CORTICAL SYSTEMS AND
BEHAVIOR LABORATORY
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Lickometer Manual

Basics of animal training

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Questions:

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Good science is good observation! Record everything!

To begin training an animal new to the chamber and the chair, the first step is adapting the subject to its surroundings to reduce any anxiety experienced by the animal.

Room Acclimation

Days 1-3: Spend the first 3 days placing the animal in the room in which it will be trained. The animal should be left in its plexi glass transporting cage. Treats should be delivered upon entering the room. Approximately ½ hour in the room should suffice. You (the experimenter) should be sitting with the subject as it needs to acclimate to you as well.

Glove Acclimation

Days 4-6: Spend 3 days familiarizing the animal to the handling gloves. Put one glove on and place it in the transport cage with the animal. Feed the animal treats from your gloved hand. Show the animal you do not intend to harm it with the glove.

Handling the Animal

Days 7-11: Spend 5 days handling the animal. For the first day or so, I recommend having another lab member with you in case the animal escapes. Some animals will be very frightened during this time, although others are less bothered. Expect erratic behavior from the animal.

Chair Adaptation

Days 12-14: Spend 3 days adapting the animal to the chair. Definitely have another person with you while doing this. If you are not comfortable, the animal will not be comfortable so make sure to relax and do not hurt the animal! After you have successfully gotten the animal in a **comfortable** position in the chair, start feeding it treats. Remember our goal is to train the animals to associate the chair with good things!

** This timeline is merely a guide. I do not recommend spending less than two weeks adapting the animal, but each period of time may be extended based on the animal's behavior. If the animal is behaving erratically at the end of a period, continue that period for longer or talk to a senior lab member about the best training strategy.
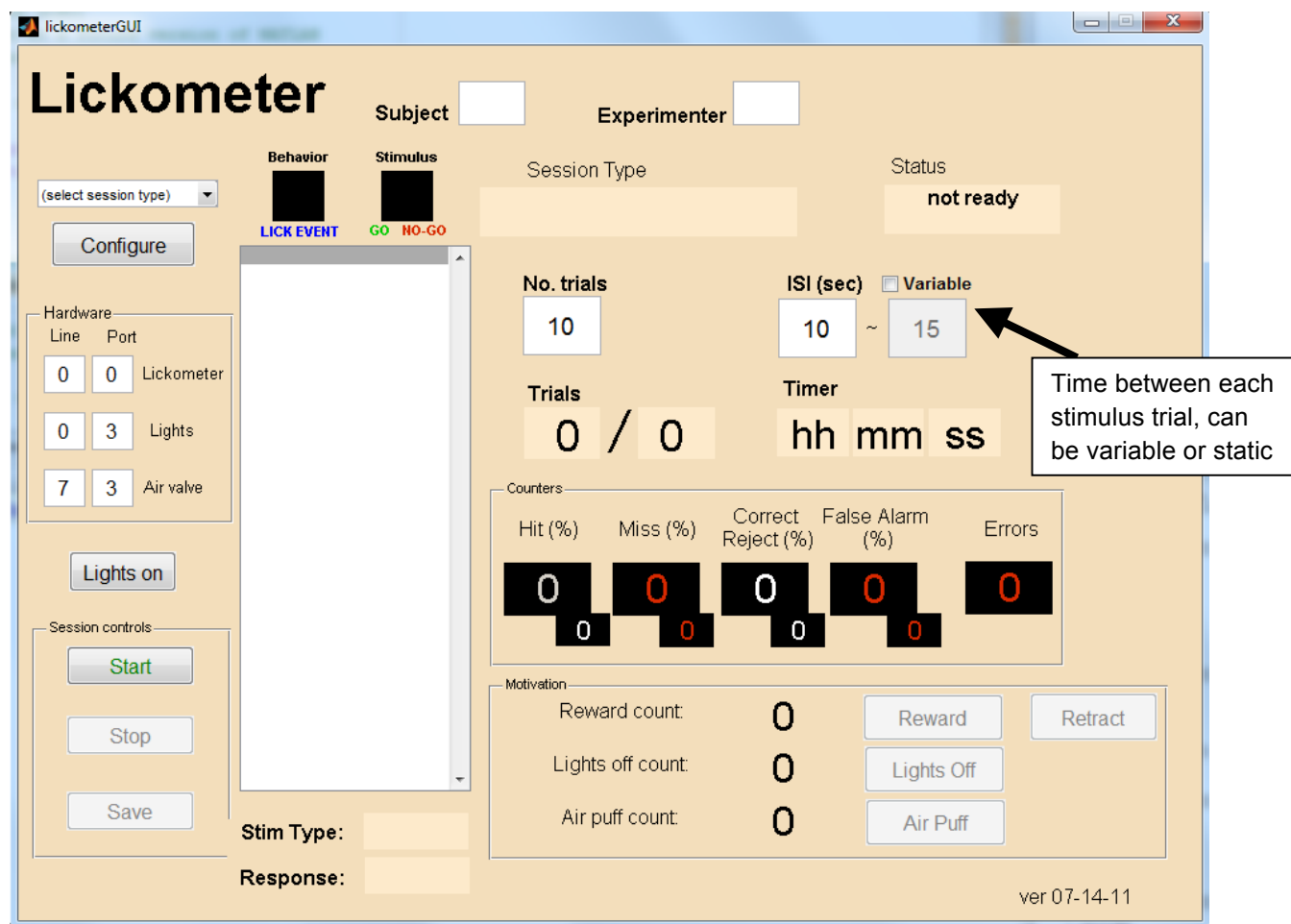
Tube Training

The goal of tube training is for the animal to make the association between licking the tube and getting a reward.

