

## **Assignment 2: Learning and Memory PSY 306 (Winter 2021)**

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**Instructions:** Please write your own responses and do not copy or lift text/code from any source. If you are referring to credible external sources other than the attached paper for your answers, please cite those sources (within the body of text and the provide a reference list at the end) in the APA citation format (<https://www.mendeley.com/guides/apa-citation-guide>). Word limits given are indicative and less than the indicated numbers may also be used.

**Please download this MS word question-cum-response template to TYPE your answers and feel free to add sheets as required. Convert this document to a PDF and rename the file: name\_roll no. before submitting. Please note that answers in this template only will be evaluated and hand-written or scanned answer sheets will not be evaluated. Please submit ONLY ONE PDF and NO EXTRA FILES as it increases the time to evaluate them. DO NOT change the basic structure of the template. DO NOT remove the marks assigned for each question.**

**[Strict deadline for submission: 2 March (Friday), 11 PM]**

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**Q1) Please read the attached article by Milad et.al.2005 and answer the following [Total word limit ~ 700 words (including sections A-C)].**

- A) Describe which type of learning is being investigated in this study? Explain its various components with examples of each component from this study. Describe what is extinction with an example from this study. [2 + 4 + 2 points; Begin each sub-section in a different paragraph]**

Here classical conditioning(aversive type) is being investigated.It is a type of learning in which one stimulus is conditioned with an event(which makes a response in the organism). later only stimulus is given to see the learned behavior. As the stimulus is unpleasant it is an aversive type of classical conditioning.

Various components of this learning process are:

US(unconditioned stimulus): It is a stimulus that causes a response without any training, here it is the electric shock given to the subject.

UR(unconditioned response): It is the response that happens naturally because of US. In this experiment it is the skin conductance of the subject.

CS(conditioned stimulus): It is a stimulus that is given along with the US which produces a CR, here it is the pictures shown to the subject.

CR(conditioned response): it is a response because of anticipation of the US but caused due to CS. Here it is the skin conductance of the subject.

As we remove the simultaneous stimulus(US), the response keeps on decreasing, this reduction in learning is called extinction in classical conditioning. In this study we can see that as we stop giving shock to the subject(US) and we give only the CS(shown pictures) slowly the CR decreases(this means learning decreases) which shows extinction.

- B) Which hypothesis is being tested in the study and why? How is learning and its retention studied and quantified behaviourally in this study? [1 + 2 + 5 points]**

They hypothesized that the thickness of one or more of rACC(rostral anterior cingulate cortex), SC(subcallosal cortex) and mOFC(medial orbitofrontal cortex) regions of the brain is directly related to the extinction retention of the person. Also the thickness of the dACC(dorsal anterior cingulate cortex) part doesn't have any relation with extinction retention.

The experiment first arrived as the author saw that there was a difference in the level of retention of PTSD in individuals. There were few studies conducted before(on animals and on humans), which correlated this phenomena to different parts of vmPFC of the brain. The author took the older work further, added their idea to this(if thickness makes the difference) and hypothesized the experiment.

We took 14 volunteers. Used MRI to measure the thickness of the interested region of the brain of the participants.

On the first day(habituation phase), we showed the participants CSs(neutral conditioned stimulus). There were 4 trials each of CS+ and CS- within visual context(CXs)(CX+ means to be conditioning context and CX- means to be extinction context). This was followed by a shock(500 millisecond)(US unconditioned stimulus). This was followed by the extinction phase where there were CSs and CXs but no US.

On the second day it was identical to the extinction phase of day one, it is the renewal phase. Here also we gave CSs within CXs but without US.

For each trial we stored the SCR(skin conductance response) of the participants. We used this SCR data for further analysis(used one tailed test).

**C) What is measured by structural magnetic resonance imaging (MRI) of the brain in this study? Explain what do the researchers conclude overall in the study by collating the MRI and other measures? [1+ 3 points]**

Using magnetic resonance imaging(MRI) they got the structural images of different parts of the brain, using which they found out(measured) the thickness of these parts.

After the analysis of data the researchers found a direct relation(correlation) between the thickness of vmPFC and the extinction retention of a person. This correlation was even greater for the mOFC part of vmPFC.

This means that more the thickness of the vmPFC regions, less is the value of SCR and more is the extinction retention among the participants. Which explains why there is a difference in the ability to control fear among people.

