Modified Multi-Attribute Task Battery – JavaScript (mMATB-JS)

Documentation and User Manual

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1. Introduction

1.1. Purpose

The goal of this project is to create a fully customizable multi-tasking experiment environment. The Modified Multi-Attribute Task Battery – JavaScript (mMATB-JS) provides a simple-to-use interface for customizing and running experimental conditions, a means for collecting human data in the form of inputs (mouse, keyboard) to the environment, and a database for organizing experimental parameters and data. mMATB-JS is built in JavaScript, HTML, and CSS on top of an SQLite database, allowing for simple storage of experimental conditions and data.

1.2. Reference Materials

Django	http://djangoproject.com/
D3	d3js.org
Original NASA MAT-B	http://matb.larc.nasa.gov/

1.3. Useful Definitions

Server – The computer or device used to store information.

Host-Site – The webpage that is the base for the server. This will be http://<ip>:<port>

- <ip>: either the ip of the server or a domain name that points to the server
- <port>: port specified when launching the server; default 9000

1.4. Required Software

Python 2.7	continuum.io/downloads#all
Django 1.8 (any version)	http://www.djangoproject.com/download/1.8.7/tarball/
Google Chrome (latest version)	http://www.google.com/chrome/
mMATB-JS	http://sai.mindmodeling.org/mmatb/

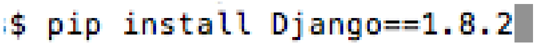
2. Installation and Setup

1) Installing Python: To install mMATB-JS, first install Anaconda2 version 2.4.0, which includes the installation of Python 2.7, to your server

- Go to continuum.io/downloads#all and download the installation file

2) Add Python Packages:

- **With Internet Access:** install Django from your terminal.
  - Open your terminal (Mac OSX: Utilities folder in Applications) or command prompt (Windows)
  - Install Django using "pip install Django==1.8.2".



```
$ pip install Django==1.8.2
```

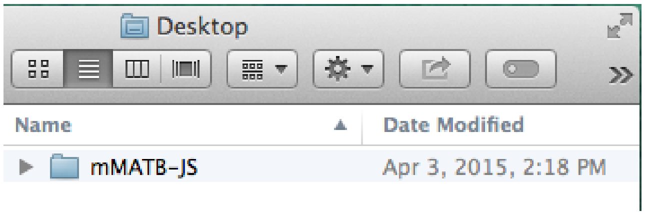
- **Without Internet Access: install Django and South**
  - Go to http://www.djangoproject.com/download/1.8.7/tarball/ and download the package file
    - Open your terminal (Mac OSX: Utilities folder in Applications) or command prompt (Windows)
    - Change directory to where the package file is downloaded using "cd PATH/TO/FILE"
      - PATH/TO/FILE is the actual path to the file; you will need to replace this
    - Install Django using "easy_install FILE_NAME"
      - FILE_NAME is the actual name of the file, you will need to replace this

*If you already have Python installed on your computer, you will only need to install Django and Tornado. Follow the same steps for installation as above.

- Tornado 4.3 www.tornadoweb.org

3) Setup mMATB-JS Environment:

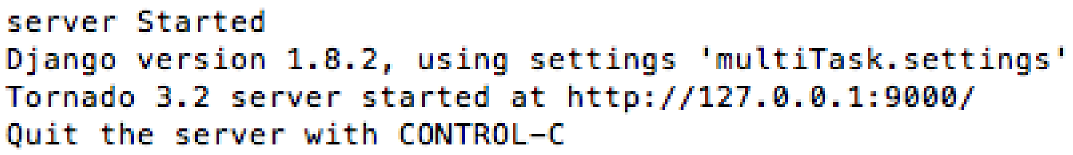
- Download the mMATB-JS.zip file from http://sai.mindmodeling.org/mmatb/
- Unzip the file
- Place the resulting mMATB-JS folder in an easy to reference location on your server. For the example, we will use the Desktop.



Name	Date Modified
mMATB-JS	Apr 3, 2015, 2:18 PM

4) Start Server:

- Use the terminal (or command prompt) to change the present working directory to the mMATB-JS folder by inputting “cd Desktop/mMATB-JS”
- Launch the server by running the command “python Tornado.py” in the terminal
    - By default the server will run on port 9000
    - The port can be changed by adding a parameter to the command with the appropriate port (e.g., “python Tornado.py 8888”, which will launch the server on port 8888).
    - If everything worked correctly you should see the text in the image below in your terminal

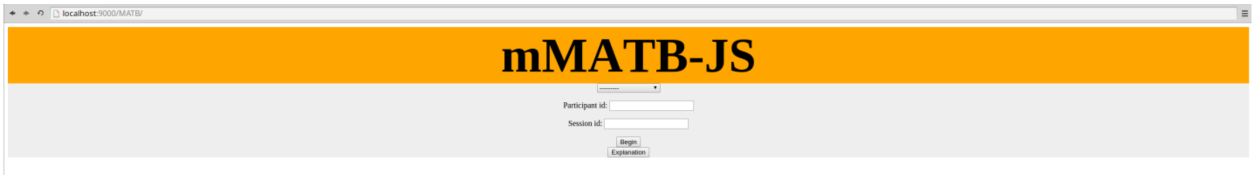


```
server Started
Django version 1.8.2, using settings 'multiTask.settings'
Tornado 3.2 server started at http://127.0.0.1:9000/
Quit the server with CONTROL-C
```

5) Accessing the Experiment: mMATB-JS can now be accessed using a client computer

- Open a Chrome browser page
- Go to host-site/MATB. This will be http://<ip>:<port> where <ip> will be either the ip of the server or a domain name that points to the server and <port> will be the port specified when launching the server, default 9000
- If you are working on the same computer you can simply input “localhost:9000/MATB”

The resulting website should look like the image below.



3. System Overview

mMATB-JS is composed of a server and client setup. The client setup is where the actual experiment will run and can be any computer connected to the server via a network. The server is where all of the code is hosted, as well as where the database containing the experimental conditions and data is stored. The server is written in python using the Django package. Once running, the server hosts a series of webpages that can be accessed by a client computer. The two major webpages for the site are the admin page and experiment page.

The basic mMATB task environment entails four individual decision making tasks, which are shown in Figure 1. The tasks are self-contained in the four quadrants of the screen, and we describe each in the following four subsections. Note that mMATB-JS allows each task to be flexibly implemented such that each subtask can be included or not in an overall experiment configuration. Within each task, the experimenter can manipulate all the individual parameters. At present, only fixed values are possible for the parameters (that is, mMATB-JS cannot currently accommodate dynamic parameter updates during an experiment, such as in staircase procedures). It is possible to set each task to be included on the screen but to have zero alerting events. If a task is not included in a configuration, the overall layout of the screen is preserved but nothing will appear in the relevant quadrant.

It is left to the experimenter to provide instructions to the participants with respect to primary versus secondary tasks or other strategies the experimenter wishes participants to employ. However, we have built in a way to link to a modifiable instructions page in the experiment.

