Tone in Tihipina (Supana)

Villarreal Moreno, Julen

Universiteit Leiden
The Netherlands

Faculty of Humanities

Tone in TiꞭpꞭna (Supana)

Julen Villarreal Moreno

Student number: s2916525

Co-supervisors: Prof. Emeritus Dr. Maarten Mous, Dr. Bert Botma.

Second reader: Dr. Christian J. Rapold

Academic year 2021-2022

Thesis in partial fulfillment for the degree of

M.A. in Linguistics

Acknowledgements

The process of writing this thesis made me remember the words by Prof. Koen Bostoen during a lecture at Ghent University: "I am an Africanist who happens to be a linguist but, deep down, I am an Africanist". I began writing this thesis in early 2022. I was extremely lucky and honored to be guided initially by my supervisor Prof. Emeritus Dr. Maarten Mous. Before your retirement at the end of the academic year, you gave me on-point advice and guidance for my thesis. I was feeling stressed about the thesis and you helped me greatly in finding a methodology for this work. I also felt that you valued and respected my work, which gave me the necessary security to keep up the research, despite how uncertain working on Tihiṗina tone can be at times. I can tell how we both share a passion for Africa.

I also wanted to express my sincere gratitude to Dr. Bert Botma, who took over the supervision of my thesis during this last semester. Finishing a project is as important as it is to start it. I am very grateful for how you validated my work and how you helped me improve it. Your kind guidance and generous feedback helped me finish this work.

Furthermore, many thanks to Prof. Dr. Yiya Chen, whose fascinating Experimental Phonetics course gave me the inspiration and academic skills for this research. I want to mention Prof. Dr. Roger Blench as well, co-contributor of the Kainji corpus (ELAR), which I used for this thesis. I was honored to be granted permission from you to be the first person to do research using this data.

Lastly, I wanted to mention Yuze Zhang, who did some amazing plots and calculations to help me figure out the interaction between intensity and frequency; and also Oleg Astafyev, who was an excellent classmate and helped me in the process of learning about phonetics.

Table of contents

List of figures

1. Introduction[1]

This thesis gives a preliminary overview of the tonal system in Tihi̱pi̱na (Supana), an endangered Bauchi language of Nigeria. Bauchi (ISO 639-3: bsf) is a language cluster belonging to the Shiroro group of the Kainji languages. The latter is classified within the Benue-Congo branch of the Niger-Congo languages. Tihi̱pi̱na is spoken by a few hundred people in an area southeast of the city of Kagara, in Niger State, even though the location and number of speakers are subject to debate and change. This represents the first attempt to describe tone in Tihi̱pi̱na. There are currently no publications on this language besides a few wordlists.

1.1 Name, location, and linguistic landscape

According to Blench (2019) Tihi̱pi̱na is the autonym, even though this language is better known as Supana. Alternative names and spellings can be found in the literature, but Supana seems to be the most widespread name for this language in academic publications[2]. The case of the term Supana is quite special: it is cited as an exonym given by the Hausa people in McGill (2010a), but is also mentioned to be the name of the only village where Tihi̱pi̱na is spoken (Blench, 2019; Decker *et. al.*, 2021). Tihi̱pi̱na speakers call themselves Ahi̱pi̱na [sg. Vihi̱pi̱na] (Blench, 2019); but McGill (2010a) includes the name Ahi̱pi̱ni instead.

Regarding the location of the Tihi̱pi̱na area, sources differ in two senses: a) the number of Tihi̱pi̱na settlements, and b) their location. On the one hand, regarding the number of settlements, Blench (2019) and Decker *et. al.* (2021) cite only one: Supana town. However, McGill (2010a) identifies nine settlements: Inguwar Ali, Mahanga, Karo, Guli'yaka (a.k.a. Izala), Makuridi̱, Makuridi̱n Langa, Dakaci, Ɗanladi, and Basuna.

On the other hand, with respect to their location, Decker *et. al.* (2021) state that "the location of Supana has not been identified", whereas McGill (2010a) gives the exact geographical coordinates for the village of Inguwar Ali (10°08'23.3"N 6°18'17.5"E)[3], as well as a description of the location: "about five miles southeast of Kagara Rafi LGA, Niger State, Nigeria"[4]. Both the description and the geographical coordinates coincide with a small settlement of 12 to 16 buildings, visible through satellite images. The buildings are grouped into four different compounds, forming what could possibly be four different family units. Approximately 500

1 Some parts of this introduction have been adapted from Villarreal Moreno (2022), an unpublished paper written for the course Diversity Linguistics, which formed part of the MA Linguistics programme of Leiden University.

2 It is also spelled Tuhi̱pi̱na in Blench & McGill (2012) and Tì-hɔ̃pɔ̃ńɔ́ in Blench & McGill (2014: 20). Hi̱pi̱na is mentioned as the main form in Blench (2019) and Blench & McGill (2012), and McGill and Blench use Hapana and Tahapana in the Tihi̱pi̱na corpus on ELAR as well as Hupi̱ni in Blench & McGill (2012) and Hipi̱n in Blench (2018). Decker *et. al.* (2021) and Glottolog use Supana, while Ethnologue uses Supana and includes Hi̱pi̱na, Tihi̱pi̱na, and Vihi̱pi̱na between brackets.

3 Stuart McGill gives the following coordinates: "N 10 degrees 08.389 minutes, E 6 degrees 18.292 minutes". Converting the minutes (which follow a decimal system) to seconds (which follow a sexagesimal system) the result is 10°08'23.3"N, 6°18'17.5"E. There are no geographical coordinates or descriptions of the location of the remaining eight settlements.

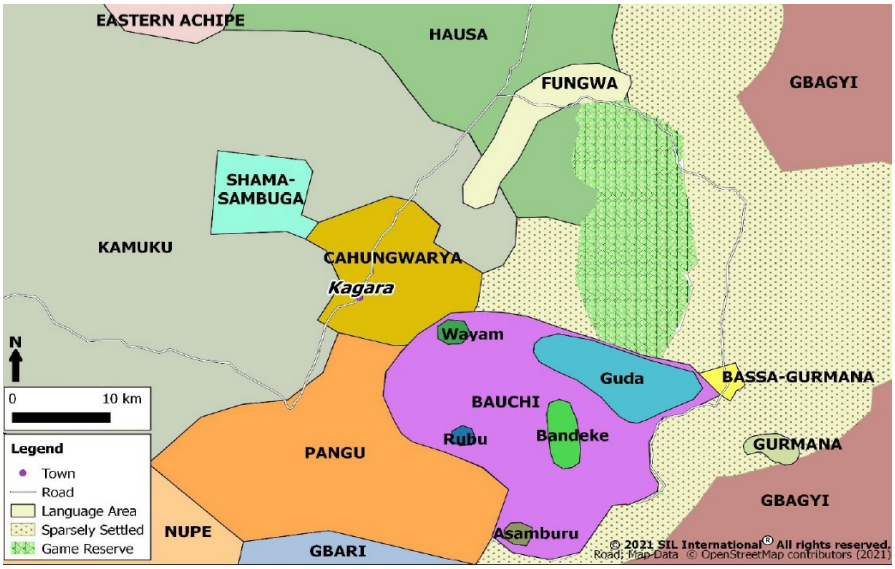
4 LGA stands for local government area.

meters away from this settlement there is a very similar group of buildings. Judging by their relative proximity and the paths that connect them, it is likely that these two settlements form a unit. Regarding the location of the settlements[5], the mismatch in the information is quite striking, more so given that the more recent sources (such as Decker *et. al.*, 2021) overlook the information given in McGill (2010a). There are other five settlements visible through satellite images in a 1.500-meter radius around Inguwar Ali. Four of them are located to the northwest and the remaining one is in the southeast.

The other Bauchi communities are located both in the Rafi and Shiroro Local Government Areas, Niger State, Nigeria (Decker *et. al.*, 2021). Decker *et. al.* (2021) state that "we do not have specific locations for most of the Bauchi communities". Apart from Tiḥipina, the ELAR Kainji corpus contains the geographical coordinates of at least one settlement belonging to every other Bauchi variety in the corpus. Decker *et. al.* (2021) estimate the number of Bauchi communities in "more than fifty-six". As far as the population, Ethnologue estimates an ethnic population of 32.000, while Decker *et. al.* (2021) highlight that it is difficult to know the "portion of the ethnic community that still speaks these languages".

Estimates and data about the number of speakers and the location of the settlements must be read with caution, given the inadequate conditions of the surveys and the turbulent daily life of the Bauchi people. For many years, the Bauchi area has been overrun with banditry and terrorist attacks which involved mass killings, rape, kidnappings, and livestock theft. This has caused the destruction and abandonment of many villages, as people fled their homes to seek safety in cities and refugee camps. As a result, the Bauchi-speaking area has been rendered unattractive

Figure (1), Languages surrounding the Bauchi and Fungwa varieties (Decker *et. al.*, 2021)



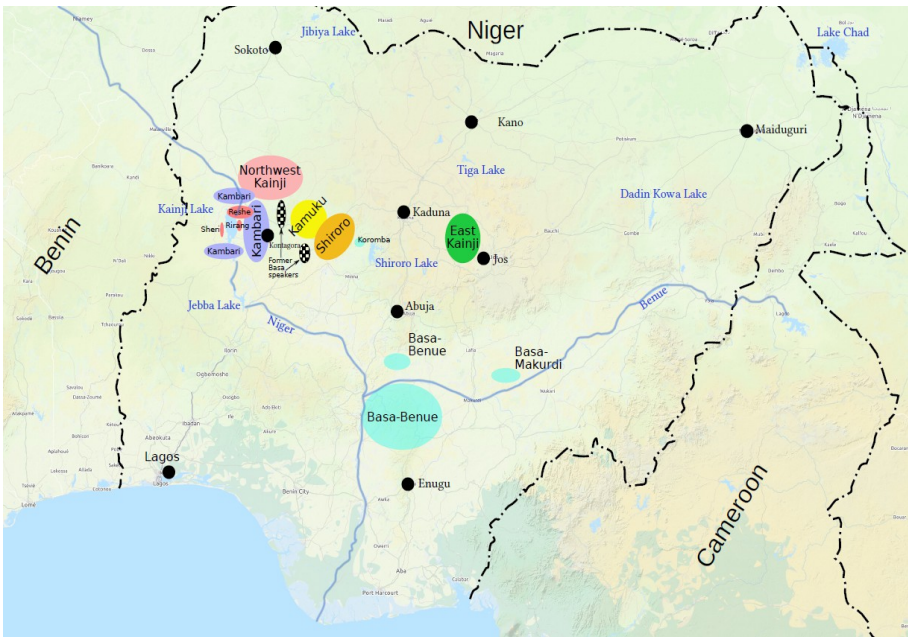
5 It may be that Supana is the ancient or central village of the Tiḥipina speakers, while Inguwar Ali and the other settlements are hamlets of that original "Supana town", whether it still exists or not. However, there is no information to back up this hypothesis.

or inaccessible for fieldworkers, and surveys can only be carried out offsite. For instance, during the 2021 SIL survey (Decker *et. al.*, 2021: 1) "research for the Bauchi varieties was limited to contacts in the refugee camp at Kagara". At the same time, against this background of drastic and profound change, the demographic, sociolinguistic, and geographical data gathered years ago may no longer hold true. Regarding the linguistic landscape, Tihi̶pi̶na is surrounded by a Chahungwarya-speaking area to the north, a Pangu-speaking area to the south and west, and a Bauchi-speaking area to the east. This is illustrated in Figure (1) (taken from Decker *et. al.* (2021).

