CFS MATLAB toolbox – User manual

Software and hardware requirements

The CFS toolbox requires the installation of MATLAB or GNU/Octave and Psychtoolbox-3. Psychtoolbox-3 is a set of functions for experimental psychology research that runs on multiple platforms (Windows, Mac, Linux) and that makes it easy to present accurately controlled visual and auditory stimuli.

The CFS toolbox has been tested under Windows 7 with MATLAB R2014a and Linux Ubuntu 15.04 with GNU/Octave 4.0. The toolbox versions for both environments are available from the project page. The CFS toolbox draws and plays visual and auditory stimuli using the functions of Screen and PsychPortAudio in Psychtoolbox-3. Screen is a function for precise control of the video display. PsychPortAudio contains a set of parameters for working with sounds. The functionality requires a suitable graphic and audio cards and computer. It is recommended that the user refers to the Psychtoolbox-3 documentation for up-to-date details.

Links

- [Psychtoolbox-3 documentation](http://psychtoolbox.org/) (http://psychtoolbox.org/)
- [MATLAB](https://se.mathworks.com/products/matlab.html) (https://se.mathworks.com/products/matlab.html)
- [GNU/Octave](https://www.gnu.org/software/octave/) (https://www.gnu.org/software/octave/)

Mirror stereoscope

In our laboratory setup (see Figure 2), stimuli are viewed through a mirror stereoscope with mounted chin and head rests. A mirror stereoscope presents the stimulus in the right half of the display exclusively to the right eye and the stimulus in the left half of the display exclusively to the left eye (see Figure 1). Some scholars have used a setup, in which two displays that are set opposite to each other, project stimulus to the left and right eye respectively via two mirrors.
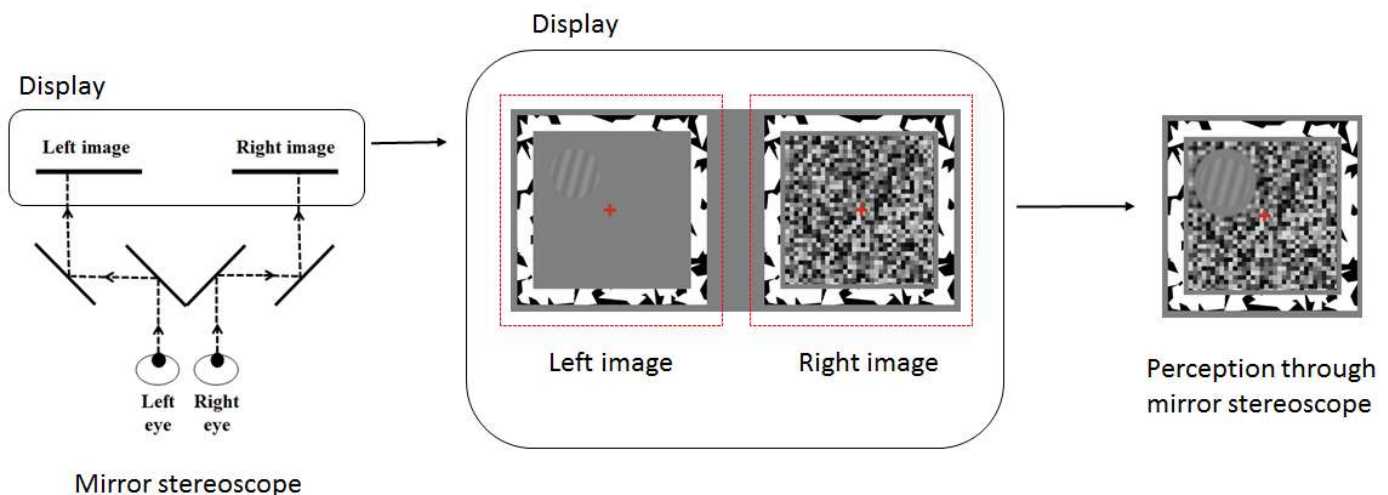

Figure 1. Mirror stereoscope presents the stimulus in the right half of the display exclusively to the right eye and the stimulus in the left half of the display exclusively to the left eye.
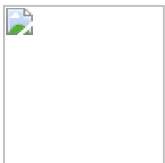

Figure 2. Photography of the test setup system in our laboratory (mirror stereoscope, chin and head rest and display)

Experiment running

The primary interface to the CFS toolbox are the stimulus parameters (stimulus_parameters.csv) and trial parameters (trial_parameters.csv) files. The CFS toolbox reads the parameter files and run experiment according to the parameters. The stimulus parameters file contains

parameters for the whole experiment setup. The trial parameters file contains a sorted list of definitions for each trial. The parameter values in the both files can be changed, although the structure of the files must be preserved when saving.

