Towards automatic assessment of emotional competence in neurological patients

Julia Sidorova and Lars Lundberg

Blekinge Institute of Technology, 371 79 Karlskrona, Sweden

Abstract

Emotive speech is a non-invasive and cost-effective biomarker in a wide spectrum of neurological disorders with computational systems built to automate the diagnosis. In order to explore the possibilities for the automation of a routine speech analysis in the presence of hard to learn pathology patterns, we propose a framework to assess the level of competence in paralinguistic communication. Initially, the assessment relies on a perceptual experiment completed by human listeners, and a model called the Aggregated Ear is proposed that draws a conclusion about the level of competence demonstrated by the patient. Then, the automation of the Aggregated Ear has been undertaken and resulted in a computational model that summarizes the portfolio of speech evidence on the patient. The summarizing system has a classical emotion recognition system as its central component. The code and the data are available from the corresponding author on request.

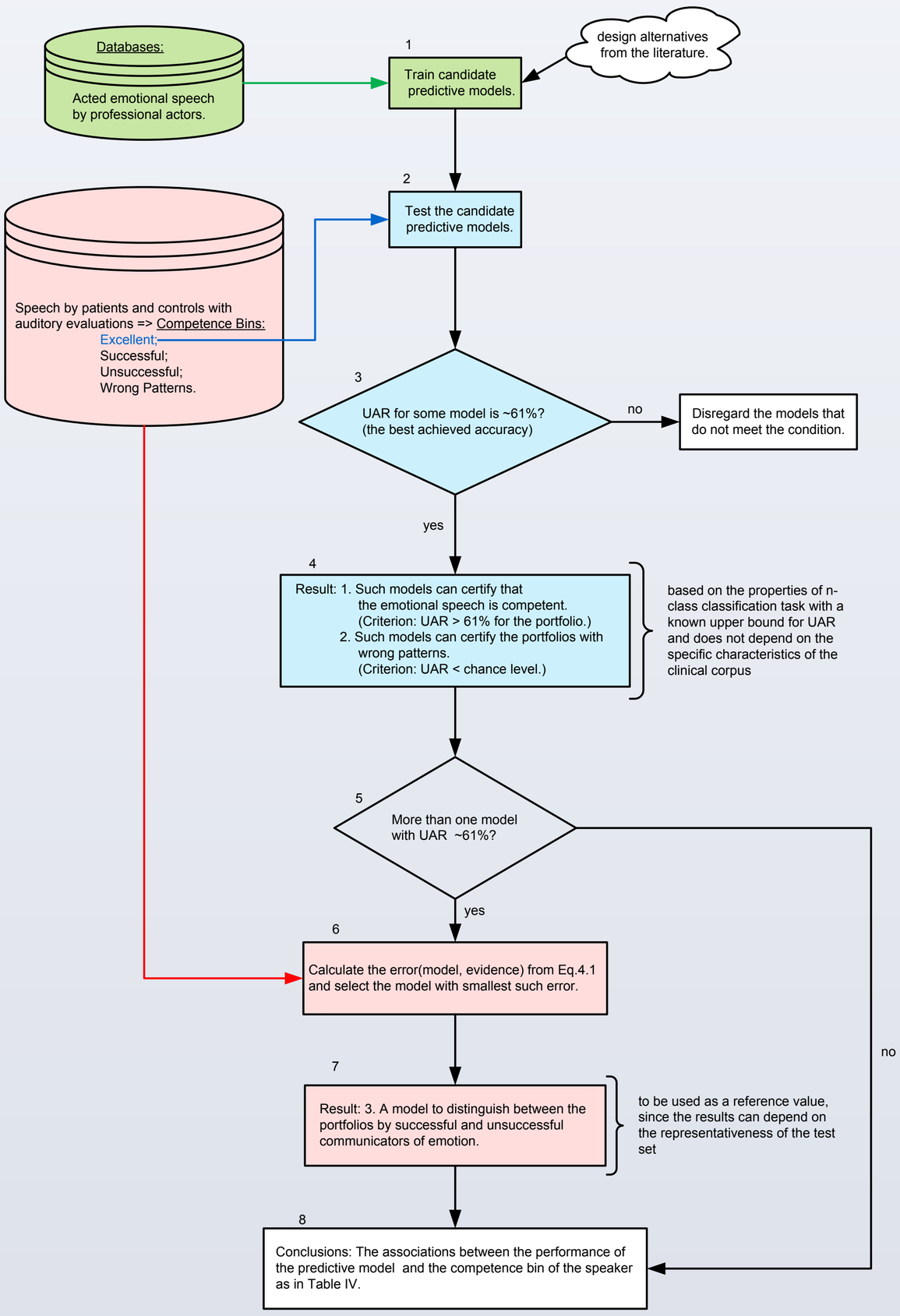

Fig 1. The training/testing protocol of the experiment

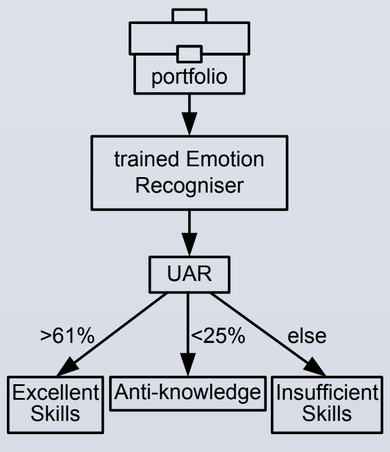

Fig. 2. The architecture of a summarizing model

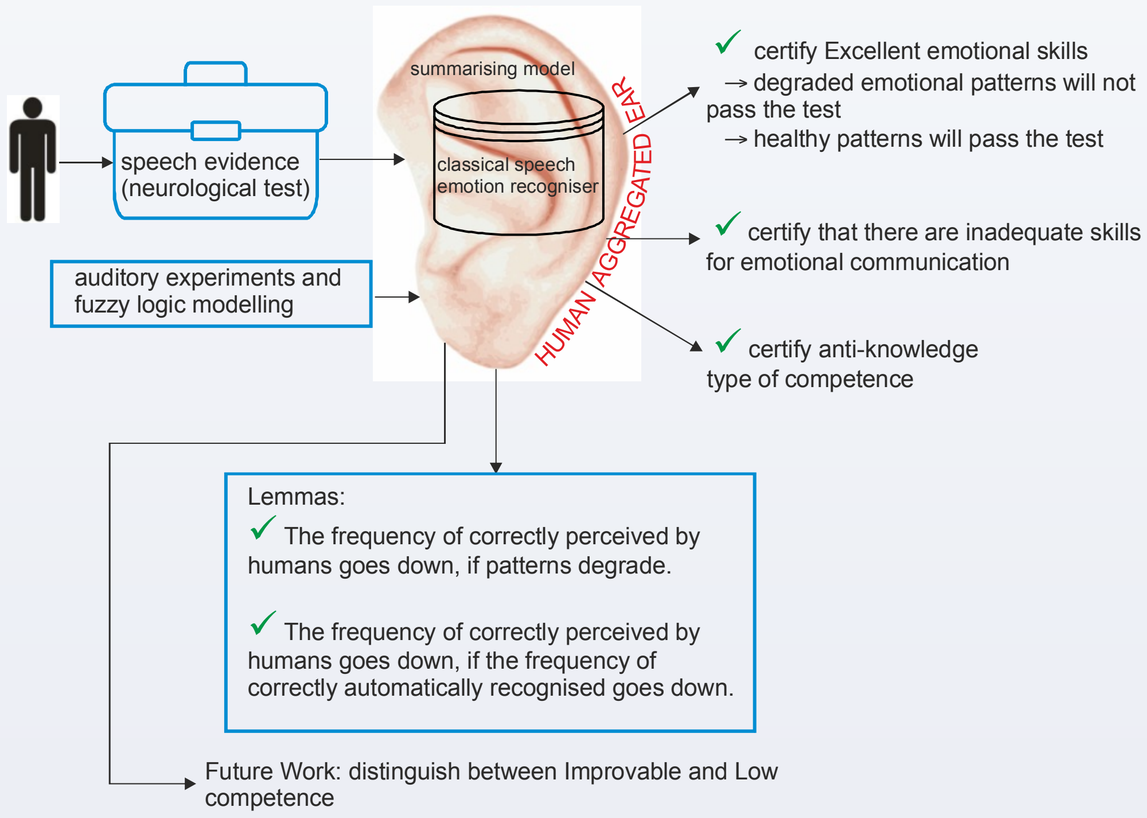

Fig. 3. Graphical conclusions of the study

Conclusions

At our departure point we ventured the automation in the situation under rather restrictive circumstances: a rare disorder with few patients and little data available. Moreover, according to its phonetic description in the medical literature, the disorder in question affects the emotive speech heterogeneously, that is, with different acoustic parameters affected from patient to patient.