**Q2) Please read the following for this question:**

- A researcher recorded electromyogram (EMG) from the extraocular muscles of a human participant as a tone was delivered through headphones and air-puff delivered to the eyes through an apparatus to the participant. The tone stimulus onset is at time = 0 ms (beginning of the trial) and continues for 650 ms. The air-puff stimulus onset is at time = 600 ms and continues for 50 ms.
- The above was done for five trials/day for four subsequent days and the EMG responses recorded as data. Download the attached data file- Data-Assignment2.xlsx
- Each sheet of the excel file contains EMG recording from one day of experiment. Each sheet has 5 rows (trials) x 1000 columns (EMG amplitudes recorded at an interval of 1 millisecond). Thus each row has 1000 ms (1 second) of recording.

Now do the following...

Insert a figure (wherever required) and paste the MATLAB/Python code for the same. The datasheet generated from the test trials may also be pasted on this sheet at appropriate places. If a GUI based software is used, insert the screenshots of the steps that led to the figures/calculations. All figures should be properly labelled and should have accompanying captions/legends to provide all information necessary to interpret the figures...

**A) Run the following steps...**

- Take the average of data across all trials/day for each time point to get one averaged signal/day.
- Run a 'moving average filter' across the averaged signal with a window width of 25 ms to get a filtered and smoothed signal. Ensure that the raw and filtered signal are of the same length.
- 'Rectify' (take the absolute value) the above moving average filtered signal.
- Plot the amplitude vs time of average signal for each day in four different subplots.

[5 points]

