

### 3. Training new phonetic categories in varying acoustic environments

As described in D4.2, we developed a new, independent version of the brain game module as a standalone PC executable. In the game listeners are trained with difficult nonnative speech categories in varying acoustic environments. Below we present

- a brief description of the current status of the game,
- a link to a short demo, with brief instructions on how to run the software,
- sample pilot data from 2 participants that played the latest version of the videogame for approximately 25 minutes.

#### 3.1 Current status of the game

The game environment is a simple arcade-style top-down space shooter. As described in D4.2, the player's task is to shoot enemy characters that appear on the screen and avoid collisions. We used as a template the Space Shooter videogame that is freely available in Unity (<https://learn.unity.com/project/space-shooter-tutorial>). Unity provides the source code, graphics and visuals, including elaborate 3D models and texture sets, as well as extensive tutorials that allowed us to modify the game according to our experimental goals. We implemented several important modifications of the original code:

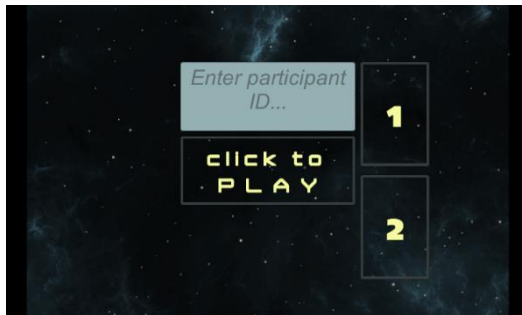
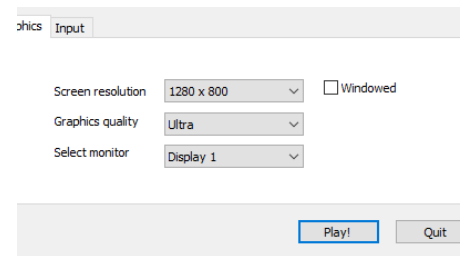
- We added phonetic stimuli from 2 nonnative phonetic categories, convolved with BRIRs from 3 simulated rooms. The stimuli are presented in a controlled schedule, according to the experimental design, with the appropriate randomization and counterbalancing procedures.
- We introduced 6 different levels of difficulty in the videogame by changing the background images, and increasing the number of enemy characters that appear on the screen. The level of difficulty is continuously adapted to the player's individual performance, keeping at least a 75% success rate (not shown in this short demo).
- We added fun game elements, such as a bonus life each time the player manages to increase the score by a certain amount.
- As described in D4.2, we implemented 2 different training conditions that incorporate our experimental hypotheses: the predictive scheme, whereby the phonemes precede the visual character, predict the location from which the target will appear and the appropriate response, and the concurrent scheme, whereby the speech stimuli appear at the same time as the visual stimuli and have no behavioral utility.
- We monitor the participants' performance (trial number, phonetic token, level of difficulty, hits, misses etc). The output is stored in log files, to be later processed and entered into statistical analyses.

### 3.2 Demo

A short demo is provided that gives an overview of the experimental conditions and game design. In the demo, we are presenting speech stimuli convolved with BRIRs from three different acoustic environments. Each acoustic environment is presented once, in a 10-trial block that contains 10 speech stimuli (5 from each phonetic category; more information on the acoustic properties of the speech stimuli and simulated rooms is provided in Vlahou et al., 2019, Attention, Perception & Psychophysics; see also D1.2). Note that in this short demo the level of difficulty increases faster than in the actual game.

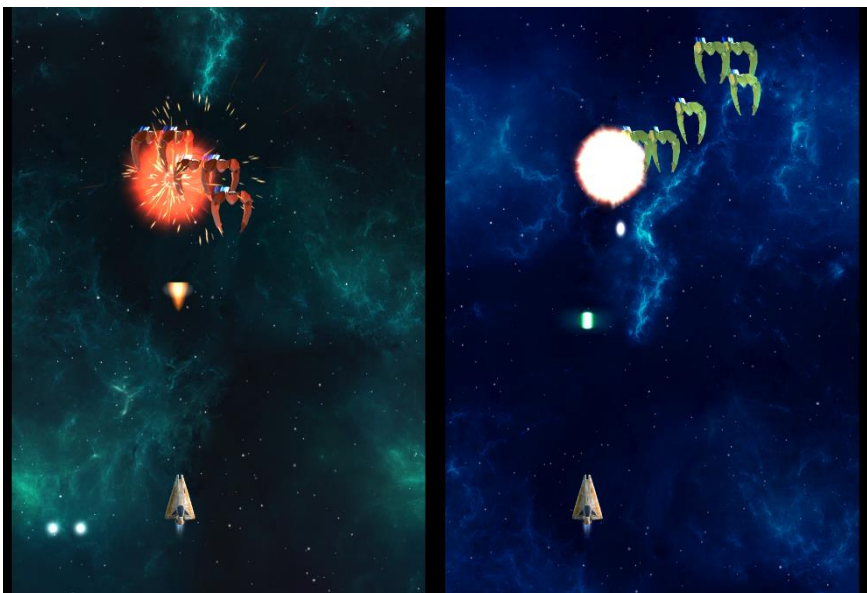
To run the demo:

1. Download “IPL.exe”, “UnityPlayer.dll”, “IPL\_data” and “Mono”. Unzip “IPL\_data” and “Mono” to the same directory.
2. Double click the “IPL. Exe” program.
3. Select screen resolution and other parameters as shown here. The current version has been tested on an Dell laptop with screen resolution 1280 X 800.

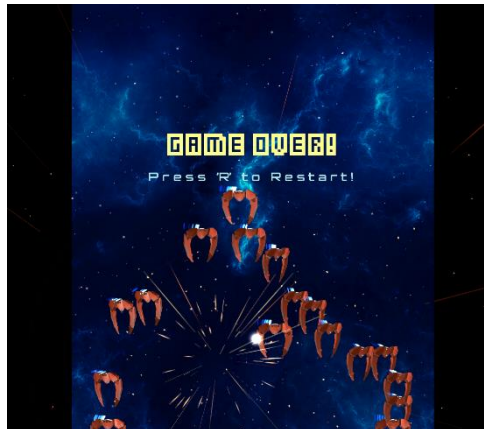


4. Type the participant’s ID and then hit enter. Then select “1” for the predictive condition or “2” for the concurrent condition (for details see D4.2). Click on “click to play” to start the game.

5. Shoot the red alien characters with left Control key and the green alien characters with the left Alt. Move the spaceship using the up, down, left and right arrow keys.



6. Try to shoot as many aliens as you can, in order to increase your score and get bonus lives.



7. Press Esc to exit the game. Press "R" to restart.

### 3.3 Piloting

As described in D4.2 "In the coming months, the game will be tested and compared to the results of the previous version of the game published in D1.1.". We are currently running pilot studies, collecting data from the two experimental conditions and assessing performance on several game metrics (reaction time, score, number of correct and wrong keypresses etc). The figure below shows sample pilot data from 2 participants that were trained in the concurrent (blue) or the predictive (red) condition, for 6 short sessions, for a total of 25 minutes each. The data so far show a trend for an improvement in score after only 25 minutes of play, but more piloting is needed to confirm this. In the next period, more pilot data will be collected to assess (a) game satisfaction, (b) game performance, (c) improvement in the phonetic identification test as a result of training and, (d), comparison across the two training conditions.

