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Period 1

Reaction Time Lab

Introduction:

Reaction time is the interval of time between a stimulus and a physical response to that stimulus. A stimulus is any external change or action that causes a response. The sensory receptors located in the peripheral nervous system detect these stimuli and send an electrochemical signal to the brain. Afferent neurons send the impulse to the brain, interneurons interpret the signal in the brain, and efferent neurons return an electrochemical signal to the site in order to produce a response. More specifically, sensory neurons receive stimuli through the dendrites. This is converted into an electrochemical impulse and is sent along a chain of neurons through the axon, and eventually to the brain. The brain interprets this impulse, and sends a signal back to the body through motor neurons. The body then physically reacts based on this signal coming from the brain. The time between the stimulus and the body's physical response is the reaction time. This entire process must occur in seconds, even fractions of a second, in order to ensure survival. In the modern world, tasks such as driving and playing sports require our body to react to certain visual, auditory, or other stimuli within a matter of seconds. However, this speedy process was around long before the invention of automobiles or recreational sports. The original purpose of our quick reaction time was to evade predators that posed an immediate threat to our survival. The danger would have to be recognized and acted upon immediately in order to evade being eaten. The null hypothesis for this experiment is that neither coffee nor the different senses will have a significant effect on reaction time.

Materials:

- Meter stick
- Two human participants (neither of which can be blind or deaf)
- At least 84 oz. of coffee
- Calculator

Procedure:

1. Place the meter stick, centimeter side facing outwards, against a flat wall at least 100 cm from the floor.
2. Have one person hold the meter stick near the top while the other person cups his hand around the base of the meter stick so that the upper-most part of his palm corresponds to 0 cm.
3. First, sight will be tested by dropping the meter stick while the other person is watching. When the meter stick is released, the partner whose hand was at the base should pin the meter stick against the wall as quickly as possible.
4. Record the number of cm the meter stick fell before the person caught it using the number that the top of the person's palm is touching.
5. Repeat steps 3-4 nineteen more times, each time recording the distance the meter stick fell.

6. Next, repeat steps 1-2.
7. Sound will be tested by saying the word “go” and dropping the meter stick simultaneously, once again recording the distance the meter stick fell each time.
8. Repeat step 7 nineteen more times.
9. Touch will be tested by touching the other person and releasing the meter stick simultaneously, recording the distance fell each time.
10. Repeat step 9 nineteen more times.
11. Switch positions so that the person who was dropping the meter stick is now stopping it and vice versa. Then repeat steps 1-10.
12. Next, have the first person drink 6 oz. of coffee.
13. After waiting 5 minutes, repeat steps 3-10 twenty times.
14. Wait another 30 minutes in order for the caffeine to wear off, and then drink 12 oz. of coffee. Wait 5 minutes and repeat steps 3-10 twenty times.
15. Wait 1.5 hours for the caffeine to wear off, and then drink 24 oz. of coffee. Wait 5 minutes and repeat steps 3-10 twenty times.
16. Switch positions so that the person who was dropping the meter stick is now stopping it and vice versa.
17. Repeat steps 12-16 and make sure to record each distance.
18. For both participants, do not use the data obtained in the first five trials, as those are used as a learning period.

Results:

Control

Trial	Sight (cm dropped)		Sound (cm dropped)		Touch (cm dropped)	
1	24	26	24	40	28	24
2	24	17	32	25	10	18
3	23	23	22	21	18	21
4	23	19	34	40	17	23
5	17	18	26	58	8	24
6	21	12	25	29	32	16
7	19	26	21	36	35	17
8	13	15	16	40	14	21
9	23	14	16	42	18	18
10	21	21	7	25	13	17
11	24	18	11	29	17	18
12	26	21	21	32	18	16
13	14	23	9	31	30	18
14	21	25	20	34	16	19
15	21	17	19	31	24	17

After 6 oz. coffee

Trial	Sight (cm dropped)		Sound (cm dropped)		Touch (cm dropped)	
1	21	21	33	40	29	24
2	23	20	28	39	34	16
3	20	18	24	37	27	17
4	21	11	29	39	25	19
5	20	14	31	41	23	18
6	17	16	20	35	31	18
7	19	19	19	32	24	17
8	26	24	14	31	22	19
9	24	21	18	36	30	16
10	15	22	21	28	26	12
11	19	15	22	29	14	22
12	20	17	15	32	20	24
13	22	21	11	33	19	23
14	18	22	7	36	23	21
15	23	26	16	29	22	26

After 12 oz. coffee

Trial	Sight (cm dropped)		Sound (cm dropped)		Touch (cm dropped)	
1	21	21	30	40	34	36
2	22	25	28	31	31	24
3	24	26	26	35	30	26
4	21	31	27	36	46	28
5	23	17	31	37	28	29
6	16	18	20	29	21	14
7	19	19	17	28	25	15
8	18	21	19	24	23	21
9	19	22	17	26	20	14
10	22	19	14	25	19	16
11	15	20	25	20	17	18
12	14	15	11	24	24	19
13	21	17	12	21	20	20
14	16	18	7	20	15	17
15	12	16	9	23	16	12

