FCSPAC

Forced-Choice test of Speech Pattern

Contact perception

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Version 3.1 August 2004

See setup information
Prepare for testing
Retrieve existing data
Play the calibration tone

Right-click on an object for information

Setup for FCSPAC testing

Test computer
Amplified loudspeaker
Stereo-mono adapter

Subject

Text File
Video --> to subject

Audio speech --> to subject
FCSPAC
Forced-Choice test of Speech Pattern Contrast perception

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August 2004

CONTENTS

Background..................................................................................... 2
Opening page .................................................................................. 3
Hardware setup............................................................................. 5
Prepare for testing ......................................................................... 7
Testing .......................................................................................... 9
Data retrieval ................................................................................ 13
Prepare graphs ............................................................................. 15
Correcting previously stored data ................................................. 18
BACKGROUND

FCSPAC – Forced-Choice test of Speech Pattern Contrast perception

This software is designed for forced-choice testing or training of auditory, visual and auditory-visual perception at the phonetic level by adults and children who have the necessary reading skills. It was developed at the Rehabilitation Engineering Research Center at Gallaudet University as part of the CEDAR project. It is one of a continuum of testing/training packages that range from the phonetic level, through the isolated word level, to the sentence level with knowledge of topic (i.e., from analytic to synthetic). This package is intended as a tool in the rehabilitation of hard-of-hearing and late-deafened adults.

The core of the software is adapted from the on-line version of the imitative test of speech pattern contrast perception (OLIMSPAC), developed at the House Ear Institute for research on audition and its development in early-identified infants with hearing loss. In both tests, the stimulus is a non-word utterance and the response is a forced choice from text versions of eight possible stimuli. In OLIMSPAC the tester responds on the basis of the subject’s imitation (or repetition) of the stimulus. In FCSPAC, however, the subject responds for himself or herself. Because FCSPAC does not require either a slave monitor or "blinding" of the tester, the hardware requirements are much simpler than in OLIMSPAC.

This software essentially replaces the THRee-Interval Forced-choice Test of contrast perception (THRIFTSPAC) (Boothroyd, 1995; Hnath-Chisolm et al., 1998). In THRIFTSPAC, each response provides information on only one contrast. In FCSPAC, each response provides information on the perception of 3 contrasts, making it more efficient.

Development of OLIMSPAC was supported by NIH grants #DC004433 and #DC006238 to the House Ear Institute.
Adaptation for FCSPAC were supported by NIDRR RERC grant #H1343E98 to Gallaudet University.

Bibliography

Buttons

Help - For help on a specific object, right-click on that object. Note that the help text can be dragged with the left mouse button. Left-click on the help text to cancel it.

--- Click the minimize button to hide the program temporarily without closing it

X and Exit - Options for leaving the program are:

1. The "Exit" button
2. The X button at top right
3. The Esc button

Setup Information - This button takes you to a page with a schematic of the hardware arrangement needed to implement FCSPAC.

Prepare for testing - Before you begin testing, you will be asked to enter a subject name, decide where data are to be stored, select the stimulus type and enter details about sound presentation.
Retrieve data - This button takes you to a page where you can recall stored data, and prepare graphs.

Calibration tone - The calibration signal is a 1000 Hz warble tone whose RMS level equals the average RMS level of the vowel peaks in the test stimuli (measured over a 50 msec window).
Buttons and Objects

Help - For help on a specific object, right-click on that object. Note that the help text can be dragged with the left mouse button.

--- Click the minimize button to hide the program temporarily without closing it

X and Exit
Options for leaving the program are:
1. The "Exit" button
2. The X button at top right
3. The Esc button

Home - returns you to the opening page

Test computer - The test computer presents the test stimuli, scores each response and logs the results. It should have a screen resolution of 800x600 or higher and enough disk space for storage of the test stimuli (approx. 500 MB). The processor should be fast enough to support the video presentation.
**Tester or Subject** - During testing, the computer will be under the control of the subject.

**Stereo-mono adapter** - One channel of the stereo output from the computer carries the audio speech signal. The other carries a masking noise to ensure that, during OLIMSPAC testing, the tester does not hear the signal presented to the subject. Separate access to these signals requires an adapter such as Radioshack model 274-375 or 274-883.

**Amplified loudspeaker** - For FCSPAC testing, the audio-speech signal will usually be presented to the subject in the sound-field via loudspeaker. A suitable amplified loudspeaker is the Roland monitor speaker - model MA-12C. Other options include:
1. An audiometer - using sound-field or headphones
2. An FM link to a hearing aid or cochlear implant.

The audio speech signals are digitized at 22050 samples per second with a resolution of 16 bits. The peak rms level of the vowels averages 80 dB in digital units.

