False, "consonent": consonent}
  else:
    sound_dict[sound] = {"spoken": False, "sung": False, "consonent": consonent}
```

```
# print(sound_dict)
```

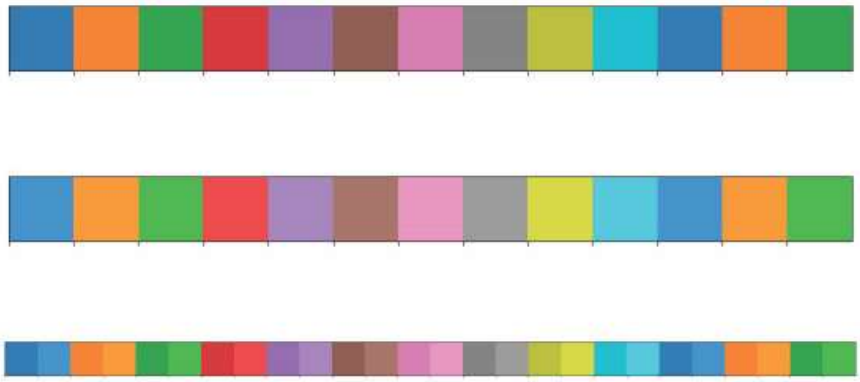
[4]:
```
# print consonants that have both spoken and sung data
both_dict = {key: value for key, value in sound_dict.items() if value["spoken"]
 ==  True and value["sung"] == True }
print(f'Consonents that have both spoken and sung data:\n{both_dict.keys()}')

print(f'\nList of consonents:')
for key in both_dict:
  cols = [col for col in df.columns if key in col]
  print(key, cols)
```

```
Consonents that have both spoken and sung data:
dict_keys(['Nca', 'Ngcu', 'Xe', 'Xo', 'Xhe', 'Nxa', 'Gxe', 'Ngxa', 'Qu', 'Qhe',
'Nqa', 'Ngqi', 'Nkqwi'])

List of consonents:
Nca ['Nca SP', 'Nca SG']
Ngcu ['Ngcu SP', 'Ngcu SG']
Xe ['Xe SP', 'Xe SG']
Xo ['Xo SP', 'Xo SG']
Xhe ['Xhe SP', 'Xhe SG']
Nxa ['Nxa SP', 'Nxa SG']
Gxe ['Gxe SP', 'Gxe SG']
Ngxa ['Ngxa SP', 'Ngxa SG']
Qu ['Qu SP', 'Qu SG']
Qhe ['Qhe SP', 'Qhe SG']
Nqa ['Nqa SP', 'Nqa SG']
Ngqi ['Ngqi SP', 'Ngqi SG']
Nkqwi ['Nkqwi SP', 'Nkqwi SG']
```

4 Create color palettes

[5]:
```
# Create color palettes
colors = sns.color_palette(n_colors=13)
k=0.1
lighter_colors = [(min(c[0] + k, 1), min(c[1] + k, 1), min(c[2] + k, 1)) for c
 in colors]
repeated_colors = [color for pair in zip(colors, lighter_colors) for color in
 pair]

sns.palplot(colors)
plt.show()

sns.palplot(lighter_colors)
plt.show()
```

```
sns.palplot(repeated_colors)
plt.show()
```



5 Plotting functions – (bar plot & dot plots & box plots)

[6]:
```
# plotting functions -- (bar plot & dot plots & box plots)
def find_great(list1, list2):
  count1, count2 = 0, 0
  for i in range(len(list1)):
    if list1[i] > list2[i]:
      count1 += 1
    elif list2[i] > list1[i]:
      count2 += 1
  if count1 > count2:
    return 0
  else:
    return 1

# bar chart
def bar_chart(component, title_str, txt_flg=True):
  comp = df.loc[component]
  spoken_values = [comp[col] for col in df.columns if 'SP' in col and col.
 ↪split()[0] in both_dict]
  sung_values = [comp[col] for col in df.columns if 'SG' in col and col.
 ↪split()[0] in both_dict]
  labels = [col.split()[0] for col in df.columns if 'SP' in col and col.
 ↪split()[0] in both_dict]
```

```
  x = range(len(labels))
  width = 0.35

  fig, ax = plt.subplots(figsize=(12, 4))
  rects1 = ax.bar([i - width/2 for i in x], spoken_values, width, label='SP')
  rects2 = ax.bar([i + width/2 for i in x], sung_values, width, label='SG')

