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Intonation in Cantonese

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Abstract: The experiment in this paper explores the nature of intonation in a language which has lexical tone. In a pilot study it was found that a method of accounting for tone preservation (the identifiability of lexical tones in sentence contexts) which included a declining tone space was better suited to the task than one which assumed a level tone space. The main experiment attempted to separate and observe the contributions to this general downtrend made by boundary effects, tonal interaction and declination. There appears to be evidence for one type of boundary effect (initial raising) and declination. The data of this experiment were not consistent with the presence of the other type of boundary effect (final lowering) or tonal interaction factors. Two important variables were manipulated in this experiment. First, the length of a test sentence was manipulated on the assumption that longer sentences would show a greater decline of F0 if there was a declination effect. Second, the discourse position of test sentences was varied (from discourse medial to discourse final) as a test for the effect of discourse final lowering.

1. Introduction

Observation of tone and intonation patterns in many languages has often revealed a tendency for fundamental frequency to decline over the course of an utterance (Ladd 1983, Cohen, Collier and 't Hart 1982). In this paper, I will call this general phenomenon by the theory-neutral term 'downtrend'. Pierrehumbert and her colleagues, in their research on intonation patterns in English and Japanese, have identified several potential contributing factors to downtrend (Pierrehumbert 1980, Liberman and Pierrehumbert 1984, Beckman and Pierrehumbert 1986).

One class of factors, boundary effects, has to do with the intonational marking of prosodic units (prosodic phrases or possibly larger units of prosodic organization). Just as prosodic boundaries can be marked by a durational process like final lengthening in many languages, they are also signaled in English by intonational processes. The two types of intonational processes most often mentioned are final lowering and initial raising.[1] These terms refer to the tendency for F0 to fall at the ends of prosodic units and for units to start with a relatively high F0. The combined result of these intonational boundary effects is an overall drop in F0 within prosodic units.

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[1] In non-tone languages boundary tones are often used in the description of intonation (Pierrehumbert 1980 for example). This does not seem to be a possibility in Cantonese because tonal distinctions are preserved before boundaries, as elsewhere.

<u>Tonal interaction</u> is another source of F0 patterns which exhibit downtrend. The proto-typical case in which the interaction between tones results in downtrend is known as <u>downstep</u>. This phenomenon, often found in African languages, is probably best characterized as a lowering of pitch range following the occurrence of a low tone. Thus, the second high tone in a sequence HLH is lower than the first high tone in the sequence. Downstep and other kinds of tonal interaction are called tone sandhi when they occur in East Asian languages, although it should be noted that not all types of tone sandhi produce downtrend.

One other type of factor which may result in downtrend is <u>declination</u>. Ladd (1983) defines declination as 'a gradually changing backdrop to local F0 events' (p. 54). Unlike boundary effects and tonal interaction, declination is an effect which operates over the entire duration of a phonological unit (exactly what constitutes the domain for declination is not yet clear).

In this paper the presence of a declination factor (as a backdrop to other F0 events) in speech production is tested. Robert Ladd (1983) suggests two methods for testing a declination-as-frame-of-reference hypothesis. The first of these two suggestions derives a test from the fact that in a declination-as-frame-of-reference model, declination is a function of time. Thus, 'the difference in F0 between two accent peaks should correlate with the length of the interval between them' (p. 67). Second, Ladd suggests the 'detailed phonetic study' of tone languages as a method of testing for declination. The advantage of studying a tone language is that 'the phonological identity or non-identity of points in contours could be much more rigorously controlled, and mean values could be obtained from phonologically comparable cases' (p. 69).

The language under study in this paper is Cantonese. It has been described as a language 'rich in the number of tones' (six in the standard descriptions) and 'rather poor in tone sandhi' (Hashimoto 1972, p. 112). The six lexical tones found in Cantonese are: high level (55), high rising (35), high mid (33), mid rising (23), low mid (22) and low level (11). (These are the same tone numbers as were assigned by Wong, 1982, with one minor change - 11 for 21.) This description of the inventory of tones is based on F0 analysis made of isolated pronunciations of a minimal set with the segments [fʌn] as produced by one speaker. The F0 patterns of the six different lexical tones of Cantonese are shown in figure 1. A description in terms of tone numbers is also indicated on this figure. The figure shows that the tones are more different from each other toward the end of the syllable than they are at the beginning. For this reason in all F0 measurements in sentence context in this paper I measured the F0 of a tone at the end of the syllable upon which it occurs.