**AVI file** - The audio-visual stimuli are contained in *.avi files. Video rate is 30 frames per second. Audio signals are digitized at 22050 samples per second with 16 bit resolution. Note that there are two sound channels. Both are truncated after 300 msec from onset of the final vowel. One channel contains the speech signal. The other contains noise that is spectrally matched to the talker.

When the system is being used for FCSAPC testing, the noise channel can be ignored - unless, of course, one wants to measure performance in noise, in which case a mixer/amplifier (or audiometer) can be used to mix and balance the speech and noise signals.
PREPARE FOR TESTING

On this page, you:
1. Select an existing subject or enter a new subject name,
2. For a new subject, specify where the logged data will be saved,
3. Choose the type of stimulus
4. Inform the software about the listening conditions and levels.

Note that the software does not control listening conditions or decibel levels. This is done externally by the tester. But the software needs this information for accurate data logging.

Buttons and combinobes
Help - For help on a specific object, right-click on that object. Note that the help text can be dragged with the left mouse button. Left-click on the help text to cancel it.

--- Click the minimize button to temporarily hide the program without closing it.
**X or Exit** - Options for leaving the program are:
1. The "Exit" button
2. The X button at top right
3. The Esc button

**Home** - allows you to return to the title page without leaving the program

**Begin Testing** - Use these buttons to advance to the actual testing page

**Select Existing Subject** - This option ensures that data for an existing subject will be appended to the existing file.

**Enter New Subject** - You will be asked for both a first name and a last name. If one is omitted, 'No' or 'Name' will be added automatically. You may also enter an ID code instead of a name.

**Location of Saved Data** - When you specify a new subject, you must also specify the drive to which the data will be saved. The directory on this drive is always called "FCSPACdata". If it does not exist, it will be created automatically.

**Stimulus Type** - In version 3.1, stimuli are available for two talkers, both women. The stimuli for the first talker are Consonant-Vowel (CV) syllables. The stimuli for the second talker are VCV disyllables. It is possible that the additional co-articulatory cues in the VCV stimuli will provide subjects with a richer source of information on which to base their response but this prediction has yet to be confirmed.

**Listening Conditions** - If an ear is unaided, select Open. Otherwise select the type of device used to enhance perception. If you enter your own descriptor, keep it short, use only alphanumeric characters and make sure the first three letters differentiate it from the other options. Note that the selections or entries made here have no effect on program operation. They are simply a way of recording important information when logging results.

**Presentation Levels** - If the listening condition is "Open, Aid or Implant" enter the sound-field level at the listener's location. If the listening condition is "Phone", enter the sound-level output of the earphone (either coupler or real-ear). If entering your own value, use only numbers. Note that the selections or entries made here have no effect on program operation. They are simply a way of recording important information when logging results.

**Units** - Indicate whether the presentation level is expressed in dBSPL, dBHL or dBSL.
This page contains the core of the testing program. You are also able to select the presentation modality and the test form and provide practice.

Buttons and checkboxes

Help - For help on a specific object, right-click on that object. Note that the help text can be dragged with the left mouse button. Left-click on the help text to cancel it.

-- Use the minimize button to temporarily hide the program without closing it.

X and Exit
Options for leaving the program are:
1. The Exit button
2. The X button at top right
3. The Esc button

Home - This button returns you to the starting page
Back - Use this button to change:
- Subject name
- Stimulus type (C-V or V-C-V)
or to record changes of
- Listening conditions
- Presentation levels

Print this page - The print option is available after you have completed a test run and saved the data.

Subject - The name of the current subject is shown here but it cannot be edited on this page. To change the subject name, click "Back" at the top of this page.

Show animation - When this option is selected, periodic animations will appear on the subject's section of the screen. The purpose is to help maintain interest and attention in younger subjects.

Enable entry correction - When this option is selected, the subject will be asked to confirm each response before it is logged. This confirmation slows down the testing process but provides the opportunity for correction of errors.

Audio-visual - Under the Audio-visual and Video-only conditions, the subject is presented with a video clip of the utterance to be imitated. A blue circle appears on the screen before the utterance is presented. Its purpose is to draw attention to the location of the talker's mouth.

Audio-only - In the "Audio-only" condition, the image of the talker is replaced by a picture of a loudspeaker whose color changes during the test utterance.

Video-only - In the event that you wish to test via lipreading only, select the "Video-only" option.

Form - There are four forms of the test. The different forms embody the same phonetic contrasts but use a different selection of utterances. As of Aug 2004, form equivalence has not been established.

Practice - In the practice mode, the subject can play the first eight utterances of the current test form in whatever mode is selected.

