Prosody of languages in the Guaporé-Mamoré language area: an exploration

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Abstract

The Guaporé-Mamoré language area hosts a large amount of linguistic diversity; however, its history of contact remains understudied. This thesis aims to shed light on the contact patterns in the region through a study which compares languages in area with regards to their word stress and phonological tone. For this aim, a sample of 40 languages belonging to the area, plus 9 control languages, was collected which gathered the characteristics of their word stress and tone systems. The results show that languages in the Guaporé-Mamoré area tend to prefer right-bound, fixed stress, although only the languages south-west of the Guaporé river, corresponding to the Mojo-Chiquito culture area, are significantly different from the control languages ($p = .003$) in this regard. The results thus imply different levels of contact in subregions of the proposed area. Further research is needed into the commonalities and differences between languages in the region, as well as documentation of the languages.

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1 Introduction

The Guaporé-Mamoré linguistic area, as proposed by Crevels and van der Voort (2008), consists of about 55 languages spoken in the Southwest Amazon region, straddling the border between Bolivia and Brazil. It is considered to be a highly diverse region where considerable contact has taken place between different groups. It has been studied from several perspectives after its initial proposal, namely in morpho-syntax (van Gijn, 2015), and in segmental phonology (González & Gil Bustos, 2019). However, it remains an understudied area. This thesis attempts to contribute to the description of the area via a new approach to exploring the possible patterns of contact, in our case from the perspective of suprasegmental phonology, more concretely word stress and phonological tone.

Supra-segmental phonology is generally understood to be susceptible to borrowing in contact situations, although not many concrete examples of such a phenomenon exist in the literature outside of the field of tonogenesis, i.e. the origin of phonological tone in languages. Contact between languages in the Guaporé-Mamoré area is therefore likely to be reflected in the stress and tone systems of the languages. The present thesis is an exploratory study of the prosodic patterns in 40 languages belonging to the area: using visualization methods as well as statistical tests, I attempt to find traces of contact among different, often unrelated languages in the realm of word stress and phonological tone, with the aim of being able to shed some more light on the linguistic history of the area as well as producing new evidence for the borrowability of prosody.

This being an exploratory study, the conclusions reached are tentative and merely a beginning, as more research will have to be carried out in order to understand the history and mechanisms of the area.

The thesis is structured in four parts. In Section 2, I give some background to the study with a focus on the prosodic patterns most often found in South America, the borrowing of prosody in contact situations, and the Guaporé-Mamoré linguistic area. In Section 3 I explain the method of data collection and analysis. In Section 4 I show the results of the study, and in Section 5 I give some conclusions on the general characteristics of the languages, the status of the Guaporé-Mamoré as a linguistic area, and the general borrowability of prosodic patterns across languages.

2 Background

2.1 Prosody in the languages of South America

2.1.1 A definition of tone and stress

Prosody is generally considered to concern "tone, stress, prosodic constituents, and intonation" (Gussenhoven & Chen, 2020). In this thesis, I am focusing on the first two elements: tone and stress.

Stress is understood as the property of the most prominent syllable in a word, and usually has both phonetic (physical) and phonological (structural) correlates. The former may be any combination of an increase in duration, pitch and loudness, while the latter may concern a change in vowel quality and consonantal features (Gordon & van der Hulst, 2020). Stress can be determined by "quantity" or "weight" of a given syllable, be fixed in a certain position in the word, or be arbitrarily determined by the word itself. Syllable weight is a broad term that might refer to different phenomena, but which generally relates to its perceptual salience. Stress may be attracted to vowels of a certain quality, to closed syllables, or to certain tone levels.

A language is generally considered to have tone when the pitch properties of a syllable (or another prosodic unit, such as a mora or a foot) create a distinction between different phonemes (Hyman & Leben, 2020). This may be illustrated by the fact that two completely different morphemes can be differentiated only by their pitch, as in (1) from Mundukurú (Tupí).

(1) *é* (high tone) 'path' vs *e* (low tone) 'tobacco'
íhí (HH) 'path' vs *íhi* (HL) 'monkey species' (Aikhenvald, 2012, p. 119)

In both examples, the first is differentiated from the second word only by its tone and otherwise phonologically identical; therefore, both sets of two words can be considered a minimal pair.

The boundary between stress and tone is often blurry, most notably with the existence of what have been named "pitch accent" languages. This term is falling out of favor due to the fact that it encompasses several distinct phenomena (see Wetzels & Meira, 2010, for discussion), but it is nevertheless useful in our case to talk about systems in which tone and stress intersect. There exist many languages, including a considerable amount in South America, our area of study, in which what is traditionally considered "stress" is marked by a variation in pitch, i.e. "tone". This falls under Hyman and Leben's broad definition of tone; however,for the purposes of classification, in this thesis I will only consider languages which make a distinction between two or more pitch levels in any given tone bearing unit to be tonal (see 3.2.1).

South America as a linguistic macro-area hosts a vast range of linguistic diversity. Hammarström et al. (2021) lists 716 language varieties (both extant and extinct), while Campbell (2012)

gives the number of 420 South American languages still being spoken at the time of writing, divided among 108 language families. Of these, 53 have more than one member, while 55 are isolates, having no known relatives. The possibilities for diversity in all linguistic realms, including prosody, are therefore considerable. Nevertheless, writing about the typology of prosody in South America (from here on, SA) in general is still scarce. One recent work on the topic is De Carvalho and Costa Chacon (2020), which attempts to survey SA prosody as a whole.

SA languages show a clear tendency to have stress systems without tone. De Carvalho and Costa Chacon (2020) claim that 93% of SA languages in their sample of 203 have a stress system, while 25% have a combined system of stress and tone and only 7% have an exclusively tonal system with no stress. In Maddieson (2013)'s sample of languages around the world, 14 out of 65 (21%) of SA languages have some sort of tonal system. Menzies (2018) places their own estimate of SA languages with tone at 14%. All this is in contrast to the distribution of tonal systems across the world's languages, as between 40% and 70% of languages in the world are estimated to have some sort of tonal prosodic system (Maddieson, 2013; Rolle, 2018; Yip, 2002).

2.1.2 Stress systems

When marking stress, SA languages tend to use pitch as the main phonetic cue, with many languages also having it as the only physical correlation for a stressed syllable (De Carvalho & Costa Chacon, 2020). The latter are what would typically be called *pitch accent* systems, as defined above. The physical correlates of stress in a given language have some relation with its structure. For instance, languages with contrastive vowel length will use pitch as their main phonetic cue, while duration will not normally be used; in languages with tone, duration will be the most common marker while pitch will not be used (Wetzels & Meira, 2010). In both cases, intensity lies somewhere in the middle of the hierarchy. Finally, in languages that have neither contrastive vowel length nor contrastive tone, pitch is again the main phonetic correlation to stress.

SA languages tend to bind stress to the right edge of the word. In De Carvalho and Costa Chacon (2020)'s sample about 70% of languages with bound stress systems locate their primary stress on one of the last three syllables of the word, while the rest do it on one of the first three syllables. Combining the data in Goedemans and van der Hulst (2013a) and Goedemans and van der Hulst (2013d), which deal with fixed stress and weight-sensitive stress in the languages of the world respectively, 62% of the 45 SA languages in the sample have right-aligned stress systems, while 33% have left aligned ones. This contrasts somewhat with the overall distribution of the world in the same database, where 46% of languages of the world are right-aligned, 42% are left aligned, and 11% are unbounded. The distribution of left and right-aligned stress languages can be seen in Figure 1.