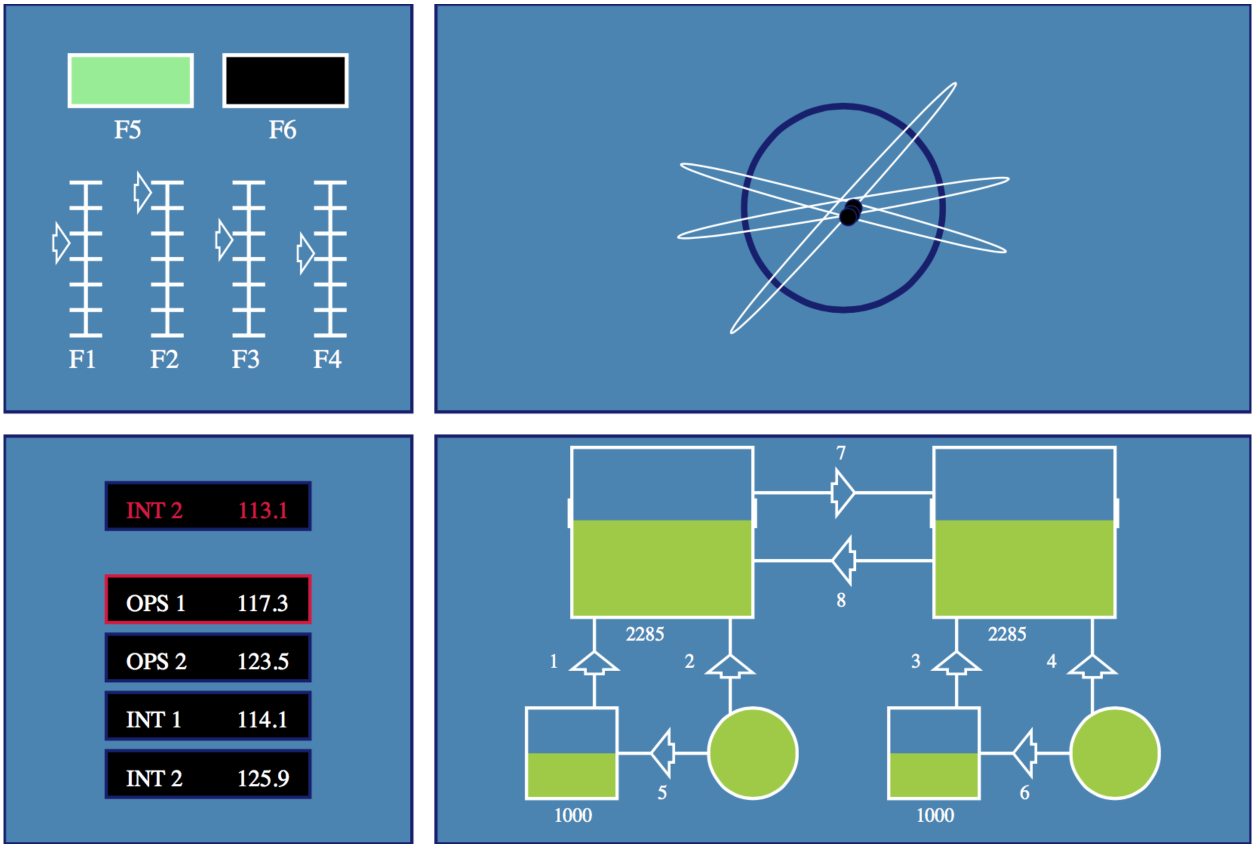


Figure 1. Full mMATB-JS experiment. With monitoring task top left, tracking task top right, communication task bottom left, and resource management task bottom right.

3.1 Tracking

The tracking task is included in the upper right quadrant of the mMATB-JS environment. On the screen, colored dots are continually moving along pre-defined trajectories. The default task consists of three oval trajectories. Randomly, a dot will turn red, indicating it is the target dot. The correct response is for the participant to mouse click on the red dot, which turns green meaning “target acquired”, and then to track the green dot with the mouse continuously. When a dot turns red, the participant acquires and tracks this target.

Data recorded in this tracking task are x, y coordinates of the target object, x, y coordinates of the mouse movements, and time and location of mouse clicks to acquire targets.

Failure to acquire the target dot will result in the target remaining red, continuously moving, until the next target is cued and a miss being recorded in the data.

3.2 Monitoring

In the monitoring task (upper left quadrant), the participant must respond to two types of “out of bounds” alerts with appropriate keyboard presses. First, a set of vertical sliders is shown on the screen. Each slider consists of a vertical bar with hatch marks and a moving triangle slider. The normal range of motion of the sliders is +/- 1 from the center hatch mark. If a slider moves above or below this center range, the participant must push the F1-F4 button associated with that slider to reset the position of the triangle. Upon key press, the triangle returns to the 0 mark, or center of the vertical slider range.

Data collected on the vertical sliders include the timestamp and input buttons of the keyboard presses. If the correct keyboard button is not pressed when a slider is alert, it will eventually time out and the triangle will move back in bounds and the alert state will return to normal. A miss is recorded in the data. If an incorrect button is pushed, the button press is recorded, but the state of the slider is unchanged until the correct button is pressed.

In addition to the sliders, the monitoring task has two colored blocks, which can “go alert” by changing colors. The normally green block on the left can randomly turn black and must be reset with an F5 button press. The normally black block on the right can randomly turn red and must be reset with an F6 button press.

Data collected on the colored blocks include the timestamp and input buttons of the keyboard presses. If the wrong button is pressed, it will be recorded in the data but the state of the color block will not change (it will remain alert). If a color is not reset with a button press, it will eventually time out and return to its normal color state. If the color block times out, a miss is recorded in the data.

3.3 Communications

The visual communications task is contained in the lower left quadrant. It contains a set of four channels, labeled with white text Ops 1, Ops 2, Int 1 and Int 2, together with their current state values. Above these is a cue box, which cues changes to be made to the communications channels. When the text in the cue box turns red, it is notifying the user of a change to be made; the cue contains a channel to be adjusted and the new target state value for that channel. The user responds to the alert by using the up/down arrows to select the target channel (selection indicated by a bounding box) and using the right/left arrows to adjust the state value by an increase/decrease, respectively. Once the target channel state is at the cued value, the participant submits the changes by pressing the Enter or Return key on the keyboard.

Data recorded in this task include all arrow key presses, with timestamps, and the final submitted value with the timestamp for the Enter/Return key press. If the cue box returns to the non-alert state (text changes from red to white) before the user submits the corrected channel state, then a miss is recorded with all the relevant key presses.