# Add values on top of bars
  for rect in rects1:
    height = rect.get_height()
    if txt_flg: ax.text(rect.get_x() + rect.get_width() / 2, height, f'{height:.
 ↪2f}', ha='center', va='bottom', rotation = 30, fontsize=9)

  for rect in rects2:
    height = rect.get_height()
    if txt_flg: ax.text(rect.get_x() + rect.get_width() / 2, height, f'{height:.
 ↪2f}', ha='center', va='bottom', rotation = 30, fontsize=9)

  ax.set_ylabel(component)
  ax.set_title(f'{component}: {title_str}', wrap = True)
  ax.set_xticks(x)
  ax.set_xticklabels(labels, rotation=45, ha='right')
  ax.legend()

  plt.tight_layout()
  if save_flg:
    filepath = os.path.join(save_dir, f'{component}_bar.png')
    plt.savefig(filepath, format='png')

  plt.show()
  # break

# DOT plot
def make_dot_plot(df, both_dict, col_name, title_str, txt_flg=True):
  comp = df.loc[col_name]
  spoken_values = [comp[col] for col in df.columns if 'SP' in col and col.
 ↪split()[0] in both_dict]
  sung_values = [comp[col] for col in df.columns if 'SG' in col and col.
 ↪split()[0] in both_dict]
  categories = [col.split()[0] for col in df.columns if 'SP' in col and col.
 ↪split()[0] in both_dict]

  # Create the dot plot
  plt.figure(figsize=(8, 6))
  plt.plot(categories, sung_values, 'o', markersize=8, color='blue')
  plt.plot(categories, spoken_values, '*', markersize=8, color='red')
```

```
  great_id = find_great(sung_values, spoken_values)
  if great_id == 0:
    offset_sung = sung_values[0]*0.2
    offset_spoken = -offset_sung
  else:
    offset_sung = -1*sung_values[0]*0.2
    offset_spoken = offset_sung

  # Add values on top of dots
  if txt_flg:
    for i, val in enumerate(sung_values):
      plt.text(categories[i], val+offset_sung, f'{val:.2f}', ha='center',␣
 ↪va='bottom', color = 'blue',fontsize=9)
    for i, val in enumerate(spoken_values):
      plt.text(categories[i], val+offset_spoken, f'{val:.2f}', ha='center',␣
 ↪va='bottom',color = 'red', fontsize=9)

  # Customize the plot
  plt.xlabel('Categories')
  plt.ylabel(f'{col_name}')
  plt.title(f'Dot Plot: {col_name}\n {title_str}', wrap = True)
  plt.grid(axis='y', linestyle='--')
  plt.grid(axis='x', linestyle='--')
  plt.legend(['Sung', 'Spoken'])
  if save_flg:
    filepath = os.path.join(save_dir, f'{col_name}_dot.png')
    plt.savefig(filepath, format='png')
  # Show the plot
  plt.show()

def get_relevant(df, col):
  mdn_val = df[col].loc['Median pitch']
  mean_val = df[col].loc['Mean pitch']
  sd_val = df[col].loc['Standard deviation']
  min_val = df[col].loc['Minimum pitch']
  max_val = df[col].loc['Maximum pitch']
  return mdn_val, mean_val, sd_val, min_val, max_val

def gen_box_data(mean, std, min_val, max_val):
  np.random.seed(42)  # For reproducibility
  data = np.random.normal(loc=mean, scale=std, size=1000)  # 1000 points
  data = np.clip(data, min_val, max_val)
  return data

def get_pitch_relevant(df, col):
  mdn_val, mean_val, sd_val, min_val, max_val = get_relevant(df, col)
  box_data = gen_box_data(mean_val, sd_val, min_val, max_val)
```

```
  return box_data, mean_val

def gen_spline_data(data, power):
  T = np.array(range(len(data)))
  xnew = np.linspace(T.min(), T.max(), 1000)
  spl = make_interp_spline(T, data, k=power)
  power_smooth = spl(xnew)
  return xnew, power_smooth
  # plt.plot(xnew, power_smooth, color='red', marker='o')
  # plt.show()

def get_iqr_vals(df):
  stats_data = cbook.boxplot_stats(df)
  qr1_act = [dat[i] for dat in stats_data for i in ['q1']]
  qr3_act = [dat[i] for dat in stats_data for i in ['q3']]
  qr1_vals, qr1_power = gen_spline_data(qr1_act, 2)
  qr3_vals, qr3_power = gen_spline_data(qr3_act, 2)
  return qr1_vals, qr1_power, qr3_vals, qr3_power, qr1_act, qr3_act

def get_consonent_relevant(df, cols):
  mdn_vals, mean_vals, sd_vals, min_vals, max_vals = [], [], [], [], []
  for col in cols:
    mdn_val, mean_val, sd_val, min_val, max_val = get_relevant(df, col)
    mdn_vals.append(mdn_val)
    mean_vals.append(mean_val)
    sd_vals.append(sd_val)
    min_vals.append(min_val)
    max_vals.append(max_val)
  # agggregate for relevant cols
  mdn_val_consonent = np.median(mdn_vals)
  mean_val_consonent = np.mean(mean_vals)
  sd_val_consonent = np.mean(sd_vals)
  min_val_consonent = np.min(min_vals)
  max_val_consonent = np.max(max_vals)
  # generate box data
  box_data = gen_box_data(mean_val_consonent, sd_val_consonent,␣
 ↪min_val_consonent, max_val_consonent)
  return box_data, mean_val_consonent

def get_consonent_cols(df, dict_name, sound_dict):

  if dict_name == "dental":
    curr_dict = {key: value for key, value in sound_dict.items() if␣
 ↪value["spoken"] == True and value["sung"] == True and value["consonent"] ==␣
 ↪"dental"}
  elif dict_name == "lateral":
```