I. To quantify the communicative damage at a paralinguistic level caused by pathology, we have proposed four disjoint competence bins with tangible communicative consequences: excellent paralinguistic competence, improvable competence with successes in half of cases, low competence with failures in more than half of cases, and anti-knowledge (a will to do badly on the test or wrong patterns in the generative model).

II. We have shown that using a predictive model trained on healthy emotive speech in the same language, it is possible to certify that a portfolio of speech evidence contains emotive speech of excellent competence (UAR is 61%), and when anti-knowledge is involved (UAR is below the chance level). Insufficient competence (Improvable and Low) is certified via exclusion of the Excellent and Anti-knowledge. It is done without any assumptions made about the pathology manifestation, distributions in the pathological speech or number of patients. It follows from the properties of the 4-class classification task with a known upper bound for UAR.

III. The resulting system creates a "summary" of the evidence that contains the recordings of a reading-based neurological check-up. Therefore, the machine can provide decision support to a speech therapist, if the duration of the neurological test is extended to 40 minutes.

References

Sidorova J. , Carlsson S., Rosander O., Moreno-Torres I., Berthier M., Towards automatic assessment of emotional competence in neurological patients, IEEE Transactions on Affective Computing. Accepted.

Contact

Julia Sidorova or Lars Lundberg
Department of Computer Science and Engineering
Blekinge Institute of Technology
371 79 Karlskrona, Sweden
Email: julia.a.Sidorova@gmail.com, lars.lundberg@bth.se