The Big Australian Speech Corpus (The Big ASC)

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Abstract

Under an ARC Linkage Infrastructure, Equipment and Facilities (LIEF) grant, speech science and technology experts from across Australia have joined forces to organise the recording of audio-visual (AV) speech data from representative speakers of Australian English in all capital cities and some regional centres. The Big Australian Speech Corpus (the Big ASC) will provide a standard recording setup and a collaboratively-designed elicitation protocol to create a corpus of AV speech data incorporating annotations and metadata, accessible via a centralised storage facility. The Big ASC infrastructure will provide a significant boost to research in speech science and human communication in Australia.

Index Terms: speech corpus, audio-visual data, Australian English, annotation, data storage.

1. Introduction

Speech Science, in addition to its wider linguistic contribution beyond phonetics, such as to sociolinguistics and psycholinguistics, underpins applications in Speech Technology, such as Text-To-Speech (TTS) synthesis, Automatic Speech Recognition (ASR), speaker recognition and forensic identification, talking head interfaces and hearing prostheses. Paramount among the basic infrastructure needs of Speech Science is a large speech corpus collected and annotated to accommodate multiple applications, and stored to allow easy and immediate access. As yet, no such corpus exists for Australian English, mainly because such speech corpora are difficult and expensive to create. Although data for a variety of languages can be obtained from various sites such as the LDC, these corpora are either not large enough or not systematically designed to serve the interests of a variety of users. On the other hand, while large systematically designed speech corpora cannot be bought off the shelf and they are extremely expensive, labour-intensive and time-consuming to

construct, their collection does not constitute research in itself, so the usual funding avenues are unavailable.

Recognising the importance of such a corpus, speech science and technology experts from across Australia banded together and in 2010, MARCS Auditory Laboratories, with partners Macquarie University, Flinders University, University of Melbourne, University of Canberra, University of New South Wales, University of Queensland, University of Sydney, University of Western Australia, Australian National University, University of Tasmania, the Max Planck Institute for Psycholinguistics and the Australasian Speech Science and Technology Association were awarded an Australian Research Council Linkage Infrastructure, Equipment and Facilities grant for a project entitled '*The Big Australian Speech Corpus: An audio-visual speech corpus of Australian English*' [1].

The Big ASC will establish the infrastructure for the collection of large quantities of AV speech data from many locations across multiple sessions per speaker. It will provide standardised recording equipment and protocols for data collection and annotation and will provide access to the annotated data and the meta-data via a centralised storage facility. The Big ASC will, as far as possible, take on board lessons learned in other large-scale corpus collection exercises such as those undertaken within the EU CLARIN and US American National Corpus projects. However the Big ASC is not only a large Australian speech corpus, it is also the only Australian corpus of audio-visual speech in the public domain, and it is designed to cater to various clients with a variety of interests.

2. Aims and goals of the Big ASC

The only publicly available Australian speech corpus is the 14-year-old ANDOSL database [2], which, although still relevant for research, is now outmoded due to its small number of speakers, non-representative sampling, and a single recording session per speaker. In addition, it is audio-only and has limited coverage of Australian English (AusE) variation. With the Big ASC, we are now in a position to establish a much

larger and more representative corpus of speakers from all over Australia, using more modern technology, and resulting in higher quality data. Over a period of time, 30 of the top speech scientists and technologists from 11 Australian universities have participated in the definition and design of the project, which builds on pre-existing collaboration across a range of networks, projects and associations. The data collection will be conducted at each of the 11 sites, with additional data collection in major regional centres.

The Big ASC infrastructure will provide a significant boost to speech research in Australia now and well into the future because it incorporates contemporary and rigorous design features. With a projected research lifespan of at least two decades, the Big ASC, once established, will have the potential to engender and enhance Australian efforts in a range of human communication and speech science areas:

- *Phonetics and linguistics*

A corpus such as the Big ASC is essential in order to examine variation in AusE over geographical areas [3], [4], [5], [6], [7]; ethnocultural and social background, and speech style [8]; changes to the language since the collection of the ANDOSL database [9]; and to provide greater access to information on speech production [10].

- *Psycholinguistics*

The Big ASC will have applications in projects on psycholinguistic models for word processing [11], [12]; young children's perception of phonetic variability and dialectal variation in spoken words [13]; the effect of pronunciation on written language [14]; and hearing training programs for children and adult users of cochlear implants [15], [16].

- *Engineering – Spoken Language Processing*

The Big ASC will support research projects in AV/ASR [17], [18], [19] and AV separation [20], [21], [22]; the development of real-time visual biometric systems and more robust systems for authentication or identification [23]; improved perception for cochlear implant sound processing [24], [25]; emotion recognition and/or detection for automated user interfaces and for talking heads [26], [27], [28]; and auditory-visual TTS synthesis [29]. The mapping between the auditory and visual components of the Big ASC will contribute to the development of smarter ASR and talking heads.

