ICT Innovations 2009

[Hardcover]

Danco Davcev (Editor), Jorge Marx Gómez (Editor)

Table of Contents

Invited Keynote Papers

Proceeding Papers

Phonetic Experiment Web Application

Anastazija Kirkova-Naskova[2], Goran Bakraceski[1], Vladimir Apostolski[1], Dimitar Trajanov[1]

[1] Faculty of Electrical Engineering and Information Technologies, Karpoš II bb, 1000 Skopje
[2] Faculty of Philology "Blaže Koneski" Bul. Krste Misirkov bb, 1000 Skopje

akirkova@t-home.mk, goran.bakraceski@ feit.ukim.edu.mk, vladimir.apostolski@feit.ukim.edu.mk, mite@feit.ukim.edu.mk

Abstract. This paper describes the development of a methodology and software for phonetics designed with the support of the Internet and web technologies. A web application was created as a data gathering instrument for a phonetic study which aimed to detect the most frequent segmental markers of Macedonian-English accented speech as perceived by native speakers of English and to find out whether English native speakers of different backgrounds perceive the same segments as non-native. The results demonstrate the manifold advantages of the approach as well as the flexibility of its adaptation in applied linguistic research and second language learning/teaching.

Keywords: web application, online experiment, phonetics, computer-assisted research

1. Introduction

In recent years the incorporation of computer technology in various fields of scientific research has increased enormously and become necessity in itself. One such field where computer assistance marks advancement and yields remarkable outcomes is theoretical and applied linguistics, in particular phonetics, phonology and second language phonological acquisition [4]. Studies related to speech recognition, text-to-speech synthesis, spoken dialogue systems, and speech corpora (recording, archiving, tagging, transcribing) make use of specialist software packages. Furthermore, technology is more and more used to manipulate second-language phonological components in studies related to L2 speech perception and production, foreign accent phenomena, spoken comprehensibility and intelligibility, development of listening and speaking competence as well as to teach particular aspects of L2 pronunciation.

Research practice with foreign accent ratings and segmental analysis studies has shown that traditional methodology of conducting such experiments can be lengthy

and wearisome both for the researchers and the participants [2]. For the researchers, this usually involves hours and hours of speech materials preparation. The listeners, on the other hand, are expected to listen to recorded speech stimuli and complete various identification /discrimination tasks or to provide detailed phonetic analysis. As a result, they may become impatient, bored and indifferent thus compromising the validity of the responses. To avoid such problems, researchers started to use computer technology to manipulate speech in order to gain empirical evidence of comprehensibility, fluency and native and non-native perceptions of foreign accents [8, 9]. However, such attempts were made in highly controlled laboratory conditions, with expensive equipment and with limited number of participants.

Only recently have the possibilities that the Internet offers been challenged; apart from general linguistic questionnaires and surveys administered via the Internet and quiz-based applications for practicing phonetic symbols and target sounds, the study conducted under the auspices of the Utrecht Institute of Linguistics OTS in the Netherlands [11] employed a large-scale Internet survey which addressed the issue of intelligibility and acceptability of non-native pronunciation features by English native speakers. In this study the WWStim [13] software is used. WWStim is a perl CGI script for presenting web-based questionnaires and experiments. The system basically presents predefined sequences of template based HTML pages. One of the shortcomings for which we could not use this software was its inability to display phonetic symbols.

In addition to the expensive equipment and the length of the experiments, another drawback with the phonetic studies that collect responses for segmental elements and global accent ratings is the specific listeners' profile required for the experiment and their availability at the time of the study. Flege [5], for example, argues that despite the possibilities of gathering quantitative measurements of foreign-accented speech, it is the qualitative judgments of native speakers that remain "the golden standard". Furthermore, many studies have concluded that ratings gathered from phonetically trained and experienced listeners have proved more reliable [1, 3, 10].

The web application we created was part of a phonetic experiment which was designed to determine and describe the vocalic and consonantal markers of foreign accent in the speech of Macedonian speakers learning English as a foreign language as perceived by English native speakers who speak different English dialects. The choice for such approach was determined by the particular research context with respect to: a) the applicability of traditional methods employed in similar research studies; b) our knowledge of more recent attempts of Internet survey use; and c) the prerequisite for a specific target group of native speakers.

