

令和 2 年 7 月 7 日現在

機関番号：32615  
研究種目：基盤研究(C) (一般)  
研究期間：2016～2019  
課題番号：16K02641  
研究課題名(和文) A Phonetic Typology of Consonant-Tone Interaction  
  
研究課題名(英文) A Phonetic Typology of Consonant-Tone Interaction  
  
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交付決定額(研究期間全体)：(直接経費) 3,500,000円

研究成果の概要(和文)：この研究は南バンツ語と日本語に行われる子音とアクセントの関係を究明する事である。音声学の方法論を適用して対象言語の資料を南アフリカ共和国と日本で収集した。声帯のどの風に揺れるを示す方法と聴覚実験の方法を利用し、対象言語を分析した。共通の結果は子音の種類が発音の高さに少なくても影響を受ける事が知られた。しかし、子音とアクセントの関係は発音で区別をする場合も聴覚的には区別出来ない事が見られた。

#### 研究成果の学術的意義や社会的意義

This project explored the consonant-tone interaction in southern Bantu languages and Japanese. Results show that speakers may not perceive a contrast even though they produce the phonetic differences, showcasing near mergers. The society may benefit from this research for pronunciation education.

研究成果の概要(英文)：This project has investigated the relationship between consonants and tone in southern Bantu languages and Japanese. Data collection using phonetic methods was conducted in South Africa and Japan. Analysis was done using data obtained with equipment designed for observing the vocal folds vibration. Results show that the production of consonants affects how pitch height is realized in all languages. Even so, in languages with consonant-tone interaction, production does not always result in a perceptibility of the production contrast.

研究分野：言語学

キーワード：tone phonetics Bantu Japanese

## 1. 研究開始当初の背景

This 3-year research project investigated tonal languages with the objective of showing that these languages are similar in the ways in which their consonants and tones interact, despite the fact that they are from unrelated African and Asian language families. Tonal languages are languages which use pitch to distinguish one word from another. For example, in Chinese, [mā] pronounced with a high pitch means ‘mother’, but [má] with a rising pitch means ‘hemp’. The use of pitch in this way to distinguish meaning of words is called tone (Yip 2002). Physiologically, the production of tone and consonants is related (Hombert 1978 and thereafter) in that an intervening consonant can affect the pronunciation of tone. It has been suggested that the interplay between tone and consonants is a result of their pronunciations being physiologically constrained by the mechanics of sound production. However, I argued in Lee (2008) that it is in fact the result of the pronunciation of tone and consonants being cognitively constrained by the part of the mind that regulates language use, which explains the grammatical universals displayed across tonal languages in Africa and Asia under a single analysis. Previous theories based on physiological constraints (Bradshaw 1999, Tang 2008) did not fully explain the empirical data observed in consonant-tone interactions.

What has been missing from previous research, however, is an understanding of the types of consonants that participate in the consonant-tone interaction. Languages differ in three ways when it comes to types of consonants participating in consonant-tone interaction (1).

### **(1) Consonant types and consonant-tone interaction**

- a. Type 1: Voiced obstruents only (sounds like [b] in ‘boy’, eg. SiSwati)
- b. Type 2: Voiced obstruents & breathy sonorants (eg. Xitsonga, Burmese)
- c. Type 3: phonetic interaction only (eg. Japanese)

SiSwati-like languages (Type 1) have voiced obstruents as depressors, while Xitsonga-like languages (Type 2) have voiced obstruents as well as sonorants as depressor consonants. There are also languages such as Japanese (Type 3) that only show phonetic interaction between consonants and tone. There has been no known previous cross-linguistic study that examines in detail the articulation of consonants which engage in consonant-tone interaction.

Related to the typology in (1), languages show different patterns regarding the phonologization of depressors.

### **(2) Cross-linguistic roles of depressor consonants in a language**

- a. Type A: Depressor consonants actively interact with tone (Xitsonga, Type 2)
- b. Type B: Depressor consonants limit the co-occurrence of tone (SiSwati, Type 1)
- c. Type C: Depressor consonants only have a phonetic effect on tone (Japanese, Type 3)

In Xitsonga, depressors actively participate in tonal processes (2a); the spreading of high tone is blocked by depressors. In SiSwati, depressors lower the pitch, and only such lowered tone can

appear next to depressors (2b). Japanese belongs to Type C; voiced consonants lower the pitch, but this is an automatic process. As such, there is no phonologization, and no interaction.

