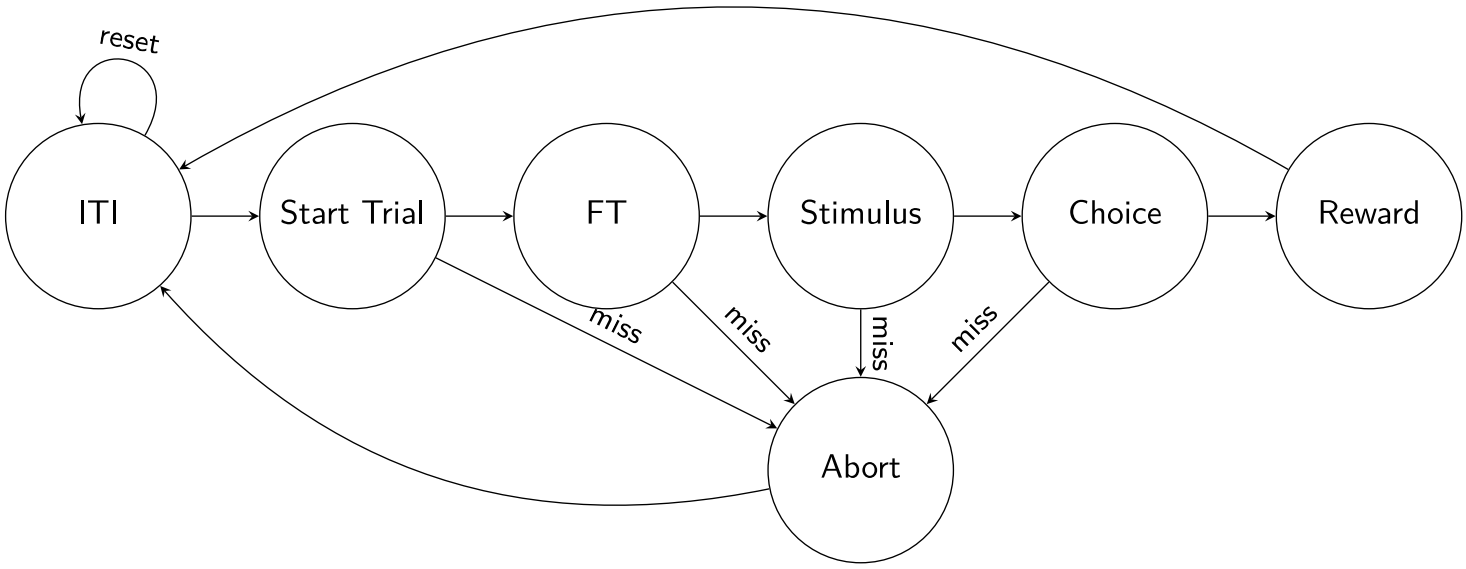
Introduction

The sound lateralization task implemented in the current project, which is based on [1], was designed as a state machine, where the progression through the different states is driven by certain events. The figure below is a representation of the state machine that describes this task.



From the figure, notice that from most states there are two possible states that these states can progress to. This happens because there are certain conditions that have to be met in order for the state machine to progress to the next "desired" state.

The remaining pages of this subsection are dedicated to the description each individual state (which include an explanation of what happens and what are the progression conditions).

Inter-Trial Interval

The Inter-Trial Interval (ITI) state is, as the name suggests, the time interval that separates two consecutive trials.

Since there is a need to setup each trial (for example, to (re)set some parameters) and the duration of the ITI is, typically, a few seconds, this state is also a preparation of the new trial. Currently, the actions that take place in the ITI state are:

- Updating the trial number.
- Checking if a block of trials ended in the previous trial and, if so, reset the block variables and update the block number and training level.
- Randomizing the ABL (average binaural level) and ILD (inter-aural level difference) values and selecting the sound that is going to be played in the current trial (**Note:** this only happens if the Level0 setting is 0).

Progression conditions

If the ITIReset setting is 1, this state resets everytime the animal is poking the CNP before the ITI is over.

Start Trial

A trial starts when the rodent pokes his nose in the central nose port (CNP). So this state consists of waiting that the rodent starts poking the CNP.

Progression conditions

If there is a poke within a certain time limit (determined by the MaxWait parameter), the task continues as it is supposed to, otherwise this trial is aborted.

Fixation Time

This is the state that precedes the stimulus presentation. The rodent must stay in the CNP during the entire time this state lasts so that the task progresses as expected, otherwise the trial is aborted.

If the RandomizeFT setting is 1, the fixation time varies from trial to trial - it is randomly generated - in order to make the timing of the stimulus presentation (which happens as soon as the fixation time ends) unpredictable. In this case, the fixation time is given by:

$$t_{\mathbf{Fix}} = t_{\mathbf{Base\ Fix}} + (X \sim \mathbf{Exp}(\lambda))$$

If RandomizeFT is 0, the fixation time is only given by $t_{\mathbf{Base\ Fix}}$.

Progression conditions

If the animal doesn't leave the CNP during this state, the task continues as it is supposed to, otherwise this trial is aborted.

Stimulus

This is the state where the stimulus is presented. The stimulus stops when either the rodent leaves the CNP (if UseRT is 1) or when the animal enters one of the LNP's (if UseRT is 0) or when the defined presentation time elapses (the presentation time is defined by MaxRT).

Progression conditions

If the animal leaves the CNP after the minimum reaction time (defined by MinRT) and before the maximum reaction time (defined by MaxRT), the task proceeds as expected. Otherwise, it is aborted.

Choice

In this state, the animal has to pick the side (left or right) which corresponds to the speaker that played the loudest sound by poking in either lateral nose port (LNP).

Progression conditions

If the animal pokes either LNP after the minimum movement time (MinMT) and before the maximum reaction time (MaxMT), the task proceeds as expected. Otherwise, it is aborted.

Reward

The Reward state evaluates whether the rodent got the answer right or not. In case the answer is wrong, a penalty time is applied (10 seconds for instance). If the answer is right, the animal only gets the reward (water) if he stayed in the correct LNP for at least a minimum amount of time (IntendedLNP). This is the final state of a successful trial.

Additionally, the following variables/metrics are updated:

- AbortEvent
- RepeatTrial
- BlockAbortRatio
- BlockPerformance
- BaseFT
- BaseRT
- IntendedLNP

Abort

The Abort state is triggered when some conditions are not met in the previous states. This state consists of a small time penalty. The penalty time is defined by AbortPenalty, unless a fixation abort occurred. If that's the case, then the penalty time is defined by FixationAbortPenalty.

Since this state is one of the two possible final states of a trial, there is a need to set/update some variables that would normally be set/updated in states that the state machine did not get into during the current trial.