In figure 2 the data of figure 1 are presented as percentages of the F0 envelope defined by the highest and lowest tones. In this figure the highest tone was defined as 100% of the possible range for tones and the lowest one was given the value 0%. The other tones were computed as percentages of this tone space.

The lack of tone sandhi in Cantonese seems to imply that tonal interaction phenomena can be eliminated from consideration prima facie. Casual observation indicates that even without tonal interaction downtrend

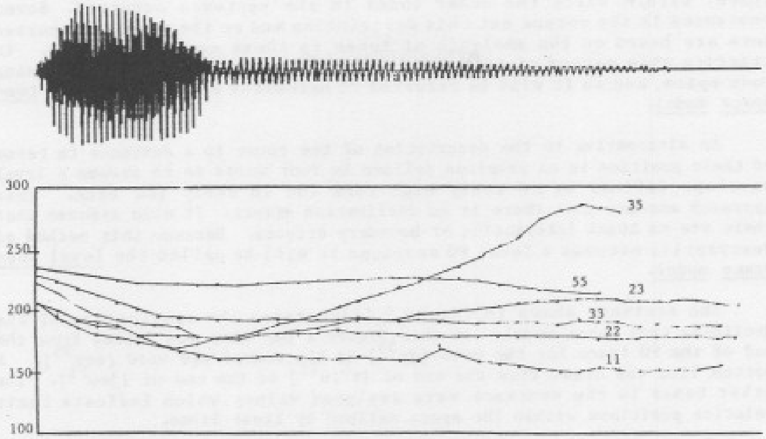


Figure 1: F0 patterns of the six different lexical tones of Cantonese.

is present in Cantonese. For instance, in sentences in which all of the words have high tones the later occurring high tones have lower F0 than earlier ones. It is also the case that the identities of tones are preserved in sentence context. Hashimoto (1972) describes this tone preservation: 'Except for unstressed syllables, almost every syllable is pronounced with the same tone in isolation that it bears in sequence' (p. 112).

In a pilot study I examined the possibility of accounting for tone preservation by the inclusion of a declination component in the description of Cantonese intonation. The study was an investigation of the F0 patterns of a portion of a corpus of sentences which were originally recorded during a field methods class at Ohio State. As such, the corpus was not designed to meet any particular qualifications but rather was a random collection of sentences. The sentences included in this study all exhibited the following pattern: there was a high-level or high-rising tone early in the sentence and one near the end of the sentence. Also, there was a low tone early in the sentence and one late in the sentence. These four words in each

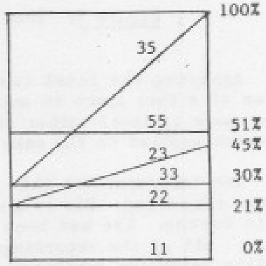
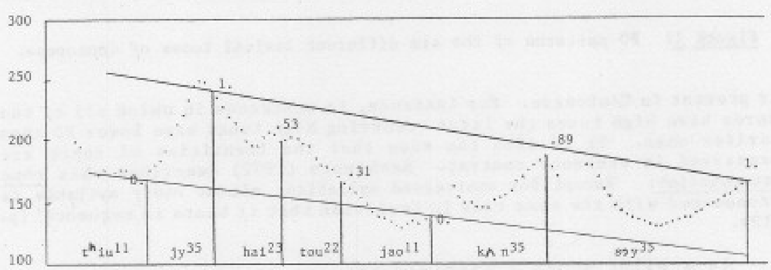


Figure 2: Tones in isolation as percent of the tone space.

sentence served to define an F0 envelope (which I will also call a tone space) within which the other tones in the sentence occurred. Seven sentences in the corpus met this description and so the results reported here are based on the analysis of tones in these seven sentences. In practice this method of defining an F0 envelope resulted in a declining tone space, and so it will be referred to hereafter as the <u>declining tone space model</u>.