Start Test - When testing is started, the subject is presented with each of the eight response options shown in the numbered response boxes. Once these eight have been presented, a second set follows, for a total of 16 utterances. This completes a single test session. The first set of eight utterances embodies three binary contrasts and the second set embodies a different three for a total of six:
Vowel Height (VH),
Vowel Place (VP),
Consonant Voicing (CV),
Consonant Continuance (or manner) (CC),
pre-alveolar Consonant Place (CPf),
post-alveolar Consonant Place (CPr).

**Cancel and Start over** - Clicking on this button will terminate the current test run before all 16 utterances have been presented. You will then be given the choice of saving the partial data or discarding it.

**Repeat** - This button allows the subject to repeat the previous stimulus in the event that the subject was distracted or was not paying attention.

**Numbered response buttons** - These buttons have no function until "Practice" or "Start Test" have been selected. During a practice session, the subject can on these buttons to generate the specified utterance in either the Audio-visual, Audio-only or Video-only mode - whichever has been selected. During a testing session, the subject clicks on one of these buttons to indicate which of the eight utterances has been perceived. If the utterance seemed like none of the options offered, the subject must pick the one that seems closest, or pick one at random.

During testing, the number keys 1 through 8 can be used instead of a mouse click.

**Score tally** - The numbers at the bottom of the screen keep a tally of performance:

- **Total Trials** = number of utterances so far
- **Correct responses** are shown for each contrast
- **Total binary trials** = 3 for each utterance
- **Total binary hits** = the sum for all contrasts

**Contrasts:**
- VH = vowel height (oo vs. aa)
- VP = vowel place (oo vs. ee)
- CV = consonant voicing (voiced vs. unvoiced)
- CC = Consonant continuance (continuant vs. stop or affricate)
- CPf = Consonant Place front (alveolar vs. labial)
- CPr = Consonant Place rear (alveolar vs. palatal)

**Screen** - During testing or practice, video images are presented on this screen.

**Blue dot** - The blue dot is intended to direct the subject's attention to the screen when an utterance is about to be presented.
Graph - After 16 imitations, the accuracy of the subject's responses is shown in graphic form, and the tester is given the opportunity to enter a note before the data are saved. For protection against lost data, the current page may also be printed.

The graph shows % correct performance - after correction for guessing. The corrected score is given by:

\[ c = \frac{(a-g)}{(m-g)} \times 100 \]

where
- \( c \) = corrected score in %
- \( a \) = actual score in responses correct
- \( g \) = expected chance score (4 for each contrast and 24 for the composite score)
- \( m \) = the maximum possible score (8 for each contrast and 48 for the composite score)

The brighter red indicates scores that exceed the 95% confidence limit (1-tail) for performance based on guessing.
RETRIEVE DATA

From this page, you retrieve previously saved data and select specific sessions for averaging and graphing.

Buttons and objects

Help - For help on a specific object, right-click on that object. Note that the help text can be dragged with the left mouse button. Left-click on the help text to cancel it.

Click the minimize button to hide the program temporarily without closing it.

X and Exit - Options for leaving the program are:
1. The “Exit” button
2. The X button at top right
3. The Esc button

Home - returns you to the opening page

Open - Click this button to access a previously saved file. Usable files are in the OLIMSPACdata directory on whatever drive is selected and have the extension ".csv"

When you select Print page, the background color is changed to white and the current date and time are added after the subject name

Prepare graphs - This option is available after you have selected one or more records for graphing by left clicking on the session number.

Columns in the Table:

Session number - The first column of the table shows session number. Use a left-mouse click to select or deselect a session for inclusion in graph preparation. Selected sessions are highlighted in yellow.

Date and time - shows the test dates and times
**Mode** - shows how the stimuli were presented
   Aud = sound only, Vid = lipreading only, AV = sound and lipreading together

**Form** - indicates which of the four forms was used for this test session

**R/L** - shows the listening conditions for the two ears. Only the first three characters are shown here. (If there is any confusion, the complete entry can be read by loading the *.csv file into Excel).

**dB** - shows the decibel levels for the right and left ears (for the audio-only and audio-visual modes)

**Contrast scores** - These columns show six contrast scores and a composite score

If "Raw Contrast Scores" is selected, the score is the number of correct responses in 8 trials for a single contrast, or in 48 trials for the composite (assuming these are not partial data)
If "Contrast Scores in % re chance" is selected, the raw scores are converted using the equation:
   
   \[ c = \frac{(a-g)}{(m-g)} \times 100, \]

   where
   
   \( c = \) the corrected score in percent
   \( a = \) the raw score
   \( g = \) the raw score expected from guessing (4 for a single contrast or 24 for the composite)
   \( m = \) the maximum possible score (8 for a single contrast, 48 for the composite)

White boxes indicate that the score is significantly higher than the expected guessing score at the 0.05 level (1-tail).
Grey boxes indicate that the score fails to reach this level of significance.
Pink boxes indicate partial data - i.e., the test run was terminated before 16 utterances had been presented.
Partial data are not available for conversion to % re chance and cannot be selected for graphing.

