Sharif University Of Technology

Electrical Engineering

Neuroscience Lab

Homework 01- Psychophysics

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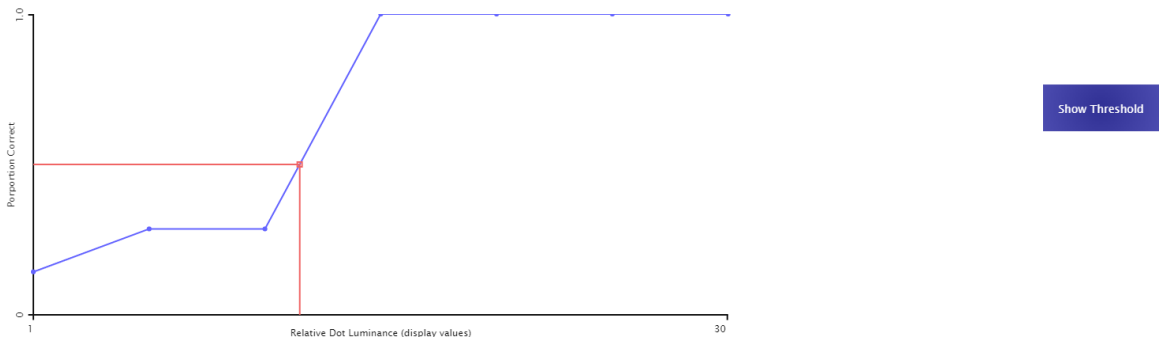
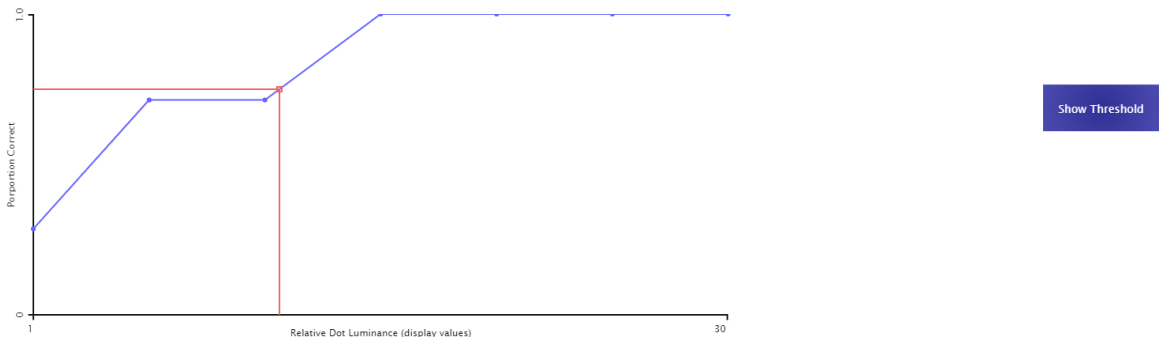
1 Question 1

a) My psychometric function:

Traditional Method Instructions:



Forced-Choice Method Instructions:



b) Threshold : We take the 75% performance level and consider the a stimulus level that produce this performance level as 'threshold'. In this task, the stimulus is relative dot luminescence and my threshold is 11.27, it means, as the relative dot luminescence reach this point, proportion correct reach 75%.

PSE is defined as a stimulus level which reach the 50% performance level. In this task , My Threshold is 12.12.