3.4 Resource Management

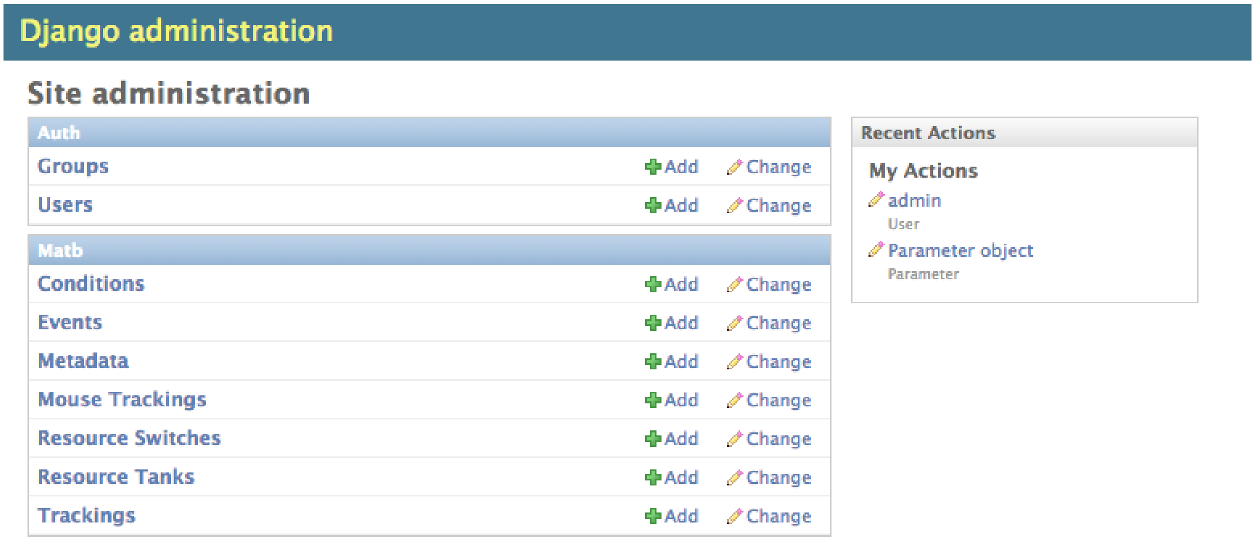
In the resource management task (lower right quadrant), participants must keep the resource levels in the main tanks as close to the center of the target region as possible. The target region is indicated by the thicker bars on the sides of the main tank boxes. The tanks are connected to a fuel source (circle) and a reserve tank (smaller rectangle), as well as to each other. Directional channels (indicated by the triangles on the connecting lines) are available between each tank and its source and reserve, as well as between the two tanks. The channels are off at the beginning of the experiment, indicated by the gate triangles being an empty or background color. Participants can open the flow gates by selecting the number key associated with each gate in the diagram. An open flow gate is green.

Gates can break, which is indicated by the triangle turning red. Participants cannot change the state of the broken gates (which eventually time out a return to an off state), but they can adjust the activity of other gates to accommodate any unavailable gates to maintain the appropriate resource levels. Participants can interact as much as they want with this task with no consequences.

The data recorded in this task consist of each number key press with its timestamp, and the current resource levels in the tanks.

4. Admin Page Overview

The admin page, depicted in Figure 2, is where experimental data can be viewed and conditions can be changed.



Django administration

Site administration

Auth		
Groups	Add	Change
Users	Add	Change

Matb		
Conditions	Add	Change
Events	Add	Change
Metadata	Add	Change
Mouse Trackings	Add	Change
Resource Switches	Add	Change
Resource Tanks	Add	Change
Trackings	Add	Change

Recent Actions

My Actions

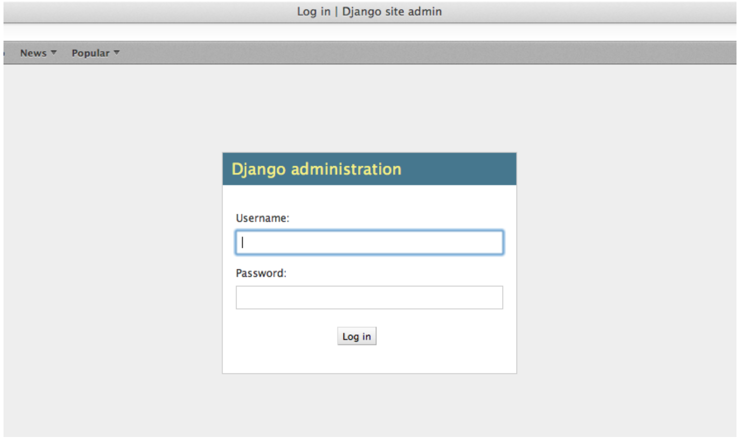
admin
User

Parameter object
Parameter

Figure 2. Admin page.

4.1 Admin Login

The admin page can be reached by going to host-site/admin/ (e.g., localhost:9000/admin) in a web browser on a client computer. This will take you to the Admin login page, depicted in Figure 3. By default the Username and Password will be “admin”. The username and password can be changed once logged in by going to *Users* under *Auth* and selecting Admin and then changing the values. You can also click on the *Change password* link in the top right hand corner.



Django administration

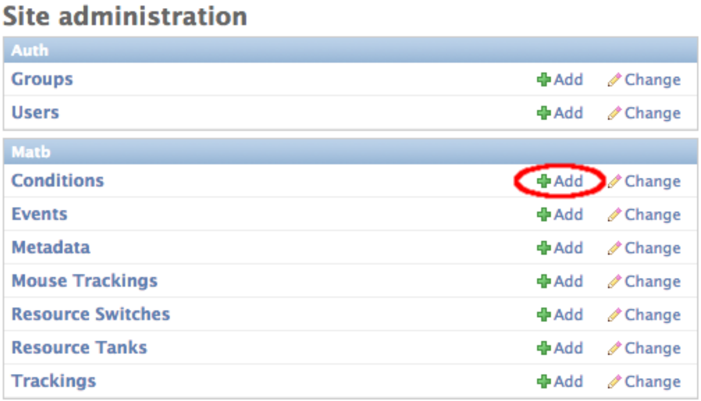
Username:

Password:

Figure 3. Admin login page.

4.2 Creating and Editing Experimental Conditions

The main purpose of the admin page is creating and editing experimental conditions. To create a new experimental condition click on the add button next to the *Conditions* object.