In summary, for the purposes of the phonetic experiment we needed English native speakers speaking different English varieties with linguistic or phonetic expertise; to our misfortune, no such high profile specialists resided in Macedonia. We also wished to address a wider audience and gather relevant linguistic data in a short period. To avoid these shortcomings, the experiment was designed as a web application and eventually proved to be an invaluable tool for gathering authentic listeners' data. We also wanted to design a general purpose software that can be easily adapted for the requirements of future research studies involving language phenomena and in the language teaching/learning practice not only for Macedonian and English but for any other language.

2. Software solution description

2.1 Software Requirements

From a technical point of view, we were required to develop a web application that would be able to display a predefined set of questions and keep track of the checked answers by each of its users (namely the English native listeners). In addition, our team had to provide an easy way to play audio files inside the web page itself. Also, the experiment administrator was able to create accounts for the users. Users could choose answers from check box lists or radio button lists, and free text boxes were also available so that the listeners could make comments on speech phenomena they had heard or noticed. The users were not allowed to go backwards with the experiment. They were, nevertheless, allowed to opt for a break during the experiment. To finish the experiment, they were instructed to log in again and continue where they had stopped i.e. by being redirected to the next question. At the end of the experiment, the users were given an option to choose whether they wished to receive an e-mail notification about the results of the phonetic experiment.

2.2 Development Tools and Environments

For the development of the application, we used the Microsoft ASP.NET 3.5 technology, which is especially suitable for developing dynamic web applications, such as the Phonetic Experiment Web Application. The code was written in C# 3.0 and Microsoft Visual Studio 2008 was the development environment which was used in order to design and program the application. The collected data were kept in a Microsoft SQL Server 2005 database. Additionally, a Flash component was developed in order to play the audio files.

The application work with the most popular Internet browsers available today: Internet Explorer 7+, Mozilla Firefox 2+, Opera or Google Chrome. Because the component that was used to play the audio files was based on Adobe Flash, note that the latest Flash Player was also required.

2.4 Software Design

The idea behind the software solution was to create a general-purpose, flexible poll-based application, adapted for the requirements of the experiment. This way, the application was not dependant on the set of questions that were provided, allowing us to change the number of questions as desired, without changing a single line of code. The same pattern can be reused in various similar applications, not necessarily related to phonetics or, if phonetic in nature, not necessarily for Macedonian and English language. By having the context separated from the logic, we could readapt the same code in different situations with minor changes.

Our data tier was represented by the SQL Server database that we used, the business logic tier consisted of C# classes, which acted as wrappers for the business logic; they were responsible for calculations, binding the questions and the answers and invoking the database queries that were previously written. The presentation tier was represented by the user controls and pages that displayed the results of the business logic that stayed behind them. It is important to note that only one .aspx page was created for the presentation tier, and no query string parameters were passed during the experiment. Session variables were used instead, mainly for security reasons. The session lasted 20 minutes. The audio player Flash component could be observed as add-on to the presentation tier, since it played the mp3 files that were located on the server.

Fig. 1 present screenshots of the phonetics experiment start web pages.

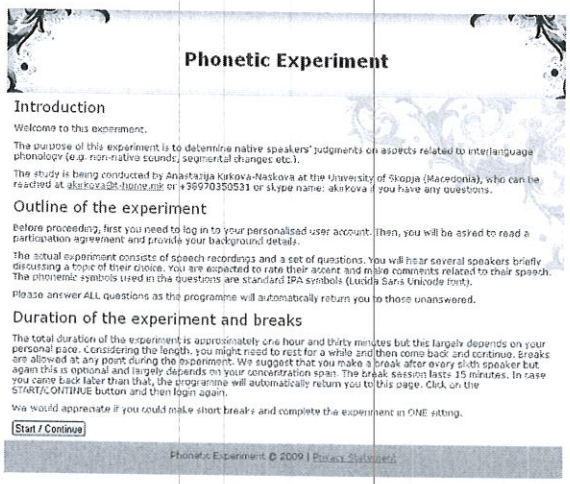

Fig. 1. Phonetic experiment start page

2.5 Experiment Flow

A total of 17 Macedonian speakers were recorded producing a free speech in English. They were all Skopje residents, 19-25 years old. All of them were students majoring in English Language and Literature. Their English language proficiency level was B2 (n=6) and C1 (n=11). None of them had a longer stay in an English-speaking country.