Within stress windows, SA languages with fixed stress appear to have a preference for assigning stress to the left of the window (what is commonly known as a trochaic foot pattern), although

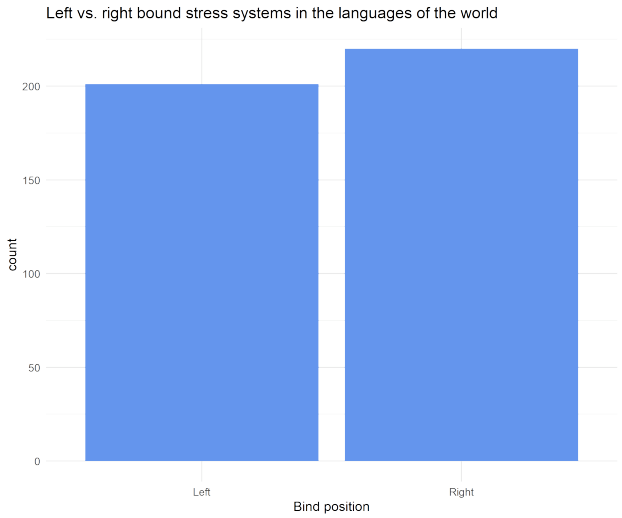

Figure 1: Alignment (left or right) of stress systems in the languages of the world according to the sample in Goedemans and van der Hulst (2013a).

many languages also assign stress to the rightmost syllable of the window (that is, in an iambic pattern). In De Carvalho and Costa Chacon (2020)'s sample, about about 45% of SA languages with fixed stress have iambic feet while 55% have trochaic feet, illustrated in Figure 2. The results in Goedemans and van der Hulst (2013a) show a more skewed distribution, with only 35% of SA languages with fixed stress having iambic stress patterns and 65% of them having trochaic patterns. This might be due to the small subset of SA languages within the latter sample, only 21. In this sense, SA languages also differ from the overall distribution in languages of the world, as Goedemans and van der Hulst (2013a)'s sample has 24% of languages with fixed stress marked as having an iambic pattern, and 76% as having a trochaic pattern. This can be seen in Figure 3.

Genetically, Wetzels and Meira (2010) make some generalizations regarding language families and the stress systems of their languages. They identify fixed stress in the Tupian, Macro-Jê, Panoan, and Tukanonan families, and weight-sensitive stress in Arawakan, Cariban, Panoan, Chibchan, and Tucanoan languages. Goedemans and van der Hulst (2013a) count up to 19 families, including isolates, with fixed stress, 9 families, also including isolates, with weight-sensitive stress, and only three languages (Campa Pajonal Asheninca from the Arawakan family, Desano from the Tucanoan family, and Hixkaryana from the Cariban family) as having unpredictable (lexically determined) stress.

2.1.2.1 Stress in Amazonia

Most of the languages in Amazonia have a stress system, and stress is mostly predictable (Aikhenvald, 2012). Aikhenvald identifies instances of fixed stress in Arawakan, Yanomamic,

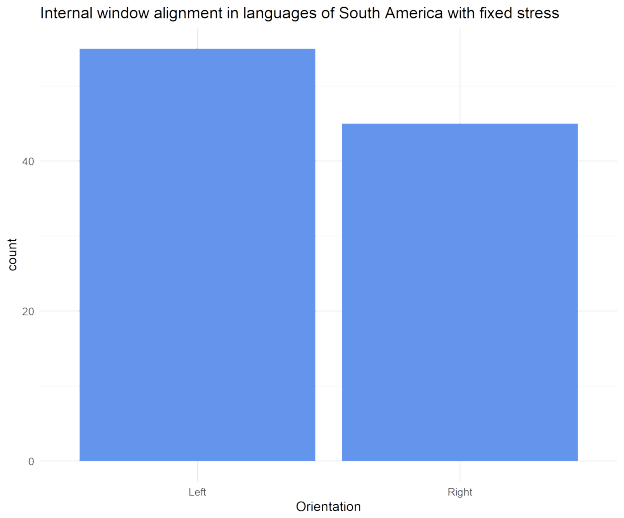

Figure 2: Alignment (left or right) of stress within the window in languages of South America with fixed stress, according to the sample in De Carvalho and Costa Chacon (2020).

and Cariban languages; weight sensitive stress in Cariban and Panoan languages, and contrastive (lexically defined) stress in Arawak and Guahiboan languages.

2.1.3 Tone systems

As advanced above, between 14% and 25% of SA languages possess some sort of tone system. Maddieson (2013) makes a distinction between simple tonal systems, defined as those with that make a distinction between no more two tone values, and complex tone systems, which make a distinction between three or more levels. Among the SA languages in the sample, of the 14 languages with tone, only 2, Southern Nambikuára (Nambiquaran), and Ticuna (Ticuna-Yuri) have a complex tone system, while the rest have a simple tonal system[1]. It is worth noting that Maddieson includes in the "simple tonal system" category languages which use tone only to mark stress, also known as "pitch accent" as mentioned above, so the number of simple grammatical tone systems in SA is not directly retrievable from the database if we are to distinguish them from "pitch accent" systems. Similarly, 92% of the languages in Menzies (2018)'s sample which have a tonal system make no more than two tone distinctions.

Genetically, Wetzels and Meira (2010) identify cases of tone languages in the Arawakan, Tupian, Macro-Jê, Chibchan, and Tukanoan families.

[1]Nambikuará is analyzed elsewhere as having only two underlying tones, see Aikhenvald (2012, p. 122), and Hyman (2016).

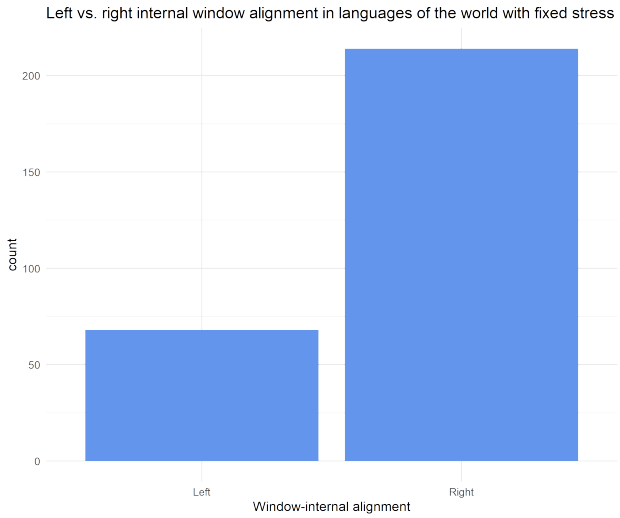

Figure 3: Alignment (left or right) of stress within the window in languages of the world with fixed stress, according to the sample in Goedemans and van der Hulst (2013a).

2.1.3.1 Tone in Amazonia

Within South America, the Amazon region, more concretely its western side, is home to most of the languages with tone. Among these, Hyman (2016) considers only one language, the aforementioned Ticuna (Ticuna-Yuri), to have a three-tone system, with the rest having no more than a two level distinction. Aikhenvald (2012) considers Andoké (isolate) as also having a three-tone system, but Hyman analyzes it (and several other languages) as having three tones on the surface but only two underlyingly. Genetically, tone is divided among many different families, including Tupí, Macro-Jê, Arawakan, Peba-Yagua, Zaparoan, Witotoan, Makú, and Tucanoan (Aikhenvald, 2012, p. 121).