Site administration

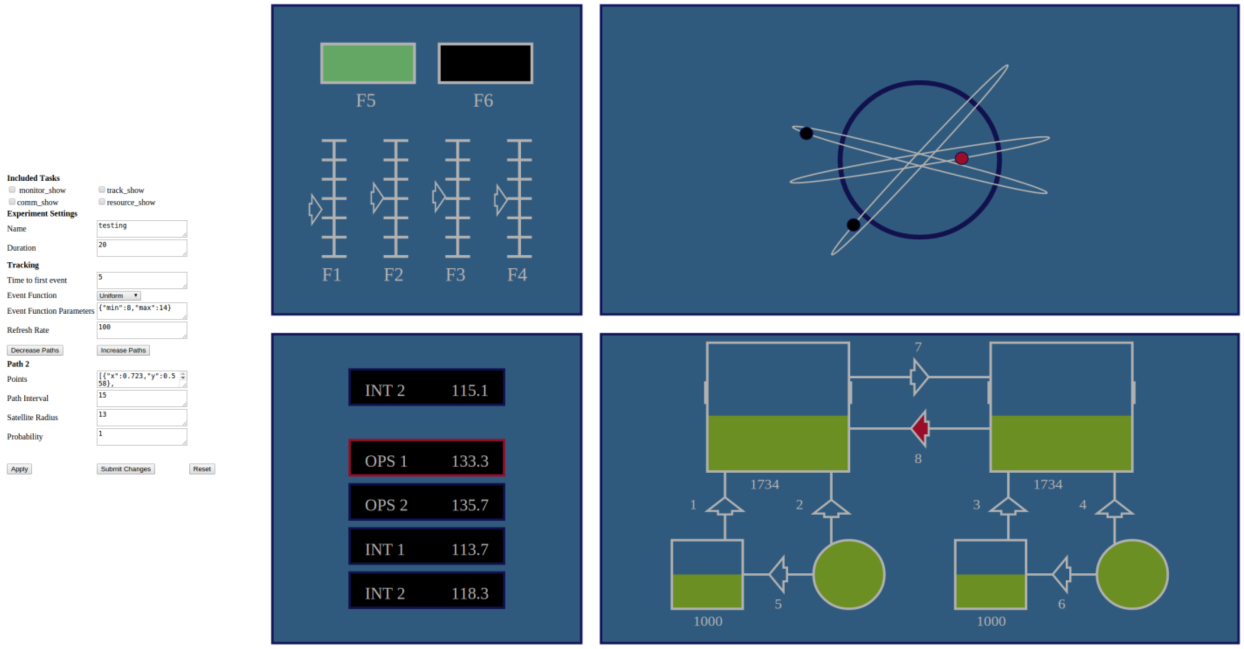
Auth		
Groups	Add	Change
Users	Add	Change

Matb		
Conditions	Add	Change
Events	Add	Change
Metadata	Add	Change
Mouse Trackings	Add	Change
Resource Switches	Add	Change
Resource Tanks	Add	Change
Trackings	Add	Change

When creating a new experimental condition you will be asked for a name (make sure not to press enter after typing the name or include an extra space after the name) and duration for the condition in minutes. Then, hitting the “Save and continue editing” button will take you to the experimental condition configuration page. Otherwise, hitting the “Save and add another” button will generate a new condition and hitting the “Save” button will save current progress, but will stay on the same page.

4.3 The Configuration Page

The configuration page allows for easy customization of experimental conditions using a point, click, and set approach. The first step is to select the particular tasks you would like to include in the condition. You can do this with the check boxes under the “Included Tasks” section on the left-hand side. By default, each task is unchecked, and the corresponding task images will be muted on the right-hand side, showing that they are not included in the task (see Figure 4).


Included Tasks

□ monitor_show □ track_show

□ comm_show □ resource_show

Experiment Settings

Name: testing

Duration: 20

Tracking

Time to first event: 5

Event Function: Uniform

Event Function Parameters: {"min":8,"max":14}

Refresh Rate: 100

Path 2

Points: [{"x":0.723,"y":0.558},

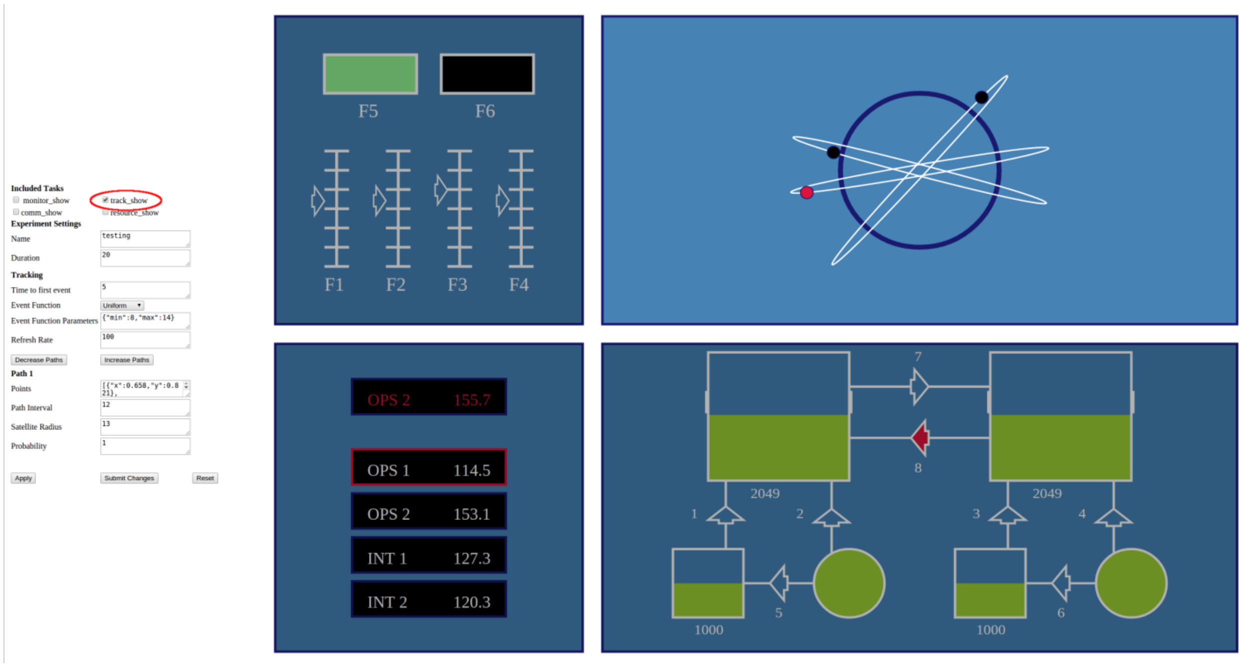
Path Interval: 15

Satellite Radius: 13

Probability: 1

Figure 4. The configuration page when none of the tasks have been added to the condition.

To add a task to the condition, you need to check the corresponding box next to the task name (see Figure 5). As you can see below, the tracking task has been selected and the quadrant is no longer muted.