One English native speaker who worked at the Department of English Language and Literature was recorded speaking and was part of the experiment; he served as a control speaker in the accent rating section.

The Macedonian speakers and the control speaker were recorded in a sound prove booth. They were given a 'free speech' task with four optional topics and were expected to speak on the chosen topic for about 2 minutes. The recordings were then edited and tested for authenticity. The total duration of the speech samples that were part of the experiment was 373 seconds (approximately 6 minutes).

The application was advertised as a research project on the LINGUISTLIST http://www.linguistlist.org/ and the IATEFL Pronunciation Special Interest Group - PronSIG yahoo group http://uk.groups.yahoo.com/group/iatefl_pronsig/. These sites are well-known and acknowledged as useful discussion forums as well as media for notification and exchange of information related to current research and conference details. Another method for listener recruitment included direct approach to experts in the field by e-mail and personal acquaintance.

A total of 14 English native speakers completed the experiment and rated the speech produced by the Macedonians. They were 28-71 years old (median 49 years). All of them had gained higher level university degrees and had the phonetic-phonological expertise (some had experience as raters too). As reported in the questionnaire, they spoke the following English variants: Southern British English (n=6), American English (n=6), Irish English (n=1) and Canadian English (n=1).

The web application consisted of several parts organized in separate webpages: 1) introduction and instructions; 2) user account window; 3) participation agreement; 4) personal background details; 5) experiment questions (Q1-Q4) with audio files (repeated for every speaker): consonantal variables, vocalic variables, foreign accent ratings, general variables for foreign accent evaluations; 6) impressionistic comment on Macedonian-English speech; 7) comments on the experiment.

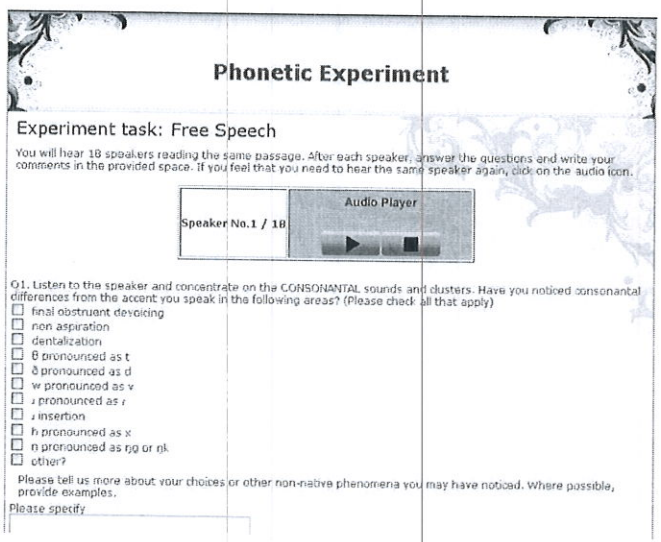

Fig. 2. Question web page

The listeners were expected to listen to the individual speaker's audio file and answer the questions as instructed. The procedure was repeated for every speaker. Two types of data were collected: a) quantitative (frequency of phonetic segment variables and global foreign accent ratings on a 5-point scale), and b) qualitative (open-ended questions with comment boxes).

The administrator first created accounts for each listener and then sent the username and password to the listener via e-mail. Having received the username and password, the listener was expected to log into the system. First, the user had to agree

with the terms of usage for the Phonetic Experiment Web Application. Then the application displayed a page with questions rendering data about the listeners' personal data, educational background and prior experience with accent ratings. Once this had been fulfilled, the user was redirected to another page and could start answering the experiment questions. The questions were divided in three parts. An audio file was associated with the set of questions. A list of check boxes and radio buttons was provided for each answer, in addition to a free text box for comments (Fig 2).

The listener answered each question on the page and then had to click on the button to be redirected to the next set of questions (for another speaker). Once the user listened to all speakers and answered the questions, he/she was redirected to a Impressions and comments page (Fig 3). If the listener did not complete the whole experiment in one sitting, he/she could log in again and continue where he/she had stopped, since the application kept track of the user's answers.

The total duration of the experiment was 1-1,5 hours (as reported by listeners who completed the pilot version of the experiment).