There have been only few studies that directly address the phonetic nature of depressors. Downing and Gick (2001) suggests minor acoustic differences in the depressors of Kalang'a and Nambya. Thus, this study was proposed to fill the gap in the study of cross-linguistic typology of depressors with production and perception experiments; we revisit languages known to have each type of depressor-tone interaction, and determine whether these grammatical differences follow from differences in how the depressors are produced.

## 2. 研究の目的

This research has proposed to systematically examine both production and perception aspects of depressor consonants in Xitsonga, SiSwati and Japanese. In particular, comparing acoustic and articulatory data in understudied languages (Xitsonga and SiSwati) has contributed to our understanding of how depressors are produced, using methods that have only been used in studying major languages without consonant-tone interactions. Comparing the production mechanism with languages that do not employ phonological depressor consonants (such as Japanese) was also essential because it provided insights as to why the same consonant can behave as a depressor in one language, but not in another.

The articulation of depressors is the least understood area in the study of consonant-tone interaction. A study using Electrolottograph that measures the degree of the closure of vocal folds showed whether there is any interplay between the movement of vocal folds and the mechanism of producing depressors. Results that show different articulation of the same voiced consonants explained why languages differ in treating certain sounds as depressors. Such data, when paired with data obtained from acoustic measurements, provided with a comprehensive understanding of the production of depressors.

There is also no known study of the perception of depressors. The production of depressors has been reported on impressionistically since 1970's, but it is not clear whether the phonetic depression matters when it comes to the perception of speech. Are depressors part of the perceptual grammar? How do listeners utilize production information regarding depressors in their perception? We cannot know if differences in production explain grammatical differences unless we can show that people can perceive them.

The findings of this research project extended to a further understanding of consonants that interact with tone in other languages reported in Lee (2008). While the current project focuses on depressor consonants only, Mulao, a language spoken in China, is known to have elevator consonants: voiceless consonant that interact with tone. A future study of production and perception of elevators can be conducted using the methods developed in the current project.

It has also been suggested that the effect of depressor consonants may not be local. Numerous cases in Bradshaw (1999) show consonant-tone interaction is limited to certain prosodic position. Lee (2015, in print) also reports an unusual effect of consonants on tone at the juncture between phonetics and phonology; blocking of H tone spreading by depressors is context-dependent. Of course, the current study has shed light in understanding the role of

depressors at different levels of sentence phonology.

### 3. 研究の方法

During FY 2016, a cross-linguistic database of consonant types that interact with tone was compiled. These diverse patterns helped to identify gaps in the previous descriptions of Xitsonga, and acoustic and articulatory data for Xitsonga was collected to fill those gaps. Analyzing the newly collected data provided critical base for subsequent research that have taken place after FY 2016. From FY 2017, acoustic and articulatory data for SiSwati and Xitsonga was collected in Thohoyandou, South Africa with support by the Mathivha Centre on African languages at University of Venda. The Japanese data was collected in Kanto and Hokkaido. Annotation and analyses of the data were conducted by members of the ICU Linguistics Lab. The last stage of data collection asked participants to judge consonant-tone interaction parameterized according to relevant acoustic and articulator parameters. The findings were written as journal articles during the final stage of the grant.

### 4. 研究成果

The results of the grant have shown that the phonetic effect of consonants to tone is present, but not all effects are necessarily phonologized into a difference. The major outcome from the perception shows that the production of a sound does not necessarily result in perceiving an apparent contrast, suggesting that undergoing near-mergers of certain sound contrast. While Xitsonga distinguishes modal and breathy phonation, SiSwati does not show clear use of phonation type in the language. Japanese voicing and accent display some relationship, but the multiple acoustic cues of voicing were the major finding. Some results have implications for larger questions that couldn't be addressed directly as part of this grant; what the role of contrasts is, and how individuals utilize the contrast in communicating with one another.

Over the three years, the grant has produced multiple papers and presentations. The results were disseminated in the proceedings of the International Congress of Phonetic Sciences, one of the important venues in phonetic research. The results were also shared in domestic and international conferences. We also shared the results in conferences held in Africa so that the community members we worked with have a chance to learn about our findings.

## 5. 主な発表論文等

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〔図書〕 計0件

〔産業財産権〕

〔その他〕

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6. 研究組織

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