Included Tasks

□ monitor_show ☑ track_show

□ comm_show □ resource_show

Experiment Settings

Name: testing

Duration: 20

Tracking

Time to first event: 5

Event Function: Uniform

Event Function Parameters: {"min":8,"max":14}

Refresh Rate: 100

Path 1

Points: [{"x":0.658,"y":0.821},

Path Interval: 12

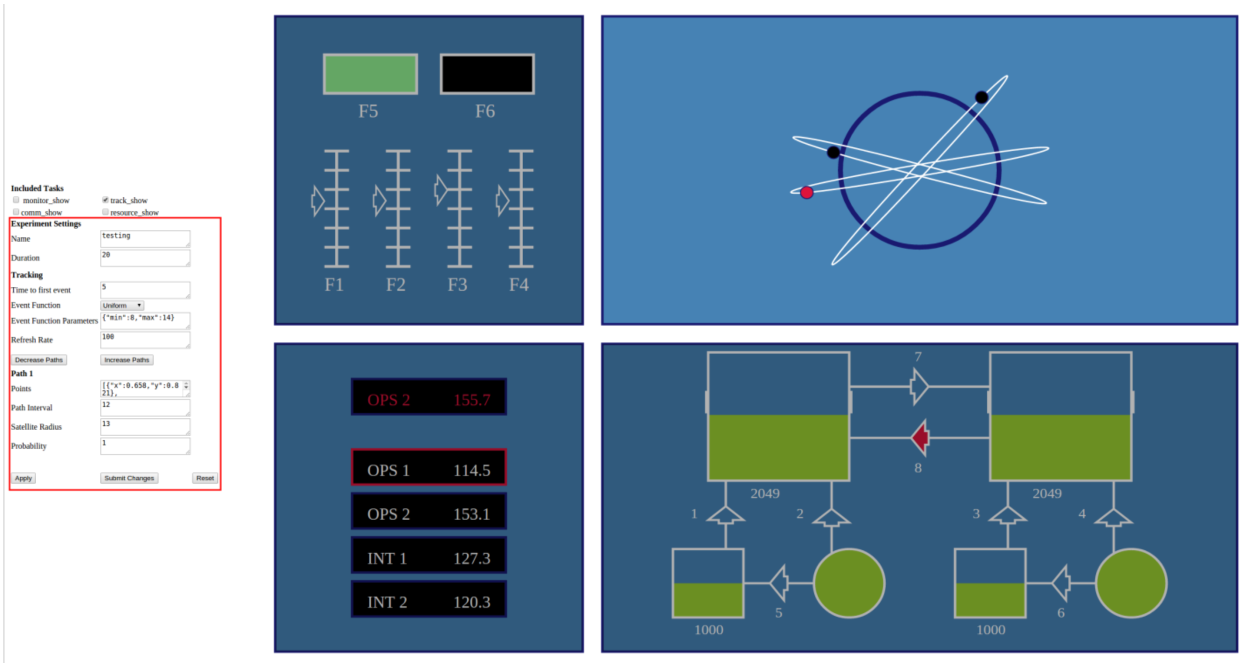
Satellite Radius: 13

Probability: 1

Figure 5. The tracking task is present in the current condition.

Once you have added the tasks you want to be present in the condition, you can make changes to the particular properties of the task components. To do this, click on an object in the right-hand image whose properties you wish to change. See Appendix A for a list of all editable objects.

For example, if the tracking task is active, click on one of the ellipses to access the parameters of that ellipse. An *Experiment Settings* area should appear on the left side of the page (see Figure 6). This area is broken into three areas. The first area is the name and duration of the condition. The second area is parameters for the overall tracking task. The last area is specific parameters for the path that was chosen. In the example below, *Path 1* is currently selected.



Included Tasks

□ monitor_show ☑ track_show

□ comm_show □ resource_show

Experiment Settings

Name	testing
Duration	20

Tracking

Time to first event	5
Event Function	Uniform ▾
Event Function Parameters	{"min":8,"max":14}
Refresh Rate	100

Path 1

Points	[{"x":0.658,"y":0.8 21},
Path Interval	12
Satellite Radius	13
Probability	1

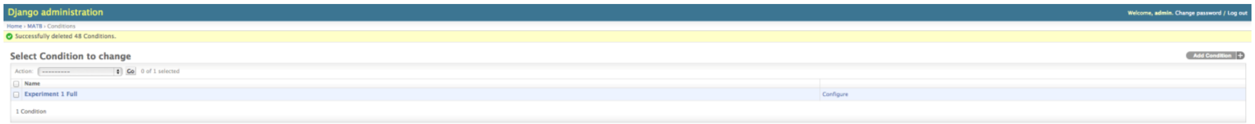
Figure 6. Path 1 is currently selected for the tracking task. The Experiment Settings are outlined in the red box.

Changing one of the parameters in the *Experiment Settings* list, and then clicking the *Apply* button will update the settings running on the live demo on the right, giving you a preview of how the experiment will look when running. For example, change the *Satellite Radius* to 25. Then click the *Apply* button. You should now see a much larger satellite for that particular ellipse. If you want to undo the *Apply*, click on the *Reset* button. Note that the *Reset* button will reset the settings to the default settings. Similarly, you can change other parameters associated with this path, as well as the other paths in the Tracking Task. A list of parameters that can be changed and a description for each can be found in Appendix B. Clicking the *Submit Changes* button will then save the changes you have made to the condition to the database and then will proceed to the *Conditions* page.

4.3 Conditions Page

The *Conditions* page has a list of all the created conditions. If you click on the *Configure* link, this will allow you to edit the configurations for the specific tasks in the condition (this will take you back to the *Configurations* page). If you click on the name of your condition, it will take you to a page where you can change the name of the condition, the duration of the condition, and you can also delete the conditions by clicking the *Delete* button. You can also add an additional condition through the *Conditions* page. Near the top right corner is an *Add*

Conditions button; this button will take you to a new page where you will input information for your condition.



Successfully deleted 48 Conditions.

Select Condition to change

Name	
Experiment 1 Full	Configure

1 Condition

5. Running a Condition

1. Go to the experiment home page by opening a Chrome browser window
2. Go to the host-site/MATB (e.g., localhost:9000/MATB)
3. To select the condition to run, click on the drop menu in the center of the screen (see Figure 7). You will see a list of available conditions. Select the specific condition you would like to run
4. Enter a Participant ID and a Session ID

There are two additional buttons on the experiment home screen. The *Explanation* button will bring up all four quadrants of the task on the screen, but will not actually run the condition. This page is strictly for instructional purposes (i.e., explaining the task to the participant). There is a *Reset* button available if you need to reset the quadrants. If you proceed to this page, click on the back button in the browser to return to the previous page.

The *Begin* button will continue to an initial page before the execution of the condition. This initial page allows the participant to begin the condition when they are ready. The participant presses the space bar, and then the condition begins.

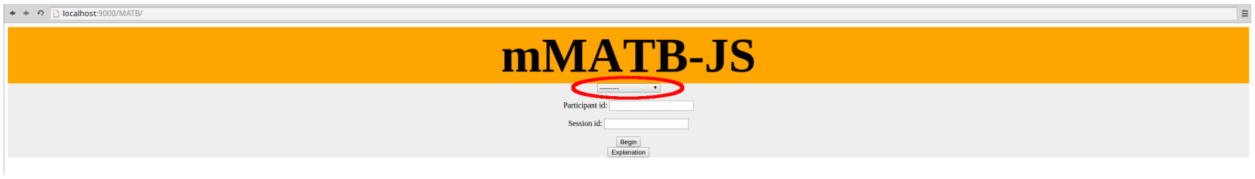


Figure 7. Experiment home page for running a condition. The circle surrounds the drop-down menu that will give all available conditions, taken from the listing that can be found and edited in the Conditions Page.

6. Database

6.1 Confirming Data has Saved Correctly

The Admin page is an easy way to confirm that the data from an experiment was saved correctly to the database. Data stored in the database can be seen by selecting which data table you wish to view. To check that data is correctly saving to the database, go to the admin page through host-site/admin/ (e.g., localhost:9000/admin). Along with the *Conditions* link are links for various data tables (e.g., *Events*, *Metadata*, *Mouse Trackings*, etc.). For this example we will select the *Events* data table. Click on either the *Events* link (see Figure 8) or the *Change* link associated with *Events*, this will take you to a new page (see Figure 9) that gives a preview of each data entry. Here you will find specific information (i.e., variables collected) for the condition. For example, in *Events* you will find the time the condition started and the session ID, event type, type of task, and key associations for the condition. Clicking on the time for a given entry will bring you to a new page with any extra pieces of information for the entry, currently all information is shown in the preview for each data entry. See Appendix C for information regarding each data table and the corresponding variables.