- *Language technology and computer science*

With data from the Big ASC, a range of interfaces will be enabled: ASR tailored for Australian English and its variety of accents and emotional tones/textures/expressions [30], speech dialogue management [31], [32]; AV user-centric/context-aware/ask-once/ask-nonce information retrieval and monitoring [33]; as well as web search and training products and guides based on grounded speech understanding [34], [35], [36].

- *Speech pathology*

While the current Big ASC will only collect a small set of disordered speech from stutterers, corpora of representative Australian speech are critical to disordered speech research generally, as typical speech provides a framework against which atypical speech can be investigated. Such corpora can contribute to the understanding of disorders and to the development of intervention strategies and devices [3], [38].

- *Forensic speech science*

Speech data collected across multiple sessions allows estimation of between- and within-speaker variability. This allows estimation of the strength of evidence with a Likelihood Ratio using Bayes theorem [39]. The Big ASC will be of great use in testing forensic speaker recognition approaches and conducting real-world casework, as well as identifying individuality in speaker behaviour [40], [41] and will work with a recently awarded Linkage Project grant (LP100200142) on reliable forensic voice comparison.

3. Infrastructure

The legacy of the Big ASC project will not only be the extensive set of annotated AV data, but also the recording infrastructure and elicitation protocols that will form the basis of further standardised data collection for Speech Science and Technology research in Australia and overseas.

3.1. Data Storage

A single server on the web will provide both a web-based view of the data and a 'shared drive' view allowing the data to be accessed from a desktop.

3.2. Hardware / Software

Standardisation in equipment and data collection procedures is essential to the success of the Big ASC. A Standard Speech Science Infrastructure Black Box (SSSIBB) and a Standard Speech Collection Protocol (SSCP) are to be used at each collection site by all research assistants to ensure that speech collection conditions are carefully controlled and documented.

- *Standard Speech Science Infrastructure Black Box*

The Standard Speech Science Infrastructure Black Box (SSSIBB) is designed to ensure consistency of data capture across all sites. The recording equipment comprises a headworn and desktop microphones, digital audio acquisition device, and a stereo camera. The data is all digitally captured to a computer. For the Map Task (see below) an additional headworn microphone and stereo camera are used. All these items are packaged together in a specially designed piece of hardware which serves as a reinforced box for transportation and folds out into a table with integrated shelves for recording. The SSSIBB ensures the same equipment is used at all locations, in the same configuration and with the same setup and spacing. The portable design allows the data collection to be conducted in any location and to be extended to new locations as needed.

- *Standard Speech Collection Protocol*

The Standard Speech Collection Protocol (SSCP) covers the requirements for software on the SSSIBB. It not only includes the drivers for all relevant devices but also a single application to control recording of audio and video data, storage to disk and management of sessions. At a minimum, the protocol will provide the following functions:
- collect session meta-data (subject id, location, etc.);
- perform calibration, to ensure that settings and conditions are known when recordings start, and to ensure that all components are set up correctly;
- synchronise capture of audio and video devices, writing data to disk in appropriate format to minimise risk of data loss;

- manage the recording session, allowing the RA to control timing, restart tasks, and store all recorded data in defined file structures;
- provide randomised prompts for read speech tasks, and record order of presentation with the recorded data;
- carry out backup copying of data and register session meta-data with central server at the end of each session.

3.3. Meta-data

A central meta-data store receives the meta-data entered as part of the recording process and associates it with audio and video data in the main file store. This will provide the main entry point for browsing/searching the corpus data, via a web interface to the meta-data store.

3.4. Annotations

The audio and video data will be annotated to varying degrees, one imperative of the project being that the management of the annotation data is key to making this corpus as useful as possible.

For recordings that are read (digits, words, read sentences, etc.) this consists of storing the start and end offsets of each word, while for longer unscripted recordings annotations, this will be a transcript of what is said aligned at the phrase or sentence level.

Basic level annotation, together with more detailed annotation, will be conducted by a central Annotation Team, following consistent principles and protocols for annotation. The Annotation Team will mark up aspects of dialogue, intonational, syntactic and rhetorical structure as appropriate, using variants of the Emu and ELAN tools to be interfaced with the shared annotation server, thus ensuring that the corpus is built collaboratively and consistently.

The annotation task will be automated as far as possible, first by performing forced alignment for the read speech, and second by using annotation tools allowing checking and inter-annotator comparison.