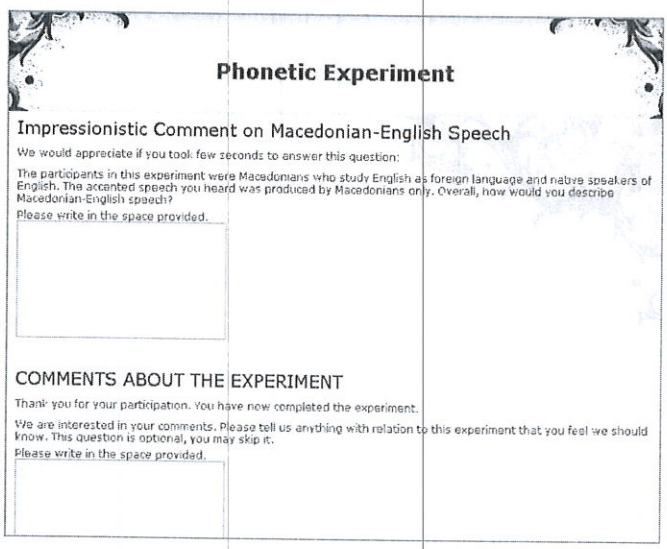

Fig. 3. Impressions and comments page

2.6 Security issues

Security is one of the most important aspects when developing web applications. User data must be secure from any threats. For the sake of increasing the level of security, we decided to keep the query string clean and pass no variables through it. That way we ensured that the user could not manipulate the question he/she was answering. Moreover, if the user clicked on the Back button of the browser, he/she could not return to that question because the session variable that was used for tracking the current question was kept on the server, and not on the client. Every time the user

clicked on the Submit button, the database was updated as well, meaning the user could leave the application any time he/she wanted.

As every application that collects sensitive data from its users, we published a privacy policy, stating that all data had been used for the phonetic experiment only. It was also stated that cookies had been used, which contained the session keys and other useful data. Our application displayed the privacy policy at the bottom of every page. By using this application, the user agreed to participate on voluntary basis and no payment compensation was given to any participant.

2.7 Data Collection and Data Extraction

One of the reasons for the development of this application was the creation of a small-scale corpus of listeners' responses on segmental aspects related to Macedonian-English speech. This allowed for access to data that would be already stored and eventually easily grouped for faster analysis.

The database behind the application was carefully designed for easy data extraction, meaning tables were connected with each other, containing the primary keys from other related tables, so that SQL queries were much simpler. Once the phonetic experiment was over and all participants had completed it, the data was required to be extracted in a human-readable format. However, the statistical analysis was conducted using SPSS program and this required additional data input to calculate the frequency of checked variables.

3. Results

The satisfactory number of listeners who responded to the project advertisement and their successful completion of the experiment suggest that the Phonetic Experiment Web Application demonstrates a great potential that is yet to be enhanced.

From a linguistic point of view, the experiment in the form of a web application fully met our expectations. The variables used in the questions were typical mispronunciations observed in the phonetic literature related to Macedonian-English speech and in the teaching practice in Macedonia. The result analysis shed light on the predicted phenomena and pointed out to three variables as the most frequent markers of Macedonian-English accented speech: obstruent devoicing in final word position, vowel shortening and substitution of English dental fricatives with Macedonian dental plosives. It also reflected phonetic aspects that we were not aware of or phenomena that used to be poorly explained in the reference literature such as allophonic distributional differences between the two languages and intonational mismatch (sporadic use of weak forms and frequent inappropriate use of rising tones). Based on the listeners' responses (both qualitative and quantitative) we were able to construct a detailed profile of the English speech produced by the Macedonian learner of English (the typical representative of our sample) and to propose practical pedagogical implications.

From a technical point of view, the advantages of the application, being the first of this kind administered in Macedonia, surpass its limitations. As part of the application, the listeners had an opportunity to provide comments about the experiment itself. We have gathered really constructive responses. The positive comments highlighted the clarity of the instructions, the high quality of the recordings in the audio files and the well-defined and user-friendly experiment as a whole. The negative comments addressed the length of the experiment and the need for a pause button in the audio file icon.