2.2 Supra-segmental phonological borrowing in contact situations

It is by now common knowledge that languages have a tendency to undergo changes when in contact with other languages, that is, in situations of extensive bilingualism. This includes not only the lexicon, sounds, morphology or syntax, but also prosody (stress, tone, and intonation). Of these, tonogenesis, the process by which toneless languages acquire phonological tone, is one of the most widely studied phenomena in this area (see, for example, Matisoff, 2006, for a survey of tonogenesis in South-East Asia), while other prosodic contact phenomena, such as the borrowing of stress patterns and intonation, have not received as much attention in the scientific literature, despite this kind of borrowing being considered common. Matras (2009) considers prosody (in his definition, something akin to what I would consider intonation) and stress to be generally

more borrowable than segmental phonological features, while Salmons (1992, p. 17), in his work on contact-induced stress changes, claims that "accentual features often coincide with linguistic areas, cutting across language and language family boundaries". Some examples given are: in the realm of tone, the aforementioned South-East Asia tone area, and West Africa, both showing distributional patterns for tone that go beyond genetic affiliations; in the realm of stress, the Turkic languages, Armenian, and Iranian languages that all present final stress despite not being related. Salmons (1992) is the most prominent study on accentual change in contact situations, going in depth into contact situations in Northern Europe. From his study he extracts that contact-induced accent shift appears as a strong tendency at various degrees of contact, from short-term to long term bilingualism, and with various balances of dominance between languages, and both in individual contact as well as part of a geographical spread. He also identifies a tendency for tonal languages to "yield" to pitch accent and fixed stress systems when in contact, despite the fact that tone has a tendency to spread areally as mentioned above.

One unique characteristic of suprasegmental phonological borrowing is that, unlike other types of structural borrowing, it does not necessarily get borrowed through vocabulary (Grant, 2020, gives as an example the lengthening of consonants in Wales English despite little lexical borrowing from Welsh). This opens up the possibility of prosodic contact to languages which may share few features on the surface, namely borrowed words, and attests to prosody's general borrowability.

When borrowing words from languages with different suprasegmental systems, borrower languages have different strategies of adapting the prosody of the donor language, and there appears to be a difference between tone (and pitch accent) languages and stress languages (Kang, 2010): as tone languages have a less defined distribution of prominence, they are more likely to preserve the prosody of the donor language (with the exception of East Asian tone languages, seem to have a more complex set of cues for prominence and therefore be less permissive with its assignment of prosody). Stress languages, on the other hand, are more restricted when it comes to assignment of prominence and will usually either ignore the original stress and assign it based on native rules or modify the word (usually by deleting segments or modifying the length of the vowels) to make it fit with native phonology. What we see less often in these cases is the use of the borrower's stress assignment system, but this becomes more likely the closer contact is between the two languages. Berger (2014) attributes a change in Czech from free to initial stress to intensive contact (including loan words) with German, despite it not being exactly the same stress system.

Overall, the general tendencies in borrowing of suprasegmental phonology in the world seems to give credit to the idea that such phenomena are likely also in the Guaporé-Mamoré linguistic area.

2.3 The Guaporé-Mamoré linguistic area

The concept of linguistic areas has been part of the study of contact linguistics for almost two centuries, its basic definition being a place where languages share structural features due to contact between one another (Grant, 2020). It has been pointed out many times that the concept of a language area is fuzzy and that there exist varying definitions. Campbell (2006, 2017) especially notes the disparity in characteristics that different phenomena classed under the term *linguistic area* present, both linguistically and socially, and goes so far as to conceive of a linguistic area as "merely the sum of borrowings among individual languages in contact situation" (2017, p. 23). A recent defense of the concept of language areas is van Gijn and Wahlström (to appear), which emphasizes the importance of working with extra-linguistic (historical) factors in order to take make good use of the concept.

In this thesis I am taking the latter position; I believe that linguistic areas are a "useful conceptual aid" (Hickey, 2017, p. 1), even after acknowledging their shortcomings, as a way to talk about places where there has been a significant amount of multi-lateral contact between languages for a period of time.

Guaporé-Mamoré was first proposed as an area of language contact by Crevels and van der Voort (2008). It gets its names from two major rivers in the Southwest Amazon, the Guaporé (known as Iténez on its Bolivian side), which divides the state of Rondônia in Brazil from the departments of Santa Cruz and Beni in Bolivia, and the Guaporé, which flows from the South of Bolivia and joins the Guaporé to make the Madeira river, an affluent of the Amazon. These two rivers form a landscape of tropical lowlands on both sides of the Bolivia-Brazil border where contact between different groups takes place.

The Guaporé-Mamoré area presents itself as one of the most linguistically diverse regions in South America as by Crevels and van der Voort's (2008) estimate, there at least 55 language varieties still being spoken in the area belonging to several different families, including 13 unclassified languages. These languages share a number of structural features despite many not being related to one another. Culturally they are generally divided into two distinct areas, the Mojo-Chiquito culture area to the southwest of the Guaporé river, on the Bolivian side, and the Guaporé culture area northeast of the Guaporé, on the Brazilian side, a distinction which has mostly stayed the same since Lévi-Strauss (1948) first described it. Lévi-Strauss further divides the Guaporé culture complex into a Chapacuran speaking area and a Tupian speaking one.

Maldi (1991) assigns a series of cultural traits to a subset of Lévi-Strauss's Tupian area she calls the Marico area, which Crevels and van der Voort (2008) extend to most of the Guaporé area and gather as the following, among others: small, egalitarian societies, a semi-nomadic mode of life, the combination of swidden agriculture and hunting and gathering, shamanistic religion involving the use of hallucinogenic substances, and a particular way of making *chicha*, a local fermented

Figure 4: Map of the approximate geographical extent of the Guaporé as delimited by the languages appearing

drink. As for the Mojo-Chiquito area, Crevels and van der Voort characterize it by the following traits: a more stratified society, a raised field agriculture also combined with hunting, gathering and fishing, and a religion based on jaguar cult. Crevels and van der Voort also claim that there is archaeological evidence for contact across the Guaporé river, bringing these two large cultural complexes together.

The linguistic evidence for a Guaporé-Mamoré language area has relative acceptance. One of the main criticisms to make is that the languages used in Crevels and van der Voort (2008) as control languages, i.e., as falling outside the language area, appear in the comparison not to be that different from the languages in the area. These languages are Aymara (Aymaran), Quechua (Quechuan), and Uru (Uru-Chipaya), spoken in the Andean parts of Bolivia. This might be because the traits used to distinguish the area are quite high-level, i.e. they refer to abstract grammatical categories. After the intial proposal, more in depth work has been done to find the specific commonalities in the languages of the area, as will be seen below.

Some common linguistic features listed in Crevels and van der Voort (2008) are: a low incidence of classifiers and noun class systems, a high incidence of symmetrical morphology (i.e., a balance between morphological suffixing and prefixing), a high incidence of evidentiality distinctions, verbal number, directionals, a clusivity distinction, and an alienability distinction. Addition-

ally, they mention "a relatively high degree of synthesis", a claim which is taken up and supported by van Gijn (2015), who finds in the Guaporé-Mamoré area a common type for verbal morphology with incorporating tendencies. González and Gil Bustos (2019) survey the segmental phonology of Guaporé-Mamoré languages and find the following tendencies specific to the region: a prevalence of small consonant inventories, few points of articulations for obstruents compared to languages outside of the region, a high incidence of languages without voiced plosives, a high incidence of retroflex consonants, and a high incidence of nasal vowels and phenomena related to nasality. They are also able to corroborate the distinction between two subareas divided by the Guaporé river, with unique features east and west of the river. However, the authors point out that a delimitation of the area based on phonological traits remains imprecise and more work needs to be carried out in that realm. Nevertheless, this points to a series of shared phonological features which must have come about by extensive contact, regardless of the Guaporé-Mamoré area's status as a language area, and sets the stage for the possibility of such commonality also being present in suprasegmental phonology. It also points to a possible division along the Guaporé river in prosody, which must be taken into account.