1.2 Genetic affiliation

A literature review on Kainji languages can be found in Blench (2018). According to Hammarström *et. al.* (2020), the first reference to the Bauchi cluster dates back to a hundred years ago in Temple (1922). Decker *et. al.* (2021) cites Blench & McGill (2012), who classify Tihi̶pi̶na and the other Bauchi languages as Niger-Congo, Atlantic-Congo, Volta-Congo, Benue-Congo, Kainji, Western, Shiroro. In Blench (2019) the node Western is present as well, when Blench classifies Tihi̶pi̶na as "Benue–Congo: Kainji: West: Baushi cluster". This is surprising, given that Figure 10 in Blench & McGill (2012) does not include the node Western Kainji. Moreover, this publication highlights the fact that "[a] structural problem with any synthesis of the Kainji languages relates to the opposition between East and West Kainji". According to the author "[t]he literature has characteristically divided Kainji into these two groups; but the evidence for this is non-existent". Thus, Figure 10 in Blench & McGill (2012) subdivides the Kainji group into three groups (Lake, Northwest, and Central), excluding such dichotomy. Regarding its upper affiliation, the Kainji group belongs to the Central branch of the Benue-Congo languages. In this way, its nearest relatives are the Jukunoid and Plateau groups, which also descend from the Central branch (Williamson 1971; 1989; Williamson & Blench 2000).

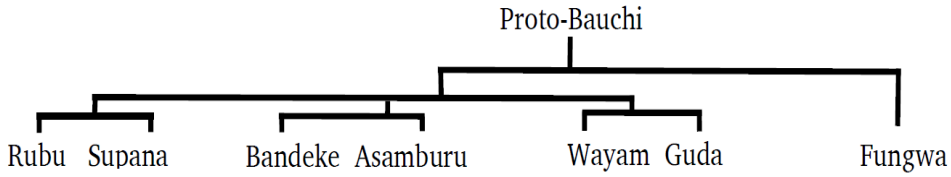
Figure (2). The Kainji languages (Blench, 2012: 4)



There are approximately 80 Kainji languages (Blench, 2018)[6] scattered across five states of western and central Nigeria: Kebbi, Niger, Kaduna, Plateau, and Kogi. Most of the clusters are located in the western Nigerian states (Kebbi and Niger), between the Kainji and Shiroro lakes, while Basa-Benue and East-Kainji constitute an exception, being located about 350 km and 280 km away from the Kainji heartland, respectively. See Figure (2) (Blench, 2012: 4).

The Bauchi cluster is formed by Tiꞑipɨna and five other languages: Mɨn (Guda), Wãyã (Wayam), Ndəkə (Bandeke), Samburu (Asamburu), and Rubu (Decker *et. al.*, 2021: 109). Figure (3), taken from Decker *et. al.* (2021) shows a dendrogram of the Bauchi cluster, following the lexical similarity seen in comparative wordlists. The dendrogram includes Fungwa, which does not belong to the Bauchi cluster, but under a higher node (i.e. Proto-Bauchi). Within Bauchi, Tiꞑipɨna is closer to Rubu than it is to any other variety. Decker *et. al.* (2021) estimate the lexical similarity between Tiꞑipɨna and Rubu at 52–67%. According to McGill (2010a), "there appear to be no dialects of Supana", and Glottolog does not indicate any dialect either.

Figure (3). Dendogram of the Bauchi cluster (Decker *et. al.*, 2021: 26)



From an ethnographic perspective, speakers of Bauchi languages see themselves as belonging to the same ethnic group, sharing a similar culture, and speaking the same language, i.e. Bauchi[7]. The six Bauchi speech communities share a similar history and have all suffered from similar traumatic historical episodes (such as the enslavement by the Fulani in the 19th century); however, despite this shared identity, their languages remain clearly distinct and, according to Decker *et. al.* (2021), should all have different ISO 639-3 codes. Tiꞑipɨna lacks such a code yet because, as mentioned in section 1.1, collecting sufficient data on the language has proven to be challenging (Decker *et. al.*, 2021: 27), while the committee that grants ISO codes requires solid evidence and information about the candidates to grant an ISO 639-3 code.

1.3 Language vitality and status

The language use of the Bauchi varieties has an EGIDS level 6b language vitality, i.e. threatened (Ethnologue). This relatively good vitality rate has attracted the interest of missionary language development initiatives, such as Bible translation projects. Nevertheless, throughout the Kainji group, the tendency towards language shift is becoming stronger, while

6 A previous count resulted in 60 Kainji languages (McGill & Blench, 2012).

7 The term Bauchi is an exonym given by the Hausa (McGill, 2010a). Other names and spellings are Baushi, Bauci, and Kushi (Blench, 2019).

there are "many families (and even whole towns) in which the heritage language is no longer being transmitted intergenerationally" (McGill & Blench, 2012). In this way, speakers of Bauchi languages are shifting to Tarin [i.e. Pangu] (McGill & Blench, 2012) or Hausa (Decker *et. al.*, 2021).

This tendency might be accelerated due to the displacement to cities and refugee camps, where lingua francas are more commonly used in daily life. However, language shift is also happening in the villages themselves, especially in the more accessible ones, where children are said to speak Hausa regularly (Decker *et. al.*, 2021). Comparing the ELDP 2010 survey at Inguwar Ali with the results of the 2021 SIL survey the change of the last decade becomes evident. In 2010, when asked whether they expected the children to speak the vernacular language, the consultants of Inguwar Ali "were convinced that the small children being born now will continue to speak Supana after they are married" (McGill, 2010a). On the contrary, the consultants of the 2021 SIL survey showed "doubts as to whether the children will speak their heritage languages in the future". The lack of institutional support and public presence contributes to the negative prospects for the Bauchi languages. According to Blench & McGill (2012), there is "virtually no teaching of the [*Kainji*] languages in schools and no broadcasts in media such as radio and television". The lack of description and documentation of this and many other Bauchi languages is an additional factor for their lack of linguistic development.

2. Overview of tone

2.1 Overview of tone in Africa

Yip (2002) provides a good introduction to tone in Africa. Tone is a very prevalent feature in African languages of different phyla and the high ratio of tonal to non-tonal languages makes it comparable to East Asia, the other region of tonal study *par excellence*. The Niger-Congo family, to which TiꞭipɨna belongs, has the highest ratio with only a few non-tonal languages. African tonal languages often share a number of characteristics that distinguish Africa from other tonal regions such as East Asia or South America. These features are mainly tonal mobility, the relative smallness of tonal inventories, downstep/downdrift, and polarity.

According to Yip (2002), tone mobility is the most "striking" characteristic of tonal systems in Africa. Tone can easily detach from its source TBU, and "migrate" or spread to other morphemes. Thus, the association between tone and its TBU is not always lexically controlled, and instead obeys phonological needs: e.g. positioning tone in a permanent position even when morphology is added, preventing the location of tone in a specific position, providing toneless morphemes with tone, etc. The phenomenon of tone mobility seems to be linked to or caused by the agglutinative morphology of African languages, which is rare in East Asia. As morphological complexity is added to the stems, the tonal shape of the words can be rearranged accordingly. This is the case in the Chizigula example in (1a). In this Bantu language, the bare stem *lómbez* ('to request') has a H tone in the first syllable. That H tone will migrate to the penultimate syllable every time morphology is added in suffixal position. (1b) shows an example of spreading in the Bantu language Shona (Myers, 1997).

(1) Tone mobility (Yip, 2002; Myers, 1997)

(a)	lombéz	L-H	'to request' (bare root)
	ku-lombéz-a	L-L-H-L	'to request'
	ku-lombez-éz-a	L-L-L-H-L	'to request for'
	ku-lombez-ez-án-a	L-L-L-L-H-L	'to request for each other'
(b)	árí	H-H	'he/she is'
	kugara	L-L-L	'to stay'
	árí kúgara	H-H-H-L-L	'he/she is staying'

Another aspect that differentiates African tonal languages from their East Asian counterparts is the size and nature of the tonal inventories. African languages tend to have smaller tonal inventories, with fewer types of level tones, and contour tones are rare and limited to specific contexts. The most common inventory is a two-level contrast involving H and L tone, contrary to the exuberance of East Asian tonal inventories. In two-way contrast systems, often only the H tone is active, while the L tone is a default tone that is assigned to toneless syllables (i.e. those who do not have a H tone).

Regarding downdrift and downstep, they represent the most common tonal interaction in African languages. They both refer to the same phenomenon, i.e. the lowering of a H tone that is preceded by a low tone. The particularity of downstep is that the L tone is a floating tone, instead of an over L tone as it is the case in downdrift. Other kinds of downsteps include the lowering of a H tone after another H tone, or even the lowering of an L tone. This complicates the initial tonal analysis, as multiple tone levels are realized on the surface. Nevertheless, Yip states that "[t]here are various ways in which downstepped Hs can be distinguished from mid". A typical case of downdrift occurs in Majang (Nilo-Saharan). In the example given in (2a), retrieved from Joswig (2015), the second H is realized at a considerably lower pitch because it is preceded by a L tone. Downstep is very prevalent in the Bamileke dialect Medumba (Cameroon), where a floating L tone makes the following H tone to be realized with a lower frequency. The floating L tone is a tonal remnant of a genitive construction that has been segmentally lost. This is shown in (2b), from Hyman (2003).

(2) Downdrift and downstep (Joswig, 2015; Hyman, 2003)

(a) wɛ́ːŋàríŋ ‘you (PL) breathe’ ¯ _ –

| | |

H L H

(b)

tɨ́	'tree'	¯
mɛ́ŋ	'child'	¯
tɨ́ mɛ́ŋ	'thing of child'	¯ – /tí `mɛ́ŋ/

Finally, polarity consists of a rule whereby affixes and stems always end up having opposite tones. The tone of the affix that attaches to a given stem will be predictable from the tone (or one of the tones) of the stem, and vice versa. This phenomenon is similar to tone spreading in that tones can be predicted from their neighboring tones. A clear example of tone polarity occurs in Bangime (a language isolate of Mali). In order to guarantee that the stem and the plural suffix *-ndɛ* have opposite tones, the tone of the last mora of the singular stem can be changed. (3) shows this phenomenon (retrieved from Hantgan, 2009).

(3) Tone polarity (Hantgan, 2009)

Singular	Plural	Gloss	
dɔ́ɔ̀	dɔ́ɔ́-ndɛ̀	paper	H-L → H-H-L
kúɥɛ̀	kúɥɛ́-ndɛ̀	calabash	H-L → H-H-L
bʊ̀ʊ́	bʊ̀ɔ̀-ndɛ́	field	L-H → L-L-H
kùrɛ̀ɛ	kùrɛ̀ɛ̀-ndɛ́	dog	L-L → L-L-H

2.2 Tone in other Plateau languages

It is very difficult to find grammars of languages located in the closest branch to the Kainji group, i.e. the Plateau languages. A search on Glottolog revealed one single grammar (Migili Grammar; Stofberg, 1978) and a few grammar sketches of some languages belonging to that branch. The description of tone in these documents is rather schematic, sometimes restricted to a single paragraph, and no in-depth analysis of a tonal system was found. Access to the Migili Grammar is restricted but brief tonal descriptions of some Plateau languages are available, namely Mada (mda; Ninzic), Kuche (ruk; Ninzam-Rukuba), Gwara (no ISO 639-3 code; Northwestern Benue-Congo Plateau), Idũ (no ISO 639-3 code; Northwestern Benue-Congo Plateau), Ndun (no ISO 639-3 code; Ndunic), and Shakara (no ISO 639-3 code; Ndunic).
A comparison of the tonal inventories of these languages is given in Figure (4). The green color stands for a tone that is described by the source(s); the grey color refers to a tone whose existence is in dispute by different sources or for which there is not sufficient information; and the red color represents a tone that does not exist or which is not phonemic in the language.