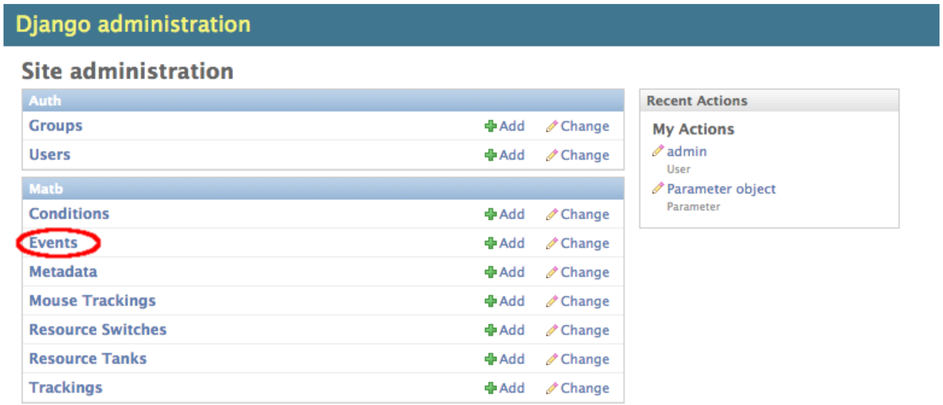
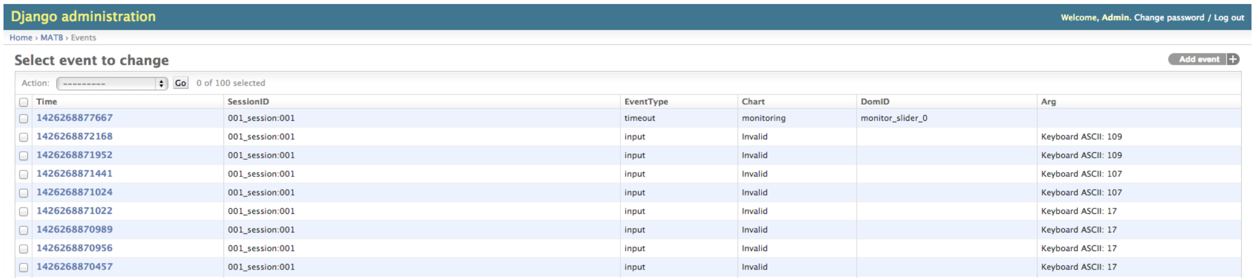


Figure 8.



□ Time	SessionID	EventType	Chart	DomID	Arg
□ 1426268877667	001_session:001	timeout	monitoring	monitor_slider_0	
□ 1426268872168	001_session:001	input	Invalid		Keyboard ASCII: 109
□ 1426268871952	001_session:001	input	Invalid		Keyboard ASCII: 109
□ 1426268871441	001_session:001	input	Invalid		Keyboard ASCII: 107
□ 1426268871024	001_session:001	input	Invalid		Keyboard ASCII: 107
□ 1426268871022	001_session:001	input	Invalid		Keyboard ASCII: 17
□ 1426268870989	001_session:001	input	Invalid		Keyboard ASCII: 17
□ 1426268870956	001_session:001	input	Invalid		Keyboard ASCII: 17
□ 1426268870457	001_session:001	input	Invalid		Keyboard ASCII: 17

Figure 9.

6.2 Extracting Data from the Database

To extract data from the database, you will need to use a script to query the database and extract the information you want. Although other programming languages have packages for accessing SQLite databases, we provide basic R code for accessing the database.

```
#Install package
install.packages(“RSQLite”)

#Load package
library("RSQLite")

#Set path to database db.sqlite3, e.g. your desktop
setwd("/Desktop")
```

```
#Connect to database
drv = dbDriver("SQLite")
con = dbConnect(drv, "db.sqlite3")

#Use this command to list the tables in the database
dbListTables(con)

#Use this command to list fields within a specific table
dbListFields(con,"MATB_event")

#Query specific fields from a table
data = dbGetQuery(con, "Select id, time, sessionID, eventType, chart, arg, DomID from MATB_event")

#Query all fields within a table
data = dbGetQuery(con, "Select * from MATB_event")
```

6.3 Making Changes to the Data in the Database

While not generally recommended, you can delete instances of data by checking the data you want to delete and then clicking the drop menu labeled *Action:* and selecting *delete this SOURCE,* where SOURCE is the type of data you are working with (e.g., trackings, conditions, etc.). Alternatively, you can click on the *Time* link associated with the data. This will take you to a different page, where a *delete* button is available. In order to change specific information for the data point (e.g., change Participant ID), click on the *Time* link associated with the data. You should now see the available variables you can edit. Once you have made your changes you can either press *Save and add another, Save and continue editing,* and *Save.* You can add a data point by clicking *Add SOURCE* in the top right corner. You will now see variables to fill in for that type of data point. Once you have filled in the values you can press *Save and add another, Save and continue editing,* or *Save.*

Appendices

APPENDIX A. Object List

- Monitoring Task:
  - Slider 1 (F1 slider)
  - Slider 2 (F2 slider)
  - Slider 3 (F3 slider)
  - Slider 4 (F4 slider)
  - Button 1 (F5 box)
  - Button 2 (F6 box)

- Tracking Task:
  - Path 1 (bottom most left ellipse)
  - Path 2 (middle)
  - Path 3 (top most left)

- Communications Task:
  - Channel 1 (OPS 1)
  - Channel 2 (OPS 2)
  - Channel 3 (INT 1)
  - Channel 4 (INT 2)

- Resource Management Task:
  - Tank 1 (Click on upper left square tank fuel or fuel level number)
  - Tank 2 (Click on upper right square tank fuel or fuel level number)
  - Tank 3 (Click on lower left square tank fuel or fuel level number)
  - Tank 4 (Click on lower right square tank fuel or fuel level number)
  - Switch 1 (Click on arrow 1)
  - Switch 2 (Click on arrow 2)
  - Switch 3 (Click on arrow 3)
  - Switch 4 (Click on arrow 4)
  - Switch 5 (Click on arrow 5)
  - Switch 6 (Click on arrow 6)
  - Switch 7 (Click on arrow 7)
  - Switch 8 (Click on arrow 8)

APPENDIX B. Parameter list

- Check boxes: When checked, signify that the task will be a part of the condition

- Experiment Settings
  - Name: Name of the condition (String)
  - Duration: Duration of condition in minutes (Integer)

