Collecting Phonetic Data on Endangered Languages

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ABSTRACT

Working with native speakers to find out about a language is one of the most rewarding and enjoyable activities in which linguists engage. Much of the crucial work to ensure a successful fieldwork experience is conducted in advance of actually collecting data in the field. Background work on the language should include locating all possible sources of data. Digital recorders and laptop computers provide enhanced opportunities for collecting accurate acoustic data. Acoustic and aerodynamic data can be supplemented with simple techniques for accessing articulatory data, such as palatography. Phonetic fieldwork is especially important given the endangered status of the majority of languages in the world.

1. INTRODUCTION

One of the most rewarding and important jobs of a linguist is working with native speakers of a language. The excitement of hearing foreign languages and testing hypotheses using live data is in fact what leads many linguists to do phonetic fieldwork. The experience of fieldwork can also be intellectually stimulating for the linguistic consultant providing the data, as questions posed by the researcher often lead the speaker to make interesting discoveries about her own language.

Despite the obvious joys associated with conducting fieldwork, gathering high quality data is a difficult job requiring patience, perseverance, and great care. It is virtually inevitable that, despite the most thorough preparation by the fieldworker, work will bring surprises, some good and others not so good. There are several steps one can take, though, to make the fieldwork experience smoother and more rewarding for both the researcher and linguistic consultants.

2. PREPARING FOR FIELDWORK

Much of the crucial work to ensure a successful fieldwork experience is conducted in advance of actually collecting data in the field. This statement holds true whether the fieldworker is conducting a general overview of the phonetic properties of a language or is collecting data to test very specific hypotheses about one particular phonetic aspect of a language, for example, the voice onset time of voiceless alveolar stops in different prosodic positions.

After you have found speakers who have agreed to participate in your research and have ethical approval from your home institution, a first useful step is to collect any existing materials documenting the phonetics and phonology of the language. Reading through these materials (and listening to audio recordings if any are available) will provide a sense of what is known about the language and what is not yet known, and will allow you to pinpoint what properties to target during the fieldwork study.

It is also an extremely good idea to locate a dictionary or word list for the language, since phonetic investigation of a language typically requires compiling lists of words or sentences designed to illustrate the phonetic properties of a language. Even if you are interested only in collecting narratives or conversations from speakers, a dictionary or wordlist will likely come in handy at some point during the fieldwork as questions arise about particular words in the recording. It is also highly advisable to contact any linguists who have experience working either with the language on which you are conducting fieldwork or with other related languages. They might be able to direct you to sources on the language, point you to areas of potential phonetic interest, or bring to your attention facts about the language which could necessitate modifications in your experimental design. If you are conducting the first quantitative phonetic study of a language, a researcher who has prior experience describing the phonology of that language might even want to accompany you on your fieldwork trip, in which case the experience is likely to be more fruitful and efficient. In any case, it is a good idea to bring the written materials you consulted on the language to your data collection sessions, as it may be necessary to consult these materials on the spur of the moment if any adjustments to your corpus are necessary.

Once you have done background work on the language and have located linguists familiar with the language, you must decide on the data you plan to collect and the equipment you will use to record the data. Data can assume many different forms ranging from lists of individual words to sentences to narratives to conversations. If you are only collecting narratives from individuals or recording conversations, you need not worry about preparing word lists, though it is likely that there are at least some items you will want to elicit. Elicitation is particularly important if you desire a basic phonetic description of the phonemes of a language (as is often the case in working with endangered languages),

including such properties as vowel quality, segment duration, tone, voice-onset time in stops, etc. A wordlist ensures that you will be able to measure phonetic properties of all sounds occurring in comparable environments; there is no guarantee that all sounds will be represented in comparable contexts in a conversation or story. On the other hand, if you are investigating certain suprasegmental properties such as prosodic organization, intonation, or sentence-level stress, less controlled and more natural data can be valuable and, in some cases, even essential. The rest of this section will focus on wordlist corpora, however, since these require substantial preparation on the part of the fieldworker.

