Comparing sound inventories for CAPT

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Abstract—**This demo introduces L1-L2***map***, a tool for contrastive analysis of the sound inventories of source and target language pairs. The demo will give opportunity to discuss its use and limitations, as well as its potential for further development.**

Contrastive analysis, multi-lingual, CAPT, demo

I. L1-L2MAP

The multi-lingual tool L1-L2*map* allows users (especially CAPT developers) to compare the phonemic sound inventories of source and target language pairs for foreign language learning. The tool has been developed on the basis of the UPSID database [1], and has now been extended to over 500 languages. It is implemented as a wiki [2] and is available free of charge. It can be integrated into any CAPT system by sending a simple query to the server running L1-L2*map*. The query results in a list of sounds in the target language that are not part of the specific learner's source language and which may potentially cause pronunciation problems.

Although this is not necessary for CAPT developers, the results can also be visualized in charts with a similar lay-out to the IPA consonant and vowel charts [3]. Figs. 1a and 1b show a contrastive analysis of Mandarin Chinese compared with south-eastern Norwegian. The colours in L1-L2*map* have intuitively interpretable functions: green indicates sounds that L1 and L2 have in common; blue indicates sounds that are only used in the learner's native language (L1, cf. blue language box at the top of the figures); and red indicates sounds that only occur in the target language (L2, cf. red language box). It is the list of sounds which are indicated on a red background which a query returns, so that the CAPT developer can direct the user to corresponding exercises for these unfamiliar sounds.
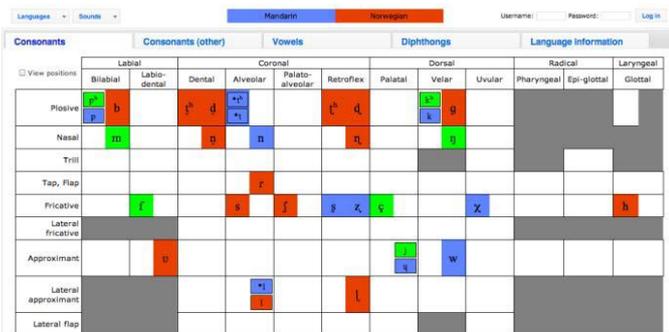

Figure 1a. Contrastive analysis comparing the consonant inventories of Mandarin Chinese and (south-eastern) Norwegian

II. EMBEDDING IN CAPT

The tool is used in a CAPT system for Norwegian [4] which is based on the VILLE system developed for Swedish [5]. The CAPT system consists of two parts [6]. The first part is devoted to vocabulary training, and exposes learners to different dialects of Norwegian (which has no accepted pronunciation standard) through listening, pronunciation and writing exercises for "1000 words and expressions". The second part consists of minimal pair/set listening exercises. In this part of the system, L1-L2*map* is used to select relevant exercises for each individual learner of Norwegian depending on his/her native language.

III. SYLLABLE POSITION

The use of consonants in different syllable positions can vary across languages. Because language learners often have problems with pronouncing known sounds in their native language when they appear in "unusual" syllable positions, information about the use of consonants in onset, nucleus and coda can also be provided in L1-L2*map*. This information is important in CAPT systems, for example to help German learners of Norwegian (or English) to learn to use lenis (voiced) consonants in syllable-final positions, where they often realize them as fortis (voiceless) sounds. Another example is the strong restrictions on the use of consonants in Mandarin Chinese, where only /n/ and /ŋ/ occur syllable-finally, while Norwegian (and English) allow a much wider range of consonants in that position [7]. Though familiar with many of the sounds, learners need to practise pronouncing them in unusual syllable positions. In cases where both language that are compared are defined for the occurrence of sounds in different syllable positions (onset, nucleus, coda), this information is included in the query result from L1-L2*map* and can be used to direct the learner to minimal pair/set exercises for unfamiliar sounds in specific syllable positions.
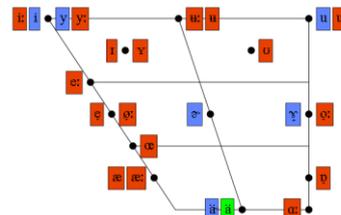

Figure 1b. Contrastive analysis comparing the vowel inventories of Mandarin Chinese and (south-eastern) Norwegian

IV.   LIMITATIONS

It is well known that a contrastive analysis cannot predict all the mistakes learners make (cf. references in [6]), and particularly it does not predict what substitutions learners make [8]. For example, learners of English make different substitutions for dental fricatives depending on the language background [9]. These substitutions would provide an optimal basis for the selection of minimal pair exercises. Automatic error detection can be a solution to this, but no ASR or signal processing techniques are available for Norwegian CAPT. Such techniques also do not yet take into account the complex systematic variation in native speakers' realization of speech sounds in talk-in-interaction, which is far outside the scope of present-day approaches [10]. Our aim is to collect data about actual substitutions by foreign learners of Norwegian, and we have started making sound recordings in a pilot project for five languages spoken by large groups of immigrants to Norway.

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