```
    curr_dict = {key: value for key, value in sound_dict.items() if␣
 ↪value["spoken"] == True and value["sung"] == True and value["consonent"] ==␣
 ↪"lateral"}
  elif dict_name == "palatal":
    curr_dict = {key: value for key, value in sound_dict.items() if␣
 ↪value["spoken"] == True and value["sung"] == True and value["consonent"] ==␣
 ↪"palatal"}

  cols = []
  for key in curr_dict:
    cols.extend([col for col in df.columns if key in col])
  return cols

def gen_consonent_box_data(df, sound_dict):

  dental_cols = get_consonent_cols(df, "dental", sound_dict)
  lateral_cols = get_consonent_cols(df, "lateral", sound_dict)
  palatal_cols = get_consonent_cols(df, "palatal", sound_dict)

  bd_dental, mv_dental = get_consonent_relevant(df, dental_cols)
  bd_lateral, mv_lateral = get_consonent_relevant(df, lateral_cols)
  bd_palatal, mv_palatal = get_consonent_relevant(df, palatal_cols)

  return bd_dental, mv_dental, bd_lateral, mv_lateral, bd_palatal, mv_palatal


def create_save_dir():
  current_directory = os.getcwd()
  final_directory = os.path.join(current_directory, r'figs')
  if not os.path.exists(final_directory):
    os.makedirs(final_directory)
    print('Directory created successfully')
  else:
    print('Directory already exists')


create_save_dir()
```

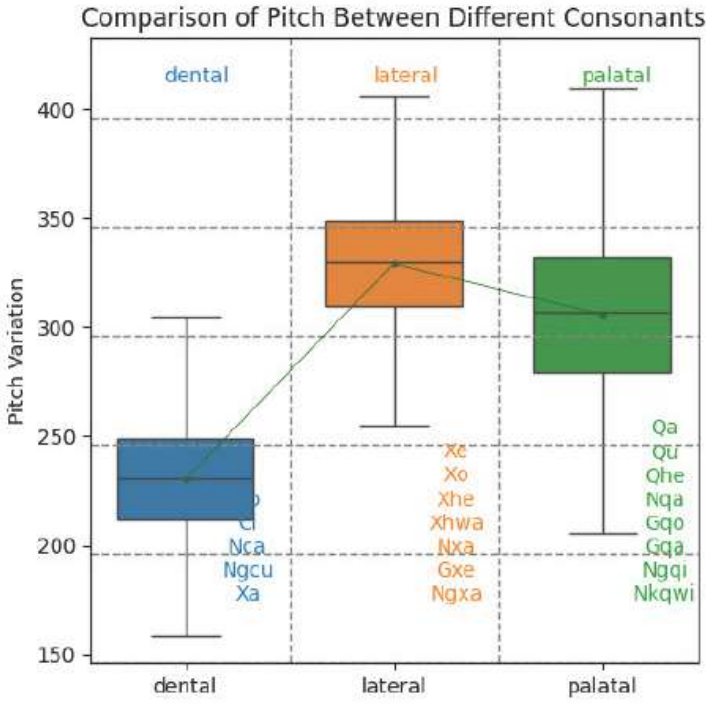
```
Directory already exists
```

6 Plotting the variation between different consonants groups

- Dental
- Lateral
- Palatal

[7]:
```
# Plotting the variation between different groups of consonants (dental,␣
 ↪lateral, palatal)
dental_str = "\n".join(dental_consonants)
lateral_str = "\n".join(lateral_consonants)
palatal_str = "\n".join(palatal_consonants)

data_dental, mean_val_dental, data_lateral, mean_val_lateral, data_palatal,␣
 ↪mean_val_palatal = gen_consonent_box_data(df, sound_dict)
box_data_consonent = pd.DataFrame()
mean_vals_consonent = []

box_data_consonent['dental'] = data_dental
box_data_consonent['lateral'] = data_lateral
box_data_consonent['palatal'] = data_palatal
mean_vals_consonent.append(mean_val_dental)
mean_vals_consonent.append(mean_val_lateral)
mean_vals_consonent.append(mean_val_palatal)