Stimulus parameters

The stimulus parameters define the location and size of experiment window and the options for all experiment elements. The CFS toolbox draws all experiment elements, such as border frames, noise pattern and visual stimuli, inside experiment window. That is, the coordinate space of experiment window is used for defining the locations and sizes of experiment elements, whereas experiment window uses the coordinate space of display device. Figure 3 shows how the parameters of experiment window are set. Figure 4 shows how the parameters of experiment elements are set.
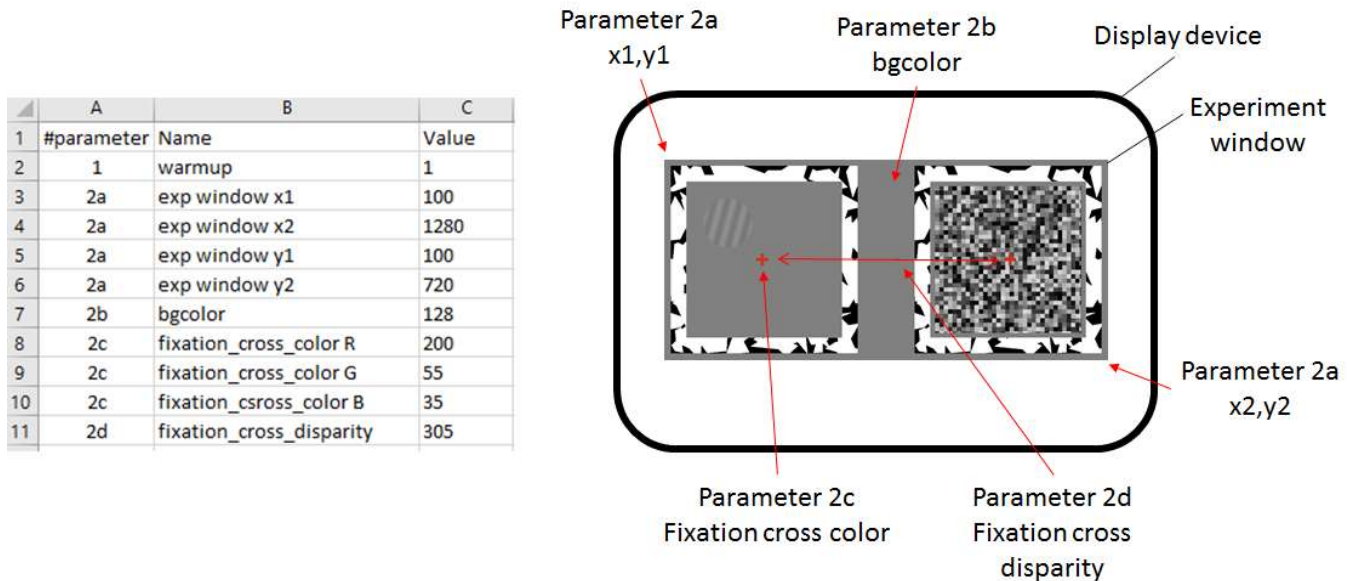

	A	B	C
1	#parameter	Name	Value
2	1	warmup	1
3	2a	exp window x1	100
4	2a	exp window x2	1280
5	2a	exp window y1	100
6	2a	exp window y2	720
7	2b	bgcolor	128
8	2c	fixation_cross_color R	200
9	2c	fixation_cross_color G	55
10	2c	fixation_csross_color B	35
11	2d	fixation_cross_disparity	305

Figure 3. The coordinates and properties of experiment window are set by the parameters 2a – 2d of the stimulus parameters file