Figure 4. Tonal inventories of some Plateau languages

	Mada	Kuche	Gwara	Idũ	Ndun	Shakara
H						
L						
M						
HL						
LH						

As far as the H and the L tone, according to the sources all of these languages have that contrast. The only nuance to be added here corresponds to the Shakara language. Blench (2006) states that a contrast between H and L exists but "the majority of words appear all low tone". The consensus is broken when it comes to the M tone. It is attested in Mada (Snider, 2020), Gwara (Blench, 2014), and Idũ (Blench, 2009), but its presence is uncertain or in dispute in Kuche (Wilson, 1996), Ndun (Blench, 2007), and it is not attested in Shakara (Blench, 2006) As far as Kuche, Wilson (1996), Hoffmann (1976), and Gerhardt (1982) state that a M tone exists, but Wilson (1996) mentions that "Bouquiaux's data only reflects two tones, high and low".[8] Regarding Ndun, according to Blench (2007) the M tone that seems to occur is conditioned. In fact, it seems to be relegated to the last syllable and it is always preceded by a HL sequence.

Contour tones are not considered to be phonemic in any of these languages, even though the descriptions seem to be quite schematic, as mentioned before. In Mada, a complete mismatch is found in the different sources about the tonal inventory, and the dispute lies particularly in the existence of the contour tones. Price (1989) describes three tonemes: H, L, and M. Samuel (2012) proposes five distinctive tones, namely H, L, M, R, and F. Blench & Kato (2019) agree

8 Any reference to Bouquiaux's publication is absent.

with Price (1989), but Snider (2020) describes four underlying tone patterns in simple monosyllabic noun stems: H, L, M, and Ø.

In the rest of the languages contour tones occur on the surface but are generally described as sequences of level tones rather than as distinctive tonemes. That is the case of Kuche, Gwara, and Idũ, which have "glide tones that arise from sequences of level tones" (Blench, 2014). The only apparent exception for this is Idũ, where some contours "appear to be underlying". In general, contour tones are far less prevalent than level tones and rising tones are especially rare. Falling tones, even if they are underlyingly non-phonemic, turn out to be important in some languages where the loss in morphology has entailed a tonal distinction between the singular and plural form of nouns. This is the case of Gwara and Idũ.

3. Method

3.1 Finding the right methodology

Some of the methodologies outlined in publications about tone description are directed towards the analysis of East Asian tonal languages such as the various Chinese dialects. East Asian tonal languages tend to have a relatively high number of monosyllabic words. The complexity of the suprasegmental information might be possible thanks to the abundance of small morphemes: words tend to be shorter and have a single rhyme. In other words, the tonal systems of East Asian languages tend to be highly complicated (for instance, the Wu dialect Wujiang has 12 contrastive tones), which is compensated by the fact that words tend to be short. A similar phenomenon happens in the Khoe-Kwadi languages, where very strict word phonotactics help accommodate the exuberant phonemic inventory of these click languages (Witzlack-Makarevich & Nakagawa 2019:389).

Publications such as Coupe (2014) draw on a methodology where the initial step is to "work first with monosyllables". In principle, contrary to multisyllabic words, monosyllabic words tend to have a single tone; thus, the interaction between tones can be ruled out when working with monosyllabic words in citation form, which facilitates the process. In fact, as Coupe (2014: 472) points out "[d]isyllables may involve tone sandhi perturbations, which justifies delaying their analysis until the tonal contrasts on monosyllables have been determined". This is a very straightforward methodology but, unfortunately, it cannot be applied to a language like Tihɨpɨna. Monosyllabic words are scarce to say the least in Tihɨpɨna and in Niger-Congo languages generally. Tihɨpɨna is a noun class language, where nouns are generally formed by a monosyllabic prefix and a stem. At the same time, even if a substantial number of monosyllabic words were found in a language like Tihɨpɨna, using them for a description of the tonal contrast might not be a good idea.

In fact, due to historical processes, the prototypical complex noun class systems of Niger-Congo languages are decaying in many Nigerian and Cameroonian languages[9]. Nowadays, the complexity of the noun class system reconstructed for proto-Bantu can be seen in languages like Zulu. Generally, noun class affixes have a specific tone, and when the segments of the noun class prefixes or suffixes are dropped a floating tone can remain. Given that tones cannot be realized without segments, the floating tone may alter the tone of the following tone-bearing unit (e.g. the next syllable). Unusual tone alternations might in fact be an indication of the presence of floating tones.

An example of this is the Nigerian language Mada, a Ninzic (Benue-Congo) language of Nigeria. Noun class morphology used to mark the singular/plural distinction in this language. These prefixes were segmental and also showed a tonal distribution: singular prefixes had a L

9 The most salient case of the presence of floating tones is probably Medʉmba, a Bamileke dialect of Cameroon. Hyman (2003) reconstructed the morphology of the sentence *yú mén* ('thing of child'), and was able to trace it back to the Proto-Bantu sentence **kì-júmà kí-á mù-jánà* ('thing of child') through a thorough analysis of the lost morphology that was reflected in the presence of multiple floating tones.

tone and plural prefixes a H tone. Such morphology is now substantially lost, and many words that used to be composed by a noun class prefix and a stem are now only formed by the stem. However, on the suprasegmental level, the prefixes are still present through floating tones. Thus, the tonal remnants of those plural and singular prefixes interact with the tone of the segmental stem, causing different tonal patterns. In Mada, *kì* means 'thing' and *kī* means 'things'. The underlying stem *-kì* has a L tone, which is unaffected by the singular L floating tone prefix, but is transformed into a M tone when preceded by the singular H floating tone in 'things'. That is why, and especially as long as there is not a description of Tihɨpɨna noun classes, monosyllabic Tihɨpɨna words such as *ba* ('child') and *tʃɛ̃ː* ('ground') must be analysed with caution.

3.2 Hyman's "Stage 1": tone patterns and contrastivity

My primary methodological reference for this thesis is Hyman (2014). The methodology presented by Hyman is adapted to the study of tonal languages of the same region as Tihɨpɨna. In fact, he illustrates this methodology using the case of a Grassroots Bantu language of Cameroon named Oku, a language which is both typologically and genetically close to Tihɨpɨna. Hyman provides a methodology to analyse the tonal system of a language from scratch in three different phases:

a) Stage 1: in this preliminary stage, words are considered in isolation and the goal is "[d]etermining the tonal contrasts and their approximate phonetic allotones".
b) Stage 2: combinations of words are created and a consultant pronounces them. The phrases are analysed in order to check if the findings of the first stage still hold.
c) Stage 3: this last stage involves the analysis itself.

Hyman recommends beginning with a list of nouns and annotating the pitch on "every vowel, and possibly, on every syllabic sonorant consonant". As more words are annotated for tone a consistency test must be carried out, to make sure that different sounds are marked differently and the same sound in the same way. This would ideally involve working alongside a speaker, but that was not possible for this research.

Once a substantial number of words has been annotated for tone, it will become clearer which tones seem to occur in the language. The goal will be to know whether those tones are distinctive or whether their shape can be attributed to other phonological factors. That is, like in any phonological description, it has to be determined whether a given sound is a toneme or an allotone. That is why the goal of Stage 1 is to determine what constitutes a contrasting tone and what constitutes an allotone. Tones that are evenly distributed throughout the word (that is tones that can occur in different positions) as well as tones that can form a wide variety of tonal patterns or sequences with other tones are likely to be contrastive. Once this has been established, Hyman proposes a third and final method to determine whether two tones can be contrastive. This is a test in which two words forming a type of minimal pair are involved. The

words forming the pair must share the same syllable structure and show an almost identical tonal pattern, as they only differ in one tone. When this happens, the differing tones must be considered to be contrastive as "we cannot predict the difference between the two on the basis of syllable structure or anything else". This, however, only constitutes a preliminary phase and the results must be corroborated and then elaborated on in the subsequent stages.

Hyman illustrates the contrastivity test with a case involving the contrast between a low tone and an unreleased low tone in Oku, i.e. L and L˚. The unreleased low tone is the same as the L tone but it does not show the common downgliding before a pause. The words used to illustrate the contrast between L and L˚ are *kàsè˚* 'baskets' and *yìtè* 'to begin'. They share the syllable structure (CVCV) and they both have a L tone in the first syllable. The contrast comes in the second syllable, the word for 'baskets' shows a L˚ tone while the word for 'to begin' has a L tone instead.

3.3 Limitations

It is worth pointing out the limitations of Hyman's method as well as the limitations of my own research. On the one hand, Hyman's contrastive pairs do not take into account the segmental nature of the words, i.e. he does not take into account the potential tone-segment interactions generated especially by consonants in onset and coda positions. For instance, consonants such as [ʧ] and [m] can have a very different effect on the frequency of the first periods of the following vowel. Because of that, I have included some changes to Hyman's method, and I focus on contrastive pairs that have comparable segments.

At the same time, Hyman seems to rule out the possibility of tone dissimilation. In one of the examples included in Hyman (2014) he states that "the change of /H/ to L˚ after L˚ would be a case of assimilation, which is of course more common than dissimilation", assuming that Oku will comply with that general trend. Thus, Hyman's method is applicable to the standard case, where tones assimilate, but is not suitable for rarer cases in which tones dissimilate. On the other hand, the results presented in this thesis are only preliminary. My research has obvious limitations due to the fact that the data come from recordings instead of informants, the impossibility of carrying out fieldwork, and the lack of additional documentation of Tihɨpɨna. Hyman's Stage 2 requires the availability of a language consultant, and thus I can only go as far as completing Stage 1.

3.4 Corpus

The raw linguistic data used for this thesis was retrieved from the "Documentation of Kainji languages" corpus archived on the Endangered Languages Archive (McGill, 2012). That corpus is the result of a documentation project carried out by Stuart McGill and Roger Blench between 2010 and 2012[10]. They traveled through the east and west area of Kainji lake (Nigeria)

10 At that time, Stuart McGill was a postdoctoral fellow at the School of Oriental and African Studies, while Roger

recording mostly wordlists and some oral narratives from a number of local Kainji languages. They documented a total of 19 lects, including Tihi̱pi̱na. At that time, the political unrest and insecurity were already hampering the lives of those living in the area.

The researchers visited the Tihi̱pi̱na-speaking villages in March 2010 and two different wordlists were elicited: the 228-item wordlist and the 700-item one. These lists contain basic vocabulary, mostly nouns and a few verbs. IPA transcriptions of the words as well as translations in English were provided in a different document. Tone was also reflected in the transcriptions, where four distinctions were made: high (˝), low (ˋ), rising (ˆ), and falling (ˇ). For this analysis, I used all the nouns in the 228-item list and about the first 60 nouns in the 700-item list. Following Hyman (2014), I excluded the verbs. This resulted in a sample of 273 words.

3.5 Tone annotation

During the annotation process I relied on two main "tools" to determine the tone quality of each vowel and sonorant: my own ear audition[11] and, to a lesser extent, Praat. I relied mostly on my ear to annotate the words for tone and I used Praat only to double-check for any aberrant annotation. I tried to run consistency tests from the beginning, but this turned out to be impossible due to the interaction between average intensity and average f0, which I elaborate on the following section. I used Praat to note the f0 values of every syllable, marking the f0 value of the 3rd clearly defined period in level tones, and the 2nd and last clearly defined periods in contours, (i.e. HL and LH).

Blench is a Chief Research Officer of the Kay Williamson Educational Foundation, a Research Officer at the Department of History of the University of Jos (Nigeria), and an academic visitor at the McDonald Institute for Archaeological Research (University of Cambridge). He still works extensively in Nigeria.

