

MACarena: a flexible computer-based speech testing environment

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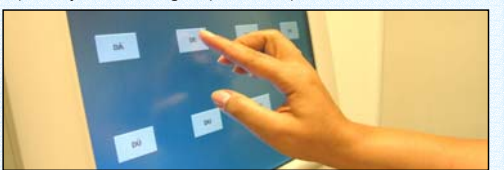
Abstract

Routine speech testing in clinical and experimental environments can be greatly simplified by implementing the speech testing environment on a computer. Advantages include reproducible presentations across sessions, automatic randomisation of the test material to minimise learning effects, and automatic saving of test results. The software should be easily installed and used in different test locations. Uniformity of test materials and procedures would facilitate better comparisons of speech test data particularly when these are collected from various test centres. MACarena fulfils these needs by providing a number of flexible templates around which speech tests can be designed and implemented. Apart from a battery of standard speech tests from the German Minimum Auditory Capability (MAC) test battery, MACarena allows users to use these templates to create custom speech tests, also in different languages. The user interface for both tester and subject can also be customised in different languages.



Introduction

MACarena provides a uniform user interface for presenting a large number of speech tests commonly used in cochlear implant as well as hearing aid research. The pre-recorded test material is saved in WAV file format and can be played back by any Windows-based computer equipped with a soundcard. Recorded material permits consistent repetition of the test material within and across test sessions while playback via the PC's soundcard eliminates the need for external equipment such as tape decks or CD players. The presentation items from each test list can be automatically randomised to minimise any possible learning effects that the test subjects may acquire. This is particularly important for context-rich test material such as words or sentences collected as test-lists. The use of a touch screen for the response interface permits the subject to easily and intuitively provide responses with minimal tester intervention. MACarena does not incorporate any mixing functions for the sound playback and tests requiring separate noise source in addition to the speech signal will have to be separately mixed for signal-plus-noise presentations.



MACarena presently incorporates the German Minimum Auditory Capability (MAC) test battery consisting of

Yes-No Tasks	Male-Female Speaker Identification
Closed Set Words	VO8 Vowel Logatomes – da/di/do C12 Consonant Logatomes – aba/ada/aga Reim Tests VM1,VM2,CA1,CE1,CA2,CM2,CE2
Open Set Words	Two digit numbers Freiburg Monosyllables
Open Set sentences	Innsbruck sentences Göttingen sentences Oldenburg sentences

The response interface

MACarena classifies its speech tests as either closed set or open set tests as follows:

Closed Set Tests use buttons to display the response items to choose from.



Yes-No Task : 2 buttons

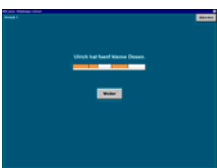


Identification Tasks : 3 to 12 buttons

Open Set Tests use text field(s) to enter the subject's response(s). With Open Set Tests, the subject does not operate the response interface directly. Instead, the subject repeats his/her response out loud while the tester types in the subject's response at the computer.



Words : 1 text field



Sentences : multiple text fields

For both Closed Set and Open Set tests, the speech material to be identified can be either words or sentences.

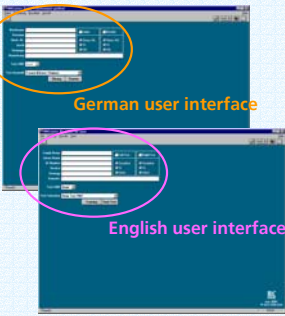
The response choices

For each presentation of a Closed Set test, the response alternatives to be displayed in the buttons are stored in a file. The order of the buttons are randomised onscreen while MACarena keeps track of the button with the correct response.

The speech token to present

The name of the WAV file to be played back for each presentation is stored as a list in a file. This playback list is randomised while MACarena keeps track of the corresponding response list. The playback list can also be repeated to lengthen a test. For instance, a test with 20 presentations can be defined with a playback list of 5 items, each repeated 4 times.

The above tests can be easily reconfigured with test material in other languages. Even the main user interface screen with menu commands, onscreen labels and prompts, which are defined in a file, can be easily redefined and adapted to another language. The flexible test templates also permit new tests (eg. Identification of Environmental Sounds) to be implemented as long as the recorded test material in WAV format is available.



German user interface

English user interface

Script Files

Each test described by its (i) response interface, (ii) response choice and (iii) speech token definitions is summarised and saved in a Script file. By dividing the template into three elements, it is possible to mix and match them in a flexible way. The choice of user interfaces are limited to those already implemented in the software. The speech tokens and response choices, however, may be freely defined by the user, thereby allowing one to adapt different test material and different response choices to the existing tests.

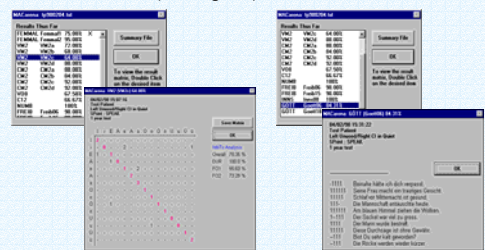
Subtests

MACarena also permits the definition of a single test with multiple test-lists (subtests). The selection of the subtest occurs immediately after the test has been selected, but before the first presentation begins.



Results and Analysis

The test results are stored to an output file in ASCII format to simplify importing into other programs such as Excel for further analysis. MACarena also summarises the results in the file onscreen, and the results of each test can be viewed as a confusion matrix (Closed Set Tests) or a Stimulus/Response list (Open Set Tests). Information Transmission Analysis after Miller & Nicely (1955) is also available for the consonant and vowel test results. The specifications of the consonant and vowel categories required for Information Transmission Analysis are stored in their corresponding Script Files.



Training Mode

During a speech test, MACarena does not allow presentations to be repeated. However, a Training Mode, whereby presentations can be repeated and feedback is also provided to the subject, is available for familiarising subjects with new test material. This mode should be used with care.



Availability

MACarena is distributed as freeware with extensive accompanying online help. Descriptions on how to customise tests and the user interface are also provided. Additional work to record new test material and to equalise the recordings will be the responsibility of the users and additional support will not be provided by the authors. Researchers interested in using MACarena should please contact the authors

Acknowledgements

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References

Miller, G.A. & Nicely, P.E. (1955). "An analysis of perceptual confusions among some English consonants", J. Acoust. Soc. Am. 27, 338-352.