The annotation store will:
- be independent of any annotation tool or format;
- be able to accept and deliver annotation data in many formats;
- provide web based browsing and searching.

4. Data Collection

This will be the first *Australian* speech corpus to meet the demands of modern speech science. It will sample widely and appropriately from AusE, an increasingly important consideration given that AusE is becoming an influential new standard in East Asia [42]. Since audio-visual data have now become essential for many applications, e.g., ASR and speaker recognition, biometric applications, automated user interfaces, all the data will be AV-recorded.

4.1. Protocol

A variety of tasks appropriate for different applications will be completed by all speakers across three separate recording sessions. As literacy cannot be assumed, some variation of the protocol is necessary: sentences and word lists may be orally prompted, and the map task may be replaced by an alternative task such as storytelling. However, importantly, all the word-level and natural sentence-level material will be retained.

4.2. Type of Data

- *Demographics*

A comprehensive set of demographic, family and historical data will be collected from all speakers to document the regional, ethnocultural, educational, language, speech and hearing, and employment backgrounds

- *Isolated Words (IW)*

The IW data consists of 325 words comprising 3 word types:
a) a monosyllabic standard word set comprising the stressed vowels of AusE in the following standard contexts: hVd, hVt, hV, hVl, hVn;
b) an additional set of words selected to address specific AusE characteristics;
c) a set of polysyllabic words to address stress patterning.

- *Read Speech (RS)*

The RS data comprises a set of sentences that deliver connected speech in a standard format from every informant in the corpus. Informal speech is sacrificed for standardisation and phonetic sampling. However, valuable phonetically comparable cross-corpus data is achieved as the sentences are derived from the ANDOSL additional set of 50 sentences.

- *Digits*

A set of 44 four-digit strings will be provided for people to read. The specific purpose of these is to provide data for background databases for audio password systems

- *Interview*

The aim is to capture spontaneous, engaged, narrative talk – 'story telling' in the 'vernacular' speech style [43]. This style of speech is hard to capture in formal interviews, but can be achieved with skilful or empathic interviewers and with particular attention to facilitating conditions of elicitation. 'Story telling' is a natural task, appropriate for all speakers and speech communities; it is a task that is equally appropriate for all groups included in the scope of the project. Different topics will be suggested for discussion, subject to speakers' preferences.

- *Map Task*

We propose to design a new Map Task [44] for the elicitation of spontaneous interactive speech data. The new map task will be of interest to a broad range of research interests by virtue of careful design at various linguistic levels. By incorporating a range of linguistic features into the map design, we anticipate that the Big ASC Map Task will additionally provide corpus data of interest outside Australia.

- *Text reading and recounting*

A short newspaper style article will be provided for people to read. Then they will be asked to retell the same story but in their own words.

4.3. Amount of Data: Size and Distribution

Large speech corpora are essential in order to cover idiosyncrasies and variation [45]. For the Big ASC, speech will be collected from around 1000 speakers at 17 collection sites from every state and territory of Australia.

- *Multiple sessions (within-speaker variation)*

Each speaker will be recorded on three separate occasions to capture within-speaker variability over time.

- *Diversity (between-speaker variation)*

Representative sampling from 17 different sites and field locations will reflect *regional* (all states & territories) and *demographic* variation (with AusE recorded from speakers whose entire school education has been in Australia, thereby capturing both Australian born and migrants who arrived in Australia before school age). This group will include specific sampling of Indigenous Australians and will also include speakers from a variety of different ethnic backgrounds (e.g. from the Lebanese and Chinese communities)

5. Looking to the future

The Big ASC project is funded for a period of 12 months, and technically will be completed in 2011. During that period, we will design and build the SSSIBB; develop the SSCP; launch the website to advertise the data collection and recruit speakers; train RAs and run the data collection at 17 different sites; collect data from 1000 speakers; establish the data server for storage and access to the data; develop the annotation environment and annotation protocols; annotate half of the data recorded.

However, this is only the first step in building a truly Australian corpus. Available funding and time restrict the kinds of data we can collect for this project, even though the corpus will be much larger in detail and scope than anything that has ever been attempted for this country. Project members are focussed on maintaining collaborative efforts that underpin Big ASC, even after the initial LIEF funding ends. We hope the planned successful completion of the Big ASC in the form outlined above will facilitate national funding in the future that will allow this initial effort to be continued and expanded by collecting other useful data which cannot be covered in this initial phase, such as speech with a variety of *emotions* and degrees of *intactness* (disordered speech), speech in *noise*, and additional varieties of *ethnocultural* backgrounds, including **indigenous** creoles (NT and Kimberley Kriol, and Torres Strait Creole).

6. Acknowledgements

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