ICA 2013 Montreal
Montréal, Canada
2 - 7 June 2013

Speech Communication
Session 1aSCa: Distinguishing Between Science and Pseudoscience in Forensic Acoustics I

1aSCa4. Assessing acoustic features in the speech of asylum seekers
Judith Rosenhouse*

*Corresponding author's address: Linguistics, SWANTECH Ltd, 89 Hagalil St., Haifa, 32684, Israel, Israel, swantech@013.net

One of the areas of forensic linguistics concerns asylum seekers who speak languages which are foreign to the official language of the country where they apply for asylum. Identifying and verifying their real national background may be difficult if their speech manner reveals non-typical properties of their (real or alleged) native languages. Governments submit speech samples of such asylum seekers for linguistic analysis on various levels, including phonetic acoustics. This aspect of forensic linguistics raises questions about the scientific merit of such an analysis. Our aim is to examine some of the questions which relate to segmental and supra-segmental features that are analyzed acoustically based on recorded samples of (alleged) native languages of asylum seekers and compared with the same features as known from the literature. We demonstrate such issues by examples from the speech of Arabic-speaking asylum seekers whose native tongue is (supposed to be) some local dialect but the recording includes foreign features reflecting different dialects or languages. These questions involve sociolinguistic factors that affect speech production of individual speakers due to their complicated and unstable life. We suggest that the acoustic methods currently used for dialect verification could be considered pseudo-science in many cases.

Published by the Acoustical Society of America through the American Institute of Physics
Introduction: Asylum Seekers and LADO

One of the areas that have been recently developing in forensic linguistics, in addition to speaker or speech identification, concerns asylum seekers’ (AS’s) determination of origin. These ASs speak languages which differ from the official language(s) of the country where they apply for asylum, and governments usually submit their speech samples to linguistic analysis. Such language examinations have been named LADO, i.e., Language Analysis for the Determination of Origin (Zwaan 2010, Zwaan et al., 2010b). The goal of these tests is to identify and verify the ASs’ real national background by identifying their mother tongue. But this process, and LADO reports in general, have raised many questions and doubts about their scientific merit.

Forensic linguistics examinations are often executed using computerized speech analysis programs, involving the analysis of the acoustic and phonetic features of the recorded speech samples and statistical calculations (cf. Rose, 2002, Gold & French, 2011). But in the context of LADO such analysis is not always implemented. Instead, a LADO report may be based on auditory analysis of the main linguistic fields, i.e., phonetics, morphology, syntax and lexicon in the AS’s recorded speech sample. The AS is usually recorded in an interview with an interpreter who speaks both the official language of the country and the AS’s language (not always the AS’s dialect), as described in Zwaan (2010), Rosenhouse (2010), etc.

The assumption that “language proficiency = political origin” is in itself questionable, as already discussed elsewhere (e.g., Zwaan, 2010). But it may be even more difficult to identify an AS’s (real or alleged) native language if the recorded speech reveals atypical properties of that language.

This paper aims at examining a few questions that relate to acoustically/phonetically analyzed segmental and suprasegmental phonetic features. This consideration is based on recorded ASs’ speech samples and compared with the features in their (alleged) native language. The ultimate goal of this study is to answer the question whether this is a scientific or pseudo-scientific area.

Before delving into the study, let us look at the definition of the term “science.” In Webster’s Dictionary (1979: 1622) we find the following definitions: “1. originally, state of fact of knowing, knowledge as often opposed to intuition, belief, etc. 2. Systematized knowledge derived from observation, study and experimentation carried on in order to determine the nature or principles of what is being studied. 3. A branch of knowledge or study especially one concerned with establishing and systematizing facts, principles and methods as by experiments and hypotheses, as the science of music. 4. (a) the systematized knowledge of nature and the physical world (b) any branch of this. 5. Skill, technique or ability based upon training, discipline and experience.” These aspects of the term will be at the background of our study.

Method

In trying to answer the leading question, i.e., whether this is science or pseudo-science, we raise here four questions. As the speaker’s identity is known, we do not concern ourselves with identification or recognition (as usually asked in forensic linguistics cases) but with comparison of the recording with the claimed language/dialect and identification/verification of the speaker’s idiolect. The questions are discussed and demonstrated with examples of Arabic speaking AS’s. Our answers are summed up and concluded in the sections that follow the examples.