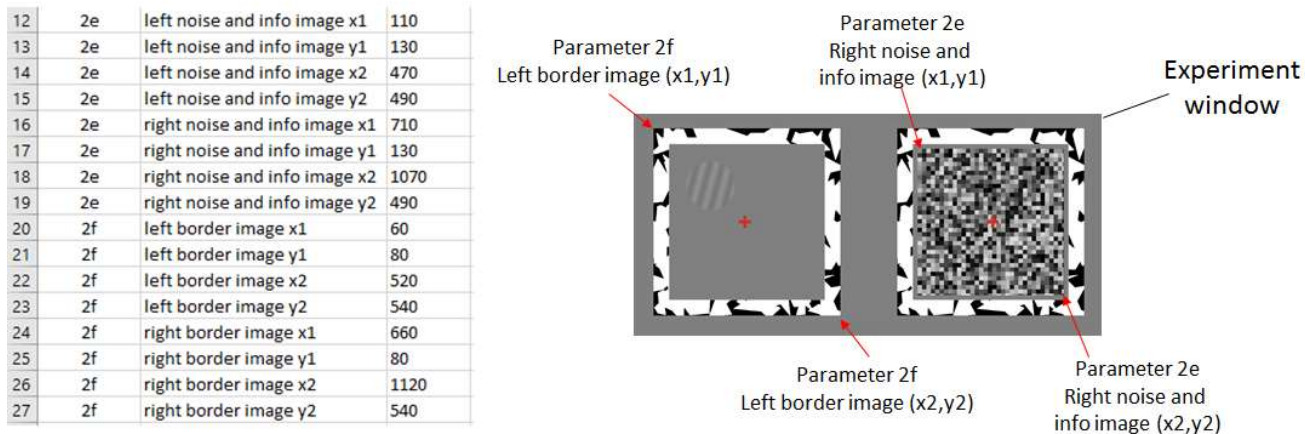|			
12	2e	left noise and info image x1	110
13	2e	left noise and info image y1	130
14	2e	left noise and info image x2	470
15	2e	left noise and info image y2	490
16	2e	right noise and info image x1	710
17	2e	right noise and info image y1	130
18	2e	right noise and info image x2	1070
19	2e	right noise and info image y2	490
20	2f	left border image x1	60
21	2f	left border image y1	80
22	2f	left border image x2	520
23	2f	left border image y2	540
24	2f	right border image x1	660
25	2f	right border image y1	80
26	2f	right border image x2	1120
27	2f	right border image y2	540

Figure 4. The coordinates of border and noise images are set by the parameters 2e and 2f

It is possible to set eight different location options for visual stimulus. Visual stimulus can be selected to be displayed e.g. on the different corners, up or down or center or any eight free positions on experiment window. The principle is that coordinate options are recorded in the stimuli parameters file from which trial specific values are selected for each trial according to the trial parameters file. Figure 5 shows an example experiment window in which red squares are eight location options in this setup that can be selected for different trials by the trial parameter file.

OBS. It should be noted that the CFS toolbox shows left noise image when the visual target is presented in positions 1, 2, 3 or 4. The right noise image is, respectively, showed when the position of visual target is 5, 6, 7 or 8.