11 I gained skills in phonetic tonal perception thanks to Yiya Chen's classes at Leiden University and thanks to previous fieldwork in Senegal.

3.6 Intensity affects frequency

Early on, it became evident that an increase in intensity produces a marked increase in frequency. The contour of the pitch track remains the same or very similar, but the register changes substantially. Figure (5) and (6) show how the same word, when pronounced with higher or lower intensity, displays a different register in the pitch track.

Figure 5. Two tokens of the word *rùmɔ̋rʷá* ('hunger'); intensity lines (left) and pitch tracks (right)

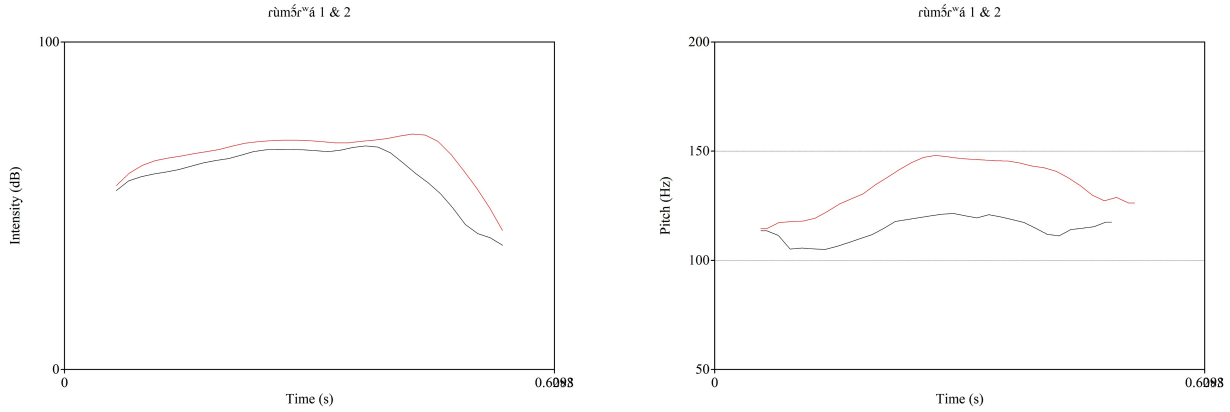
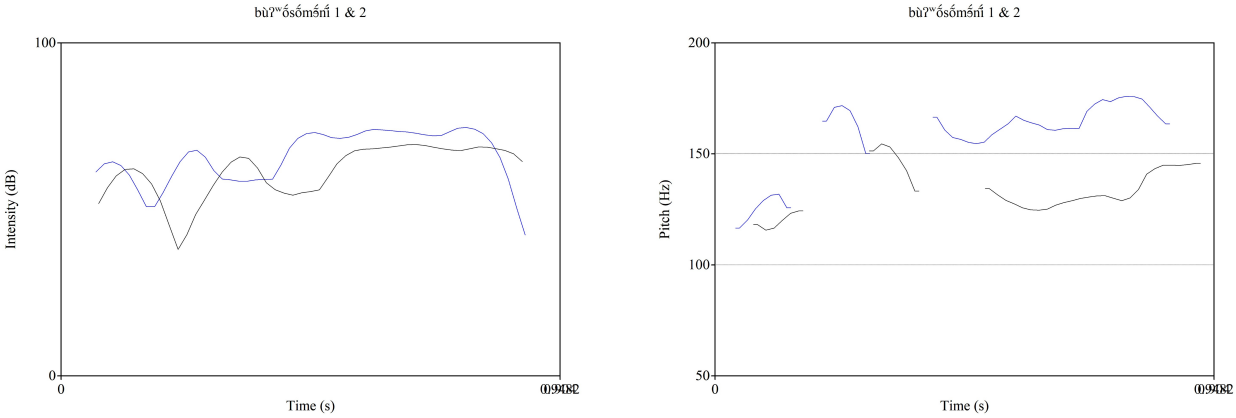


Figure 6. Two tokens of the word *bùʔʷɔ̋ɔ́mɔ̋nɔ́* ('smell'); intensity lines (left) and pitch tracks (right)



The intensity range of the speaker changes from some parts of the elicitation to others. There are moments where the mood of the elicitation room is more relaxed and others where it is more agitated, which affects the intensity of the speaker. He sometimes even goes over 70 dB. Thus, it was necessary to figure out whether the interaction between intensity and frequency was in fact regular in Tihi̱pi̱na. Otherwise, I might assign two sounds the same tone when they might only be the same on the surface (due to a difference in the dB values of the respective words)

but different underlyingly. This seems to be the case. For instance, I annotated both the word *tágà* ('food') and the word *á:ɾò̰* ('mortar') as H-L. Thus, the first syllable in 'food' and the first syllable in 'mortar' are both H tones. Nevertheless, the average frequency of the first syllable in *tágà* ('food') is 144 Hz, while that of the first syllable in *á:ɾò̰* ('mortar') is 105 Hz. At the same time, the average intensity of the first syllable in *tágà* ('food') is 74 dB, whereas that of the first syllable in *á:ɾò̰* ('mortar') is 66 dB.

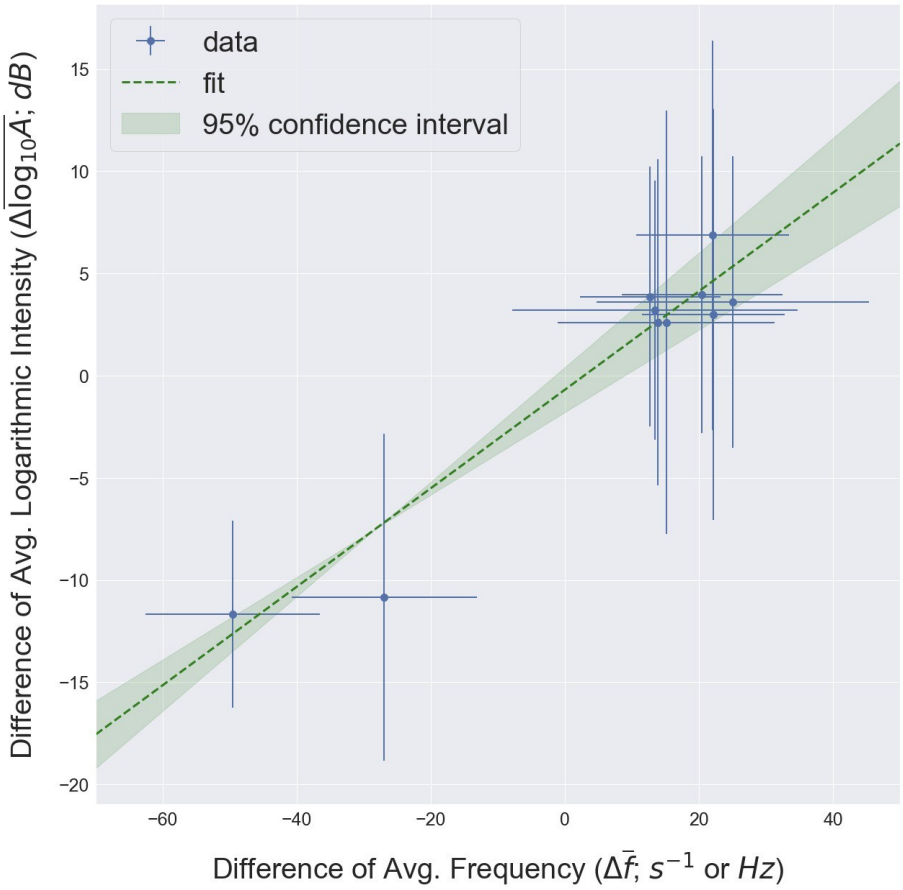
In order to know if this was a general trend, I gathered a sample of 10 pairs of identical words (i.e. 10 types, two tokens each) where each token of the pair was pronounced with a significantly different intensity. I extracted the f0 and dB values of the words using a Praat script and Yuze Zhang, MSc Astrophysics (sp. Cosmology) student at Leiden University, plotted the data on Python to find out whether there exists a discernible and constant correlation between the f0 and the dB values. The plot is given in Figure (7).

For each word, there are two different sets of data, each with a list of frequency and intensity (log scale) measured at different times of the audio file. Within a single word, there does not appear to be any correlation between frequency change and intensity change. Yuze Zhang took the average value of the frequency and intensity for each pronunciation of the word and took the difference between the average frequencies and the average intensities:

$$\Delta Frequency = Mean\ Frequency\ 1 - Mean\ Frequency\ 2$$
$$\Delta Intensity = Mean\ Intensity\ 1 - Mean\ Intensity\ 2$$

The corresponding error bars were calculated, too. Change in frequency was plotted against the change in intensity with the error bars. This is what is shown in the plot. Each point in the plot corresponds to a pair of two tokens of the same type. The green line is a linear fit (the best approximated linear relation between the intensity and frequency change). The green shadowed region is the 95% confidence interval of the fit (95% chance that the linear relation will fall into the shadowed region).

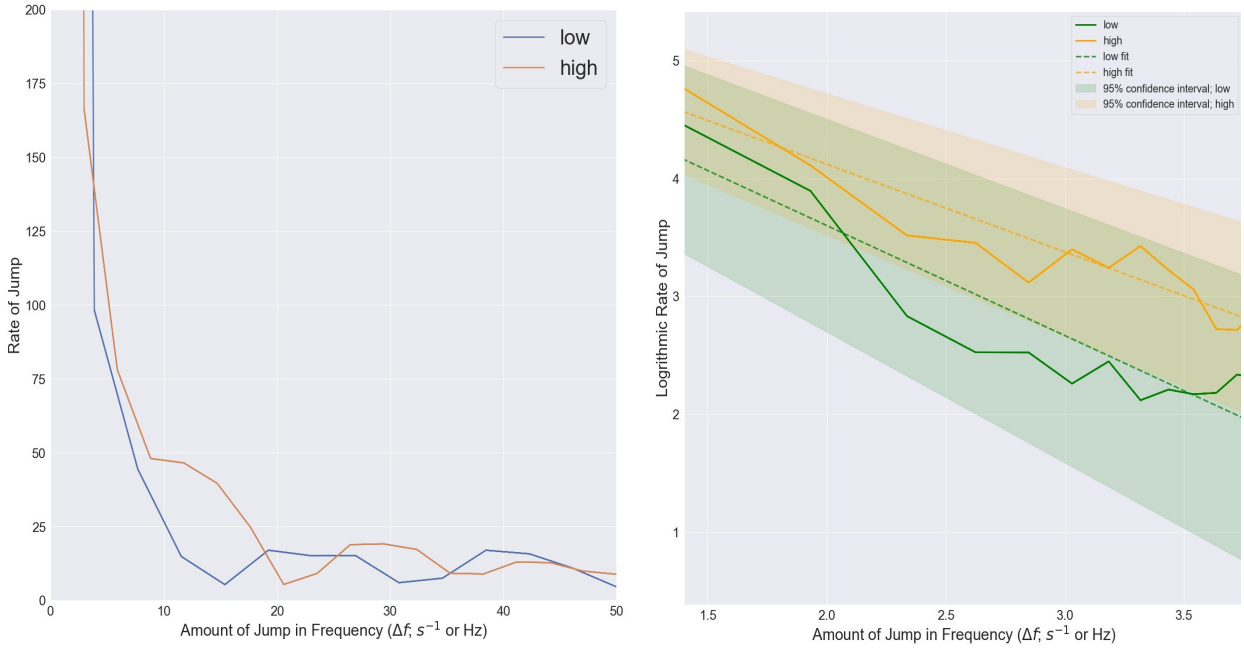
Figure (7). Frequency shift vs. Logarithmic intensity shift



The points on the positive side of the plot, i.e. those located close to the top right corner, show that an increase in average intensity causes an increase in average frequency. The remaining two points are located in the opposite corner of the plot, the negative area. This shows that a decrease in the average intensity causes a decrease in the average frequency. The points around the top right corner are pairs of tokens where the second token was realized with a higher intensity. On the contrary, the points in the negative area belong to pairs of tokens where the second token was pronounced with a lower intensity.