The Questions

*Question 1* Taking into account the fact that individual speakers’ phonetic features vary even when repeating the same utterance (word, syllable, phoneme), how can a single speech sample of a single speaker reflect a dialect or a language for LADO?

It is common knowledge (at least for phoneticians) that phonetic/phonological systems of different languages differ. So are different speakers’ idiolects when speaking one and the same language. Intraspeaker phonetic variability has also been shown. It is (partly) due to different circumstances and factors such as different speech styles and intonation patterns following different physiological, environmental circumstances, etc. (e.g., Atkinson, 1976, Braun, 1995, Lindh, 2006, H&H theory and Fig. 5, p. 418 in Lindblom (1990), Marrero et al., 2008, Nolan 1983, and others). Various phonetic studies accordingly
require speakers to repeat the test utterances several times and then the relevant features are extracted, normalized and averaged.

If an AS produces different variants of some phoneme - which variety should be considered “basic” or “the real” AS’s mother tongue? Figures 1-6 present an AS’s /r/ which fluctuates (also elsewhere in the recording) between two articulation manners. His /r’s differ from the interpreter’s /r/ (who does not speak the AS’s dialect). We present this consonant especially because it is not often discussed in CA phonetics, in spite of its variants. The figures below are extracted from a dialog between an Interpreter (I) and an AS:

I: /ʕaʃiːra uxra? aw hiyya al-ʕaʃiːra r-raʔisiyya/? ‘…another tribe? Or is it the main tribe?’ AS:/howwa ʕaʃiːra maʔal jaʔani e…ʕaʃiːra jaʔani/ ‘It is a tribe like, it means e... tribe, it means.’ Other phonetic differences in the pronunciation of the word by these two speakers are summed up in Table 1. The Table reveals that the AS’s phonetic/acoustic features are generally more similar to one another than to the Interpreter; but comparing a single candidate’s details with another one does not enable a valid statistical analysis. Now, what is the language analyst’s answer to our question to be based on – personal knowledge of the language/dialect, statistical analysis of the AS’s variants, the matching of these features with those reported in the literature of that language, or some other considerations? Any answer would be arbitrary to some extent if it is not possible to compare the AS’s features with some base line. So: can such a report be considered scientific?

### TABLE 1. DURATION, PITCH, INTENSITY AND FORMANTS OF ‘aʃiːra BY TWO SPEAKERS

<table>
<thead>
<tr>
<th>Parameter/ Speaker/</th>
<th>Duration (s.)</th>
<th>Av Pitch (Hz.)</th>
<th>Av. Intensity (dB)</th>
<th>Av.F1 (Hz.)</th>
<th>Av.F2 (Hz.)</th>
<th>Av. F3 (Hz.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interpreter</td>
<td>0.540</td>
<td>137.7</td>
<td>60.7</td>
<td>395</td>
<td>1738</td>
<td>3059</td>
</tr>
<tr>
<td>AS(1)</td>
<td>0.624</td>
<td>162.2</td>
<td>59.4</td>
<td>418</td>
<td>1495</td>
<td>2830</td>
</tr>
<tr>
<td>AS(2)</td>
<td>0.493</td>
<td>159.2</td>
<td>61.8</td>
<td>410</td>
<td>1518</td>
<td>2825</td>
</tr>
</tbody>
</table>

**Q2 Which phonetic features are important in an AS’s Arabic speech sample?**

Many ASs come from linguistically “terra incognita” places in Africa and Asia whose official language is Arabic. Even dialects from large and culturally, politically and economically important countries have been studied mainly generally and not to their fine phonetic details. Moreover, urbanization and migrations in the last century created many (as yet) un-documented linguistic changes. In addition, many of the linguistic studies of Arabic dialects focus on their sociolinguistic aspects, and much less on phonetics. (Even the highly technical and methodologically updated studies in Hassan & Heselwood (2011), for example, do not cover all the Arabic dialects, not to mention all their phonetic features.) The answer to our Question 2 involves distinguishing features of a dialect from those of other dialects and identifying each dialect’s features. But this requirement is not possible in many cases. The basic question should really be as follows: without knowing all the facts, can a language analyst’s report reflect a scientific decision?