To begin any training session, regardless of its nature, do the following:

1. Open MATLAB→marmoset_training→lickometerGUI
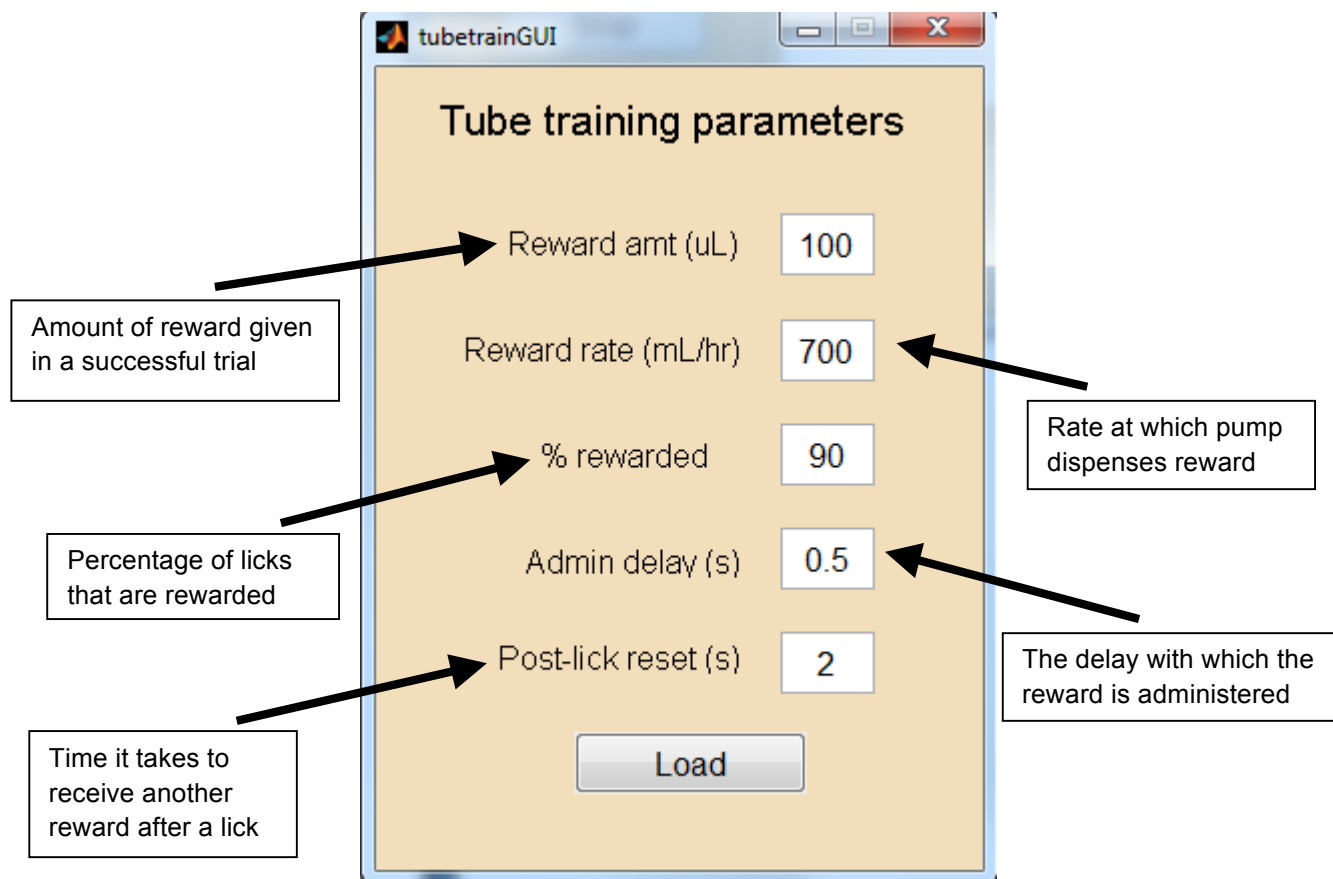2. Enter lickometerGUI in the command line

This will open up the main GUI through which all other GUIs can be accessed. Configure parameters for main GUI. **DO NOT TOUCH HARDWARE CONFIGURATION**.

Press Configure → Tube training

A second GUI will pop up. Configure the settings and then press load.

Amount of reward given in a successful trial

Percentage of licks that are rewarded

Time it takes to receive another reward after a lick

Rate at which pump dispenses reward

The delay with which the reward is administered

This is a simple program that administers rewards manually and when the subject initiates a lick. After a few days, most animals make the association between licking and getting a reward. However, some animals take longer. It is absolutely pertinent to not move on to the next stage of training until the animal is comfortable and successful in this basic stage.