Another problem that I encountered was that it was very hard to tell the tones of words that are pronounced with very low intensity. Using the f0 and dB data of multiple word pairs (two tokens of the same type in each pair), Yuze Zhang carried out a series of Fourier transforms to shed some light on this phenomenon. A general pattern was observed in all those pairs of words, which is illustrated by a particular example: the word *pʲánǎ* ('moon') in Figure (8). A Gaussian plot was carried out to double-check the results (Figure 8).

Figure 8. Fourier transform (left) and Gaussian plot (right) of word *pi̍ánā̍*



The plots confirmed my observations: the token that was pronounced with a lower intensity had a smaller pitch range than the one realized with a higher intensity. The plot shows how in the word with the higher intensity more and bigger pitch jumps occur. On the contrary, the token that is pronounced with a lower intensity shows fewer and smaller changes in pitch. Therefore, this means that it will be harder to tell a H and a L tone apart in words that are pronounced with low intensity which, in turn, makes tone annotation more difficult as different tones sound more similar.

The results given in the linear plot (7) and the Fourier transform (8) clearly point that there is a correlation between average intensity and frequency, as well as an effect of average intensity on pitch range. However, as clear as these results might seem, they are in direct dispute with studies such as Koffi (2020). The author of the latter publication includes the following reflection (Koffi, 2020: 10): "Intensity and frequency are two important acoustic correlates [...] It has been claimed falsely that an increase in one translates automatically into an increase in the other". Surprisingly, the contrary is true for Tihi̍pi̍na.

3.7 Annotating tone in relative terms

The data in figures (7) and (8) is very revealing of the interaction between the intensity and the frequency in Tihɨpɨna. The results of plot (7) showed that an increase in average frequency can be predicted by an increase in average intensity. At the same time, plot (8) demonstrated that a higher intensity entails a bigger frequency range, which means that the distance in frequency between two tones is more significant in tokens with a high average intensity and less significant in tokens with a lower average intensity. Thus, only words with identical (or very similar) average intensity values are comparable. It is possible to group words according to their average intensity but this would add an additional segmentation to an already limited word sample. That is, if words were to be grouped according to their intensity, a tentative estimate is that there would be about 40 words per group. This is a very small sample to draw conclusions from. For instance, words with the same average intensity could be grouped to determine whether there is a mid-tone (M), i.e. a distinctive tone whose average frequency does not fall in the category of a H tone nor a L tone (assuming that those exist) and which is found in between those. However, with a sample as small as 40 words, it is unlikely that the hypothetical M tone will occur in enough contexts and will be part of sufficient tonal patterns as to have solid evidence for the existence of a separate mid tone, in addition to a high and a low tone. Finding a near-minimal pair within that sample would also be more complicated than within a larger sample, thus complicating the possibility of demonstrating contrastivity.

This is further complicated by the fact that in the world's languages segments might have an effect on intensity, which is shown by a series of studies. For instance, according to Ladefoged and Maddieson (1998: 259) clicks have very high intensity, at least 6 dB over other segments. Therefore, it seems that words need to have similar segments in order to be compared in terms of tone. That, however, would make the potential sample even smaller, as words should not only have a similar intensity but also comparable segments. The biggest sample of words complying with these criteria that I could retrieve from the wordlist is composed of only three words.

So, as words are not comparable to each other, one of the steps to determine correctness in annotation cannot be done: the consistency test, whereby one checks the words that have been assigned the same tone, to determine whether tones that sound the same have been assigned to the same category and those that do not sound the same have been assigned to different categories.

It also means that there will be no such thing as a tone in absolute terms. That is, it cannot be established that a given tone occurs only between two specific frequency rates. It becomes evident that comparisons across words are not possible for tone annotation. Having no possibility to identify absolute tone categories corresponding to specific f0 values, I decided to annotate tone according to what can be observed internally in each word. That is, for each polysyllabic word, I compared each tone-bearing unit (the syllable in this case) to the other tone-bearing units. Therefore, tones were annotated relatively and not in absolute terms. I called this relative reference. Cross-speaker variation in tone realization means that tone is always

relative. Anatomic variety (especially larynx size) results in differences in f0 between different speakers. Nevertheless, the relative nature of tone goes beyond cross-speaker variety in Tihi̵pi̵na, as the difference in average intensity of the different words in the sample make them non-comparable, even though they are produced by the same speaker.

4. Results

Intuitively, five different tones can be perceived in the data, namely H, L, M, HL, and LH. The categories HL and LH are equivalent to falling tone (F) and rising tone (R) respectively. Nevertheless, there is only sufficient evidence for the existence of two tones, that is the H tone and the L tone. The other tones can be explained otherwise, or do not comply with the criteria presented above regarding their distribution, pattern formation and contrastivity. When going through this section, the limitations of the available data and the existing methodological challenges shall be taken into account but, based on the available data, the evidence to posit the presence of a H tone and a L tone is as solid as it can be. Moreover, the closest thing to a minimal pair in the data shows a contrast between the H and the L tones. This is the case of the words *suwa* ('dogs') which shows a L-H pattern, and *sũwã* ('mosquitoes') which instead has a H-L pattern.

The tone-bearing unit in Tihɨpɨna seems to be the mora. Following the criteria in Yip (2002), the segment can be ruled out as the TBU. There are tone-bearing syllabic nasals in Tihɨpɨna (some of them are prefixes) but there are onset nasal and prenasalised consonants that do not bear any tone. For instance, in a word like *ŋkʷɔ̃rĩ̃* ('buttocks', plural) the onset syllabic nasal bears a H tone, but there is no tone in the onset of the word *mɛ̃rĩ̃ŋgɘ* ('urine'). Following Hyman's (2014) methodology, I annotated the pitch of every nasal consonant, but I then realized that only some of them have tone. If the segment is ruled out as the TBU, then the remaining candidates are the syllable and the mora. According to Yip (2002), if a language has both mono-moraic and bi-moraic syllables, and the latter can take more than one tone while the former can only take one, then the TBU must be the mora. On the contrary, if syllables with varying number of moras can bear the same number of tones, then the syllable is the TBU.

Initially, also following Hyman (2014), I took the syllable as the default or preliminary TBU. However, the analysis of the contour tones seems to reveal that the mora is a more likely candidate. In fact, contour tones are prevalent in cases that involve long vowels and nasal geminates. As explained in section 4.2, contour tones do not seem to be contrastive and positing the mora as the TBU helps explain how the contour tones are formed by the combination of underlying level tones (H and L).

4.1 High tone and low tone

As mentioned before, tone is especially relative in Tihɨpɨna, due to the drastic interaction between the average dB and f0 values. Therefore, the pitch height of the H tone is variable and it is not linked to a specific f0 value or range. In fact, the frequency of the H tone can vary greatly from word to word, and it is even the case that certain instances of H tones are lower in f0 than certain L tones are. In this way, the highest H tone in the data is found in the word ('food', H-H). The syllable *ta-* in this word tágà ('food') is a H tone and its rhyme has an average f0 of 171 Hz. On the contrary, the rhyme of the lowest H tone has an average f0 of 99 Hz and it

corresponds to the syllable *a-* in the word *aːtɘ* ('humans', H-L). The same goes for the L tone, which can be as low as 85 Hz in the word *azuba* ('sky', H-L-L), but also higher than many H tones in words like *ʃiɾi* ('black', H-L), where the average f0 of the rhyme of the *-ri* syllable is 137 Hz.

Regarding the distribution of the H tone, it occurs both in the prefix and the stem. Nominal prefixes in Tihɨpɨna seem to form a system of noun classification and they can be H or L. The prefixes mark a distinction between the singular and the plural form of a noun. The stem is preserved and the prefix determines number. Prefixes seem to have been dropped (at least on the segmental level) in some of the singular/ plural pairs in the wordlist.

In pairs of words where both the singular and the plural prefix are present the prefixes have the same tone even though the prefix have different segments. Thus, a distinction such as the one in Mada, where singular prefixes have a L tone and plural prefixes a H tone, is not present in the Tihɨpɨna data. Instead, some pairs of words have a L tone prefix and some have a H tone prefix. In Tihɨpɨna there exist six different types of singular/ plural pairings. The first type consists of a pairing in which both words have different CV or V prefixes; in the second one both words have what seems to be different C prefixes; in the third one the singular noun seems unmarked and the plural one keeps the plural prefix; in the fourth one the plural noun is unmarked for prefix and the singular noun keeps it; in the fifth type the only difference between the singular and plural forms is an additional consonant at the beginning of the singular form; and the sixth type consists of the same as the fourth type but the plural form is the one that has the extra onset consonant. In the last two the initial consonant might be the remnant of a previous CV prefix. An additional type is formed via suppletion, in pairs of words such as *bibʷaːɾo* ('horn') / *ihʲɛ̃* ('horns'). Examples are given in (4).

(4) Types of noun class pairings.

·Type 1	biɾʲaːɾo	star	L-H-L	·Type 4	biʔəmbəsə	stool	L-H-H-H
	nɾʲaːɾo	stars	L-H-L		ʔəmbəsə	stools	H-H-H
·Type 2	ɾiʔiɾa	arrow	H-H-L	·Type 5	biːju	goat	L-H
	siʔiɾa	arrows	H-H-L		iːjuː	goats	L-H
·Type 3	ŋgəŋgədə	root	H-L-L-L	·Type 6	ũwã	mosquito	H-L
	aŋgəŋgədə	roots	H-L-L-L		sũwã	mosquitoes	H-L

In each of these pairs where (segmental) prefixes are still present, all of them show a H or a L tone. In type 1, both the singular and the plural prefixes show the same tone, whether H or L. There are only two exceptions for this: *ɾusʷaːbi* ('liver', L-HL-L) / *asʷaːbi* ('livers', H-H-L), and *biʔʷobi* ('navel', L-H-H) / *nʔʷobi* ('navels', H-H-H). Other than that, the prefixes always share the same tone, and the distribution between H tone pairs and L tone pairs is almost evenly distributed: among the first type of pairings 56% have L tones and 44% have H tones. On the

contrary, among the words belonging to the third and fourth types, the L tone prefixes are more common than the H tone ones. Examples of the different types of prefixes and noun class pairs are given in (5).

(5) L tone and H tone noun class prefixes and pairings

atʃeːgu	axe	L-H-L	iɾoːɾo	neck	H-L-L
sətʃeːgu	axes	L-H-L	nɾoːɾo	necks	H-L-L
opɔ̃	bone	H-L	hʷaːsu	knife	H-L
aʔõpɔ̃	bones	H-H-L	suhʷaːsu	knifes	L-H-L

The H tone is also present in all positions in the word and the stem as there seems not to be any limit to its distribution. H tones can be found in initial, medial and final position. In trisyllabic stems, H tones can also occur in all three positions. Examples are given in (6).