# Create the figure and axis
fig, ax = plt.subplots(figsize=(5, 5))
sns.boxplot(data=box_data_consonent, ax=ax, width=0.65, showfliers=None)
ax2 = ax.twinx()
ax2_indices = np.linspace(0, 2, num=len(mean_vals_consonent))
# ax2.fill_between(ax2_indices, qr1_act, qr3_act, color='gray', alpha=0.4,␣
 ↪label='Shaded Area')
ax2.plot(ax2_indices, mean_vals_consonent, color='darkgreen', marker='o', ms =␣
 ↪2, lw=0.5) # mean line

# set axis
ymin = min(ax.get_ylim()[0], ax2.get_ylim()[0])
ymax = max(ax.get_ylim()[1], ax2.get_ylim()[1])
xmin = min(ax.get_xlim()[0], ax2.get_xlim()[0])
xmax = max(ax.get_xlim()[1], ax2.get_xlim()[1])
ax.set_xlim([xmin, xmax])
ax2.set_xlim([xmin, xmax])
ax.set_ylim([ymin, ymax+10])
ax2.set_ylim([ymin, ymax+10])
ax2.get_yaxis().set_visible(False)

# Add vertical lines and corresponding text labels for dental, lateral, and␣
 ↪palatal
xticks_indices = np.arange(0.5, 3, 1)
xticks_labels = ["dental", "lateral", "palatal"]
for x_loc, x_lbl, clr in zip(xticks_indices, xticks_labels, colors):
    ax.axvline(x=x_loc, color='grey', linestyle='--', linewidth=1)
    ax.text(x_loc-0.6, ymax - 10, x_lbl, color=clr)
```

```
# Plot multi-line text annotations
text_y_offset = 250  # Adjust this value as needed
ax.text(xticks_indices[0]-0.2, ymax - text_y_offset, dental_str,␣
 ↪color=colors[0], ha='center', va='bottom')
ax.text(xticks_indices[1]-0.2, ymax - text_y_offset, lateral_str,␣
 ↪color=colors[1], ha='center', va='bottom')
ax.text(xticks_indices[2]-0.2, ymax - text_y_offset, palatal_str,␣
 ↪color=colors[2], ha='center', va='bottom')

# Add horizontal lines
hlines = np.arange(ymin, ymax, 50)
for iter in hlines:
    ax.axhline(y=iter, color='grey', linestyle='--', linewidth=1)

# Final plot customizations
ax.set_title('Comparison of Pitch Between Different Consonants')
ax.set_ylabel('Pitch Variation')

plt.tight_layout()

if save_flg:
  filepath = os.path.join(save_dir, 'consonant_comparison_groups.png')
  plt.savefig(filepath, format='png')

plt.show()
```

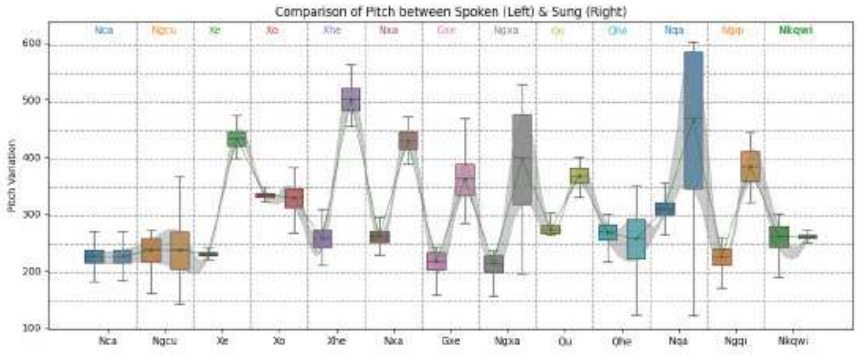


7 Comparison of Pitch between Spoken (Left) & Sung (Right)

[8]:
```
# Comparison of Pitch between Spoken (Left) & Sung (Right)
box_df = pd.DataFrame()
mean_vals = []
# colors = sns.color_palette("Set2", n_colors=13)
# repeated_colors = [x for x in colors for _ in range(2)]

for idx, key in enumerate(both_dict):
    cols = [col for col in df.columns if key in col]
    sp_data,sp_mean = get_pitch_relevant(df, cols[0])
    sg_data,sg_mean = get_pitch_relevant(df, cols[1])
    box_df[f'{key}_sp'] = sp_data
    box_df[f'{key}_sg'] = sg_data
    mean_vals.append(sp_mean)
    mean_vals.append(sg_mean)
```

```
fig, ax = plt.subplots(figsize=(12, 5))
num_xticks = len(both_dict)
sns.boxplot(data=box_df, ax=ax, width=0.65, palette=repeated_colors, showfliers␣
 ↪= None)
qr1_vals, qr1_pwr, qr3_vals, qr3_pwr,qr1_act, qr3_act = get_iqr_vals(box_df)