The use of the Internet as medium also proved rewarding by making the application global and reachable from anywhere in the world. The targeted group had no problems finding the experiment application. It addressed wider audience i.e. we had respondents from the USA, Canada, the UK, Ireland, New Zealand . It proved to be time-saving rather than time-consuming both for the researcher and the users/listeners. There was no need for the researcher to directly supervise experiment completion as the procedure was pre-programmed and could be administered on various locations at the same time, and the users were allowed to conduct the experiment according to their own schedule. Another gain was the speed and efficiency of data collection, the researchers receiving immediate results and a database being instantly created and regularly updated. This also meant that data was easily managed because there was no need for manual data input. Most importantly, the application can be easily adapted for the requirements of similar research studies due to its flexible software design.

4. Conclusion

Phonetic Experiment Web Application is an example of how a modern approach can be applied when conducting linguistic experiments. There is room for improvement and adaptation not only for research purposes but also in the area of language teaching, learning and assessment.

Our team hopes that this application will become popular with online linguistic communities and improve the methodology employed in linguistically-related experiments. In the educational context, this application can be modified as part of learning management software where teacher-student interaction is preferred. The students can record themselves and upload their speech as an audio file. The teacher on his/her part can mark their mispronunciations, give immediate feedback, and monitor their progress. Alternatively, as part of their exams, students may be required to record themselves and upload the file and the teacher can assess their pronunciation on a set of predefined phonetic items that are expected to be acquired throughout the academic year.

Finally, this approach is ideal for the promotion of research in lesser-developed countries, as is the case with Macedonia, where people and resources are always limited and insufficient. This positive experience also shows the continuing need for theoretical and applied linguists to collaborate with computer technology experts in order to improve methods and bridge the gap between research and practice.

5. References

[1] Anderson-Hsieh, J., and Koehler, K. (1988). The effect of foreign accent and speaking rate on native speaker comprehension. Language Learning, 38 (4), 561-613.

[2] Beddor, P. S. and T. S. Gottfried. (1995) Methodological issues in cross-language speech perception research with adults. In W. Strange, (Ed.), Speech Perception and Linguistic Experience: Theoretical and Methodological Issues in Cross-Language Speech Research (pp. 207-232). Baltimore: York Press.

[3] Bongaerts, T., van Summeren, C., Planken, B., and Schils, E. (1997). Age and ultimate attainment in the pronunciation of a foreign language. Studies in Second Language Acquisition, 19, 447-465.

[4] Chun, D. M. (2007) Technological advances in researching and teaching phonology. In M. C. Pennington (Ed.), Phonology in Context (pp. 274 - 299). Basingstoke: Palgrave Macmillan.

[5] Flege, J. E. (2002). Factors affecting the pronunciation of a second language [.ppt, electronic version]. Presented at Pronunciation Modelling and Lexicon Adaptation for Spoken Language Technology, September 14-15, 2002, Estes Park, Colorado, USA. Retrieved from http://jimflege.com/files/Colorado_2002.pdf

[6] Flege, J.E., Munro, M.H., and MacKay, I.R.A., 1995. Factors affecting strength of perceived foreign accent in a second language. Journal of the Acoustical Society of America, 97, 3125-3134.

[7] Major, R. C. (1986) Paragoge and degree of foreign accent in Brazilian English. Second Language Research, 2, 53-71.

[8] Munro, M.J. and T. M. Derwing, (1999) Foreign Accent, Comprehensibility and Intelligibility in the Speech of Second Language Learners. In Leather, J. (Ed.), Phonological Issues in Language Learning (pp. 285-310). Oxford: Basil Blackwell.

[9] Munro, M. J. and T. M. Derwing (2001) Modelling perceptions of the Accentedness and Comprehensibility of L2 Speech: The role of speaking rate, Studies in Second Language Acquisition, 23, 451-468.

[10] Thompson, I. (1991). Foreign accents revisited: The English pronunciation of Russian immigrants. Language Learning, 41(2), 177-204.

[11] Van den Doel, R. (2006). How friendly are the natives? An evaluation of native-speaker judgments of foreign-accented British and American English. Utrecht: LOT.

[12] Weinberger, S. H. (1998). The speech accent archive [electronic database]. George Mason University.http://accent.gmu.edu/index.php

[13] WWStim, http://www.let.uu.nl/~Theo.Veenker/personal/projects/wwstim/doc/en/