(6) H tones in different positions

ʔada	father	H-L	bikəɾibi	sheep (sg)	L-H-L-L
mahĩː	blood	L-H	bindoːʃeːpa	fish (sg)	L-H-L-H
ɔgʷɛɾe	tortoise	L-H-L	ibʲakatũ	animals	L-H-H-H

Regarding the tonal patterns, the H tone is present in many different combinations, and the results indicate that it exists. In particular, regarding the combinations involving solely the H tone and the L tone, almost all possible combinations are attested. Following Hyman's methodology, words were arranged according to their number of syllables. Among the words with two syllables, all the possible combinations involving a H tone are attested, except for one: the M-H pattern. As far as the other ones, the most common bitonal pattern was H-L. In fact, almost half of the bisyllabic words in the Tiһiрina wordlist show a H-L pattern, which makes 37 instances. The second and third most common patterns in this group are respectively L-H (16 words) and H-H (13 words). Among the trisyllabic words, the statistically higher number of possible combinations makes things more complicated. Predictably, the amount of attested possible patterns involving a H tone decreases substantially, from 85% among the bisyllabic words to 57% among the trisyllabic ones. This is both linked to the limited number of words in the wordlist and to the small number of attested instances of tones other than H and L, i.e. M, HL, and LH.

The most common trisyllabic patterns are, by decreasing order, L-H-H, H-H-L, L-H-L, L-L-H, and H-L-L. The pattern L-H-H is by far the most prevalent: 37 % of the trisyllabic words have these patterns, that is 50 of the 136 words. The prevalence of the other more-common patterns is on average 10% each. The most notable absence among the trisyllabic patterns involving H tones is probably the H-L-H pattern which, even though it is attested, only accounts for one

example: *βumãɾĩ* ('round'). Interestingly, its mirrored pattern, L-H-L, is represented by no fewer than 15 words.

As far as quadrisyllabic words, the amount of examples is much smaller. The vast majority of the possible patterns are unattested, even the ones involving only the H and the L tones. There are some patterns that presumably exist in Tihɨpɨna but are not present in the data: H-H-H-L, H-H-L-H, L-L-H-L, etc. The most prevalent pattern is L-H-L-L and accounts for only seven words that seem to share a common adjectival morpheme *una-*. Some of these words are *unag^{w}ontu* ('short'), *unãndʒɛkɛ* ('small'), and *unaʔ^{w}atu* ('big'). Other attested quadrisyllabic patterns are among others L-H-H-H, L-L-H-H, and H-L-L-L. Examples of bisyllabic, trisyllabic, and quadrisyllabic words are given in (7).

(7) Bisyllabic, trisyllabic, and quadrisyllabic words

pʲanã	moon	H-L	ugiːwa	elephant	L-H-H
atãˀ	five	L-H	ik^{w}õɾĩ	buttocks (sg)	H-H-L
k^{w}ija	chicken	H-H	ɔg^{w}ɛɾe	tortoise	L-H-L
nʔ^{w}ãɾãɾã	heels	L-H-L-L	amɔːsəbə	breasts	L-L-H-H

Across the different patterns, H tones can occur before and after a wide variety of tones. H tones occur before and after one, two, or three consecutive H tones, before a sequence of one or two L tones, and before a HL tone. They also occur after one, two, or three consecutive L tones, before a M tone and before a HL tone. H tones are not attested after a succession of three L tones, nor after a M tone.

The L tone, like the H tone, must be defined in relative rather than absolute terms, due to the interaction between intensity and frequency. Thus L tones come in different pitch heights and, as mentioned before, some L tones can be higher than some H tones that occur in words with low intensity rates. Like the H tones, L tones are both present in the prefix and the stem. In prefixes, L tones and H tones are in complementary distribution.

As far as the tonal patterns are concerned, one additional remark that can be made is that two monotonal patterns are attested for the H tone, but not for the L tone: H-H and H-H-H. Their L tone counterparts L-L and L-L-L are surprisingly not found in the corpus. This is surprising for two main reasons. On the one hand, there are a total of 50 monotonal L patterns in stems (both in monosyllabic and bisyllabic roots) and L tone prefixes are the most prevalent. However, for some reason, those L prefixes do not combine with the L stems, as monotonal L stems are always prefixed by H tone prefixes or are simply unprefixed. On the other hand, this contrasts with the H tones, which form a total of 21 H-H words, many of them composed by a prefix and a stem. So, it seems that the L stems in Tihɨpɨna are an example of tonal polarity, but this phenomenon does not seem to affect the H tone stems.

Thus, L tones occur before and after many different tones, but not as many as the H tones. L tones are attested before and after a sequence of one or two H tones, after a HL tone, and before a succession of three H tones. Like the H tones, L tones cannot follow an M tone, which in fact seems to be generally relegated to the final position and mostly combines with the H tone.

Both the H tone and the L tone occur in all sorts of contexts and are part of the formation of a wide array of patterns. In addition to this, these tones comply with the main criterion for contrastivity, i.e. the occurrence of multiple segmental and syllable structure pairs that differ in one contrasting tone. In Hyman's (2014) methodology the contrastive pairs are pairs of words that share the exact same syllable structure and that differ in one tone. That proves that the differing tone is contrastive in respect to the other, as "we cannot predict the difference between the two on the basis of syllable structure or anything else" (Hyman, 2014: 543).

I needed to adapt this rule to the specificity of Tihɨpɨna, where segments are to be taken into account, given that they have an effect on both frequency and intensity and this can have a twofold blurring effect on the tonal analysis: on the one hand, segments affect frequency directly (e.g. contrary to a bilabial nasal consonant, an onset fricative can substantially increase the f0 of the first periods of the following vowel) and, on the other hand, the intrinsic properties of segments can affect sonority and intensity, the latter having a very significant effect on average frequency. Thus, the pairs that are presented here as proof of contrastivity do not only share the same syllable structure but also have comparable segments.

Together with the results regarding the distribution and the pattern formation, the results of the contrastivity pairs clearly point towards the fact that there exists a H and a L tone in Tihɨpɨna. In fact, there is a substantial amount of contrastive pairs across several syllable structures. The H and L tones contrast with each other and also with other tones, such as the HL tone. Examples of contrastive pairs between the H tone and the L tone are given in (8)

(8) H vs. L contrastive pairs

aɾʷa	pestles	H-L	aʔə	women	H-H
aɾa	hand	H-H	ogã	drum	L-H
βətə	dust	H-H	taːɾi	stone	H-L
bikə	beans	L-H	ɗɛɾi	one hundred	H-H
atʃabi	ears	L-H-H	uʃəwə	rainy season	L-H-H
ataːpi	palms	L-L-H	utʃigi	full	L-L-H
suhʲafu	crocodiles	L-H-H			
suhʷaːsu	knifes	L-H-L			

4.2 Contour tones: HL and LH

While we can be reasonably sure that the H and the L tone exist, the issue is less clear for the other tones. The most salient of these tones is perhaps the HL tone. Even though there exist a number of syllables showing a falling contour, the HL tone rates very low in terms of distribution, pattern formation, and contrastivity. Regarding the distribution of the HL tone, it is generally relegated to the final position in multisyllabic words. In fact, more than two thirds of the falling tones occur in final position, and only four words include a HL tone in initial or medial position. As far as pattern formation, only a very small number of the potential patterns featuring a falling tone are attested. The highest percentage is found among bisyllabic words, where almost half of the patterns featuring a HL tone are represented by at least one word.

HL tones are not only scarce, restricted to a certain distribution, and present in a very low number of patterns, but also seem to occur in very specific contexts sharing a number of phonological characteristics. As a consequence, the falling contours can be explained in an alternative way that rules out the possibility of considering them contrastive. The contexts where HL tones occur are marked by a variety of factors that include tone-segment interaction and citation form effects, which, especially when combined, produce a falling contour on the pitch track.

Most of the syllables where a HL is present have at least one of the following elements: they occur in long vowels, there is a diphthong including a high vowel pronounced as a glide, and the syllable onset is a fricative, affricate, or voiceless obstruent. Generally, more than one of these factors are present in the same syllable. Additionally, a number of falling contours are located before a phrasal-level L tone. In many cases, the same syllable shows various of these factors simultaneously, in words such as *ũhʷɛ̃* ('sun', H-HL). (9) includes all the words where a HL occurs.

(9) List of words with a HL tone (HL syllable in bold)

n**tʷɔ̃**	ash	H-HL	**ba**	child	HL
ũ**hʷɛ̃**	God	M-HL	ka:ka**nũ**	grandfather	L-H-HL
tʃɛ̃:	ground	HL	ũ**hʷɛ̃**	sun	H-HL
ᵊɾʲe**ku**	two	H-HL	**ta**:tu	three	HL-L
a**ga**:wa	corpses	L-HL-L	a**hʲu**	guineacorn	H-HL
ɾi**hʲu**	guineacorns	H-HL	ᵊntʃa**tʃa**	pepper	H-H-HL
ʃe:pa	soup	HL-H	bɔ**gai**	stranger	H-HL
hʊkʊɾi**kʷɔ**	hot	H-H-L-HL	i**hʷə**	ropes	H-HL
ɾu**sʷa**:bi	liver	L-HL-L			

As mentioned before, the majority of HL tones are located in word-final position, which becomes evident in this list. This biased distribution may be linked to the way in which the Tihi̱pi̱na words were produced. In fact, the words gathered by the Stuart McGill were elicited in isolation, as if each of them constituted a phrase of its own. It is a well-know fact that such type of elicitation may pose problems to tonal analysis, given that both lexical and phrasal tones can be present in words that are elicited in this way. Among these potential phrasal prosodic cues the one that deserves more attention here is perhaps the final boundary tone. When a speaker is asked to produce a word in isolation, he or she might do so as if the word constituted a phrase by itself. In turn, the phrase might be pronounced as a statement.

Cross-linguistically, the most common tendency is for statements to end with a L tone prosody as opposed to polar questions, which end with a H tone prosody. This could explain why so many HL contours are found in final position: these instances can be an underlying H tone which ends up being downdrifted when in contact with the final boundary L tone. There are instances of HL tones that are not located in final position but which are still found before a L tone. This is the case of *taːtu* ('three', HL-L) and *agaːwa* ('corpses', L-HL-L), and an equivalent effect can be expected in those words.

Nevertheless, the study of question prosody in West African languages has relatively recently shown that this alleged universal[12] tendency for the distinction of polar questions and statements might not always hold true. The best representatives of the traditional view of question prosody are the often-cited publications by John Ohala (see 1983 and 1984). However, after analysing a sample of 78 languages (42 of which from West Africa) Rialland (2007: 1) concluded that many African languages "do not have high pitched question prosody in any respect". Rather, her findings show how in many languages pitch lowering and a constellation of various other cues are used to mark polar questions as opposed to statements (see Rialland 2009). In that case, the contrast between polar questions and statements is marked differently, i.e. not through a dichotomy between a final H boundary tone and a final L boundary tone. There has not been any research about polar question prosody in Tihi̱pi̱na, so it is unknown whether Tihi̱pi̱na follows the general trend described by Ohala or whether an alternative prosody is found. Thus, positing a final boundary L tone is for now a mere hypothesis. Apart from this, the data shows other common utterance-final cues such as breathiness. Nevertheless, neither final lowering nor breathiness are present in all the words.

Another common trait in almost every word in (9) is that HL tones occur after specific onset consonants. Fricative, affricate, and voiceless obstruents tend to rise the frequency of the first periods of the following vowel (Hombert *et. al.* 1979). Then, the frequency lowers to reach its natural level of frequency in the second part of the vowel as the effect of the onset dissipates. This creates a falling contour that can be mistaken for a HL tone. Almost all HL tones in the list follow one of such onsets, in particular [tʃ], [h], [s], [ʃ] and [t].