# # Annotate the min and max values
# act_x_indices = ax.get_xticks()
# for x_loc,y1_loc, y2_loc in zip(act_x_indices, qr1_act,qr3_act):
#   ax.text(x_loc, y1_loc, f"{y1_loc: .0f}", ha='center', va='top')
#   ax.text(x_loc, y2_loc,f"{y2_loc: .0f}", ha='center', va='bottom')

xticks_indices = np.array([0.5,2.5,4.5,6.5,8.5,10.5,12.5,14.5,16.5,18.5,20.5,22.
 ↪5,24.5])
xticks_labels = list(both_dict.keys())
ax.set_xticks(xticks_indices)
ax.set_xticklabels(xticks_labels)
ax.set_title('Comparison of Pitch between Spoken (Left) & Sung (Right)')
ax.set_ylabel('Pitch Variation')

# Add line chart using mean_vals and shaded area (bspline)
ax2 = ax.twinx()

ax2_indices = np.linspace(0, 25, num=len(mean_vals))
ax2.fill_between(qr1_vals, qr1_pwr, qr3_pwr, color='gray', alpha=0.4,␣
 ↪label='Shaded Area')
ax2.plot(ax2_indices, mean_vals, color='darkgreen', marker='o', ms = 2, lw=0.5)␣
 ↪# mean line

# set axis
ymin = min(ax.get_ylim()[0], ax2.get_ylim()[0])
ymax = max(ax.get_ylim()[1], ax2.get_ylim()[1])
xmin = min(ax.get_xlim()[0], ax2.get_xlim()[0])
xmax = max(ax.get_xlim()[1], ax2.get_xlim()[1])
ax.set_xlim([xmin, xmax])
ax2.set_xlim([xmin, xmax])
ax.set_ylim([ymin, ymax+10])
ax2.set_ylim([ymin, ymax+10])
ax2.get_yaxis().set_visible(False)

# add vline and text annotations
xticks_indices =  np.arange(1.5, 24.5, 2)
text_indices = xticks_indices - 1
for x_loc,x_lbl, clr in zip(xticks_indices, xticks_labels,colors):
  ax.axvline(x=x_loc, color='grey', linestyle='--', linewidth=1)
  ax.text(x_loc-1.5, ymax-10, x_lbl, color=clr)
# add hline
```

```
hlines = np.arange(ymin, ymax, 50)
for iter in hlines:
  ax.axhline(y=iter, color='grey', linestyle='--', linewidth=1)

ax.text(xticks_indices[-1]+0.5, ymax-10, xticks_labels[-1], color=colors[-1],␣
 ↪fontweight='bold')

plt.tight_layout()

if save_flg:
  filepath = os.path.join(save_dir, 'comparison_of_pitch.png')
  plt.savefig(filepath, format='png')