An alternative to the description of the tones in a sentence in terms of their position in an envelope defined by four words is to assume a level envelope defined by an early high tone and an early low tone. This approach assumes that there is no declination effect. It also assumes that there are no tonal interaction or boundary effects. Because this method of description assumes a level F0 envelope it will be called the <u>level tone space model</u>.

The sentence shown in figure 3 illustrates the application of the declining tone space model. In this figure a top line was fitted from the end of the F0 trace for the word $[jy^{35}]$ to the end of the word $[sɔy^{35}]$. A bottom line was drawn from the end of $[t^hiu^{11}]$ to the end of $[jao^{11}]$. The other tones in the sentence were assigned values which indicate their relative positions within the space defined by these lines.



<u>Figure 3</u>: Tone values in a declining tone space.

Applying the level tone space model we could analyze the tones in terms of a tone space in much the same way - the difference being that the tone space is level rather than declining. Figure 4 is an example of this approach applied to the same sentence.

The informant for this study was a student at Ohio State at the time of the recording. She is a native of Hong Kong and her parents both grew up in Canton. She had been living in the United States for about three years. All of the recordings were made in an anechoic chamber using high quality recording equipment. The informant read the sentences from notes that she had made during the course of the field work class sessions. The fundamental frequency analysis was performed using the Sift algorithm in the ILS software package operating on a DEC PDP 11/23 at the Linguistics Lab at Ohio State.

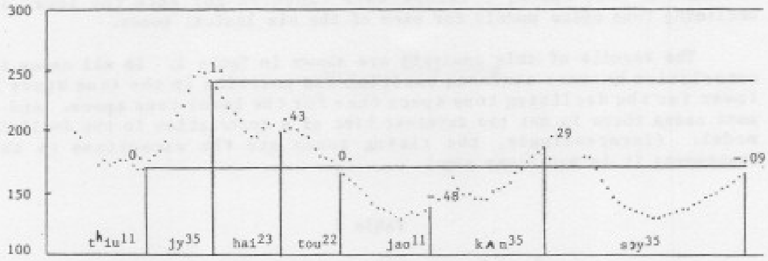


Figure 4: Tone values in a level tone space.

The results illustrated in figure 5 indicate that both the declining tone space and the level tone space models succeed in keeping the lexical tones separate from each other when averages are considered. Thus, for example, when all occurrences of the level tones 33 and 22 are considered their relative average positions within the tone space are distinct. There is, however, a difference between the two models which is hidden by this presentation of the data. The difference is that in the level tone space model there was a good deal more variation in the position of a tone within the tone space. This is illustrated in figure 4 where the first high rising tone [jy^{35}] is at the top of the range, the next high rising tone [$k\Lambda n^{35}$] is 29% up in the range and the last one [$s\text{ɔ}y^{35}$] is at the bottom of the range.

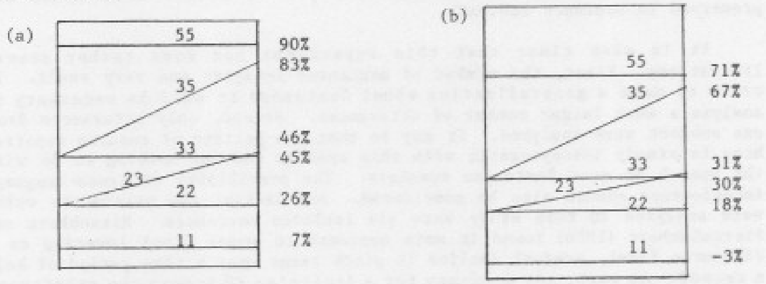


Figure 5: Tone values (a) as percent of declining tone space and (b) as percent of level tone space.

This figure also presents the possibility that the extra variation found in the level tone space model was not random but rather was correlated with the position of the word within a sentence - so that high tones early in a sentence would be higher in the range than high tones later in the sentence. To test for such a correlation between position in a sentence (as indicated by counting words from the beginning) and position within the tone space, r values were computed for both the level and declining tone space models for each of the six lexical tones.