- Monitoring
  - Task Settings
    - Time to first event: The amount of time that will pass before the first event of the task is triggered in seconds (Integer)
      - Currently this is deterministic
    - Event Function: Defines the type of distribution for the alert events. Currently the choices are uniform distribution and geometric distribution, where both are controlled by parameters set in Event Function Parameters. See below.
    - Event Function Parameters: Controlling parameters for distribution given by Event Function. (Javascript object)
      - Uniform distribution
        - Min: Denotes the minimum amount of time, in seconds, from the start of an alert event to the start of the next alert event
        - Max: Denotes the maximum amount of time, in seconds, between the start of an alert event to the start of the next alert event
      - Geometric distribution
        - Avg: Denotes the average amount of time, in seconds, from the start of an alert event to the start of the next alert event
        - Tick marks: Denotes the number of horizontal lines on each scale
    - Slider Range: Denotes the two lines that the arrows will bounce between while not alert, with the top line being 0 (Integer array)
    - Decrease Sliders: Reduces the number of sliders in the task by one
    - Increase Sliders: Increases the number of sliders in the task by one
    - Decrease Buttons: Reduces the number of buttons in the task by one
    - Increase Buttons: Increases the number of buttons in the task by one
  - Object Settings
    - Button
      - Probability: Denotes the probability that the selected button will change to an alert at any given alert event relative to all other objects in the task (Integer)
      - Alert Timeout: Denotes the amount of time, in seconds, before the alert will timeout and the button will return to its non-alert state (Integer)
      - Keyboard Key: Denotes the characters that appear below the selected button (String)
      - Keyboard ASCII: Denotes the ASCII value of the key that needs to be pressed when responding to the selected button changing to an alert (Integer)
      - Base color: Denotes the color of the button when in a non-alert state. This can be any color supported by CSS (see Appendix D)
      - Alert color: Denotes the color of the button when in an alert state. This can be any color supported by CSS (see Appendix D)

- Slider
  - Probability: Denotes the probability that the selected button will change to an alert at any given alert event relative to all other objects in the task (Integer)
  - Slider Interval: Denotes the amount of time, in seconds, it takes the selected slider to move between two lines (Integer)
  - Keyboard Key: Denotes the characters that appear below the selected scale (String)
  - Keyboard ASCII: Denotes the ASCII value of the key that needs to be pressed when responding to the selected slider being out of range (Integer)

- Tracking
  - Task Settings
    - Time to first event: Denotes the amount of time that will pass before the first event of the task is triggered (Integer)
      - Currently this is deterministic
    - Event Function: Defines the type of distribution for the alert events. Currently the choices are uniform distribution and geometric distribution, where both are controlled by parameters set in Event Function Parameters. See below.
    - Event Function Parameters: Controlling parameters for distribution given by Event Function. (Javascript object)
    - Uniform distribution
      - Min: Denotes the minimum amount of time, in seconds, from the start of an alert event to the start of the next alert event
      - Max: Denotes the maximum amount of time, in seconds, between the start of an alert event to the start of the next alert event
    - Geometric distribution
      - Avg: Denotes the average amount of time, in seconds, from the start of an alert event to the start of the next alert event
    - Refresh Rate: Denotes the amount of time, in milliseconds, between each system recording the state of the task (Integer)
    - Decrease Paths: Decreases the number of paths and satellites in the task by one
    - Increase Paths: Increases the number of paths and satellites in the task by one
  - Object Settings
    - Path
      - Points: An array of objects with an x and y property that control the shape of the selected path using a basis-closed interpolation. All points are relative to the task with (0,0) being in the bottom left corner and (1,1) being in the top right corner (Javascript object array)
      - Path Interval: The amount of time it takes the satellite to make one full circuit of the selected path (Integer)
      - Satellite Radius: Denotes the radius of the selected path's satellite, in pixels relative to the task before screen scaling (Integer)

- Communication
  - Task Settings

- Time to first event: Denotes the amount of time that will pass before the first event of the task is triggered (Integer)
  - Currently this is deterministic
- Event Function: Defines the type of distribution for the alert events. Currently the choices are uniform distribution and geometric distribution, where both are controlled by parameters set in Event Function Parameters. See below.
- Event Function Parameters: Controlling parameters for distribution given by Event Function. (Javascript Object)
- Uniform distribution
  - Min: Denotes the minimum amount of time, in seconds, from the start of an alert event to the start of the next alert event
  - Max: Denotes the maximum amount of time, in seconds, between the start of an alert event to the start of the next alert event
- Geometric distribution
  - Avg: Denotes the average amount of time, in seconds, from the start of an alert event to the start of the next alert event
- Alert Timeout: Amount of time, in seconds, before the alert event will timeout and the target channel will return to a non-alert state (Integer)
- Frequency Minimum: The lowest frequency that will be chosen when an alert event happens. (Float)
- Frequency Maximum: The largest frequency that will be chosen when an alert event happens. (Float)
- Decrease Channels: Decreases the number of channels in the task by one
- Increases Channels: Increases the number of channels in the task by one

- Object Settings
  - Channel Name: Name of the selected channel. The name will appear in the task on the left side of the channel (String)
  - Frequency Differential: Denotes the range for choosing the frequency for the cue box. The range will be plus or minus this value from the current value of the selected channel. (Float)

- Resource
  - Task Settings
    - Time to first event: Denotes the amount of time that will pass before the first event of the task is triggered (Integer)
      - Currently this is deterministic
    - Event Function: Defines the type of distribution for the alert events. Currently the choices are uniform distribution and geometric distribution, where both are controlled by parameters set in Event Function Parameters. See below.
    - Event Function Parameters: Controlling parameters for distribution given by Event Function (Javascript object)
    - Uniform distribution
      - Min: Denotes the minimum amount of time, in seconds, from the start of an alert event to the start of the next alert event
      - Max: Denotes the maximum amount of time, in seconds, between the start of an alert event to the start of the next alert event

    - Geometric distribution
        - Avg: Denotes the average amount of time, in seconds, from the start of an alert event to the start of the next alert event
    - Refresh Rate: Denotes the amount of time, in milliseconds, between each system recording of the state of the task (Integer)
- Object Settings
    - Tank
        - Max Resource: This is the maximum amount of resource that the selected tank can hold (Integer)
        - Starting Resource: This is the amount of resource that the selected tank will start the condition with (Integer)
        - Decay Rate: This is the amount of resource the selected tank will lose per minute (Float)
        - Target Range Maximum: Upper bound of the target range. This should be set to undefined if it is not one of the Main tanks (Integer)
        - Target Range Minimum: Lower bound of the target range. This should be set to undefined if it is not one of the Main tanks (Integer)
    - Switch
        - Transfer Rate: The amount of resource that will be transferred from the source to the destination per minute (Float)
        - Repair Time: Amount of time before a switch will repair itself after changing to an alert (Integer)
        - Keyboard Key: Denotes the characters that appear near the selected switch (String)
        - Keyboard ASCII: Denotes the ASCII value of the key that needs to be pressed to turn off and on the selected switch (Integer)

APPENDIX C. Data Tables and Variables

Data Tables:

- Conditions
- Events: A data entry is created for every user alert (cueing of a change), input (participant makes an action), or timeout (participant does not make an action in the required time and alerted object goes back to the normal state) during the experiment
    - Time: the specific instance of time in milliseconds from the start of the experiment (start time is 0 ms)
    - SessionID: the session ID; this is created when running the condition
    - EventType: refers to the type of event. This can be either an *alert* (cueing of a change), an *input* (participant makes an action), *timeout* (participant does not make an action in the required time and alerted object goes back to the normal state)
    - Chart: refers to the specific task of the instance (i.e., monitoring, tracking, communication, or resource)
    - Arg: this variable provides different information for different tasks
        - Monitoring task: states if the input given by the participant is correct or not (did the participant push the correct key for the alerted boxes and sliders).
            - If correct, this is represented by *correct: true* and if false, this is represented by *correct: false*.
            - This variable also denotes the ASCII key press associated with the input (F1 (input): 112, F2: 113, F3: 114, F4: 115, F5: 116, F6: 117)
        - Tracking task: states if the input given by the participant is correct or not (did the participant click on the correct alerted satellite).
            - If correct, this is represented by *correct: true* and if false, this is represented by *correct: false*
        - Resource Management task: denotes the ASCII key press associated with the input (1 (input): 49, 2: 50, 3: 51, 4: 52, 5: 53, 6: 54, 7: 55, 8: 56)
        - Communications task: states if the input given by the participant is correct or not (did the participant press accept with the correct channel and frequency).
            - If correct, this is represented by *correct: true* and if incorrect, this is represented by *correct: false*.
            - This variable also denotes the channel and frequency after the input was handled.
            - This variable also denotes the current frequency of the target channel and the target frequency when an alert event happens.
    - DomID: this variable provides information about which object caused the data point
- Metadata: a data entry is created for every experiment that is run
    - StartTime: the start time for the condition in epoch time
    - SessionID: the session ID; this is created when running the condition
    - Duration: the duration of the condition in milliseconds; this is set when creating the condition
    - ParticipantID: the participant ID; this is created when running the condition
    - Condition: the name of the condition; this is set when creating the condition and when running the condition

    - Monitoring: a check mark signifies that the task was included in the condition; a minus signifies that the task was not included in the condition
    - Tracking: a check mark signifies that the task was included in the condition; a minus signifies that the task was not included in the condition
    - Communication: a check mark signifies that the task was included in the condition; a minus signifies that the task was not included in the condition
    - Resource: a check mark signifies that the task was included in the condition; a minus signifies that the task was not included in the condition
- Mouse Trackings: a data entry is created for each path every time the task refreshes as set in the condition
    - Time: the specific instance of time in milliseconds from the start of the experiment
    - SessionID: the session ID; this is created when running the condition
    - X: the x coordinate of the mouse in pixels
    - Y: the y coordinate of the mouse in pixels
    - DomID: the alerted satellite that the participant should be following
    - TargetX: the x coordinate of the target satellite in pixels
    - TargetY: the y coordinate of the target satellite in pixels
- Resource Switches: a data entry is created for each switch every time the task refreshes as set in the condition
    - Time: the specific instance of time in milliseconds from the start of the experiment
    - SessionID: the session ID; this is created when running the condition
    - SwitchNumber: refers to a specific switch in the Resource Management Task
    - State: refers to whether the corresponding switch is on (1), off (0), and broken (2)
- Resource Tanks: a data entry is created for each tank every time the task refreshes as set in the condition
    - Time: the specific instance of time in milliseconds from the start of the experiment
    - SessionID: the session ID; this is created when running the condition
    - TankNumber: refers to a specific tank in the Resource Management Task
    - State: refers to the level of fuel present in the corresponding tank
- Trackings: a data entry is created every time the mouse is moved
    - Time: the specific instance of time in milliseconds from the start of the experiment
    - SessionID: the session ID; this is created when running the condition
    - X: the x coordinate of the referenced satellite in pixels
    - Y: the y coordinate of the referenced satellite in pixels
    - DomID: the referenced satellite (track_circle_2, _1, or _0)
    - State: whether the satellite is an alert or not (1 if the satellite is an alert and the participant should be following, 0 if the satellite is not an alert)
    - MouseX: the x coordinate of the mouse in pixels
    - MouseY: the y coordinate of the mouse in pixels

APPENDIX D. Valid CSS Colors
To see each visit http://www.w3.org/TR/SVG/types.html#ColorKeywords

BLACK	BLUE	CYAN	DARK GRAY	GRAY
GREEN	LIGHT GRAY	MAGENTA	ORANGE	PINK
RED	WHITE	YELLOW	ALICE BLUE	ANTIQUE WHITE
AQUA	AQUA-MARINE	AZURE	BEIGE	BISQUE
BLANCHED ALMOND	BLUE VIOLET	BROWN	BURLEY WOOD	CADET BLUE
CHART-REUSE	CHOCOLATE	CORAL	CORNFLOWER BLUE	CORNSILK
CRIMSON	DARK BLUE	DARK CYAN	DARK GOLDENROD	DARK GREEN
DARK KHAKI	DARK MAGENTA	DARK OLIVE GREEN	DARK ORANGE	DARK ORCHID
DARK RED	DARK SALMON	DARK SEA GREEN	DARK SLATE BLUE	DARK SLATE GRAY
DARK TURQUOISE	DARK VIOLET	DEEP PINK	DEEP SKY BLUE	DIM GRAY
DODGER BLUE	FIRE BRICK	FLORAL WHITE	FOREST GREEN	FUCHSIA
GAINSBORO	GHOST WHITE	GOLD	GOLDENROD	GREEN YELLOW
HONEY DEW	HOT PINK	INDIAN RED	INDIGO	IVORY
KHAKI	LAVENDER	LAVENDER BLUSH	LAWN GREEN	LEMON CHIFFON
LIGHT BLUE	LIGHT CORAL	LIGHT CYAN	LIGHT GOLDEN	LIGHT GREEN
LIGHT PINK	LIGHT SALMON	LIGHT SEA GREEN	LIGHT SKY BLUE	LIGHT SLATE GRAY
LIGHT STEEL BLUE	LIGHT YELLOW	LIME	LIME GREEN	LINEN
MAROON	MEDIUM AQUA MARINE	MEDIUM BLUE	MEDIUM ORCHID	MEDIUM PURPLE
MEDIUM SEA GREEN	MEDIUM SLATE BLUE	MEDIUM SPRING GREEN	MEDIUM TURQUOISE	MEDIUM VIOLET RED
MIDNIGHT BLUE	MINT CREAM	MISTY ROSE	MOCCASIN	NAVAJO WHITE
NAVY	OLD LACE	OLIVE	OLIVE DRAB	ORANGE RED
ORCHID	PALE GOLDENROD	PALE GREEN	PALE TURQUOISE	PALE VIOLET RED
PAPAYA WHIP	PEACH PUFF	PERU	PLUM	POWDER BLUE
PURPLE	ROSY BROWN	ROYAL BLUE	SADDLE BROWN	SALMON
SANDY BROWN	SEA GREEN	SEA SHELL	SIENNA	SILVER
SKY BLUE	SLATE BLUE	SLATE GRAY	SNOW	SPRING GREEN
STEEL BLUE	TAN	TEAL	THISTLE	TOMATO
TURQUOISE	VIOLET	WHEAT	WHITE SMOKE	YELLOW GREEN