To summarize, the Guaporé-Mamoré language area is an ongoing inquiry, and valuable work is being done on establishing the linguistic basis for its classification. More in depth looks into features are needed in order to establish the language area; this thesis attempts to be such an attempt in the domain of suprasegmental phonology.

3 Methodology

For the present study I am using a quantitative comparison method in which I code the languages in my sample according to a set of variables, defined in Section 3.2. The sample consists of the 40 languages classed in Crevels and van der Voort (2008) as belonging to the Guaporé-Mamoré area for which there was somewhat complete available information, plus 9 control languages from surrounding areas.

3.1 Areal typology

The study for the present thesis follows in the method attributed to areal typology, defined by Dahl (2001, p. 1456) as "the study of patterns in the areal distribution of typologically relevant features of languages". Taking from areal linguistics, that is, the study of similarities in geographically adjacent languages which cannot be ascribed to a common genetic origin, and language typology, which attempts to classify languages according to their inherent features (rather than genetic affiliation), areal typology attempts to both describe areal patterns and their origins, i.e. language contact, thus avoiding the synchronicity-diachronicity dichotomy. Furthermore, areal typology

must be conscious of the multi-dimensional aspect of language contact, the studies of which have tended towards the idea of language areas as being multi-lateral, symmetrical situations of contact among geographically adjacent languages with monolingual, static speakers. In actuality many situations of multilingualism exist, with communities that move from one place to another, and, in our case, with the overarching presence of the colonial languages, Portuguese and Spanish, with which every language in our sample has had contact. The linking of typological features and contact patterns with the geography of the places where the languages that are being studied are spoken is also important, as conditions of the climate and terrain influence to a considerable extent the type of human society that emerges in a given place and thus the type of interactions between groups, and will be reflected in the interpretations of the differences in results between geographically distinct sub-regions in the sample.

Thus, the study looks for commonalities in supra-segmental phonology in the languages of the Guaporé-Mamoré area, taking contact as the primary driver for these commonalities given the vast linguistic diversity of the area. Furthermore, in accordance with Dahl (2001), who criticizes the lack of discussion about (and thus, systematization of) variable sampling, and van der Hulst et al. (2017), who express concern about the "typical holistic approach to approach to stress/accent" which does not concern itself with the finer details of suprasegmental prosody, by definition complex and multi-dimensional, I attempt to make use of the most analytical, or granular, features of the stress and tone systems of the languages in the sample, so long as they remain relevant to the study. Section 3.2 below explains each of the variables chosen.

3.2 Definition of the variables

In order to code the languages in the sample, I am basing my variables and values heavily on the ones defined in Maddieson (2013), Goedemans and van der Hulst (2013a), Goedemans and van der Hulst (2013d), Goedemans and van der Hulst (2013c), and Goedemans and van der Hulst (2013b). I explain them below.

- **Presence of tone**

  This variable codifies whether a language has phonological tone or not. For the purposes of this study, I consider a language to have tone when there is a contrast between more than one pitch in a syllable that makes a phonological difference. There are languages that distinguish between two or more tones in all of their syllables, and those are undoubtedly tonal. There also exist languages in which only stressed syllables carry a tonal distinction, and I also classify those as tonal. For example, in Karo (Tupian), high pitch can only occur in stressed syllables, whereas unstressed syllables always carry low tone (Gabas, 1999). Therefore, tone is only distinctive in stressed syllables, which can carry low (realized phonetically as mid)

or high tone. Finally, there exist languages that mark stress by way of pitch, but with only one phonological "tone". I consider this type of "tone" to be a manifestation of stress, and not in the same category as phonological tone, so I code languages with such a system as non-tonal. One example of this is Trinitario (Arawakan), in which stress is manifested by a higher pitch, which is not otherwise phonologically distinctive (Rose, 2014). This lack of phonological distinctiveness makes it a non-tonal language according to my classification.

– **Complexity of tone system**

Following Maddieson (2013), I divide tone systems into two levels of complexity. A *simple* tone system is one with no more than two phonological distinctions, systems with three or more levels being coded as *complex*. I am using the phonological analysis for this variable. There are languages that have more than two tones on the surface, but that underlyingly only make distinction between two levels. An example of this is the aforementioned Karo (Tupian), which on the surface makes a three tone distinction (low, mid, high), but phonologically only distinguishes between two tones (high and low), the mid tone being an allomorph of the low tone in stressed position (Gabas, 1999). In contrast, in Southern Nambikwara (Nambikwaran) all three tones (low, rising, falling) may appear on any syllable regardless of context and are therefore phonologically distinctive (Kroeker, 2003).

– **Fixed stress**

This variable concerns whether stress is always on the same syllable within the word, and has a *yes* or *no* value. If the stress is not fixed, then it may be weight-sensitive or unpredictable (lexically determined). An example of a fixed stress system in the sample is Makurap (Tupian) in which stress always falls on the final syllable. This pattern is quite common in the sample.

– **Weight-sensitive stress**

This variable concerns whether stress is determined by the weight of the syllables within the word, and has a *yes* or *no* value. This of course can only exist in languages which have a weight distinction, generally between *light* and *heavy* syllables. I discuss properties which can make a syllable light or heavy in the next paragraph.

– **Weight Factors**

Heavy syllables may be classed as such by what Goedemans and van der Hulst (2013d) call "intrinsic properties", i.e. vowel length, the presence of a syllabic coda, or prominence, or "extrinsic properties", i.e. diacritic weight or "accents". The latter case I code as an unpredictable (lexically determined) stress system, as in Goedemans and van der Hulst (2013c). Goedemans and van der Hulst (2013c) give several ways that languages mark a syllable as

heavy, many of which appear in the sample for the present study. They make a distinction between quantitative and non-quantitative factors. Within the former fall the presence of a coda or a long vowel, whereas example of the latter would be the presence a nasal vowel or a high tone. An example of the latter two is again Karo (Tupian), in which both nasal vowels and high tones receive stress within the stress window (Gabas, 1999).

– **Window Boundedness**

Window-boundedness refers to which syllables in the word are eligible for primary stress based on their position. A stress window, which is always disyllabic (i.e. it consists of two syllables) can either be to the right of the word, meaning that the syllables on the right edge are eligible for stress, to the left, meaning that the syllables on the left edge are eligible for stress, or unbounded, meaning that any syllable is *a priori* a candidate for receiving stress. This phenomenon potentially affects both fixed stress systems and weight-sensitive systems. Within this framework, languages such as Baure (Arawakan), which assigns stress to the second syllable in the word (Danielsen, 2007) , and Chácobo (Panoan), which assigns stress to the heavy syllable within the first two syllables of the word (Tallman, 2018) , have a left-bound system; languages such as Makuráp (Tupian), which always assigns stress to the final syllable (Braga, 1992), and Yurakaré (unclassified), in which the rightmost heavy syllable of the word takes stress (van Gijn, 2006), have a right-bound system.

– **Window-internal orientation**

The boundedness feature is combined with headedness, which describes which of the syllables within the eligible window receives stress. This can either be the leftmost syllable or the rightmost syllable. Since I am using these variables not only for fixed stress as laid out by Goedemans and van der Hulst (2013a), but also for weight-sensitive stress, it is possible in my dataset to have languages in which both left and right syllables within the window are eligible, which is the case in all weight-sensitive languages with a bound window. One example is the aforementioned Yurakaré (unclassified), in which the rightmost (non final) heavy syllable in the word takes primary stress, regardless of its window-internal orientation (van Gijn, 2006).