The results of this analysis are shown in Table I. In all cases the correlation between sentence position and position in the tone space is lower for the declining tone space than for the level tone space. And in most cases there is not the faintest hint of a correlation in the declining model. (Interestingly, the rising tones are the exceptions to this statement; it is not clear why.)

Table I

r values for tones by sentence position.

Tone number:	55	35	33	11	23	22
Tone space model:						
Declining	.062	.323	.008	.009	.239	.095
Level	.615	.793	.377	.492	.820	.725

The results of this pilot study indicate that the phenomenon which I described earlier as tone preservation can be modeled (for these sentences) much more straightforwardly and simply by the incorporation of a declining tone space in the description of Cantonese tones in sentences. The level tone space model suffered from the limitation that the value of a tone within the tone space was dependent upon its location in the sentence. This runs counter to the native speaker's intuition that tones are preserved in sentence contexts.

It is also clear that this experiment has some rather severe limitations. First, the number of sentences analyzed was very small. In order to make a generalization about Cantonese it will be necessary to analyze a much larger number of utterances. Second, only utterances from one subject were analyzed. It may be that the pattern of results reported here is simply idiosyncratic with this speaker and has nothing to do with the speech of most Cantonese speakers. The possibility of cross-language interference should also be considered. And lastly, the utterances which were analyzed in this study were all isolated sentences. Hirschberg and Pierrehumbert (1986) found it more accurate to model final lowering as a discourse final, gradual decline in pitch range over a time period of half a second. As such, any tendency for a declining F0 across the utterances in this study may have been due to final lowering rather than declination. And so the experiment does not really constitute a test of the declination hypothesis. Almost all of these considerations were dealt with in the main experiment. (The possibility of cross-language interference could not be adequately addressed because of the nature of the subject pool available in Columbus.)

2. Main Experiment

The limitations of the pilot study were taken into consideration and an experiment was designed which avoided most of the problems which limited the interpretability of the pilot. The main difference between the two experiments was that a corpus of sentences was designed for this experiment with which the declination hypothesis could be tested.

The materials employed in this experiment incorporated three variables which tested various factors which may contribute to downtrend. The test sentences contained two test words which were segmentally similar and had the same lexical tone. The factors which were tested were length of test sentence, medial or final discourse position, and the number of sentence initial syllables (i.e. the number of syllables before the first test word).

The predictions of a model which includes declination versus a model in which there is no declination component are illustrated in Table II. In this table, an x in a given cell means that a factor could or should have a significant effect, and 0 means that it should not be significant.

Table II

Predictions for experiment 2 from two kinds of models

model	with declination	without declination
factor:		
long vs. short	x	0
discourse position	0	x (final lowering)
number of sentence-initial syllables	0	x (initial raising)

If speakers employ some sort of declination component the length factor should prove to be significant. It is, of course, possible that the length factor may be confounded with some other aspect of the test sentences in this experiment, and indeed in at least one test sentence this appears to have happened (it will be discussed later). When other factors which contribute to the F0 of a sentence are eliminated, the 'no declination' model predicts that length will not be a significant factor in F0 analysis.

If there is a final lowering factor in Cantonese we would predict that the discourse position of the test sentence will be a significant factor. This involves the assumption that final lowering is an indication of the end of a discourse and not a feature of every sentence within a discourse (see Hirschberg and Pierrehumbert 1986).

The presence or absence of initial raising should be indicated by an interaction of the sentence initial syllables variable with the length variable and by an overall difference in rate of decline depending on the number of sentence initial syllables. The interaction is expected because one of the test paragraphs confounds the length condition with the initial syllables variable.