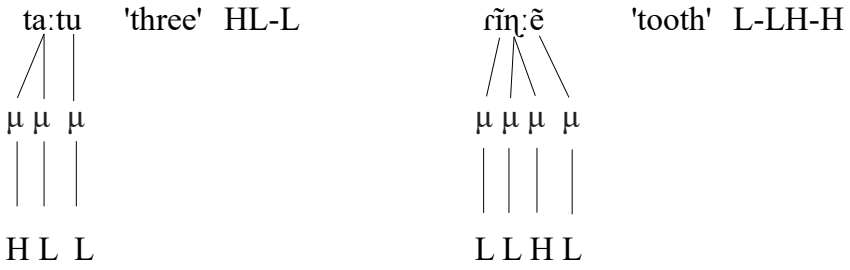
12 At some point, even an ethological explanation was suggested by researchers to justify its apparent universality.

In addition to this, certain words present a glide between the onset and the vowel of the HL syllable. These glides are, in turn, the high vowels [j] and [w]. On the one hand, high vowels tend to have a relatively higher frequency than the rest of the vowels; and, on the other hand, glides usually have a higher intensity than vowels. In Tihɨpɨna a higher average intensity translates as a higher average frequency and, therefore, the presence of these glides can also increase the frequency immediately prior to the vowel that follows. Also, some HL syllables have a long vowel, which will likely enhance the effects of both the syllable onset, the glide and the final boundary tone on the overall shape of the falling contour. Finally, there exist the hypothetical possibility that a floating H prefix tone might produce a HL contour in stems that have a L tone. That is, especially in those monosyllabic stems that show a HL tone, the underlying tone of the stem can be a L tone, which then is realised as falling as the result of the presence of a floating H tone in prefix position, as happens in many instances in Mada language (Snider, 2020).

Another contour tone can be perceived in the wordlist, i.e. the LH tone. However, there are only four words with LH contours: *ɾ̃ɪ̃ŋːẽ* ('tooth', L-LH-H), *ãŋːĩ* ('teeth', L-LH-H), *enːhʲuwo* ('smoke', LH-H-H), and *ũwʊ̃* ('salt', LH-H). In all these words there seems to be some sort of transition that is hard to define but might have something to do with vowel or consonnat gemination. In *ɾ̃ɪ̃ŋːẽ* (tooth) and *ãŋːĩ* (teeth), [ŋ] accommodates an LH tone which transitions from the initial L tone and the final H tone. In these words, [ŋ] seems geminated. Nevertheless, there exists one contrastive pair involving a LH tone: *ũwʊ̃* ('salt', LH-H) / *aːwa* ('dog', L-H).

The LH tones reveal a different perspective to contour tones, which is applicable to some HL tones as well. A significant number of HL tones and all LH tones occur in long vowels and geminated tone-bearing nasals. It is very likely that the contour tones are caused by the combination of different level tones in these bimoraic TBUs. The words *ɾ̃ɪ̃ŋːẽ*, *ãŋːĩ*, and *enːhʲuwo* show a geminated nasal segment. In the case of *enːhʲuwo*, the onset vowel seems to be ephentetic. Regarding the word *ũwʊ̃*, the Tihɨpɨna phonemic inventory has not been described yet, so it is uncertain whether glides are phonemic. Thus, *ũwʊ̃* might underlyingly be *ũːʊ̃*, and accommodate two different level tones in a bimoraic long onset vowel. The same can be true for many HL tones that occur in long vowels, such as the aforementioned *agaːwa* ('corpses'). In fact 35% of the HL tones are located in long vowels. Figure (9) provides an autosegmental analysis of two examples of contour tones.

Figure 9. Autosegmental analysis of contours



4.3 M tone

Perhaps the most problematic tone to analyse in the Tiḫipina wordlist is the M tone. The fact that intensity affects frequency and that words in the sample are pronounced with varying average intensities makes the analysis of the M tone especially complicated. Assuming that there exist a H tone and a L tone, a hypothetical M tone will be located in between both categories. Given that words are not comparable due to their diverse average intensities, M tones can only be perceived word by word, i.e. using relative reference. As mentioned before, this means that M tones can potentially be found in words which contain a H tone and a L tone, and a third tone that is lower than the former and higher than the latter in a significant and differentiated way. An alternative possibility is to find M tones in bitonal words, where the gap between the two tones is smaller than the one to be expected between H tones and L tones. However, the results shown in the Fourier transform argue against this option: e.g. a word that is H-M underlyingly could be realised as H-L if pronounced with a higher intensity. Based on these two rather unstable scenarios, a few words containing an M tone were found. These are given in (10). The number of instances is so small that it allows for a one-by-one analysis.

(10) List of M tones

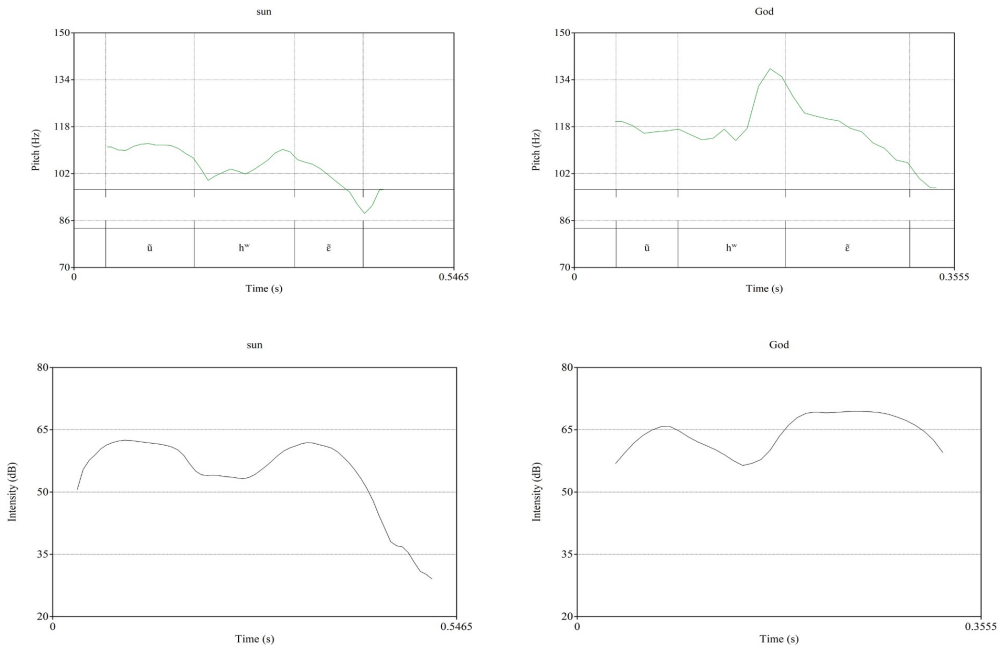
ũhʷɛ	God	M-HL	suga	drums	H-M
tuɾuma	iron	M-H-H	uʃiɾəgʷə	evening	H-M-M-L
bigigɛɾu	pot	M-M-H-L	uhʲafu	crocodile	L-H-M

There are three words in this list that illustrate the relative reference method very well: *bigigɛɾu* ('pot', M-M-H-L), *uʃiɾəgʷə* ('evening', H-M-M-L), and *tuɾumã* ('iron', M-H-H). In these words there is a sequence of seemingly H tones, but at least one of them is significantly more or less salient than the others. In the word *bigigɛɾu* ('pot', M-M-H-L) the third tone is clearly higher than the previous ones, but the gap is not as big as with the last tone. Similarly, in the word *tuɾumã* ('iron', M-H-H) the first tone is lower than the following two, but the difference is not as notable as the one to be expected with a L tone. This might perhaps suggest the presence of pitch accent in the language; however, this is a topic that I will leave for further research. Another word that can be explained alternatively is *sugã* ('drums' H-M), where there seems to be creakiness in the last syllable. Creakiness is often a cue for ending statements, which would

be consistent with the points made in section 4.2.

The extremely limited number of examples does not allow for an analysis of the distribution and pattern formation of the M tone. At the same time, there are no contrastive near-minimal pairs including M tones. The closest thing to that is the (minimal) pair *ũhʷɛ̃* (sun, H-HL) and *ũhʷɛ̃* ('God', M-HL), but this seems to be a special case that can be explained otherwise. A comparative plot of the words *ũhʷɛ̃* ('sun') and *ũhʷɛ̃* ('God') is given in Figure (10).

Figure 10. Comparison of *ũhʷɛ̃* ('sun') and *ũhʷɛ̃* ('God')



The words *ũhʷɛ̃* (sun, H-HL) and *ũhʷɛ̃* ('God', M-HL) are segmentally identical, but they differ in their tones. I annotated *ũhʷɛ̃* ('sun') as H-HL, even though the first syllable in *ũhʷɛ̃* ('sun') is lower (112 Hz) than in *ũhʷɛ̃* ('God'). The first syllable of the latter is 116 Hz. In fact, the average dB of *ũhʷɛ̃* (God) is higher than that of *ũhʷɛ̃* ('sun'). Thus, even though the first syllable of *ũhʷɛ̃* ('God') is higher than that of *ũhʷɛ̃* ('sun'), the distance between the f0 of the first and the second syllable in *ũhʷɛ̃* ('God') is bigger than when comparing the syllables in *ũhʷɛ̃* ('sun'). This is consistent with the results of the Fourier transform plot. Because of this, and because the annotations were based mainly on the relative reference of the tones, I identified the first syllable of *ũhʷɛ̃* ('God') as being relatively lower than in *ũhʷɛ̃* ('sun').

4.4 An autosegmental approach

The H tone and the L tone form a wide array of tonal patterns, which in turn is evidence to support the distinctiveness of these tones. However, from the perspective of Autosegmental Phonology (Goldsmith, 1976), not all the tone patterns that are attested on the phonetic surface correspond to underlying tone patterns. Given that there is no conclusive evidence for the existence of the contour tones and the M tone, the possible autosegmental patterns are H, L, HL,

LH, HLH, and LHL. In this section, the acronyms HL and LH are not equivalent to falling and rising tones respectively, as opposed to the rest of the text. Here, following the autosegmental methodology, HL and LH are used as umbrella terms to refer to patterns in which a H tone and a L tone are combined. So, for instance, the word *ʧaːpi* 'town' (H-L) will be labeled as a HL word.

In fact, in the autosegmental methodology tone patterns tend to be subsumed into more general groups. Following that principle, the word *arɔgʷɔ* ('rivers', H-L-L) is classified together with *ʧaːpi*, given that the H-L-L patterns can be derived from an underlying H-L sequence. There are two other main rules that autosegmental theory brings to the phonological analysis of tone: (1) the OCP constraint, and (2) the one-to-one, left-to-right association of tones to their TBUs[13]. OCP stands for obligatory contour principle, which entails that two identical tones cannot follow each other. Following these rules, the H-H-L word *tindaːtu* ('eight') cannot be derived from an underlying HL sequence, as it violates the OCP rule. The difference with the H-L-L word *arɔgʷɔ* is that, even though it violates the OCP rule, a H-L-L pattern observes the left-to-right association of tones: given that there are more TBUs than tones, the L tone spreads to the last TBU. A number of tonal patterns that are attested in Tihɨpɨna are possible following the rules of autosegmental phonology. These are given in (11)

(11) Patterns that comply with autosegmental theory

H				HL			
	H-H	vʷatə	'human'		H-L	mə̃nĩ	'water'
	H-H-H	ʔəmbəsə	'stools'		H-L-L	arɔgʷɔ	'rivers'
	H-H-H-H	həndʒegəɾi	'morning'				
LH				LHL			
	L-H	bina	'cow'		L-H-L	sətʃeːgu	'axes'
	L-H-H	kʊtʊmə	'cloud'		L-H-L-L	bikəɾibi	'sheep'
	L-H-H-H	ibʲakatũ	animal				
HLH							
	H-L-H	βumãɾĩ	'round				

The most salient property about the patterns in (11) is the absence of monotonal L tone patterns in Tihɨpɨna. As mentioned in section 4.1, the L tone is not attested on its own. The patterns L-L, L-L-L, and L-L-L-L are unattested, even though the high-toned counterparts do exist. At the same time, the monosyllabic words are not only very scarce but also not reliable, given the potential presence of onset floating tones that might alter the tone of the segmental monosyllabic morpheme. Apart from this, there are two patterns that are very poorly attested: H-L-H and L-H-L-L. The word *βumãɾĩ* is the only example of the H-L-H pattern and it is an

13 See Goldsmith (1976); for textbook discussions, see e.g. Kenstowicz (1993), Odden (2005).

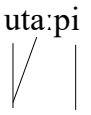
adjective (meaning 'round'), so it may have special morphological properties. The same goes for the L-H-L-L pattern, which is almost exclusively represented by adjectives, as mentioned in 4.1, too. The only word that shows a L-H-L-L pattern and is a noun is *bikəɾibi* ('sheep'). Beyond poorly attested or odd examples, there are a number of patterns that directly violate the rules presented above, and thus are unexpected from an autosegmental point of view. These are given in (12).