	A	B	C
28	3a	Visual stimulus refresh rate	0.0133
29	3b	Visual stimulus fade rate	0.02
30	3c	Visual stimuli 1 x1	890
31	3c	Visual stimuli 1 y1	310
32	3c	Visual stimuli 1 x2	1070
33	3c	Visual stimuli 1 y2	490
34	3c	Visual stimuli 2 x1	710
35	3c	Visual stimuli 2 y1	310
36	3c	Visual stimuli 2 x2	890
37	3c	Visual stimuli 2 y2	490
38	3c	Visual stimuli 3 x1	890
39	3c	Visual stimuli 3 y1	130
40	3c	Visual stimuli 3 x2	1070
41	3c	Visual stimuli 3 y2	310
42	3c	Visual stimuli 4 x1	720
43	3c	Visual stimuli 4 y1	130
44	3c	Visual stimuli 4 x2	890
45	3c	Visual stimuli 4 y2	310
46	3c	Visual stimuli 5 x1	290
47	3c	Visual stimuli 5 y1	310
48	3c	Visual stimuli 5 x2	470
49	3c	Visual stimuli 5 y2	490
50	3c	Visual stimuli 6 x1	110
51	3c	Visual stimuli 6 y1	310
52	3c	Visual stimuli 6 x2	290
53	3c	Visual stimuli 6 y2	490
54	3c	Visual stimuli 7 x1	290
55	3c	Visual stimuli 7 y1	130
56	3c	Visual stimuli 7 x2	470
57	3c	Visual stimuli 7 y2	310
58	3c	Visual stimuli 8 x1	110
59	3c	Visual stimuli 8 y1	130
60	3c	Visual stimuli 8 x2	290
61	3c	Visual stimuli 8 y2	310
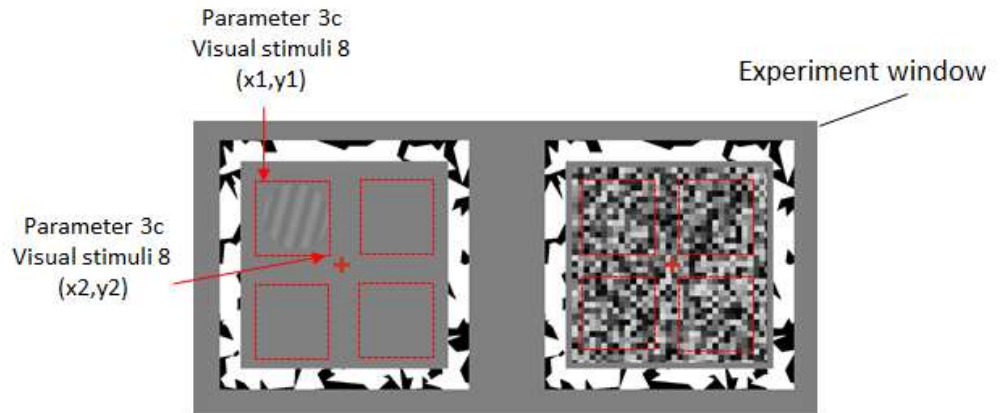
Figure 5. The location options for the visual targets are set by the parameter 3c.

Trial parameters

Each row of the trial parameters file defines the presentation of visual and auditory stimulus for one trial. The number of rows defines the number of trials. Each trial is defined by the four parameters: (1) the location of visual stimulus, (2) the type of visual stimulus (image file), (3) the timing of audio stimulus and (4) the type of audio stimulus (audio file):

- (1) The location of visual stimulus is set by integer value from 1 to 8. Actual coordinate locations for different integer values are coded in the parameter #3c of the stimulus parameters file.
- (2) In this version of the toolbox there is option to use two different visual stimulus type in experiments. The toolbox reads the visual stimuli from the director "/CFS/visual_stimuli/". The value 1 of the parameter #2 means that the visual stimulus is the image file named as "visual_stimulus_1.png" and the value 2 means "visual_stimulus_2.png".
- (3) The audio stimulus timing of each trial relative to visual stimulus is set by integer values from 1 to 4. Actual timing values for audio stimuli relative to visual stimuli are coded in the parameter #6 of the stimulus parameters file.
- (4) In this version of the toolbox there is option to use two different audio stimulus type in experiment. The audio stimulus files are read from the director "/CFS/audio_stimuli/". The value 1 of the parameter #4 means that the audio file named as "auditory_stimulus_1.wav" is selected for the trial and the value 2 means "auditory_stimulus_2.wav".

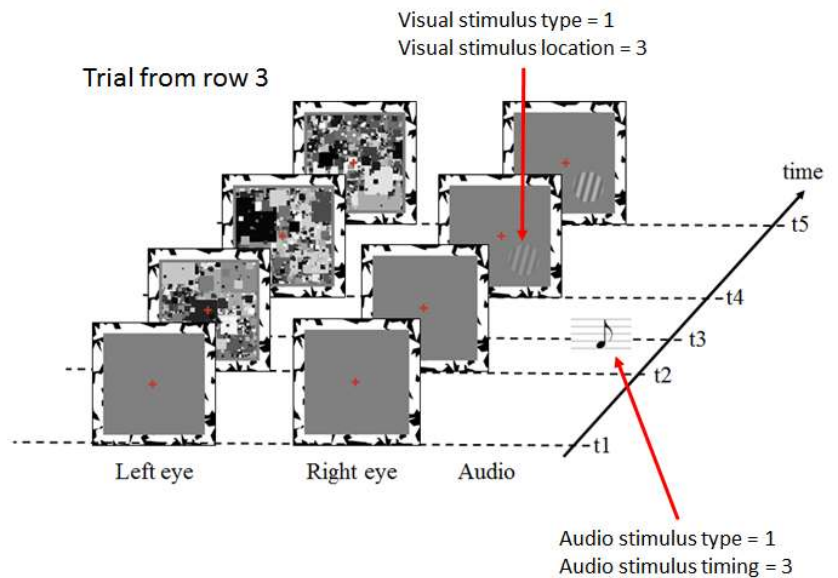Figure 6. shows an example trial as a function of time.