Stimulus Training

The goal of stimulus training is for the animal to associate a stimulus with a reward.

Press Configure (in main GUI)→Stimulus training

<u>Further Descriptions and examples</u>

Length of stim plus grace period: The length of the stimulus and an additional period of grace added together

Time into stim for reward dispense: The time into the stimulus where licks will no longer be considered errors and will instead be considered hits for GO stimuli

For most of our purposes, we want the animal to attend to the entire stimulus and not lick prematurely. Therefore, we want to train the animal to only lick at the end of the stimulus and during the grace period. For example, if I have a stimulus that is 4s and I want the animal to lick at the very end of the stimulus, the hit period (where licks are considered hits and not errors) would begin at 4s and the number 4 would be entered in the 'time into stim for reward dispense (s)'. There should almost always be a grace period because our animals are not perfect! So if I have a 4s stimulus, a good grace period is 6s. That means that there is a total of 2s after the stimulus that is considered the grace period, and a total of 6s for the trial.

Stop stim at lick: A lick will cause the stimulus to stop playing

Reward hits only: A reward is dispensed only when a lick is made during the hit period

Do not reward if errors were made: If an error lick was made during that trial, no reward will be dispensed even if the animal licks during the hit period

Punish

Error licks can be punished by using the lights off method and/or the air puff method. The air puff method is more severe and should be a last resort.

Lights out length (s): Amount of time the lights are out for

Admin latency (s): The amount of time between the error lick and the lights out

% incorrect punished: The percentage of error licks punished

Reinforcement Training

The goal of reinforcement training is to reinforce licking via reward in the presence of one type of stimulus and to extinguish licking in the presence of the other type of stimulus.

Press Configure (in main GUI)→Reinforcement training

Further explanations

Everything else in this GUI is either self-explanatory or has been explained in previous GUIs.

However, some important key words to know for this kind of training are as follows:

Hit: A lick is considered a 'hit' when it occurs in the approved window of time defined by the parameters 'time into stim for reward dispense' and 'length of stim plus grace period'. For reinforcement training, a 'hit' also has to be during a GO stimulus.

Miss: A 'miss' occurs when the animal does not lick in the approved window of time, or does not lick at all during the GO stimulus.

Correct Reject: A 'correct rejection' occurs when the animal does not elicit a lick during a NO GO stimulus.

False Alarm: A 'false alarm' occurs when the animal licks during the NO GO stimulus.

Error: An 'error' lick occurs when the animal licks outside the approved hit window and in between trials.

TROUBLESHOOTING:

Before aborting a session, restart MATLAB. Sometimes simply restarting the program will fix it.

Make sure everything is turned on (amp) and plugged in. Make sure you have sound-checked.

If an error keeps occurring, copy and paste the error into a word document, email it to me, and text me so I know what is going on. I will read the error and tell you what to do to fix it, or tell you to abort the session. Do not abort the session without my okay, unless you can't reach me.

Hardware

The system consists of components to achieve three main tasks: lick detection, reward administration and punishment.

LICK DETECTION: The lick detection system

Diode system – consists of an infrared light-emitting diode (IR LED) and an IR photodiode. The IR LED emits electromagnetic radiation at a wavelength higher than visible light. The IR photodiode detects IR radiation, and sends a signal in the form of an increased voltage when the photobean between the two components is broken. The IR photodiode is black in color because it is opaque to all visible light; only IR light can get through the plastic shield.

Lickometer circuit - detects a voltage change from the IR photodiode. Several backup circuits exist if one breaks.

REWARD ADMINISTRATION

Syringe pump – New Era Systems NE-500 OEM Syringe Pump, a programmable syringe pump.

Syringe – the system is hard-coded to work with BD 20 mL Luer Lock syringes. Other syringe brands, or sizes can be used but modifications to the code must be made.

Neck plate with tube holder – specially modified neck-plate that holds a hard polycarbonate tube from which a reward is dispensed.

 PUNISHMENT is administered either through a lights-out period, in which the house lights are turned off for a short period of time or an air puff, in which a small puff of air is delivered to the face. The lights-out system operates through a custom-made LED system that provides the only light during training and experimental sessions. During these sessions it is imperative that the everyday house lights are turned off so that the room will be fully darkened during punishment periods. The air puff system consists of a compressor to pressurize and store air, a pressure regulator to adjust the output pressure and a 3-way solenoid valve that opens briefly to allow this pressurized air to escape. As per the protocol, the air puff should only be used as a last-resort when the lights-out punishment is not effective.

House lights – Bridgelux high-efficiency 930 lumen LED, attached to aluminum heatsink. The LED runs hot, so it is important to have it attached to an appropriately-sized heat sink anytime it is running to avoid overheating. The heat sink currently attached is probably overkill.

National Instruments Data Acquisation (NI-DAQ) Card – Model NI 6518, a 16 input, 16 sink output card, housed within the computer in a PCI slot. This component allows the computer to both send and receive signals through the power supply and relay.