(12) Patterns that violate autosegmental theory

H-H-L	tindaːtu	'eight'
L-L-H	utaːpi	'palm'
L-L-H-H	ahɨaɾiga	'sand'
L-H-H-L	səʔɔgʷɛɾe	'tortoises'

A pattern like L-L-H cannot be derived from LH, as the sequence of two L tones at the beginning of the word disrupts the left-to-right mapping of tones and the OCP rule at the same time. Perhaps, in a L-L-H word like *utaːpi* ('palm') (see 13), that sequence of L tones can be derived from a single L tone that spreads from the prefix *u-* to the first TBU of the stem, but not to the second one, which remains a H tone.

(13)



The data that I have considered in this section show that the distribution of tones in Tihɨpɨna resists a straightforward autosegmental analysis.

5. Conclusion

This thesis is the first descriptive analysis of Tihi̱pi̱na (Supana) and it was meant to shed a light into the tonal system of this Bauchi language of Nigeria. Working on this topic was as challenging as it was interesting. The research was carried out using the wordlist elicitation recordings of the "Documentation of Kainji languages" corpus on the Endangered Languages Archive. Some methodologies for the study of tonal systems, such as Coupe (2014) are not applicable for languages like Tihi̱pi̱na. This is because of the small number of monosyllabic words in this language and the potential presence of floating tones. In this thesis, Hyman (2014) was the primary methodological source; and tone distribution, tone pattern formation, and near-minimal pair contrastivity were taken as evidence for the contrastivity of tonemes. However, due to the various limitations and challenges, the results reported in the thesis must be considered to be preliminary.

One of the main challenges concerns the interaction between intensity and frequency. In this language, an increase on the average intensity of a word affects its pitch in two different ways: it increases both the average frequency and the pitch range. In other words, when the average intensity increases, the contour of the pitch track remains the same but the register becomes substantially higher, and more and bigger pitch jumps occur. This has a twofold effect on the tonal analysis. On the one hand, only words with similar average intensity are comparable. On the other hand, a lowering of intensity makes the differentiation of two tones harder while an increase of intensity exagerates the gap between the tones.

Tone is always relative, especially in terms of cross-speaker variation. In Tihi̱pi̱na, this relativity is enhanced and tones change very substantially from word to word, as a consequence of the interaction between intensity and tone. Thus, the same tone will take very different registers in words pronounced with different intensities, which requires the methodology to be adapted accordingly.

Five tones can be perceived in the Tihi̱pi̱na words: H, L, M, HL, LH. The available evidence shows that the H tone and the L tone are contrastive in Tihi̱pi̱na. Regarding the M tone, the interactions between intensity and frequency makes its analysis especially complicated. Future research might reject or confirm the existence of the M tone. The contour tones do not seem to be contrastive, and are instead caused by a constellation of phonological effects including glide vowels and frequency-raising onsets. In some cases, contour tones are located in bimoraic long vowels or geminated consonants. In these cases, contours are formed by two underlying level tones. The results align Tihi̱pi̱na with other genetically close languages such as Mada, Kuche, and Gwara.

References

Blench, Roger. 2006. "The Shakara [= Tari] language of Central Nigeria and its affinities". Draft Manuscript January 4, 2006. 25pp.

Blench, Roger. 2007. "The Ndun language of Central Nigeria and its affinities".

Blench, Roger. 2009. "The Idũ language of Central Nigeria: Phonology, wordlist and suggestions for orthography changes". Draft Manuscript May 20, 2009. 32pp.

Blench, Roger. & Stuart McGill. 2012. *The Kainji languages of northwestern and central Nigeria*. http://www.rogerblench.info/Language/Niger-Congo/BC/Kainji/General/Kainji%20language%20overview.pdf

Blench, Roger. 2014. "Gwara, an unknown language of Central Nigeria: Phonology, wordlist and suggestions for orthography". Draft Manuscript December 2, 2014. 29pp.

Blench, Roger. 2018. "Nominal affixing in the Kainji languages of northwestern and central Nigeria". In John R. Watters (ed.), *East Benue-Congo: Nouns, pronouns, and verbs*, 59–106. Berlin: Language Science Press.

Blench, Roger. 2019a. *An atlas of Nigerian languages*. 4th ed. Cambridge: Kay Williamson Educational Foundation.

Blench, Roger and Kato, Barau. 2019b. *A Dictionary and Grammar Outline of Mada, a Plateau Language of Central Nigeria based on the Rija Dialect: Mada-English with an English-Mada finderlist*. Draft Manuscript December 27, 2019. iv+137pp.

Decker, K., F. Gobak, B. Abraham, C. Riepe, A. Lewinan, and L. Hon. 2021. "Preliminary findings from a sociolinguistic survey of the Bauchi [bsf] – Fungwa [ula] language cluster of Niger State, Nigeria". Journal of Language Survey Reports 2021-062.

Eberhard D. M., Simons G. F., Fennig C. D. (eds.). 2020. *Ethnologue: Languages of the world*. 23rd ed. Dallas: SIL International. http://www.ethnologue.com/.

Gerhardt, Ludwig. 1982. "Beitrage zur Kenntnis der Sprachen des Nigerianischen Plateas". Gluckstadg: Verlag J.J. Augustin GmbH.

Goldsmith, J. 1976. *Autosegmental phonology*. Ph.D. Dissertation, Cambridge, MA: MIT.

Gu, W Hirose, K., Fujisaki, H. 2006. "Modeling the Tones in Suzhou and Wujiang Dialects on the Basis of the Command-Response Model for the Process of F0 Contour Generation". TAL 2006−International Symposium on Tonal Aspects of Languages La Rochelle, France

Hammarström, Harald & Forkel, Robert & Haspelmath, Martin & Bank, Sebastian. 2021. *Glottolog 4.5*. Leipzig: Max Planck Institute for Evolutionary Anthropology. https://doi.org/10.5281/zenodo.5772642 (Available online at http://glottolog.org, Accessed on 20/01/2022.)

Hantgan, Abbie. 2009. "Does tone polarity exist? Evidence from plural formation among Bangime nouns". Indiana University Working Papers in Linguistics 8. 69–83.

Hombert, J., Ohala, J.J., & Ewan, W.G. 1979. "Phonetic Explanations for the Development of Tones". Language, 55, 37.

Hoffmann, Carl. 1976. "Some Aspects of the Che Noun Class System." Unpublished paper presented to the Department of Linguistics and Nigerian Languages, University of Ibadan, Nigeria. Along with excerpts from two student essays on the phonology of Kuche.

Hyman, Larry. 2003. "Why describe african languages?". World Congress of African Linguistics 4/Annual Conferences on African Linguistics 34 Rutgers, Keynote Address: pp. 7-14

Hyman, Larry. 2014. "How To Study a Tone Language, with exemplification from Oku (Grassfields Bantu, Cameroon)". *Language Documentation & Conservation* 8. 525-562.

Joswig, Andreas. 2015. "The basics of Majang tone". SIL International. 7 pp. https://www.sil.org/resources/archives/63315

Koffi, Ettien. 2020. "A Comprehensive Review of Intensity and Its Linguistic Applications," Linguistic Portfolios: Vol. 9, Article 2

Ladefoged, P. & Maddieson, I. 1998. *The Sounds of the World's Languages*. *Language*, *74*(2), 374–376. https://doi.org/10.2307/417875

McGill, Stuart. 2010a. "Sociolinguistic report for the Tahapana (Supana) language". Documentation of Kainji languages, Endangered Languages Archive, SOAS. Downloaded 19/04/2022.

McGill, Stuart. 2010b. "Sociolinguistic report for the Turubo language". Documentation of Kainji languages, Endangered Languages Archive, SOAS. Downloaded 21/04/2022.

McGill, Stuart. 2012. *Documentation of Kainji languages*. Endangered Languages Archive. Handle: http://hdl.handle.net/2196/00-0000-0000-000D-D3F2-4. Accessed on 04/02/2022

McGill, Stuart & Blench, Roger. 2012. "Documentation, development, and ideology in the northwestern Kainji languages". In Stuart McGill & Peter K. Austin (eds) *Language Documentation and Description*, vol 11. London: SOAS. pp. 90-135

Myers, S. "OCP Effects in Optimality Theory". Natural Language & Linguistic Theory 15, 847–892 (1997). https://doi.org/10.1023/A:1005875608905

Ohala, J., 1983. "Cross-language use of pitch: an ethological view". Phonetica 40, 1–18.

Ohala, J., 1984. "An ethological perspective on common cross-language utilization of F0 in voice". Phonetica 41, 1–16.

Rialland, A., 2007. "Question prosody: an African perspective". In: Gussenhoven, C., Riad, T. (Eds.), Tones and Tunes: Studies in Word and Sentence Prosody. Mouton, Berlin.

Rialland, A. 2009. "The African lax question prosody: Its realisation and geographical distribution". Lingua, 119(6), 928–949.

Snider, Keith. 2020. "Floating Tone Noun Class Prefixes in Mada". Summer Institute of Linguistics.

Villarreal Moreno, Julen. 2022. "Tone in Turubo". Unpublished.

Williamson, Kay. 1972. "Benue-Congo comparative wordlist: Vol.2". Ibadan: West African Linguistic Society.

Williamson, Kay. 1989. "Benue-Congo Overview". In: Bendor-Samuel J. ed. The Niger-Congo languages. 247- 276. Lanham: Universities Press of America.

Williamson, Kay & Roger M. Blench. 2000. "Niger-Congo". In Bernd Heine & Derek Nurse (eds.), *African languages: an introduction*, 11-42. Cambridge: Cambridge University Press.

Wilson, Janet Evelyn. 1996. *A Phonological Grammar of Kuche (Nigeria)*. Ann Arbor: UMI. (MA thesis, University of Texas at Arlington; ix+186pp.)

Witzlack-Makarevich, A., & Nakagawa, H. 2019. "Linguistic Features and Typologies in Languages Commonly Referred to as 'Khoisan'". In H. Wolff (Ed.), *The Cambridge Handbook of African Linguistics* (Cambridge Handbooks in Language and Linguistics, pp. 382-416). Cambridge: Cambridge University Press.

Yip, M. 2002. "The autosegmental nature of tone, and its analysis in Optimality Theory". In *Tone* (Cambridge Textbooks in Linguistics, pp. 65-104). Cambridge: Cambridge University Press. doi:10.1017/CBO9781139164559.009