2.1 Methods

The materials were designed to test for the effects of sentence length and discourse position on F0. Sentences were constructed in sets of three which constituted a short discourse, and in which the second and third sentences were interchangeable, thus allowing for a test of discourse position (whether the test sentence was medial or final). Each test sentence contained two target words (nouns with high level tone), one early in the sentence and another later. In one version of each test sentence the interval between the target words was short (from 2 to 5 syllables); in a second version, the interval between target words was long (from 5 to 8 syllables). In this way the effect of sentence length was included in the experiment. (The three sentence paragraphs which were used in this experiment are listed in the Appendix. There were six of these; they will be referred to as paragraph 1, paragraph 2, and so on.) The structure of each three sentence paragraph was thus:

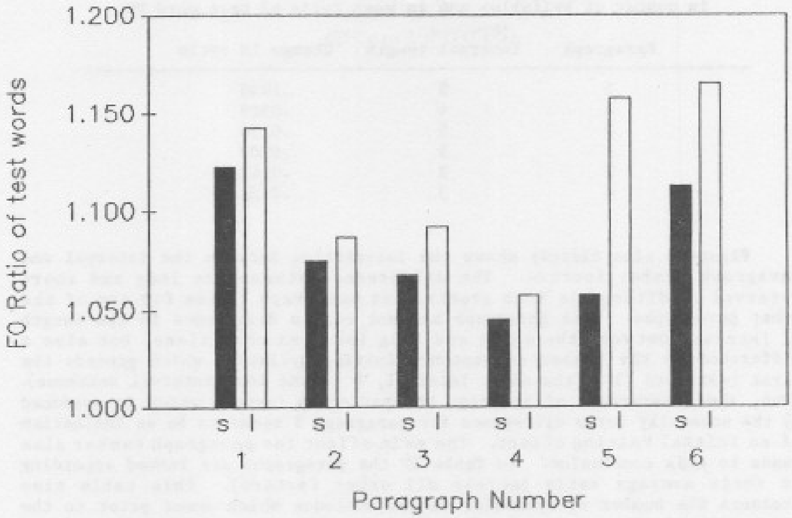
1. First sentence establishes the discourse topic.
2a. First version of the test sentence has a short interval between the target words.
2b. Second version of the test sentence has a long interval between the target words.
3. A filler sentence which can be interchanged with the second sentence.

These paragraphs were constructed by a native speaker of Cantonese and fellow linguist (Zheng Sheng Zhang) using target words which were matched in vowel quality and contained sonorants. Subjects read four versions of each paragraph (2 intervals (long vs short) X 2 discourse positions (medial vs final)). The corpus was thus composed of 24 paragraphs. They were written in traditional characters on separate sheets of paper.

Two speakers read the corpus a total of five times each. Each time the order of the items was re-randomized. Recordings were made in an anechoic chamber using high quality recording equipment. The fundamental frequency analysis was performed on a DEC PDP 11/23 using the Sift algorithm (or a modified cepstral processing technique) in the ILS signal processing software package. The two F0 measurements for each test sentence (measured at the end of each test word as in the first experiment) were converted to a ratio - TW1/TW2. Thus, for each of the 120 X 2(subjects) productions recorded there was a ratio indicating the relative difference between an early and late high tone under the various conditions being tested.

2.2 Results

In a repeated measures ANOVA performed on the data from this experiment the interval between test words proved to be a significant factor ($F(1,1)=59.39$, $p<.1$). The main effect for paragraph number was marginally significant ($F(5,5)=2.23$, $p=.2002$), and the interaction of the interval and paragraph factors was marginally significant ($F(5,5)=2.85$, $p=.1378$). No other main effects or interactions approached significance.



<u>Figure 6</u>: Mean F0 ratio of test words, divided by interval length and paragraph. Clear bars are for long intervals, shaded bars for short.

Figure 6 presents the results of this experiment. The vertical axis is the mean ratios of the test words, averaged over the two speakers. In all cases the ratio is greater than 1.00. This indicates that under all combinations of treatments the F0 of the first test word was on average higher than the F0 of the second test word. In this graph the length of a bar corresponds to the amount of F0 decline over the interval between test words. The twelve bars drawn in this graph represent the long and short interval conditions for each of the six paragraphs. The interval main effect which was reported above can be seen in this graph by comparing the short vs long condition for each paragraph. In all cases the short interval condition has a smaller amount of decline than does the long interval condition. As is clear in the paragraphs listed in the appendix the difference in terms of number of syllables between the long and short interval conditions is not the same for each paragraph.

