Procedures of Investigating Intonation Phonology in a Tonal Language

Methods for intonation phonology research in non-tonal languages has been described and discussed in detail (e.g. Jun and Fletcher 2014; Arvaniti 2016) and many studies have proven these methods to be useful. However, procedures from such languages can be at times difficult to apply to intonation analysis in a tonal language, especially when studying an understudied language which has limited previous research. While the phonology of intonation in tonal languages may not and should not be any different from non-tonal languages, the practical procedures of the investigation differ substantially due to the influences from the lexical tones, the interaction between lexical tones (e.g. tone sandhi), and the interaction between lexical tone and intonation components. This paper presents a set of suggestions for the procedures of investigating the phonological aspects of intonation, from choosing materials and tasks, to the final analysis. These procedures have been tested to be effective in an understudied Mandarin variety, Tianjin Mandarin (Zhang 2018).

1. Selection of task and speech materials

Task: Lab speech. Admittedly, spontaneous speech is more and more valued in current intonation research (see Arvaniti 2016) and should be the final goal for the investigation in any language, the initial investigation benefit more from strictly controlled data with carefully monitored and recorded speech in laboratory settings so as to exclude confounding variables as much as possible.

Size of Material: smallest tone-bearing unit/morpheme. Jun and Fletcher (2014) suggested that words in isolation should only be examined after examining multi-word phrases since multi-word phrases allow us to tease apart the word prosody from phrasal prosody. While this works very well in non-tonal languages, due to the complicated tonal interaction on word level and sentence level in tonal languages, having anything longer than the smallest tone-bearing unit makes it harder to tease apart the lexical tonal specification (i.e. intra-tune, Zhang 2019) and sentence intonation (i.e. inter-tune, ibid). Jun and Fletcher also suggested using "sentences where all syllables or all but one target syllable have the same lexical tones". While this method was used in many phonetic studies of Mandarin intonation, it does not necessarily work in all tonal languages since a sequence of the same lexical tones very often go through tone sandhi due to Obligatory Contour Principle.

Tune: A default tune and a salient tune. A default tune should be identical or similar to the citation tone (e.g. the default tune for Tianjin Mandarin is the statement tune). A salient tune often has syntactically identical text with the default tune but sounds intonationally marked to listeners. For instance, in Tianjin Mandarin, the intonational yes/no question is one of those tunes.

2. Analysis Procedures

Step 1: Segmentation. The onset and offset of tone-bearing unit should be annotated. Smaller units (e.g. individual phonemes within a TBU) often do not need annotating unless there is a good reason.

Step 2: Visual inspection. As with non-tonal languages, visually inspecting the f0 contours in Praat is a good way of comparing the statement tune (or another unmarked tune that is as similar to the sequence of citation tones as possible) and the target tune. The differences observed among the instances help with formulating hypotheses that can be tested further in the analysis.

Step 3: Data analysis and modelling. Different modelling methods can be adopted in this step. Three commonly used methods are: (1) mixed linear effect regression analysis of the mean values; (2) analysis of the acoustic parameters using Generalised Additive Mixed Modelling (GAMM); (3) Function Principal Component Analysis which reduces the dimensionality of the data.

References: Arvaniti, A. (2016). Analytical Decisions in Intonation Research and the Role of Representations. Lessons from Romani. *Laboratory Phonology*, *7*(1), 6. **Jun, S. A., & Fletcher, J.** (2014). Methodology of studying intonation: From data collection to data analysis. *Prosodic typology II: The phonology of intonation and phrasing*, 493-519. **Zhang, C.** (2018). *Tianjin Mandarin Tones and Tunes* [Doctoral Thesis]. University of Oxford. **Zhang, C.** (2019). Stacking and Unstacking Prosodies : The Production and Perception of Sentence Prosody in a Tonal Language. *ICPhS 2019*.