– **Nonperipherality**

In theory, the stress window explained above consists of two syllables. In cases where the facts of a language's stress pattern do not fit with this two-syllable stress window, such as when a language has antepenultimate or third stress, theorists talk of *extrametricality*, or *nonperipherality*. In these cases, the most peripheral syllable (i.e. the first syllable in left-bounded stress systems and the last syllable in right-bound systems) are considered to be excluded and thus not to be counted when assigning stress. Examples of this phenomenon

are Cayubaba (unclassified), which has fixed antepenultimate stress (Crevels & Muysken, 2012), and Araona (Tacanan), which has a weight-sensitive stress system that excludes the last syllable in the word (Emkow, 2019).

Goedemans and van der Hulst (2013a) admit that this abstract concept may lead to ambiguous interpretations of stress patterns, as, for example, a language with second syllable stress could be considered either left-bound, right-headed, and peripheral, or left-bound, left-headed, and non-peripheral. In these cases, I follow the authors' consideration of non-peripherality as being a marked phenomenon and thus only being used when it is the only feasible explanation.

– **Rhythm**

Rhythm is somewhat of secondary variable in this study, as many grammars do not include information on it. This concerns the assignation of secondary stress within the two-syllable unit known as the foot as described by Goedemans and van der Hulst (2013b). Rhythm types can either be *trochaic*, in which the first (leftmost) syllable within the foot is stressed, or *iambic*, in which the last (rightmost) syllable within the foot receives stress. For example, Moseten (unclassified) combines initial primary stress with secondary stress on the third syllable, making it a trochaic system as stress always falls on the leftmost syllable within the word (Sakel, 2004).

– **Prominence**

Like with rhythm above, prominence is a secondary variable, as information on it is relatively scarce in the descriptions of the languages of the region. Prominence concerns the phonetic correlates of stress, as in how a stressed syllable is differentiated from unstressed syllables. The salient features is usually a longer duration, a higher pitch, or higher intensity. When a language differentiates stress only by way of pitch, I consider it a "pitch accent" language.

3.2.1 Qualitative considerations

Most phonological descriptions of languages do not describe stress and tone in the ways laid out in section 3.2, instead using more synthetic, intuitive terms such as "initial", "penultimate", "final", etc. Therefore when coding languages I am often analyzing those types into these more granular categories. Thus, a language with fixed final stress can be analyzed as right-bounded, right-headed, and peripheral, for example. This inevitably leads to some conflicts as, like with all typological enterprises, languages do not always fit into the mold of the variables designed for the study, no matter how refined.

One way that languages may not fit neatly into the database is by having a mixed system. Aikana (unclassified), for example, has a separate system for nouns and verbs (Vasconcelos, 2004):

while nouns follow a predictable stress pattern, verbs have mostly unpredictable stress. In this particular case the information available on stress was not enough to code the language into the database. If there had been enough information, I would have coded it as having both predictable (whether that be fixed or weight-sensitive) and unpredictable (lexically-determined) stress.

Another, more common way that languages have dual systems is with weight sensitivity. In most languages with a weight-sensitive system as described above, there are bound to be words with no heavy syllables to attract stress. In that case, languages have a different strategy to assign stress, usually by fixing it on a certain syllable. In these cases I give weight primacy and code the language in question as a weight-sensitive language, and not a fixed stress language.

There are languages in which weight-sensitive stress and fixed stress are one in the same, as stress always falls on the same syllable, which is also always heavy. Two examples of this are Itene (Chapacuran, also known as Moré) and Oro Win (Chapacuran, also known as Orotowati). In both languages, a lexical word always ends in a heavy accented syllable (Angenot-de-Lima, 2002; de França, 2002). This makes the languages effectively have fixed final stress, making it impossible to distinguish between fixed and weight-sensitive stress. In these cases, I choose to code the language as having fixed stress and not weight-sensitive stress, considering the former to be the simplest explanation.

Finally, there are languages that are fixed not on the level of the syllable, but of the mora. One example of this is Sirionó (Tupian), which generally has penultimate stress except for when the last syllable contains a long vowel, in which case it is final (Dahl, 2014). This is then interpreted as the stress falling on the penultimate mora of the word. I code this the same way as penultimate stress on the syllable level.

3.3 Distance between languages

In order to carry out the analysis I compare languages along major traits (fixed stress, weight-sensitive stress, presence of tone) using data visualization tools as well as statistical tests. I am also carrying out more fine-grained analysis based on granular variables using `glottodist`, the distance analysis function in Norder et al. (in press) designed to measure typological distances between languages. This function is based on the method known as Gower's distance, first introduced by Gower (1971). This is a "general coefficient measuring the similarity between two sampling units" (p. 857), which compares values between two vectors across a number of variables and returns a measure of distance. Using this measure I look for possible patterns of contact by comparing the values to the geographical position of the languages. For the major categories, in addition to visualization tools I am carrying out a series of chi-square tests to determine whether the distributions of the Guaporé-Mamoré language area are significantly different from those of South American languages as well as those from the world's languages.

Another analysis undertaken for this project is a permutational analysis of variance, or PERMANOVA, which, based on the results of the distance test, attempts to find a difference between two groups by comparing their centroid, or their "average" member. With this I attempt to find significant differences between the languages of the Guaporé-Mamoré linguistic area and the control languages, as well as between languages north-east of the Guaporé (Brazil) and languages south-west of the Guaporé (Bolivia) within the proposed area. It should be noted that, with a relatively small sample such as the one used in this study, statistical significance will be volatile, and thus is only one of several ways of looking at the data.

4 Results

4.1 Overview of the stress systems of Guaporé-Mamoré languages

Languages in the Guaporé-Mamoré language area exhibit a number of different stress and tone systems. Below is a summary of the basic features, comparing them to the distribution of the named features to the distribution in South America and the world. For the latter two, I am using the sample in Goedemans and van der Hulst (2013d).

4.1.1 Stress types

Of the 35 Guaporé-Mamoré languages in the sample for which information on stress was available, 25 languages have fixed stress, 7 have weight-sensitive stress, 3 and have lexically determined stress. There were five languages in the Guaporé-Mamoré part of the sample with no information on their stress system. Figure 5 shows a map of the location of the languages color-coded for their stress type, and Figure 6 shows a bar plot with the distribution of the stress systems compared to the distribution for SA languages and world languages according to the sample in Goedemans and van der Hulst (2013d).

As can be seen on the plot, compared to the general distribution of SA languages and of the world languages as discussed in Section 2.1 above, in which about 54% of languages have fixed stress, 39% have weight-sensitive stress, and 5% have lexically determined stress, the Guaporé-Mamoré languages show a slightly higher tendency to have fixed stress (71%), a lower tendency to have weight sensitive stress, (20%), and about the same tendency to have lexically determined stress (7%). Fisher's exact test showed no difference between Guaporé-Mamoré languages and world languages in the realm of stress types, $p = .052$. Another instance of the same test between Guaporé-Mamoré languages and South American languages also showed no difference with regards to stress type, $p = .871$.