Table III lists the differences between long and short interval conditions in terms of (1) number of syllables and (2) change in average ratio. There is a rough correspondence among these measurements such that greater change in length corresponds to greater change in ratio. This is consistent with the hypothesis that a declination component is involved in the production of intonation in Cantonese.

Table III

Differences between short and long interval
in number of syllables and in mean ratio of test word F0

Paragraph	Interval length	Change in ratio
5	5	.1038
6	4	.0519
3	3	.0236
1	5	.0203
2	2	.0143
4	3	.0126

Figure 6 also clearly shows the interaction between the interval and paragraph number factors. The difference between the long and short interval conditions is much greater for paragraph 5 than for any of the other paragraphs. This paragraph has not only a difference in the length of interval between the short and long interval conditions, but also a difference in the number of sentence initial syllables which precede the first test word (3 in the short interval, 0 in the long interval sentence). Thus, the interaction of interval and paragraph factors which is produced by the unusually large difference for paragraph 5 seems to be an indication of an initial raising effect. The main effect for paragraph number also leads to this conclusion. In Table IV the paragraphs are ranked according to their average ratio (across all other factors). This table also presents the number of syllables in the sentence which occur prior to the occurrence of the test word. The correlation between overall decline and position of the first test word relative to the beginning of the sentence is striking evidence for initial raising.

Table IV
Relationship between number of initial
syllables and F0 ratio

Paragraph	Ratio	Initial syllables
6	1.1383	0
1	1.1316	1
5	1.1076	1.5*
2	1.0808	1
3	1.0806	2
4	1.0501	6

*3 in short version and 0 in long version thus, 1.5 average.

3. Discussion

This experiment has identified some of the contributing factors to the downtrend found in the pilot study. Of the boundary effects, initial raising seemed to play a part in the realization of F0 in these utterances, while final lowering did not seem to be present. The present experiment offers no evidence in favor of positing any tonal interaction effects (if low level assimilation is not included in this category). Because of the reports to the effect that tone sandhi is limited in Cantonese, I chose not to include a test for tonal interaction factors. The possibility of tonal interaction should, however, be tested in an experiment which manipulates as an independent variable the identity of the tones which occur between two test words. Until such an experiment is conducted the question is an open one.

Finally, this experiment does provide evidence for a declination effect in Cantonese. It was the explicit goal of the experiment to test the declination hypothesis in an experiment which took Ladd's (1983) suggestions into account. The results indicate clearly the presence of a declination component in the production of F0 in Cantonese.

The declination component has a couple of properties which make it worthy of further study. First, unlike boundary effects and tonal interaction, declination is a global factor. As such it presents different challenges for explicit descriptive systems: for instance, whether declination should be modeled as a linear or logarithmic function; whether the rate of decline should be modeled as constant or varying; and how much preplanning should be included in a model of declination (there is a tendency for both steeply falling and slowly falling utterances to end at the same F0). It should be noted that the relative difficulty involved in modeling declination or the extra power that such a global effect adds to the formal power of the descriptive system is not a valid argument to the effect that declination is not really a factor in the production of speech. It is rather only an argument to the effect that declination is relatively difficult to model or that a powerful formalism is required to describe this aspect of speech. The presence or absence of declination is an empirical issue which must be decided empirically.

The second interesting property of declination is that it has a physiological motivation. Unlike boundary effects and tonal interaction the declination effect seems to have a physiological cause. Lieberman's (1967) proposal that virtually all F0 downtrend in English could be attributed to declining subglottal pressure has been discredited (see Ohala 1978). However, there is a tendency for a small decline in subglottal pressure over the course of utterances (Lieberman 1967, Ohala 1978). The correlation between subglottal pressure and F0 demonstrated by van den Berg (1958) leads to the conclusion that if subglottal pressure does decline during an utterance then the potential range for F0 will also decline. If declination is an automatic consequence of speaking while the other intonational effects discussed here are not, then there is the interesting possibility that the nonautomatic effects are derived from the more natural (physiologically motivated) one. This could be an explanation for the fact that final lowering and initial raising are common while final raising and initial lowering are not - that downstep is common while upstep isn't.