2 Question 2

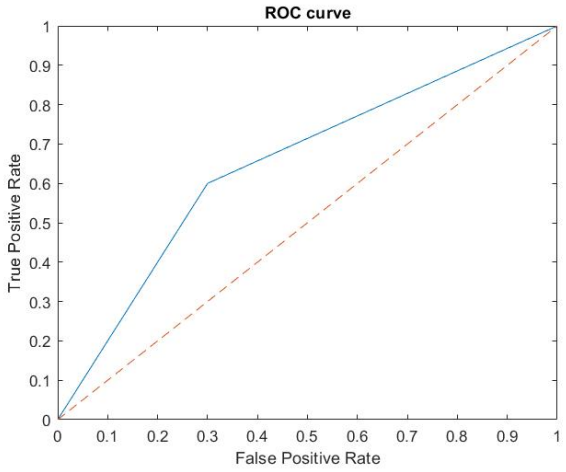
Signal Detection Paradigm

	Present	Not Present
Happened	0.6	0.3
Did not Happened	0.4	0.7

a) Sensitivity Index: $d^{'} = z(H) - z(F) = z(0.6) - z(F) = 0.2533 - (-0.2533) = 0.5066$

criterion: $c = -0.5[z(H) + z(F)] = -0.5(0) = 0$

b) ROC curve:



The ROC curve shows the trade-off between sensitivity (or TPR) and specificity (1 – FPR). Classifiers that give curves closer to the top-left corner indicate a better performance. A random classifier is expected to give points lying along the diagonal (FPR = TPR). The closer the curve comes to the 45-degree diagonal of the ROC space, the less accurate the test.

In this task, the sensitivity is $\frac{0.6}{0.6+0.4} = 0.6$ and specificity is $\frac{0.7}{0.7+0.3} = 0.7$, so my performance is not really good but acceptable!

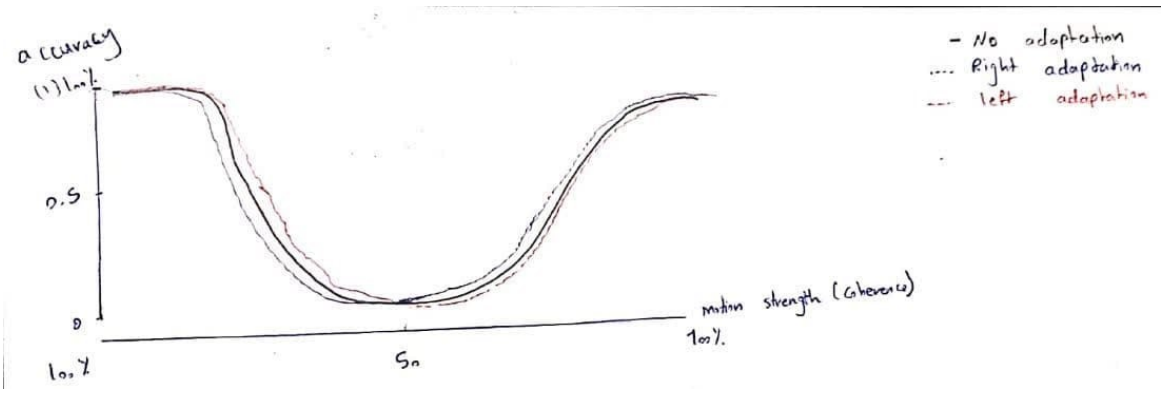
$sensitivity = \frac{TP}{TP+FN} specificity = \frac{TN}{TN+FP}$

3 Question 3

a. Psychometric function for a subject show accuracy as a function of motion strength (coherence). When all dots have a same direction (coherence=100), ideal subject can easily detect the direction of movement, but when the dots move left or right with equal probability, movement detection could be harder.

b. In order to study the motion aftereffect, an adapter stimulus is added to the motion discrimination task. In other words, The experiment is started by showing a dot motion stimulus that is always moving in one direction and then another dot motion stimulus is presented.

After one directed stimulus, the subject detect movement in that direction faster and more accurate. So the psychometric curve shift base on the adapter stimulus direction.



4 Question 4

Dyschronometria is a condition of cerebellar dysfunction in which an individual cannot accurately estimate the amount of time that has passed (i.e., distorted time perception). In this part, we want to design experimental investigate the perception of duration in these patients.

Hypothesis:

The perception of duration in patients with Dyschronometria condition is longer than normal people.