plt.show()
```

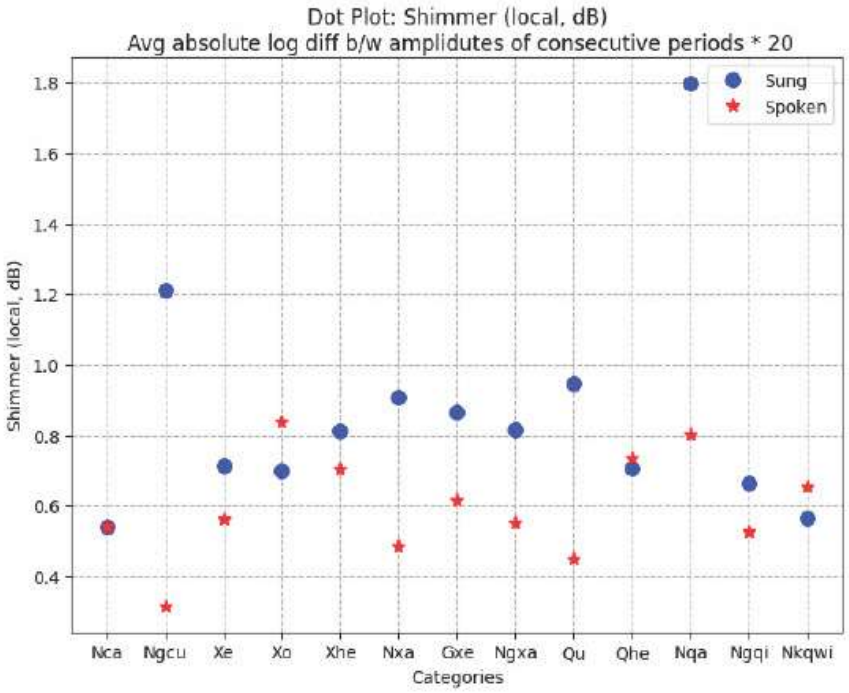


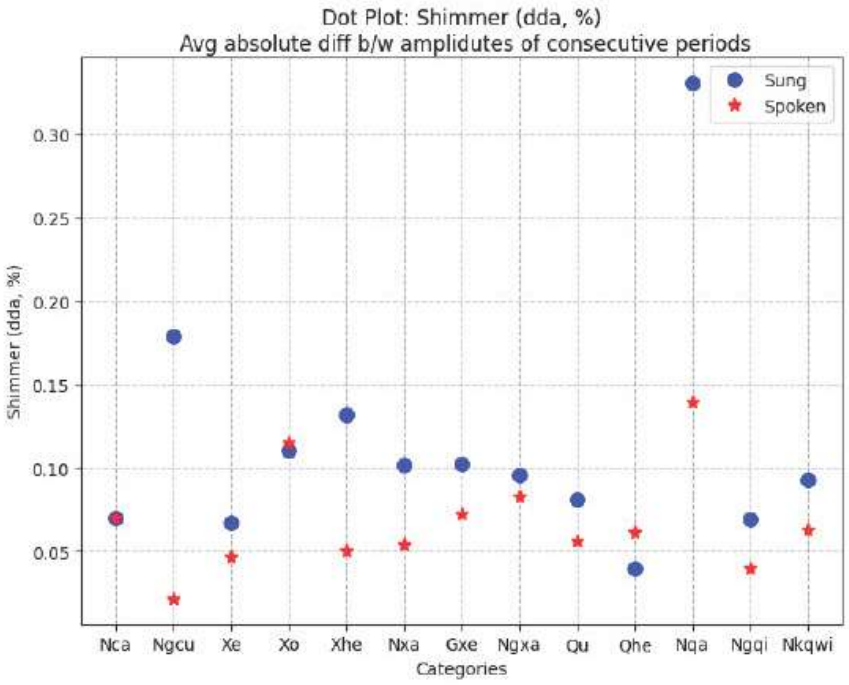
8 Shimmer Analysis –

https://www.fon.hum.uva.nl/praat/manual/Voice_3___Shimmer.html

[9]:
```
# Shimmer Analysis -- https://www.fon.hum.uva.nl/praat/manual/Voice_3__Shimmer.
 ↪html
shimmer_comps = ['Shimmer (local) (%)', 'Shimmer (local, dB)', 'Shimmer (apq3,␣
 ↪%)',
                  'Shimmer (apq5, %)', 'Shimmer (apq11, %)', 'Shimmer (dda, %)']

txt1 = 'Avg absolute log diff b/w amplidutes of consecutive periods * 20'
txt2 = txt = 'Avg absolute diff b/w amplidutes of consecutive periods'