Acknowledgements

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Appendix: Sentence Sets

I. 1. sɔ·^{35} jaʊ̯^{23} kɛ·^{33} tɕɔ·ɪ̯^{21} li·ʊ̯^{35} toʊ̯^{55} hɔ·^{35} ji·^{23} tɕoʊ̯^{11} tɕɔ·ŋ^{53}
all material in all cases can do pack

søy^{35} kə jɛ·^{23}
water thing

2. (a) pɔ·^{55} $\boxed{\text{leɪ̯}^{55}}$ tɕøn^{55} haɪ̯^{11} pɔ·^{55} $\boxed{\text{leɪ̯}^{55}}$ tɕoʊ̯^{11} kɛ·^{33}
bottle be glass made

(b) pɔ·^{55} $\boxed{\text{leɪ̯}^{55}}$ tɕøn^{55} t^{h}oŋ^{21} ma·ɪ̯^{21} pɔ·^{55} leɪ̯^{55} pu·ɪ̯^{55}
bottle and drinking glass

haɪ̯^{11} pɔ·^{55} $\boxed{\text{leɪ̯}^{55}}$ tɕoʊ̯^{11} kɛ·^{33}
be glass made

3. søy^{35} t^{h}oŋ^{33} haɪ̯^{11} kəm^{53} sok^{11} wak^{11} tɕɛ·^{35} mak^{11} t^{h}aʊ̯^{21} tɕoʊ̯^{11} kɛ·^{33}
water bucket be metal or wood end made

II. 1. ha^{11} t^{h}i·n^{55} t^{h}ɕoŋ^{21} tɕi·^{35} tɔ·^{55} kwɔ·^{33} toŋ^{55} t^{h}i·n^{55}
summer insect suff. much more winter

2. (a) ji·ʊ̯^{33} $\boxed{\text{mən}^{55}}$ hœ·ŋ^{55} jaʊ̯^{11} jiʊ̯^{33} $\boxed{\text{mən}^{55}}$ tɕœ·ŋ^{33} si·n^{53}
must have mosquito incense and must have mosquito net only

tɕi·^{33} fʌn^{21} tək^{33} tɕœ·k^{11} ka·ʊ̯^{33}
sleep can

(b) ji·ʊ̯^{33} $\boxed{\text{mən}^{55}}$ hœ·ŋ^{55} mən^{55} jaʊ̯^{21} t^{h}oŋ^{21} ma·ɪ̯^{21} $\boxed{\text{mən}^{55}}$
must have mosquito incense mosquito oil and mosquito

tɕœ·ŋ^{33} si·n^{53} tɕi·^{33} fʌn^{21} tək^{33} tɕœ·k^{11} kaʊ̯^{33}
net only sleep can

3. tøy^{35} mən^{55} tɕən^{53} haɪ̯^{11} moʊ̯^{23} mat^{55} jɛ·^{23} hoʊ̯^{33} pa·n^{11} fa·t^{33}
as for mosquito really there is nothing good way of managing

III. 1. ŋɔ·^{23} tɕɛ·k^{33} ma·ʊ̯^{55} hoʊ̯^{33} pa·k^{33} ji·m^{33}
I meas. cat very naughty

2. (a) nɛ·^{55} tɕɛ·k^{33} $\boxed{\text{ma·ʊ̯}^{55}}$ tɕaɪ̯^{35} hoʊ̯^{33} tɕoŋ^{53} ji·^{33} tɕøy^{53}
part. meas. kitten much likes to chase

$\boxed{\text{koŋ}^{55}}$ kaɪ̯^{55} t^{h}oŋ^{21} ma·ɪ̯^{21} wa·n^{35} t^{h}ɛ·k^{33} p^{h}eɪ̯^{21} k^{h}aʊ̯^{21}
rooster and play kick leather ball