Participants:

A group of patient in Dyschronometria condition, different age range (e.g. between 10 and 60 years old) participate to this study (also try to have both man and women in the group). The control group comprised people with no problem in their perception (try to have different age range and gender in the group). Any kind of effective disorder is an exclusion criterion for either group.

Stimuli:

There are three test session: one with stimuli on the second scale, one with stimuli on the millisecond and other type of stimuli: Circle test.

Task procedure:

A three visual stimulus apply. Before main task, all participate do another task to get familiar with the experiment situation. At the beginning of the first task, the white cross display on the screen with black background, Then a white circle show as a target time duration (in second scale). After that, subject has to judge whether this duration was longer or shorter than duration of previous target and press the related buttons. Next trial begin when the subject press enter key (or other arbitrary button). The subject successfully pass the train if answer half of the trials correctly.

In second task, we can show each stimulation in millisecond and repeat the last task procedure.

In third task, we display three circle on the screen and ask the subject to describe his/her perception of past,present and future by them. Subject could adjust the size and overlap of all circles.

Experimental conditions:

To reduce the likelihood of tiredness effects, every task record in three different day. To encourage subject answer correctly, we can use smile face. If recognition was correct, happy face appeared, otherwise sad face.

Experimental method

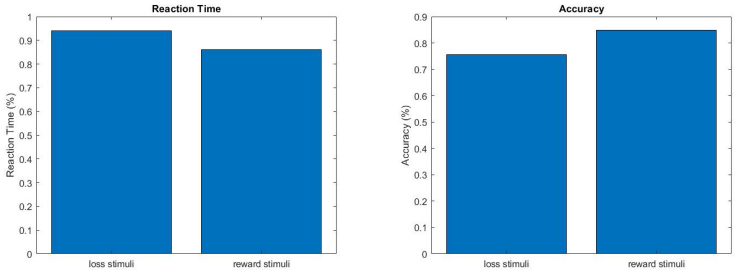
The first two test, we have forced-choice method and the last task is method of adjustment.

Rationale reason for choosing these methods: Forced-choice method: patient in Dyschronometria condition could not easily detect how long the stimuli was displayed. This get harder when the time interval of each stimuli is in millisecond.

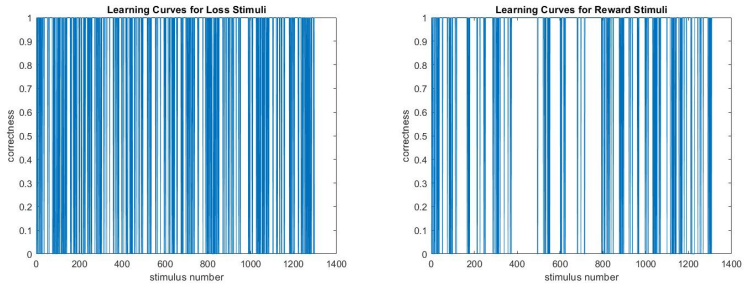
Method of adjustment: patient usually connect this three time and draw interlocked circle and connect their past experience with present.

5 Question 5

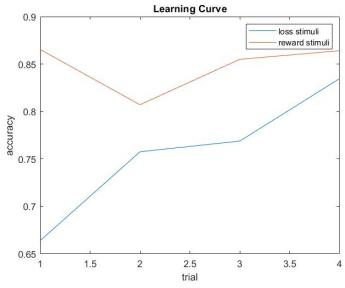
a. For each loss-associated stimuli and reward-associated, we compute the average reaction time and accuracy. In reward-associated, the average reaction time is less and the accuracy is higher.



b. We plot the correctness for both stimuli over all trials.