Figure 7. An example trial (row 3) as a function of time

Run experiment

Once the experiment has been specified in the parameter files, it can be run from the MATLAB command window by calling the function "run_experiment". This function reads the parameter files and runs the experiment. The demo video "run_experiment_demo.mp4" is a screen capture in which the actual experiment has been run. For the video, we used a screen keyboard for clarifying the keys that are used for controlling the user interface of the experiment setup. It can be noted that "return" and "space" keys are used when moving from the infograph display to the trials and "up" and "down" arrow keys are used to record the responds of trials. A new trial is always started by pressing the "space" key.
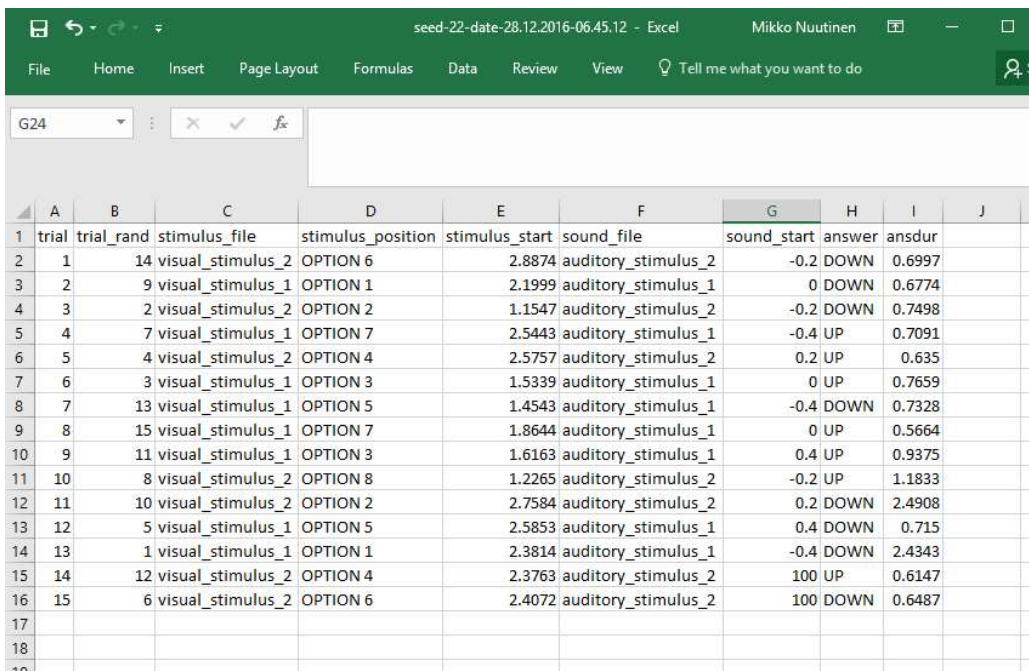
- [Run experiment demo video](#)

Save results

After all trials defined in the trial parameters file have been run, experiment specific result file is saved to the result director. Result files are named as "seedID-date-dd.mm.yyyy-hh.mm.ss.txt", in which 'ID' is participant identification number, 'dd.mm.yyyy' is the date and 'hh.mm.ss' the exact time when the experiment was finished.

Figure 7 shows example result file opened in Excel. The first row of the file shows that the trial parameters were selected from the row 14 of the trial parameters file (column: trial_rand). That is, the order of the trials was randomized. The visual stimulus of the first trial was the image file "visual_stimulus_2.png" (column: visual_stimulus_file), which was triggered 2.8874 second after noise (column: stimulus_start). The position of the visual stimulus was the location coded in the option 6. The audio file of the first trial was "auditory_stimulus_2.wav" (column: audio_file). In this trial the audio was played 0.2 second before the visual stimulus (column: audio_start = -0.2). The column of answer shows that the observer pressed the "down" button.

OBS. The sound_start values in the trials 14 and 15 is 100 seconds. In a that way, by setting audio start time long enough, audio can be muted for the specific trials.

Figure 7. Screen shot of result file opened in Excel

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