This is the python code used ,It is well commented.

```
import pandas as pd
# import xlrd
# import openpyxl
import matplotlib.pyplot as plt

col_n=['Amplitude']
for i in range(1,1001):
    col_n.append(str(i))
# print(col_n)
#command to read the excel file provided
data = pd.read_excel('Data-Assignment2.xlsx', sheet_name=['Day1', 'Day2', 'Day3', 'Day4'])
#storing the different day data in different variable
df1 = pd.DataFrame(data['Day1'])
df2 = pd.DataFrame(data['Day2'])
df3 = pd.DataFrame(data['Day3'])
df4 = pd.DataFrame(data['Day4'])
#renaming the columns
df1.columns=col_n
df2.columns=col_n
df3.columns=col_n
df4.columns=col_n

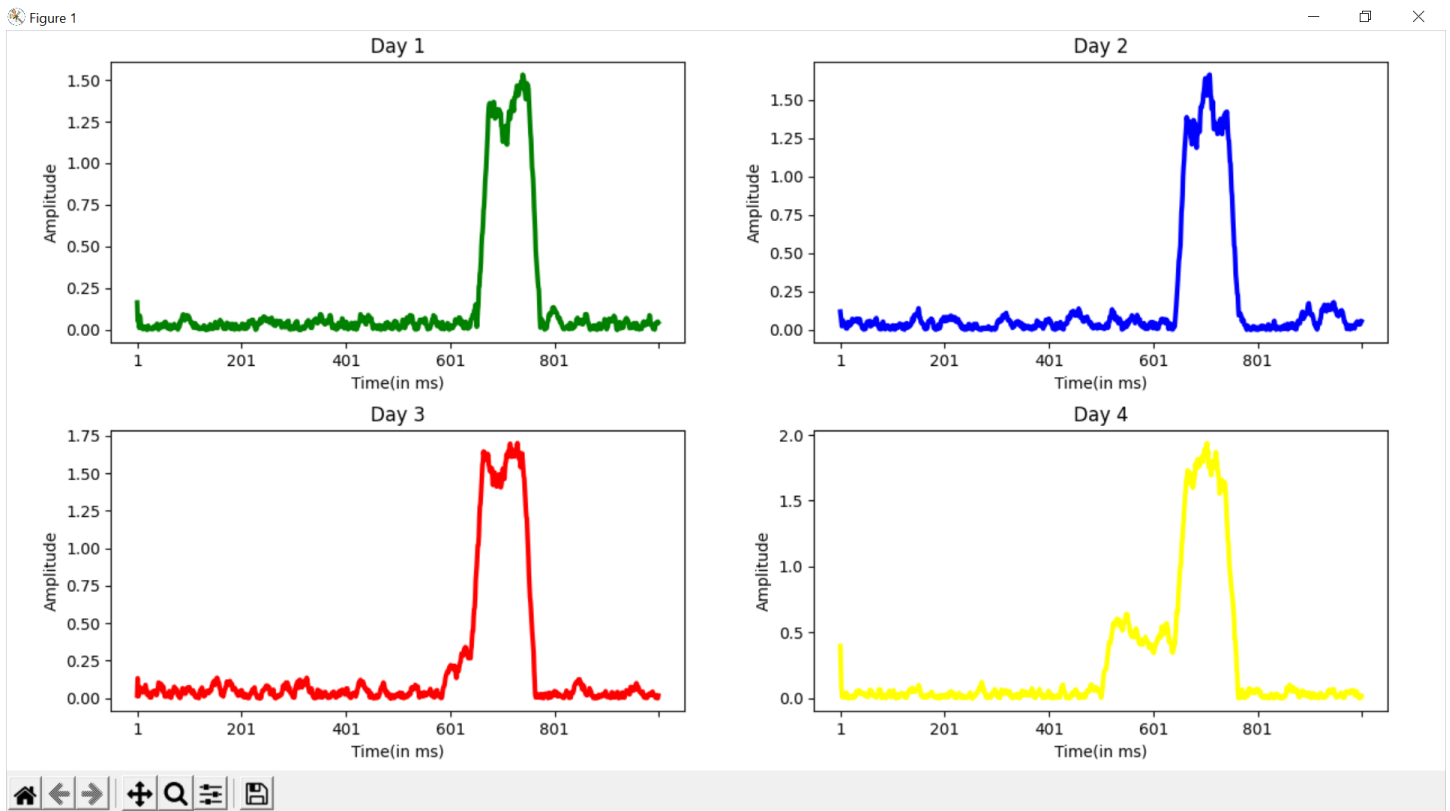
#finding mean of the data for each time point
mean_df1 = df1.mean()
```

```
mean_df2 = df2.mean()
mean_df3 = df3.mean()
mean_df4 = df4.mean()
```

```
#running an moving average filter of width 25
fs_df1 = mean_df1.rolling(25, min_periods=1).mean()
fs_df2 = mean_df2.rolling(25, min_periods=1).mean()
fs_df3 = mean_df3.rolling(25, min_periods=1).mean()
fs_df4 = mean_df4.rolling(25, min_periods=1).mean()
```

```
#taking absolute value of each variable
fs_df1 = fs_df1.abs()
fs_df2 = fs_df2.abs()
fs_df3 = fs_df3.abs()
fs_df4 = fs_df4.abs()
```

```
#plotting the graphs
fig, axes = plt.subplots(nrows=2, ncols=2)
fig.tight_layout(h_pad=2)
fs_df1.plot(kind='line', color='green', linewidth=3, figsize=(14, 6), ax=axes[0,0], title='Day 1', xlabel='Time(in ms)',
ylabel='Amplitude')
fs_df2.plot(kind='line', color='blue', linewidth=3, figsize=(14, 6), ax=axes[0,1], title='Day 2', xlabel='Time(in ms)',
ylabel='Amplitude')
fs_df3.plot(kind='line', color='red', linewidth=3, figsize=(14, 6), ax=axes[1,0], title='Day 3', xlabel='Time(in ms)',
ylabel='Amplitude')
fs_df4.plot(kind='line', color='yellow', linewidth=3, figsize=(14, 6), ax=axes[1,1], title='Day 4', xlabel='Time(in ms)',
ylabel='Amplitude')
plt.show()
```



**B) Explain the learning mechanism evident in the plot created in (A) with all necessary components. Refer to the specific parts of the plot (A) wherever necessary to draw your conclusions about the learning mechanism and its components.**

**[5 points]**

The learning is a classical conditioning type learning. Different components are:

US(unconditioned stimulus): It is a stimulus that causes a response without any training, here it is the air puff.

UR(unconditioned response): It is the response that happens naturally because of US, in this experiment it is the blinking of the eye.

CS(conditioned stimulus): It is a stimulus that is given along with the US which produces a CR. Here it is the tone through the headphones.

CR(conditioned response): it is a response because of anticipation of the US but caused due to CS. In this experiment it is the blinking of the eye.

In the plots we can see that by day 3 the subject is anticipating an air puff as there is a slight increase in amplitude prior to the actual air puff, by day 4 we can see that the anticipation is quite strong as the amplitude we can see is quite high before the stimulus.