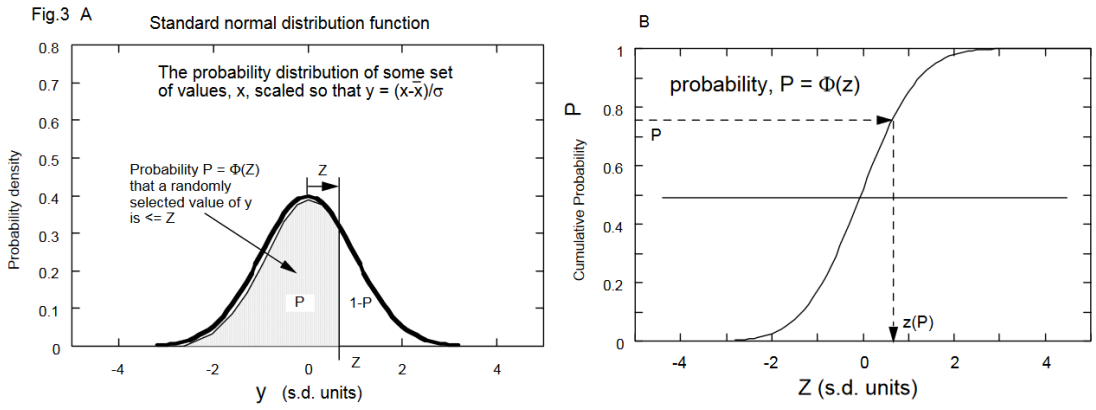


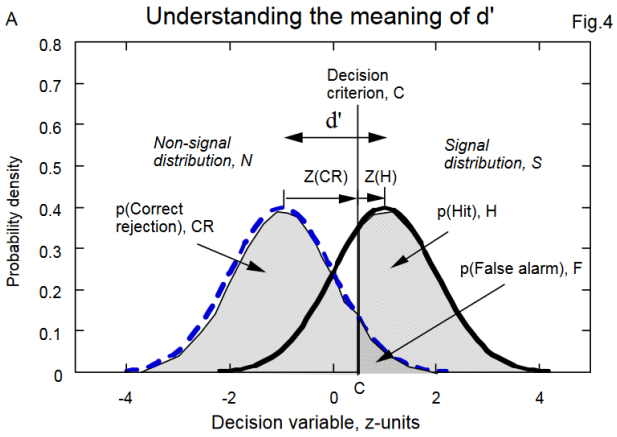
Also, for each subjects we measure the accuracy for loss-associated stimuli and reward-associated for each trials and plot the average subject accuracy in trial.



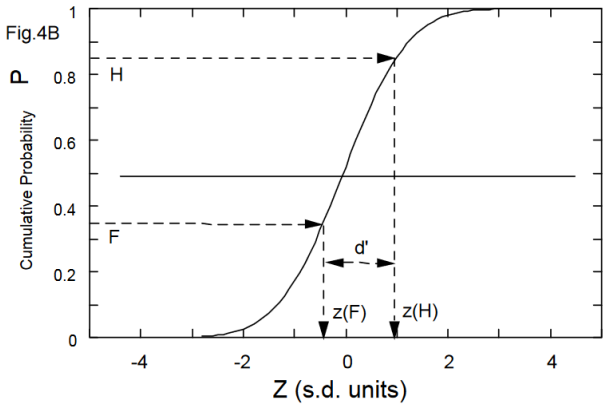
6 Question 6 (Bonus assignment)

From fig. 4A that : $d' = z(CR) + z(H)$. Also: $CR + F = 1$, hence $CR = 1 - F$, and so $z(CR) = z(1 - F)$. From fig. 3 we have $z(1 - F) = -z(F)$, therefore $z(CR) = -z(F)$. Hence: $d' = z(H) - z(F)$.





Thus d' is the difference between the z-transformed probabilities of hits and false alarms. It is also the sum of z-transformed probabilities of hits and correct rejections. It is NOT the hit rate, nor $z(Hits)$, nor $z(P(c))$. All these vary with criterion; d' doesn't. This is so central I'll repeat it: $d' = z(H) - z(F)$.



Reference : https://www.birmingham.ac.uk/Documents/college-les/psych/vision-laboratory/sdtintro.pdf