Somatosensory Stimulation Apparatus for Rodent Cages
Design Matrix

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Cage - Motor Interface				
Design Criteria (weight)	Connected		Disconnected	
Stabilization (20)	5/5	20	3/5	12
Isolation (20)	3/5	12	4/5	16
Ease of Use (10)	5/5	10	3/5	6
Total	**42**		**34**	

Vibration Source				
Design Criteria (weight)	Solenoid Motor		Speaker Actuator	
Force (20)	4/5	16	5/5	20
Accuracy (15)	4/5	12	3/5	9
Durability (10)	4/5	8	2/5	4
Amplitude (5)	4/5	4	5/5	5
Total	**40**		**38**	

Design Descriptions:

Both cage-motor interface designs consist of 10inWx12inDx12inH clear polycarbonate cages with open tops. These boxes have a stilt in each corner to raise the box off the ground. On the bottom panel of each box there are two 1inx1in openings. The vibrational motors sit underneath the boxes, centered in the openings for the rats to place their hind limbs. The connected design has a shock absorbing rubber bottom that connects the cage stilts to the motors, holding them in place under the openings. The disconnected design does not have this rubber base, preventing the motors from touching the cage.

Criteria Definitions:

Stabilization of the cage-motor interface is defined as the ability for the cage to stay aligned with the motor platforms. This is weighted as one of the most important factors because if the motor platforms don't stay centered in the cage openings, it will potentially cause the rat to step off of the platform and/or vibrate the entire cage floor. The connected cage design was given a 5/5 because the cage will be held in place over the motors via the shock absorbing rubber base.

The disconnected design was given a 3/5 because the motors will be weighted down with a heavy base, but will not be rigidly attached to the cage.

Isolation is defined as the ability for each vibrating motor platform to be completely unaffected by the other motor's vibration. This is also weighted as one of the most important factors because the goal of the project is to be able to apply stimulation to a single limb at a time. The connected cage design was given a 3/5 because the shock absorbing base will absorb motion, but there is still potential for the vibration to be transmitted through the connection of the motors to the cage. The disconnected design was given a 4/5 because vibration will not be directly transmitted between the cage and the motors, however, because they will both be sitting on the same surface, there is potential for the vibration to transmit through this interface.

Ease of use is defined as the amount of time and effort required to store, move, and set up the device. This was weighted lower because the device can still be successful even if it takes some time to set up. The connected design was given a 5/5 because it is all one piece that can be easily moved and stored and requires no accurate set up. The disconnected design was given a 3/5 because it is two separate pieces that must be properly aligned before use.

Force of the vibrational motor is defined as the Newtons of force generated by the motor. This is weighted the highest because the force must be less than 3 Newtons to ensure the comfort and safety of the rat. The speaker actuator received a score of 5/5 because it generates a force of less than one Newton. The solenoid motor received a 4/5 because it generates a force of 2 Newtons. This is still well below the threshold, which justifies its rating. This is still higher than the speaker, so it could not receive a perfect score.

Accuracy is defined as the ability for the motor to achieve the desired frequency range of 5-60Hz. The motor also has to be able to maintain the exact frequency +/- 0.5Hz. Accuracy was weighted second highest because the goal of the project is to stimulate the rat's hindlimbs at a specific desired frequency. The solenoid motor was given a 4/5 because it is designed to run at various frequencies, but the exact range is unknown without testing. The speaker actuator received a 3/5 because it is designed to operate at high frequencies and may not be able to reach the lowest end of the desired range.

Durability is defined as the length of time the motor will remain functional in the device. This was weighted lower because both components are inexpensive and would be able to be replaced. The solenoid motor was given a 4/5 because it will be used in the device as intended, but it's low price indicates that it may not be the most reliable. The speaker actuator was given a 2/5 because it is inexpensive and the device will utilize the motor in a manner that was not originally intended.

Amplitude is the measure of the displacement of the vibrations caused by the source. Although other categories were given higher precedence, this is important because too large of a displacement could agitate or irritate the rat. The solenoid motor was given a 4/5 because they tend to have larger amplitudes ranging from 1-4.5mm. The speaker actuator received a 5/5 because they have much smaller amplitudes, making the concern for the rat's comfort due to the displacement virtually nonexistent.

Final Design:

Our final design will feature the two winners from both design matrices. The cage and motor will be connected using an insulating, rubber bottom. The vibrations will be generated by a solenoid motor.