**Q3 Which foreign features should be considered relevant for dialect/language distinction in an AS’s speech sample?**

Almost all the languages/dialects include foreign features since they are usually not isolated. Thus many words are borrowed from one language and integrated in the vocabulary of another. E.g., many English words are now known and used all over the world). Similarly, speakers of a less dominant dialect may adopt phonetic features of the loanwords from a dominant dialect or a foreign language e.g. /p/ in Arabic speakers. Thus, an AS who otherwise is not supposed to know English may use an English consonant in English loanwords in the speech sample. What is the implication of such foreign items and how should the linguist consider them in the LADO report – are they foreign or not? The consonant /p/ is not part of the Arabic system and usually /p/ > /b/ in CA. Yet, in loanwords such as “petrol,” “pump” or “pipe” an AS may use this consonant. So, is his/her phonetic system typical of the native speaker’s dialect, or not? (See Fig. 7.)
FIGURE 1. /avanaugh/ '(and) tribe' (AS1)

FIGURE 2. /ira/ in AS1 /Yahwe/ (/r/ marked in pink)

FIGURE 3. /Isra/ (AS2)
Q4 How should we consider foreign features in an AS’s speech sample in our “global village?”

For Arabic it is not simple to answer this question, firstly because there are so many dialects and languages which an AS might acquire. For example, Cairo /g/ is used in Cairo for a phoneme that in other Arabic dialects is pronounced as /d/ or /g/. But /g/ also occurs in some other (e.g., Bedouin) dialects as the reflex
of /q/. Now, /q/ is also the standard pronunciation of a consonant in Modern Standard Arabic (MSA), which in various dialects is pronounced as /dz/, /dz/, /g/ or /g/. That is to say, the same sound serves for different phonemes in different dialects, and different sounds may reflect one phoneme in different dialects. MSA is the literacy medium, studied at school and spoken on formal occasions (in addition to reading and writing. An AS may use phonetic MSA features (e.g., /q/ instead of /g/), since the LADO interview is a formal event. How then should a linguist assess this /q/? Does it indicate that the AS is literate, or that the AS’s original dialect retains /q/, or that s/he fakes the speech of a literate Arab speaker since s/he is really from a non-Arab origin? Fig. 7 presents a Moroccan Arabic utterance, which contains the non-original-Arabic /p/, the typical Moroccan affricate /t/ (for /t/ elsewhere) and MSA grammatical elements. Fig. 8 shows some other MSA grammatical features in the same AS’s speech. This is a typical picture of the mixed state of CA. It also indicates that a speech sound can imply issues beyond phonetics, which linguists ought to consider. But do foreign elements annul the possibility that an AS speaks the claimed dialect as a native speaker? Which scientific approach defines it? Is it science?

**FIGURE 7.** AS: /wulītisu fi a'līf taṣniyati u-tsalisin fi madīnat P./ ‘I was born in 1993 in the town (of) P.’ (Moroccan CA)

**FIGURE 8.** AS /wa-'innahu kāna majjizan/ ‘and that he was distinct’ (MSA)

**Intonation**

This phonetic domain is generally more complex to study than segmental examples for (1) it refers to longer speech sequences, (2) there are less intonation studies of specific Arabic dialects, and (3) ASs do not usually use the whole range of their intonation patterns in an interview, because they mainly use statements
in answering the interpreter’s questions. Thus, an analysis of basic features of Cairo intonation (e.g. in Hellmuth, 2010) may not be relevant for a speaker who comes from another dialect-community, even if it is in Egypt. Therefore, even if language analysts recognize an AS’s dialect upon hearing it (without relying on literature), it is difficult to verbally describe its relevant features in the LADO report. Furthermore, without using speech analysis programs, how can they, how can they describe (in the report) the differences between what they hear and what the AS’s intonation pattern is supposed to be or to indicate? As they are not present at the interview and work only with a recording, how can they know what happened at the recording which causes the AS to pause, or use some unexpected intonation pattern? Again: these issues do not enable considering such reports as completely scientific.