There are a number of considerations involved in constructing a corpus to elicit from speakers, the most important of which are the goals of your research. If you have a specific goal, such as examining voice onset time in obstruents, you would tailor your list to include the targeted sounds. For example, if voice onset time were your focus, you would want a list of words in which all obstruents (or some predetermined subset of obstruents) are represented in different contexts, e.g. word-initially, intervocalically, word-finally. If, however, your goal is a general description of the phonemes of a language, you would want to include all sounds, and ensure that phonemes belonging to the same phonetic class occur in comparable contexts. Thus, consonants should occur in the same position, e.g. word-initially before a vowel, preferably the same vowel, as should vowels, e.g. in the first syllable of words between bilabial consonants. Controlling for environment is important, since you are primarily interested in the target sounds and not the context in which they occur, unless of course you are conducting a study of contextual variation in the realization of a sound. If all your consonants occur word-initially before the vowel /a/, you can be fairly confident that any differences (for example, differences in voice onset time) that you observe between the stops are attributed to the stops themselves. If, on the other hand, /t/ occurs before /a/ in your corpus and /k/ occurs before /i/, it will be unclear if observed differences between /t/ and /k/ in voice onset time are due to differences between the consonants themselves or to differences in the vowels. Confounding variables (in this case, consonant place and vowel context) makes data interpretation difficult.

In addition to examining properties of phonemes (and potentially, allophones), you might also want to investigate suprasegmental features such as tone and stress, in which case your measurements would include fundamental frequency, and, in the case of stress, probably also intensity and duration. The same principles of controlling environment apply to these properties; surrounding context should be as similar as possible across the syllables or vowels targeted for measurement.

It is highly advisable to check the wordlist with a native speaker before your trip or to find a speaker at the beginning of the trip who has some extra time to go over the list with you. In any case, it is important to be flexible and to have some back-up words, as some speakers may not know certain words on your list. If time with consultants will be limited (as it often is), one should divide a word (or sentence) list into separate sections according to the essentialness of the data. The first words recorded should be the ones which are most crucial to testing your core hypotheses and/or illustrate the basic phonetic structures of the language, while other interesting but less critical data should be elicited afterwards. Every word should be elicited at least twice in case one repetition is affected by any fleeting background sounds or dysfluencies on the part of the speaker.

There is not a fixed recipe for number of speakers one should record, though increasing the number of speakers can help to ensure that properties discovered during elicitation are general properties of the language as opposed to characteristics of individual speakers. In general, one should record at least three male and three female speakers for a quantitative phonetic study with an ideal target being six male and six female speakers [5].

3. INSTRUMENTATION TECHNIQUES

3.1 Acoustic recordings

There are several options a fieldworker has for recording data and several types of data one can collect. The most basic type of data consists of acoustic recordings. Nowadays linguists usually make digital recordings using a high quality microphone with a good signal-to-noise ratio connected to either a DAT recorder, a minidisc recorder, or directly to a laptop computer. Minidisc recorders are considerably less expensive than DAT recorders and are fairly durable, but they rely on a signal compression algorithm that DAT recorders do not. Capturing data directly on a laptop computer is perhaps the most time-effective way of collecting data, since one ultimately must transfer data onto a computer in preparation for acoustic analysis. For collecting or transferring data onto a laptop, there are several pieces of software now available. One powerful piece of software which has the advantage of being available as a free download for either Mac or PC is the Praat program developed by Paul Boersma and David Weenink (www.praat.org). Another downloadable program is SFS, which is available at the University College London website (http://www.phon.ucl.ac.uk/resource/sfs/). Yet another (more expensive) option is the PCQuirer/MacQuirer software developed by Scicon Research and Development (www.sciconrd.com). Both of these programs enable the user to analyze several phonetic properties, including fundamental frequency, duration, overall intensity, and the frequency distribution of energy using power spectra and LPC analysis.

Regardless of the recording medium, one should have a back-up system available in case your primary system

fails. One possibility is a professional quality analog cassette recorder with a high signal-to-noise ratio (≥45 dB) and a broad frequency ratio, minimally up to 12kHz [5]. Before a field trip, all recording equipment should be thoroughly checked (and cleaned and demagnetized in the case of analog recorders), and spare batteries (or rechargeable ones) should be brought along as well.