if bars_dot == 0:
  bar_chart(shimmer_comps[1], txt1)
```

```
  bar_chart(shimmer_comps[5], txt2)
else:
  make_dot_plot(df, both_dict, shimmer_comps[1], txt1, 0)
  make_dot_plot(df, both_dict, shimmer_comps[5], txt2, 0)
```



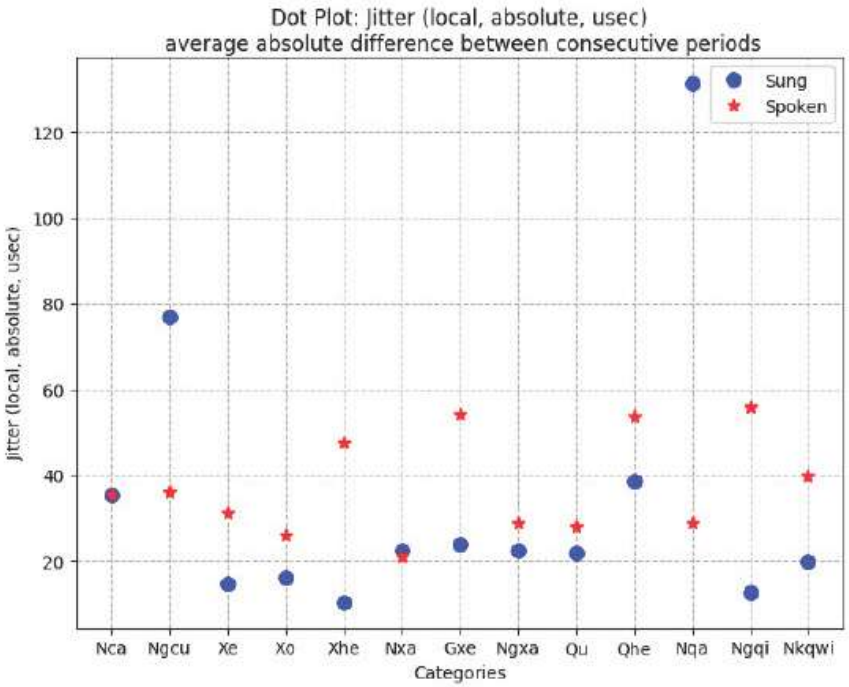


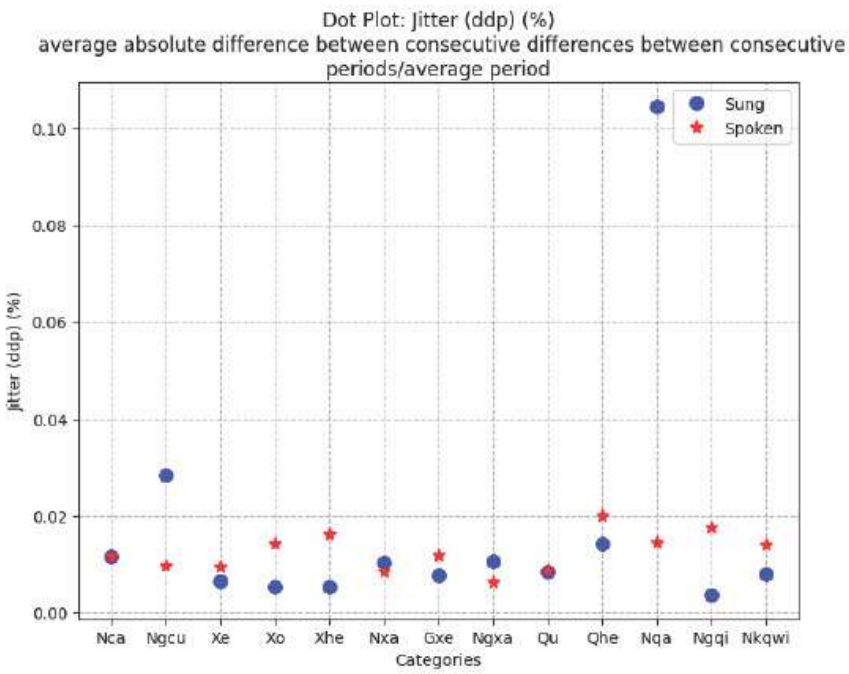
9 Jitter Analysis –

https://www.fon.hum.uva.nl/praat/manual/Voice_2___Jitter.html

[10]:
```
# Jitter Analysis -- https://www.fon.hum.uva.nl/praat/manual/Voice_2__Jitter.
 ↪html
jitter_comps = ['Jitter (local) (%)', 'Jitter (local, absolute, usec)',
               'Jitter (rap) (%)', 'Jitter (ppq5) (%)', 'Jitter (ddp) (%)']

txt1 = 'average absolute difference between consecutive periods'
txt2 = txt = 'average absolute difference between consecutive differences␣
 ↪between consecutive periods/average period'

if bars_dot == 0:
  bar_chart(jitter_comps[1], txt1)
  bar_chart(jitter_comps[4], txt2)
else:
  make_dot_plot(df, both_dict, jitter_comps[1], txt1,0)
```