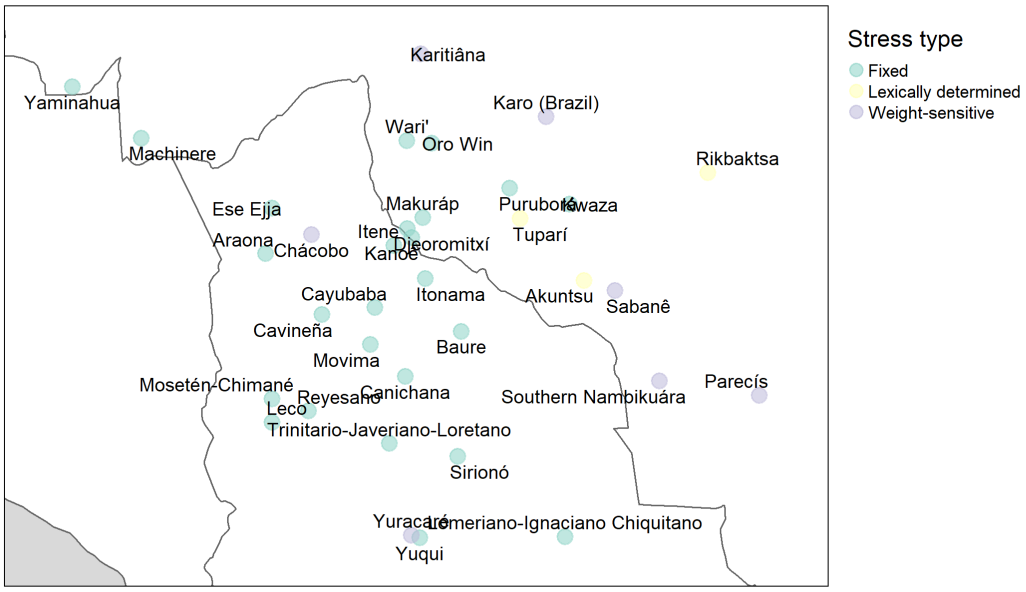

Figure 5: Map of languages of the Guaporé-Mamoré language area according to their stress type

4.1.2 Tone

As for tone, 8 languages in the Guaporé-Mamoré area show phonological tone, whereas 32 do not. Of the languages with tone, 6 have a simple tone type (no more than two tone levels) and 2, Southern Nambikuará (Nambiquaran) and Gavião (Tupian), have a complex tone type (three or more tone levels). Figure 7 shows a map with the spatial distribution of tone in the Guaporé-Mamoré area, and Figure 8 shows a bar plot with the distribution of tone in Guaporé-Mamoré, South America, and the world.

Comparing this to general SA languages, the distribution of tone is similar, with 20% of the languages in the sample showing phonological tone. This similarity is corroborated by a chi-square test comparing the two populations, χ^2 $(1, N = 40) = 0.06$, $p = 0.813$.

The amount of languages with tone is lower than most estimations of the amount of tonal languages in the world (even with differing definitions), which is expected given the general tendency of SA languages not to have tone, and despite the fact that most languages with tone in SA are concentrated in the Amazon region. Indeed, a chi-square test comparing the distribution of tone in

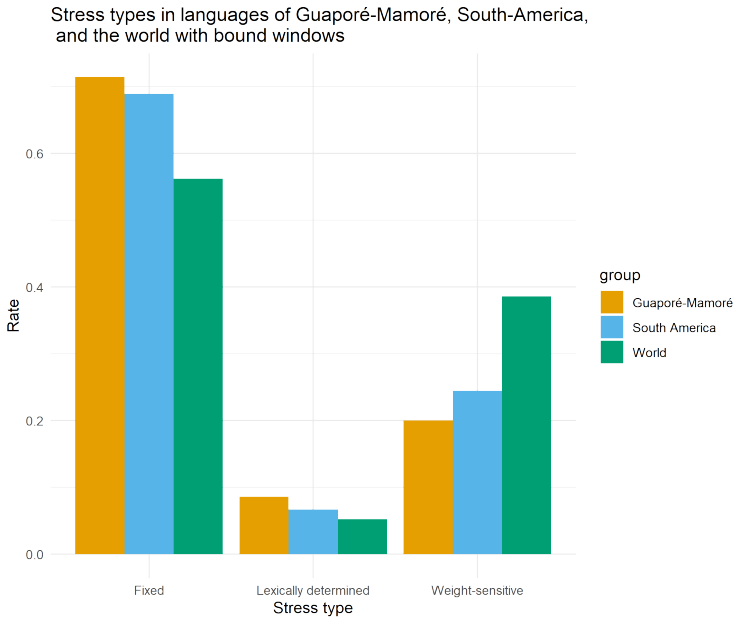

Figure 6: Distribution of stress types in the languages of the Guaporé-Mamoré language area, South America, and the world. Guaporé-Mamoré values are from my own sample, South America and World values are from Goedemans and van der Hulst (2013d).

the languages of Guaporé-Mamoré and the world yields a significant result, χ^2 (1, N = 40) = 7.78, p = .005.

4.1.3 Stress alignment

Within the 25 languages with fixed stress, 10 languages have final stress, 8 have penultimate stress, 4 have initial stress, 2 have antepenultimate stress, and 1 has second stress. There are no languages in the sample with third position stress. Figure 9 shows a bar plot visualization of the distribution of fixed stress positions Finally, of the 7 languages with weight-sensitive stress, four are unbounded to either end of the word, two are right-aligned, and only one, Chácobo (Panoan), is left-aligned. This means, in synthesis, that of these languages, 24 are bound to the right edge of the word, and 6 are bound to the left edge. Figure 10 shows the distribution of the languages of Guaporé-Mamoré, South America, and the world with regards to their window-boundedness.

This general ratio of left- to right-aligned stress systems coincides to a large extent with the general distribution of SA stress systems as discussed in Section 2.1, as SA languages have a higher tendency to bind to the right edge of the word than the general distribution of languages in the world (70% vs. 30% in SA, 46% vs. 42% in the world). A chi-square test comparing the distribution of the Guaporé-Mamoré languages to South American languages supports this, similarity, χ^2 (1, N = 30) = 2.97, p =.085. At the same time, another chi-square test conducted comparing the

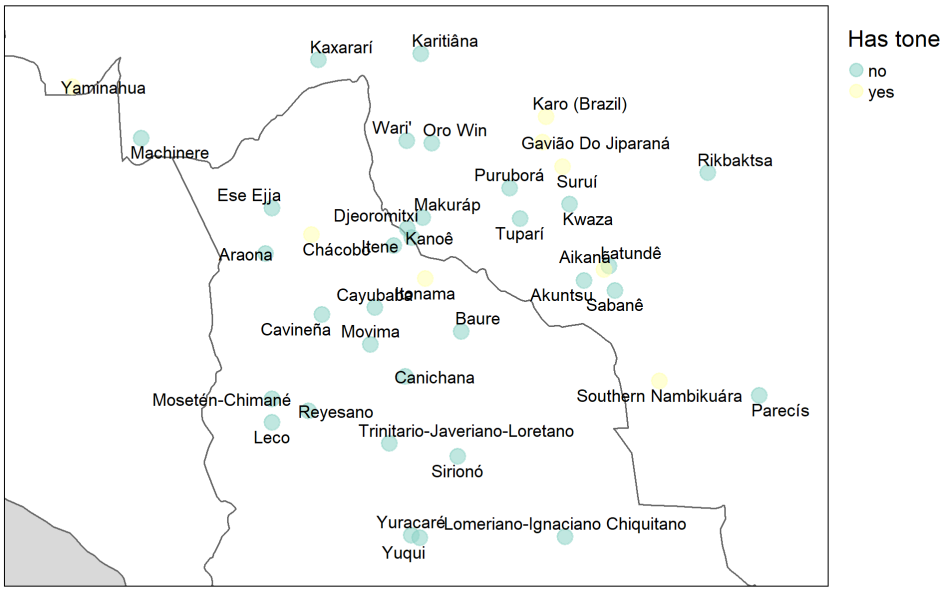

Figure 7: Map of distribution of phonological tone in the languages of the Guaporé-Mamoré language area, South America, and the world. Guaporé-Mamoré values are from my own sample, South America and World values are from Goedemans and van der Hulst (2013d).