Acoustic recordings are an informative and non-invasive way of finding out about many aspects of speech. Some basic displays that one might want to examine include the following, all of which are available in many acoustic analysis programs including Praat, SFS, and Pc/MacQuirer. For measuring duration of a sound, it is useful to look at a waveform in conjunction with a spectrogram. A wideband spectrogram is an excellent general display which allows for segmentation of a word into individual sounds and provides information about both the time course of the utterance and the distribution of energy in the frequency domain. Figure 1 contains both a waveform and a spectrogram of a word in Chickasaw (a Muskogean language spoken in Oklahoma) made using PcQuirer. For examining the pitch of a sound, e.g. in a tone language or in the investigation of intonation, a pitch trace is useful (see figure 2). For a study of vowel quality, an FFT power spectrum together with an LPC analysis provide information about the formant frequencies of vowels, allowing one to draw inferences about the position of the tongue. Figure 3 shows both a spectrum and an overlaid LPC curve for the vowels /i/ and /a/ taken from a Chickasaw word. The peaks in the LPC display occur at the resonating frequencies of the vocal tract for the measured vowel and occur in close proximity to the most intense harmonics in the accompanying spectrum. Power spectra are also useful for examining the distribution of noise in fricatives [1]. Further discussion of various types of acoustic analyses can be found in an acoustic phonetics textbook, e.g. [2].

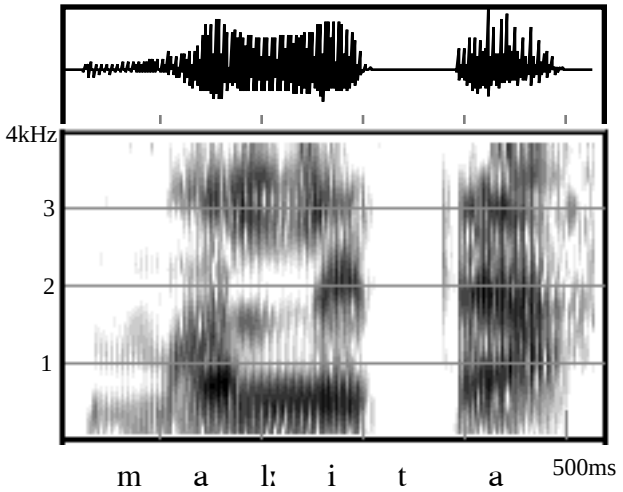

Figure 1. Waveform and spectrogram of Chickasaw word /maliːta/ 'Is s/he jumping?' (female speaker)

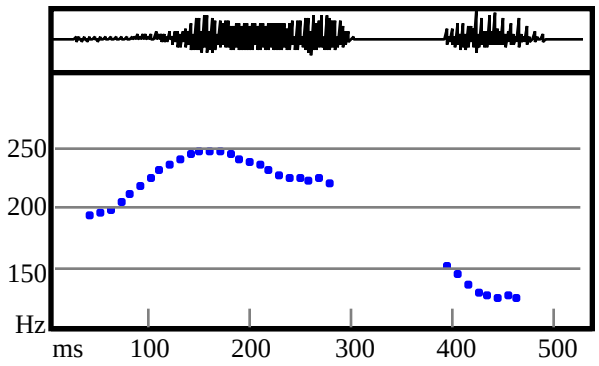

Figure 2. Waveform and pitch trace of Chickasaw word /maliːta/ 'Is s/he jumping?' (female speaker)

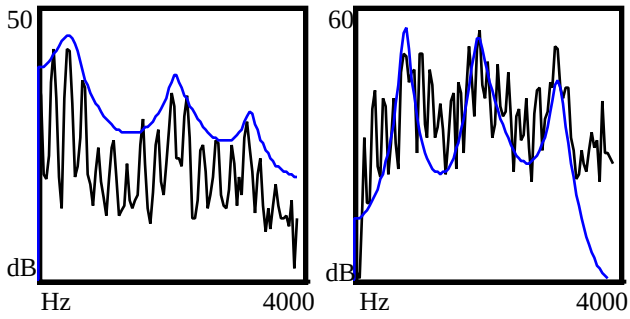

Figure 3. FFT spectra and LPC from /i/ (on left) and 2nd /a/ (on right) in Chickasaw word /maliːta/ 'Is s/he jumping?'