```
make_dot_plot(df, both_dict, jitter_comps[4], txt2,0)
```

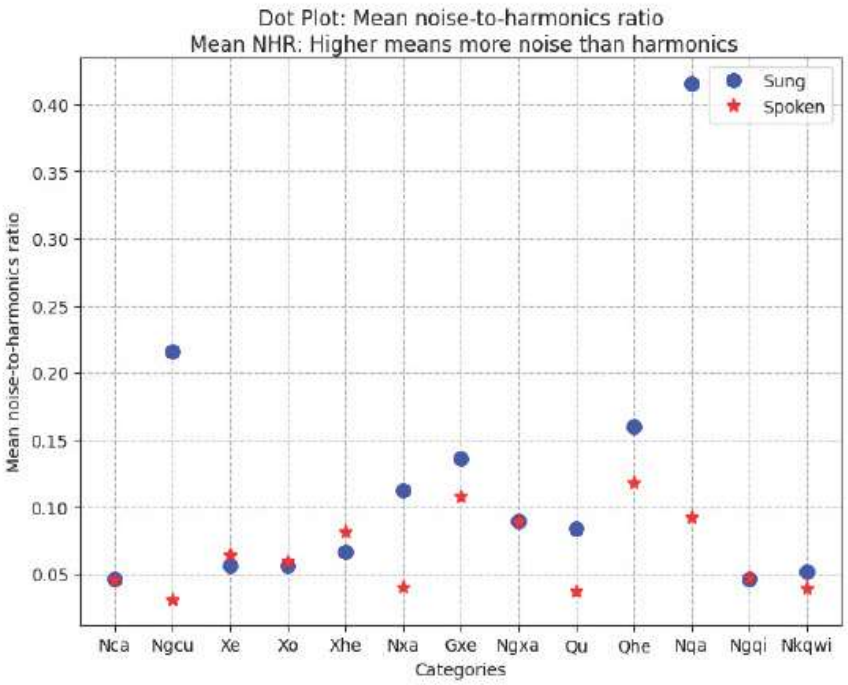


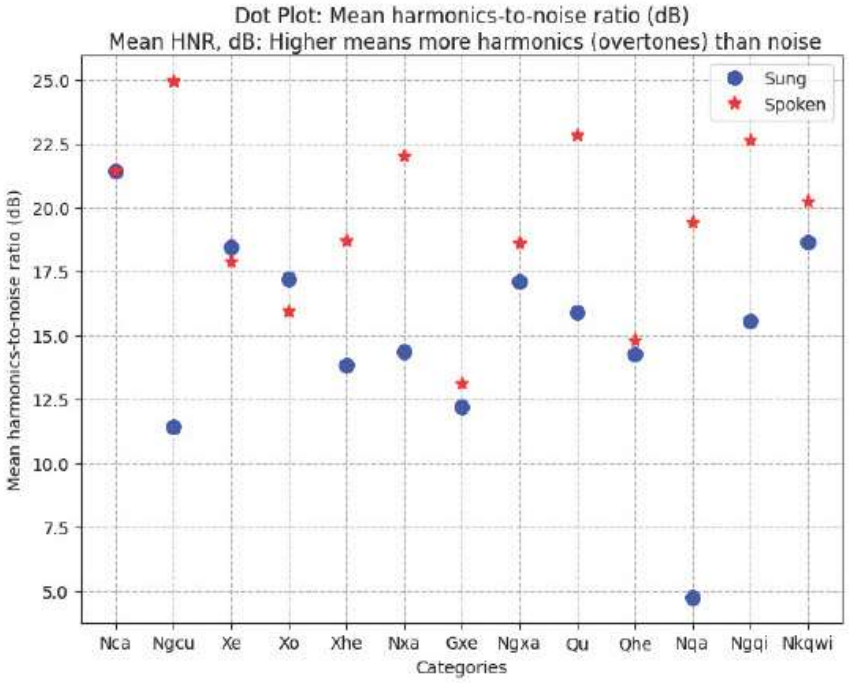


10 NHR Analysis –

https://www.fon.hum.uva.nl/praat/manual/Voice_4___Additive_noise.html

[11]:
```
# NHR Analysis -- https://www.fon.hum.uva.nl/praat/manual/
 ↪Voice_4__Additive_noise.html

nhr_comps = ['Mean noise-to-harmonics ratio', 'Mean harmonics-to-noise ratio␣
 ↪(dB)']

txt1 = 'Mean NHR: Higher means more noise than harmonics'
txt2 = txt = 'Mean HNR, dB: Higher means more harmonics (overtones) than noise'

if bars_dot == 0:
  bar_chart(nhr_comps[0], txt1)
  bar_chart(nhr_comps[1], txt2)
else:
  make_dot_plot(df, both_dict, nhr_comps[0], txt1,0)
  make_dot_plot(df, both_dict, nhr_comps[1], txt2,0)
```


Dot Plot: Mean noise-to-harmonics ratio
Mean NHR: Higher means more noise than harmonics
Sung
Spoken
Mean noise-to-harmonics ratio
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
Nca
Ngcu
Xe
Xo
Xhe
Nxa
Gxe
Ngxa
Qu
Qhe
Nqa
Ngqi
Nkqwi
Categories



11 Export to html

[ ]:
```
!jupyter nbconvert --to html "/content/drive/MyDrive/Colab Notebooks (1)/DISC␣
↪OU/Acoustic Analysis/acoustic_analysis.ipynb"
```

[ ]:
```
!sudo apt-get install texlive-xetex texlive-fonts-recommended␣
↪texlive-plain-generic
!apt-get install pandoc
!jupyter nbconvert --to pdf "/content/drive/MyDrive/Colab Notebooks (1)/DISC OU/
↪Acoustic Analysis/acoustic_analysis.ipynb"
```

```
Reading package lists… Done
Building dependency tree… Done
Reading state information… Done
texlive-fonts-recommended is already the newest version (2021.20220204-1).
texlive-plain-generic is already the newest version (2021.20220204-1).
texlive-xetex is already the newest version (2021.20220204-1).
0 upgraded, 0 newly installed, 0 to remove and 34 not upgraded.
```

```
^C
[NbConvertApp] Converting notebook /content/drive/MyDrive/Colab Notebooks
(1)/DISC OU/Acoustic Analysis/acoustic_analysis.ipynb to pdf
[NbConvertApp] Support files will be in acoustic_analysis_files/
[NbConvertApp] Making directory ./acoustic_analysis_files
[NbConvertApp] Writing 98979 bytes to notebook.tex
[NbConvertApp] Building PDF
[NbConvertApp] Running xelatex 3 times: ['xelatex', 'notebook.tex', '-quiet']
```