## Creating a new maze

With the *MazeBuilder* tool it is possible to create new mazes by using a drawing board like interface. Every element of the maze can be placed and shaped, which includes walls, start and end positions, reward points, teleporting points and moving walls. It is also possible to create a maze automatically, which is the easiest way to create corridor mazes. This can be done by defining the size of the maze manually by either defining the length directly or by the number of pictures to show on the corridor walls. In the latter case the maze is created automatically, matching the number of images.

The maze is then saved in the maze folder and can be loaded from Maze Master. It is also possible to change the maze either by opening it again in Maze Builder or by hand, opening the file and changing the numbers manually.

### Placing a wall

A new wall is created by clicking on an empty node on the drawing board, this will create the starting point of the wall. To set the wall you have to click on another node as the end point. The wall is created and you can continue with the next one, while still in creating mode. To end the creating mode click the right mouse button. All walls are marked in purple.

### Deleting a wall

You can delete a wall by simply clicking on an existing wall with the right mouse button.

### Placing reward points

Reward points are positioned by clicking on them and then click on the position where it should be placed. The number of reward points can be set by clicking on the minus and plus buttons. Whether the reward area should be visible in the virtual environment, can be set via the *reward visible* checkbutton.

### Placing the start point

The start point is positioned by clicking on the button and then click on the position where it should be placed. The virtual player will face the southern direction of the maze when started.

### Placing the teleporter point

The teleporter point is positioned by clicking on the button and then click on the position where it should be placed. After a teleportation event is triggered, the virtual player will be transported instantly to this teleporter point.

### Placing sensors

A sensor is placed by first clicking on the button and then on a starting point, followed by an end point of the sensor wall.

### Placing false walls

A false walls is placed by first clicking on the *add sensor* button and checking the *False Wall* checkbutton. The wall is placed like a sensor by defining on a starting point, followed by an end point of the wall.

## Creating a virtual tunnel by number of cues

An easy way to create a new virtual tunnel is to define the total number of cues it should contain. Each square on the drawing board equals the size of one cue. Define the total number, including the blanks in between cues, and enter this number in the *number of pictures* field. You can add cues in the beginning of the tunnel or in the end of the tunnel, which do not count as cues, so no sensors are created for them. By clicking on create maze, a normal corridor is created with a start position and a sensor for each cue.

## Creating an endless maze

This maze type consist of a linear tunnel. It is functional similar to complex mazes, when a reward point is placed at the end of the corridor. Cues can be used as background texture on the walls. An often used type of a corridor maze is an endless corridor. In this type of maze, the corridor seems to be endless, the virtual user can move without reaching an end. Nevertheless, there can be a separation into single trials, which are saved and restarted after a certain distance or time. This becomes handy when triggering other hardware like a camera or a microscope, or just to separate the data into repeating parts.

The normal way of creating an endless corridor is to set the number of pictures, which should be on the wall. This determines its length and can even be used without using any pictures in the end. The endless maze factor sets the factor with which the length will be multiplied to give the impression of an endless maze (default = 6). After entering those values a click on the button *create endless maze* will create the corridor.

### Textures

Textures for the walls can be loaded by using the buttons ion the *Textures* section. Background is the texture for the maze walls. Textures for ceiling and floor can be loaded by clicking one of the buttons. The textures should be square in size.

### Saving the maze

After finishing the design, a name should be entered. After that, clicking the save button will save the maze in the maze folder.

## Setting up an experiment

For creating and starting an experiment, follow the following steps.

### Load a maze

A maze can be loaded by clicking the *Load Maze* button. It will be opened and displayed in the maze window. The name of the maze is shown above the load maze button on the top.

### General Settings

The place where to store the data can be defined here. There are some presets from which to choose, which can be changed in the settings.

There are presets of settings which can be defined and saved for each task separately. For this, first the experiment has to be chosen, to which the task is assigned. You can add new experiments by clicking the plus button next to the dropdown menu. The same can be done with task, which are then assigned to the currently chosen experiment. Tasks and experiments can be deleted by clicking the red x next to the dropdown menu. Be aware that if you delete an experiment, all assigned tasks are deleted as well.

The currently selected settings are saved to the chosen task by clicking the *save settings* button.

For an identification of the dataset, an ID can be entered for the test subject.

The filename and directory is then created automatically out of the experiment, task and ID. Alternatively, it can be set manually by checking *set manually*.

### Trial Control Settings

In this section, all the settings regarding the trial can be set.