3.2 Aerodynamic data

Another potentially valuable source of information comes from aerodynamic analyses of air pressure and flow. Aerodynamic data are particularly instructive in describing consonants produced with different airstream mechanisms, e.g. ejectives and implosives, cf. [3]. Examination of nasal and oral air flow is useful in determining the degree to which a sound is nasalized or not [4]. Pressure and flow data can be collected from both the nose and the mouth non-invasively using masks containing transducers connected to a laptop computer via an A-D conversion box. Each transducer produces an output recorded as a separate channel to accompany the audio signal (assuming you are simultaneously making an audio recording with a microphone). For the researcher interested in recording the pressure within the mouth, it is also possible to connect a pressure transducer to a small tube placed behind the lips to record intraoral pressure changes. Figure 4 illustrates oral and nasal airflow and the audio signal for the sequence /amp'a/ as uttered by the author and collected using the hardware that is available as an option for purchase with Pc/MacQuirer. The reader is referred to [5] for more thorough discussion of techniques for collecting aerodynamic data.

3.3. Articulatory data

For the researcher interested in documenting details about place of articulation beyond coarse descriptions of constriction location, palatography provides a fairly simple way of collecting data on consonants produced

with the tongue tip or blade [6]. The speaker's tongue is painted with a mixture of charcoal and olive oil [6], before the speaker is asked to produce a word containing the sound of interest. The tongue will leave residue from the charcoal-oil mixture on the portion of the roof of the mouth where there is contact. The exact location of the contact can be recorded using a video camera to yield palatograms like the ones in figure 5, which illustrates a denti-alveolar and post-alveolar stop as uttered by a speaker of the Austronesian language Ndumbea [7]. Ideally, the sounds in the word other than the target consonant should be produced with minimal contact between the tongue and the roof of the mouth since any other contact other than that associated with the consonant of interest will obscure the data for the target consonant. Low vowels make for good surrounding contexts for palatography on consonants.

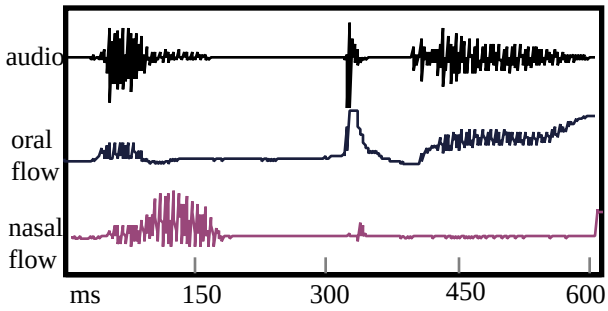

Figure 4. Oral and nasal flow (with audio) for /amp'a/

A video camera can also be used to collect data on sounds involving the lips, e.g. rounded vowels or labial consonants [8].


Figure 5. Palatography of denti-alveolar /t̪/ in /t̪aː/ 'reef (on left) and post-alveolar /ṭ/ in /ṭá/ 'ground' (on right) in Ndumbea (from [7])

It is conceivable that more advanced techniques for collecting articulatory data, e.g. electropalatography and electromagnetometry, will become possible in the field in the future, as devices for capturing this type of data become smaller and more portable.

4. CONCLUSIONS

Advances in technology have dramatically increased possibilities for collecting quantitative phonetic data of endangered languages in the field. Digital recorders and laptop computers have enhanced opportunities for collecting accurate acoustic data. Acoustic and aerodynamic data can be supplemented with simple techniques for accessing articulatory data, such as palatography. As technology advances, even more opportunities for collecting data in the field promise to become available. Technology is nevertheless no substitute for the substantial preparation necessary for a successful fieldwork experience. As a final note, it should be mentioned that this paper has offered only a brief description of some of the issues related to phonetic fieldwork; the reader is referred to [5, 9] and the papers by Paul Foulkes, Peter Ladefoged, and John Wells in this session for more complete discussion of data collection methodology, as well as [10] for discussion of other fieldwork related topics.

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