**Notes** - This column shows the beginning of any notes that were added when data were saved. If the complete note is not visible, hold the mouse over it.

**Trials** - The last column shows the number of trials, or utterances, for each record. For complete sessions, this number will be 16. Obviously it will be less for partial data.

**Convert** - Use this button to toggle between raw scores and percent scores that are corrected for guessing. Note that the change only applies to the display on this page. The original data file is not altered.
PREPARE GRAPHS

On this page you will see the averages for the data highlighted on the previous page. These averages are shown in both graphical and tabular form.

Buttons and objects

Help - For help on a specific object, right-click on that object. Note that the help text can be dragged with the left mouse button. Left-click on the help text to cancel it.

-- Click the minimize button to hide the program temporarily without closing it

X and Exit - Options for leaving the program are:
   1. The "Exit" button
   2. The X button at top right
   3. The Esc button

Home - returns you to the opening page

Back - returns you to the data page
Reorder - This button toggles between two different ordering of the bars for each contrast from back to front:
a) Audio-Visual at the back, Video-only at the front.
b) Highest score at the back, lowest score at the front.

Note that the color coding does not change when you reorder the bars.

When you select Print page, the background color is changed to white and the current date and time are added after the subject name.

Bar chart - The bar chart shows the mean score for each contrast together the composite score, which is the average of the six contrasts. The scores are shown in percent correct after correction for guessing. The equation used for correction is:
\[ c = 100 \frac{(a - g)}{(m - g)}, \]
where
\[ c = \text{corrected score in percent} \]
\[ a = \text{actual number of correct responses} \]
\[ m = \text{maximum possible number of correct responses (8 x the number of sessions for a single contrast and 48 x the number of sessions for the composite score)} \]
\[ g = \text{number of correct responses expected from a subject who is guessing on each trial (= m/2)} \]

Color coding distinguishes the three presentation modes: Audio-visual, Audio-only and Video-only.
When you first enter this page, the order of the bars (back to front) is Audio-visual, Audio-only and Video-only.
Clicking "Reorder bars" will change the order from highest to lowest.

Check boxes - The boxes at right can be used to select or deselect specific modes for display, providing at least one session for that mode has been selected on the data page.

Conf. lim. - Also shown on the graph are the 95% confidence limits for scores that are based on guessing only. That is, if the subject is guessing on each trial, the probability of obtaining a score that exceeds this limit is less than 0.05.
These confidence limits are based on the normal approximation to the binomial function, using the equation:
\[ cl = \sqrt{0.5x0.5/nt} \times 1.67 \times 200, \]
where
\[ cl = \text{confidence limit in percent} \]
\[ \sqrt = \text{square root} \]
\[ nt = \text{number of trials (= number of sessions x 8 for a single contrast, or number of sessions x 48 for the composite score)} \]
**Chance**
The area under the confidence limit is shaded when displaying a single presentation mode or, if displaying more than one, when the same number of sessions is included for each mode.

**Table**
The top three rows of the table show, for each presentation mode, the number of correct responses for each contrast together with the sum for the six contrasts.
The bottom three rows show the scores in percent after correction for guessing.
The equation used for correction is:
\[ c = \frac{100(a - g)}{(m - g)} \]

- \( c \) = corrected score in percent
- \( a \) = actual number of correct responses
- \( m \) = maximum possible number of correct responses (8 x the number of sessions for a single contrast and 48 x the number of sessions for the composite score)
- \( g \) = number of correct responses expected from a subject who is guessing on each trial (= \( m/2 \))
Addendum

1. Correction of previously stored data
On the “Retrieve Data”, page it is possible to correct erroneous entries. The correction possibility exists for:

- Listening conditions
- Listening levels
- Notes
- Raw contrast scores

To correct an entry, double-click with the left button on the cell to be corrected and enter the new information.

When correcting a contrast score, you must enter a digit between 0 and 8.

You cannot correct the sum, but it will be updated automatically when you change one of the contrast scores.

Great care must be exercised when making corrections to the scores. Each response generates three independent scores – one for each contrast currently being tested. If, for example you selected “ooboo” when you intended to select “oopoo”, and if the stimulus was, in fact, “ootoo” you may increase the score for CV by one.

This is a dangerous option because any changes you make will be recorded in the *.csv file. In other words the logged data will be modified as well as the data shown on the screen.

2. Backup files
When data are logged, the software includes a second copy with the extension *.bak. If the *.csv file is damaged or deleted, the data can be retrieved from the backup file. When opening a file on the “Retrieve data” page, enter *.bak under file type. You can then select from the list of *.bak files.

You should never make changes to the backup files.