The button *Start Block of Trials* will initially start the experiment after the connection to Blender has been established.

The *New Trial* button will directly start a new trial when pressed. Please note that the current trial will be aborted.

#### Tracking

If this setting is enabled, the path the virtual subject took in the maze is tracked by a line with the entered frequency. This is normally only necessary when using a ball as an input device.

#### Digital triggers

There are up to four digital triggers for cameras or any other devices, which are either triggered directly at the start or end of each trial or only once at the beginning of the first trial.

#### Start trial

With this setting you can switch between an automatic start of each trial and a speed triggered start. When the triggered start is chosen, the start of each trial is delayed until the given speed is reached for at least one second.

#### Supply reward

If this setting is enabled, a water droplet is given, when the virtual subject enters a reward

Area. The amount can be set via the duration of the valve opening. In addition, a probability can be set, with which the reward will be given each trial. The *flush manually* button will open/close all valves.

#### Save a comment

Comments can be added to individual trials with this text editor. They are saved together with the data for each trial.

#### Block and trial settings

In this block, the *maximal number of trials* can be set. After reaching this number, the program will automatically stop running. The *maximal trial duration* determines the amount of time after the trial is terminated automatically. The same goes for the *maximal trial distance,* which determines the number of steps after the trial is terminated automatically.

A zero means infinite in all cases, the trial/experiment will not stop automatically.

The entry field *minimal inter-trial-interval* sets the delay time between trials.

#### T-maze control

The 2-afc experiment comes with a simple bias correction, to correct for a side bias. You can enable this by clicking the checkbutton. Furthermore the time can be entered in *End time,* after which the trial ends when entering one of the arms in a T-maze.

#### Air-puffs

An air puff can be given by clicking the button in the *Trial Control* section. The valve (digital port) will open for the set duration.

#### Autorun

Normally, the virtual subject moves accordingly to the input of the encoder (Wheel) or the computer mice (Ball). The length of one square in the maze can be defined here. In addition to the normal running, there is the possibility of using the autorun mode. This mode can be used either with a constant automatically movement (*constant* mode), or a movement profile of a recent trial (*variable* mode). For the latter option, the trial data file has to be loaded to extract the movement data from by clicking the *Speed* button. When you want a randomization of those recent running profiles, simply check the *random* checkbutton.

### Loading Cues

The cues are shown in the *cues* section on the left side. Ten cues can be loaded in total to show on the maze walls. A new cue can be loaded by clicking on the image/placeholder of the cue. An already loaded cue is replaced with the new one. You can delete cues by right-clicking on the cue image.

All loaded cues can be saved as a set of cues, which can be loaded afterwards. For this, use the *Load Cue Set* and *Save Cue Set* buttons.

Cues can be shown in two different modes: Flashed or as texture on the wall. When the flashed mode is used, the images will be flashed on the walls at the sensor positions for a certain duration, which can be set here as well. The sensors positions are normally automatically created from the *MazeBuilder,* so that the images are distributed throughout the length of the corridor. The cues are flashed from left to right/ascending order, which mean, that the cue number one will always be the first one. The number of cues should match the number of sensors, but ignoring the sensor number zero (teleportation sensor). That means there should be one more sensor than cues.

Cues can be omitted by simply deleting the cue in the row.

When the *cues on Walls* mode is chosen, the cues will be as a texture on the walls, lined up from left to right. Again, the number of cues should match the length of the corridor. Normally one cue equals one square (or sensor) on the maze window.

#### Varying sequences of cues

It is possible to change the cues from trial to trial automatically. A predefined list of cues can be loaded via the *Load Sequence* button. This list should be a .csv file with one column named “cue”. In this column all the cues should be listed with their index numbers according to the cue indices in Maze Master. An often used method is to load more cues than sensors and automatically change the cues, which should be shown, via the sequence file. Each row should contain one cue index number, the program will simply assign the next cue in the list to the next sensor and after finishing the trial, it will continue with the next position in the list, assigning it to the next sensor again.

You can find an example sequence file for alternating cue triplets in the doc folder.

### Starting the Experiment

To start the experiment, the Blender game engine has to be started and connected to Maze Master. This can be done by first clicking on the connect button in the *Server Control* section. When the *Autostart Blender* option is marked, Blender will start automatically when clicking the connect button. Otherwise, Blender can be started by clicking the *Start Blender* button. Blender will open a window and connect automatically to Maze Master.

When the connection is successfully set up, the server status will change to *connected.*

The first trial can be started by clicking on *Start block of trials* button in the *trial control* section.