Discussion and Conclusion

This paper began with the definitions of “science” in Webster’s Dictionary (1979: 1622), which showed various applications and contexts of the term. Definition (1) there contrasts knowing with “intuition, belief etc.” – the examples above suggest that the LADO reports are not necessarily purely based on knowledge but they may be based on intuition (due to lack of scientific evidence). Definition (2) stresses the need for “observation, study and experimentation” used in “systematized knowledge”; but these activities cannot be attributed to a language analyst who works without the ability (and permission) to use data of different ASs for their reports. Thus, each case is apparently a single case study, which cannot yield a valid and generalized knowledge or science. The same consideration can be repeated for definition (3) which deals with “establishing and systematizing facts, principles and methods” – unless one considers meta-activity such as the present one – but this is not an example of the day-to-day work of a language analyst. Also definitions (4) cannot be relevant for the work of language analysts, because they do not usually deal with “the systematized knowledge of nature and the physical world (b) any branch of this.” Apparently, only definition (5) could be attributed to LADO report writing because it requires “skill, technique or ability based upon training, discipline and experience.” Yet, this mentioned skill is not based upon a well-defined training for a well-defined discipline, as several publications point out, though experience does help in analyzing AS’s recordings. So, even from a purely theoretical perspective the task of language analysts can be hardly described as scientific.

The questions raised above are (at least for this author) basic in the context of LADO, but their answers are not simple. Question 1 shows speech variability. To answer question 2 the language analyst should know the phonetics of the AS’ dialect, and not always is it feasible, since there are so many dialects. Question 3 examines a language-specific issue, involving more than one language system. Question 4, on the other hand, reflects the linguistic mixture in our “global village.” Thus, many linguistic and extra-linguistic aspects are involved in a LADO report. Statistical methods are applied in many scientific fields, including speech analysis and synthesis. But even the statistical “likelihood ratio” method (described in, e.g., Rose, 2002) cannot usually promise 100% certainty that a speech sample reflects an AS’s assumed or claimed dialect/language, when not all the necessary information is available. Likelihood Ratio in a report may be large (e.g., above 80%), but this still does not prove that the AS really belongs to the claimed origin and that the recorded sample is his/her mother tongue. In fact, at present the practice reflects language analysts’ level of certainty according to some (unofficial, variable and indefinite) scale of certainty of the correctness of his/her opinion (cf. again Gold & French, 2011).

We should also think of the terms science / pseudo-science in their relation to linguistics. Languages are not static but develop and change constantly. Languages have rules, but the actual facts are often unexpected (chaotic). To start with, each speaker has somewhat different vocal tract structure, features, etc., which yield somewhat different results when considering acoustic-phonetic vocal and speech features. Therefore, linguistic rules are not considered (as yet?) in the same manner as mathematical or physical rules (though the 20th century has shaken also many of these laws). Gold and French (2011) note that the combined features are considered important in forensic linguistic cases, and thus not only phonetic features should be considered for LADO. Can then a relativity theory be defined for languages? This has hardly been done so far, and definitely not for LADO or forensic linguistics in general.

Concerning Arabic, as demonstrated here, “Likelihood Ratio” goes only partly towards a solution. Lack of data about many dialects and their features is a major drawback in this problem. In addition, numerous related questions appear, e.g., who should do the linguistic analysis for LADO reports (a trained linguist or
a native speaker?), what should a language analyst do if an AS does not produce typical features of the dialect s/he claims to belong to (missing information), how to assess mixed Arabic varieties and features (since, e.g., mixing MSA and CA features are normal in daily Arabic communication), etc. Yet, LADO requires language analysts to decide to what extent (at which level of certainty) a speaker’s phonetic features (or all the linguistic features) reflect a certain language/dialect.

Elsewhere (Rosenhouse, 2011) we proposed a large computerized research project, like a data bank, which would analyze the phonetic features of CA dialects and MSA (as well as the rest of the grammatical and lexical features). Each AS case may add and combine the various features into a general picture of ASs’ speech of a certain dialect. But this is a huge project. To begin with, it initially requires much field work for data acquisition (which is still lacking, as noted) from the entire Arabic-speaking world. Moreover, this would be a never-ending task due to the continuous changes that occur in every living language, including Arabic. Some Arabic data banks exist (e.g., LDC in the USA) and are being developed and studied in various research programs (e.g., Biadsy et al., 2010), but they are not designed for LADO goals, as far as we know. For the time being, then, it appears that in LADO cases of ASs’ speech as part of forensic linguistics, the phonetic-acoustic features are to be considered rather pseudo-scientific. At present, we will therefore call (like Gold & French, 2011, and Zwaan et al., 2010a) for more discussions of the problems involved in the search for unified scientific methods for LADO within forensic linguistics.

REFERENCES