(b) nɛ·^{55} tɕɛ·k^{33} $\boxed{\text{ma·ʊ̯}^{55}}$ tɕaɪ̯^{35} hoʊ̯^{33} tɕoŋ^{53} ji·^{33} li·ʊ̯^{23}
part. meas. kitten much likes to tease

kaʊ̯^{35} tɕaɪ̯^{35} tɕøy^{53} $\boxed{\text{koŋ}^{55}}$ kaɪ̯^{55} t^{h}oŋ^{21} ma·ɪ̯^{21} wa·n^{35}
puppy chase rooster and play

t^{h}ɛ·k^{33} p^{h}eɪ̯^{21} k^{h}aʊ̯^{21}
kick leather ball

3. k^{h}øy^{23} fu·n^{53} heɪ̯^{35} wa·n^{35} sɪk^{33} jok^{55} kɛ^{33} jɛ·^{35}
it likes play moving part. thing

IV. 1. ŋɔ·^{23} saɪ^{33} loʊ̯^{35} hoʊ̯^{33} pa·k^{33} ji·m^{33}
my younger brother very naughty

2. (a) jaʊ̯^{21} jət^{55} jət^{11} k^{h}øy^{11} kɛ·^{33} saʊ̯^{35} tɕi·^{35} $\boxed{\text{meɪ̯}^{55}}$ jəp^{11}
is one day he poss. hand finger end put

tɕɔ·^{35} lɔ·k^{11} høy^{33} pɔ·^{55} $\boxed{\text{leɪ̯}^{55}}$ tɕøn^{55} toʊ̯^{33}
in down go bottle

(b) jaʊ̯^{21} jət^{55} jət^{11} k^{h}øy^{11} kɛ·^{33} saʊ̯^{35} tɕi·^{35} $\boxed{\text{meɪ̯}^{55}}$ ham^{11}
is one day he poss. hand finger end whole,

pan^{11} la·m^{23} jəp^{11} tɕɔ·^{35} lɔ·k^{11} høy^{33} pɔ·^{55} $\boxed{\text{leɪ̯}^{55}}$ tɕøn^{55} toʊ̯^{33}
entire put in down go bottle

IV. 3. k^{h}øy^{11} moʊ̯^{23} ɕi·^{23} tsəw^{21} wɑ·n^{35} ŋok^{55} k^{h}eɪ̯^{35} kɛ·^{33} jɛ·^{23}
he have not matter finish play home poss. thing

V. 1. sɛk^{11} ji·n^{55} tɕən^{53} haɪ̯^{11} hoʊ̯^{33} wu^{53} tɕoʊ̯^{53} kɛ^{33}
smoking certainly is very dirty

2. (a) m̩^{21} saɪ̯^{35} kɔ·ŋ^{35} ji·n^{55} tɕaɪ̯^{35} pin^{33} ji·n^{55} fu·ɪ̯^{53} la^{55}
not send say cigarette turn into ashes

(b) ji·n^{55} tɕaɪ̯^{35} t^{h}oŋ^{21} ma·ɪ̯^{21} ji·n^{55} tɕi·^{35} pi·n^{33}
cigarette and cigarette turn into
paper

saɪ̯^{53} ji·n^{55} fu·ɪ̯^{53} kɛ·^{33}
completely ashes

3. toʊ̯^{33} t^{h}cy·^{33} toʊ̯^{55} haɪ̯^{11} ji·n^{55} t^{h}aʊ̯^{35}
everywhere all be cigarette butt

VI. 1. sɪk^{11} ji·n^{55} taʊ̯^{35} hoʊ̯^{33} kwɔ·^{33} sɪk^{11} ji·n^{55} tɕaɪ̯^{35}
smoking pipe better than smoking cigarette

2. (a) ji·n^{55} taʊ̯^{35} haɪ̯^{11} moʊ̯^{23} ji·n^{55} t^{h}aʊ̯^{35} kɛ·^{33}
smoking pipe be have not cigarette butt

(b) ji·n^{55} taʊ̯^{35} m̩^{21} t^{h}ɕi·^{23} ji·n^{55} tɕaɪ̯^{35} kam^{33} jaʊ̯^{23} ji·n^{55}
smoking pipe not looks like cigarette so have cigarette

t^{h}aʊ̯^{35} kɛ·^{33}
butt

3. si·k^{33} ji·n^{55} taʊ̯^{35} kwɔŋ^{53} tɕɪn^{53} kwɔ·^{33} sɪk^{11} ji·n^{55} tɕaɪ̯^{35}
smoking pipe clean more than smoking cigarette