Guaporé-Mamoré languages to the languages of the world shows a significant difference regarding its window-boundedness, χ^2 (1, N = 30) = 9.26, p =.002.

4.2 Distance measurements

Figure 11 shows the results of an NMDS visualization test performed on the languages of the sample, with the aim of quantifying the distances between them.

As can be seen, there are two main clusters of similar languages. The first appears at around (-0.2, 0.1) and gathers mostly Brazilian languages. The languages in this cluster are mostly non-tonal, final fixed stress languages. The second cluster appears around (-0.2, -0.1) and gathers mostly Bolivian languages, but also a few control languages. The languages in this cluster are mostly non-tonal, penultimate fixed stress languages.

Overall, it appears that the Brazilian languages are spread out over a larger portion of the matrix

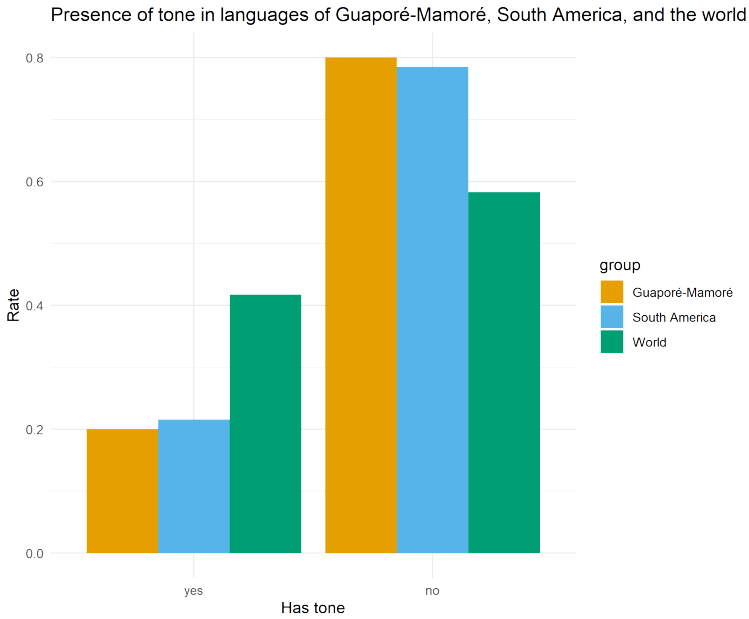

Figure 8: Presence of tone in the Guaporé-Mamoré language area.

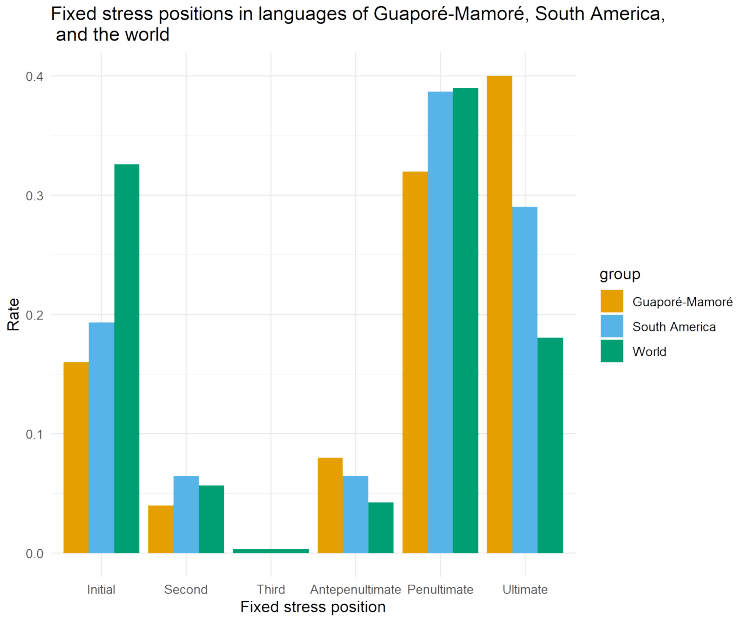

Figure 9: Fixed stress positions in languages of the Guaporé-Mamoré language area.

than the Bolivian languages, suggesting that the former show more variety and difference than the latter.

Finally, a PERMANOVA test applied to the two groups (Guaporé-Mamoré and control), including the two subgroups (Brazilian languages north-east of the Guaporé river, and Bolivian lan-

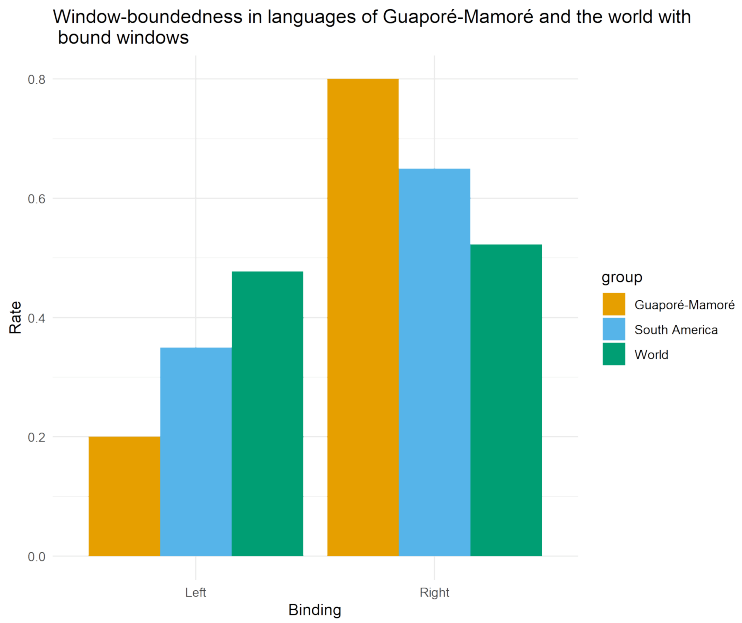

Figure 10: Distribution of window-boundedness of languages in the Guaporé-Mamoré language area, South America, and the world. Guaporé-Mamoré values are from my own sample, South America and World values are from Goedemans and van der Hulst (2013d).

guages south-west of the Guaporé river) showed a significant difference between the Bolivian and the control languages (p = .003), as well as a significant difference between the Bolivian and the Brazilian languages (p = .006). It showed no difference between either the Brazilian languages and the control languages (p = 1), or between the languages of the Guaporé-Mamoré linguistic area as a whole and the control languages (p = .095).

It must be noted again, as in Section 3.3, that given the small size of the sample, any statistical results are at best tentative, as at this point any new data point might affect results in an outsize manner.

5 Conclusions

Having seen the results presented in Section 4, some preliminary conclusions can be reached. I present some of them below.

5.1 Traces of contact in prosody in Guaporé-Mamoré

Some general tendencies can be ascertained about the prosody of languages in the Guaporé-Mamoré area. They show higher rates of fixed stress and of right-edge binding than the languages

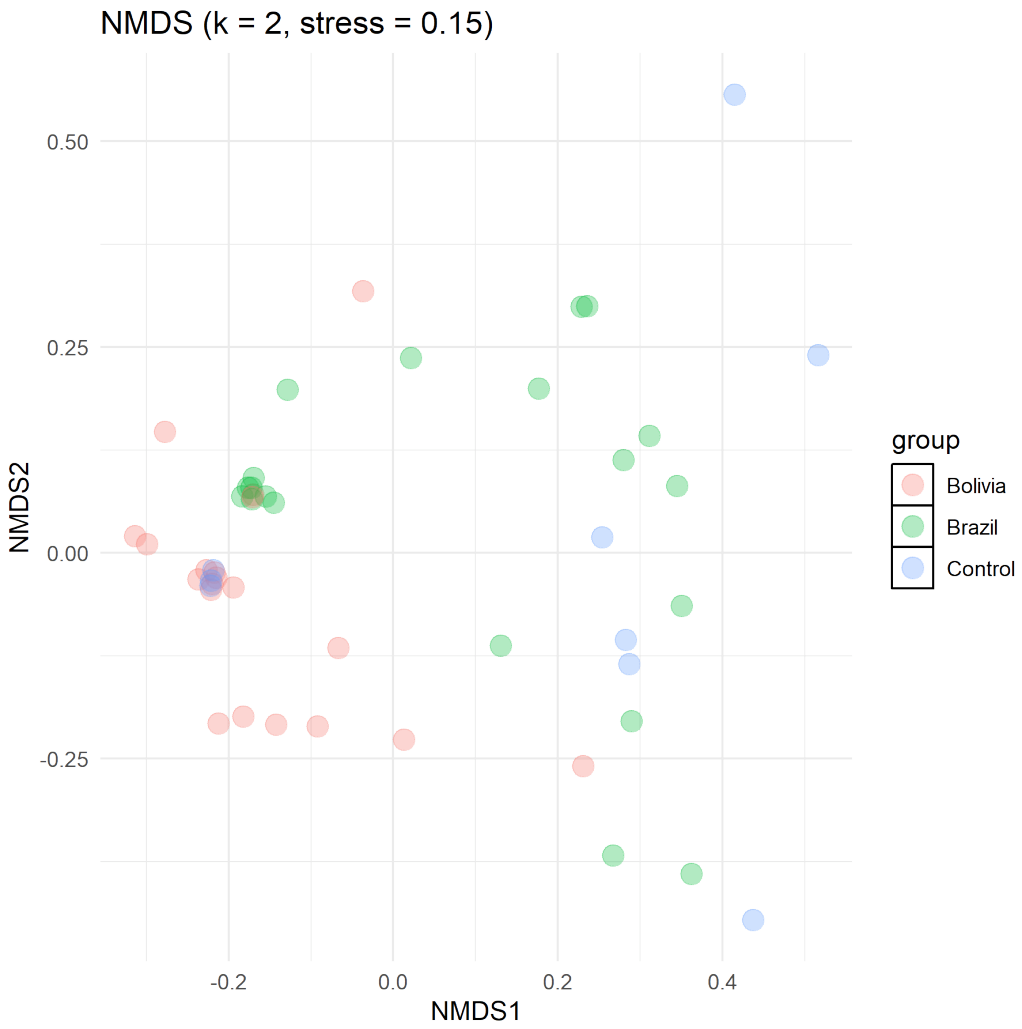

Figure 11: Plot showing the distance between languages of the sample, divided by groups, according to an NMDS test.

of the world and of South America, as well as slightly fewer rates of phonological tone. Whether that is enough to define a single coherent type under which to classify the languages of the region is a debatable question, and I would likely argue against it, at least when it comes to the entire area: while, as seen in Section 4 above, there exist clusters of features around which languages converge to some extent (fixed, final, toneless in Brazil; fixed, penultimate, and toneless in Bolivia), there exists considerable diversity (and thus, divergence) in the systems employed by these languages. Nevertheless, a tendency can be observed, and the question may arise of whether fixed, right bound stress might be more borrowable than other types. I come back to this question later.

One thing that is immediately apparent is the differences between languages on either side of the Guaporé river. The PERMANOVA test confirmed a significant difference between the Bolivian

group (south-west of the Guaporé) and the Brazilian group (north-west of the Guaporé). This distinction is nothing new, as it corresponds to Lévi-Strauss (1948)'s Mojo-Chiquito and Guaporé culture areas respectively, an anthropological classification which was also noted by Crevels and van der Voort (2008). Thus, at least in the realm of prosody, this (sub)division is strong enough so as to be statistically significant, and could lead to a stronger division between the two subareas.

One of the main differences between the Bolivian and the Brazilian side is that the former forms a considerably closer pack, with languages being more similar. This reflected not only in the visualization plot but also in the results of the PERMANOVA test as shown in Section 4: whereas the languages in Brazil do not show a significant difference with the control group, the ones in Bolivia do. I believe that this points to stronger traces of contact in the Bolivian side (Mojo-Chiquito) than in the Brazilian side (Guaporé), with languages possibly borrowing penultimate fixed stress from one another in the former, and thus only gives clear evidence of the Mojo-Chiquito side as being a language area as per the standard definition.

5.2 Borrowability of prosody

The results of this study point to a general borrowability of stress, as supported by Salmons (1992), with sustained language contact. Seeing as both language subareas studied show a certain tendency towards fixed, right-bound stress, one might wonder if there is something inherently more borrowable about this type of stress than, for instance, weight-sensitive stress, as Salmons (1992) identified a tendency for tonal languages to become pitch-accent, fixed stress systems when in contact, and Berger (2014) describes a shift from free to fixed stress (although left-bound).

Indeed, fixed stress appears as cognitively less demanding than weight-sensitive and lexically determined stress, as stress placement is not subject to either the phonological form of the word nor to the lexicon, but is determined by a single rule of the language itself. Thus, one possible, though speculative historical explanation would be that languages which initially had other types of stress (or no stress to speak of at all, maybe in the case of certain tonal systems), namely weight-sensitive and lexically determined stress, might have acquired fixed stress through contact with languages with this type of stress. This would need to be substantiated with studies in other areas of the world, and ideally a general typology of prosody borrowability, and seeing which types of stress and tone systems are more likely to prevail in situations of language contact.

5.3 Further questions

This is only an exploratory study on the possible contact patterns in languages of the Guaporé-Mamoré area when it comes to prosody, so any result obtained here is tentative and preliminary. More work needs to be done in order to describe and explain these phenomena properly.

Firstly, the study would gain robustness, especially in the statistical aspect, by adding in more control languages, of which there are few due to time constraints. A larger control of at least the same size as the Guaporé-Mamoré part of the sample would give a more solid backing to the claims of statistical significance in the differences between each group, and would possibly even change the results, shedding a completely new light on the matter.

Secondly, it would also enrich the study to look at the colonial languages with which practically every language in the Guaporé-Mamoré area has been in contact, Spanish and Portuguese, and compare their prosody to the prosody of languages in the area. At this stage of the investigation, however, it does not seem like Spanish and Portuguese have had much influence in the areas, as languages on both sides of the river tend towards fixed stress, whereas both colonial languages exhibit weight-sensitive stress.

Finally, more documentation of the languages and history of the area is needed in order to produce richer, more robust descriptions of their prosodic systems and the actual contact that has taken place there, as there were several languages belonging to the area for which there was not enough information to include them in the final sample. Further documentation and descriptions of these languages would bring better scientific results, and more knowledge about the people, their languages, and their history.

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A Dataset

The dataset and analysis used for the study can be found at https://github.com/cicervlvs/Thesis-data.