After 24 oz. coffee

Trial	Sight (cm dropped)		Sound (cm dropped)		Touch (cm dropped)	
1	21	21	21	40	30	21
2	20	20	26	31	25	36
3	19	16	24	32	24	30

4	26	14	25	30	26	24
5	27	20	30	28	20	25
6	10	16	15	20	19	16
7	12	15	17	22	16	17
8	16	17	20	19	15	14
9	13	13	18	17	14	21
10	9	20	19	21	17	20
11	15	9	16	18	20	18
12	12	15	17	23	21	14
13	14	13	15	16	19	16
14	20	14	21	18	13	15
15	13	17	19	20	18	13

$$\text{Reaction Time} = \sqrt{\frac{\text{cm}}{490}} \text{ sec}$$

Control

Trial	Sight (sec)		Sound (sec)		Touch (sec)	
1	0.22	0.23	0.22	0.29	0.24	0.22
2	0.22	0.19	0.26	0.23	0.14	0.19
3	0.22	0.22	0.21	0.21	0.19	0.21
4	0.22	0.20	0.26	0.29	0.19	0.22
5	0.19	0.19	0.23	0.34	0.13	0.22
6	0.21	0.16	0.23	0.24	0.26	0.18
7	0.20	0.23	0.21	0.27	0.27	0.19
8	0.16	0.17	0.18	0.29	0.17	0.21
9	0.22	0.22	0.18	0.29	0.19	0.19
10	0.21	0.21	0.12	0.23	0.16	0.19
11	0.22	0.22	0.15	0.24	0.19	0.19
12	0.23	0.23	0.21	0.26	0.19	0.18
13	0.17	0.22	0.14	0.25	0.25	0.19
14	0.21	0.23	0.20	0.26	0.18	0.20
15	0.21	0.19	0.20	0.25	0.22	0.19

After 6 oz. coffee

Trial	Sight (sec)		Sound (sec)		Touch (sec)	
1	0.21	0.21	0.26	0.29	0.24	0.22
2	0.22	0.20	0.24	0.28	0.26	0.18
3	0.20	0.19	0.22	0.27	0.23	0.19
4	0.21	0.15	0.24	0.28	0.23	0.20
5	0.20	0.17	0.25	0.29	0.22	0.19
6	0.19	0.18	0.20	0.27	0.25	0.19
7	0.20	0.20	0.20	0.26	0.22	0.19
8	0.23	0.23	0.17	0.25	0.21	0.20
9	0.22	0.22	0.19	0.27	0.25	0.18
10	0.17	0.17	0.21	0.24	0.23	0.16

11	0.20	0.20	0.21	0.24	0.17	0.21
12	0.20	0.19	0.17	0.26	0.20	0.22
13	0.21	0.22	0.15	0.26	0.20	0.22
14	0.20	0.19	0.12	0.27	0.22	0.21
15	0.21	0.23	0.18	0.24	0.21	0.23

After 12 oz. coffee

Trial	Sight (sec)		Sound (sec)		Touch (sec)	
1	0.21	0.21	0.25	0.29	0.26	0.27
2	0.21	0.23	0.24	0.25	0.25	0.22
3	0.22	0.23	0.23	0.27	0.25	0.23
4	0.21	0.25	0.23	0.27	0.31	0.24
5	0.22	0.19	0.25	0.27	0.24	0.24
6	0.18	0.19	0.20	0.24	0.21	0.17
7	0.20	0.20	0.19	0.24	0.23	0.17
8	0.19	0.21	0.20	0.22	0.22	0.21
9	0.20	0.21	0.19	0.23	0.20	0.17
10	0.21	0.20	0.17	0.23	0.20	0.18
11	0.17	0.20	0.23	0.20	0.19	0.19
12	0.17	0.17	0.15	0.22	0.22	0.20
13	0.21	0.19	0.16	0.21	0.20	0.20
14	0.18	0.19	0.12	0.20	0.17	0.19
15	0.16	0.18	0.14	0.22	0.18	0.16

After 24 oz. coffee

Trial	Sight (sec)		Sound (sec)		Touch (sec)	
1	0.21	0.21	0.21	0.29	0.25	0.21
2	0.20	0.20	0.23	0.25	0.23	0.27
3	0.20	0.18	0.22	0.26	0.22	0.25
4	0.23	0.17	0.23	0.25	0.23	0.22
5	0.23	0.20	0.25	0.24	0.20	0.23
6	0.14	0.18	0.17	0.20	0.20	0.18
7	0.16	0.17	0.19	0.21	0.18	0.19
8	0.18	0.19	0.20	0.20	0.17	0.17
9	0.16	0.16	0.19	0.19	0.17	0.21
10	0.14	0.20	0.20	0.21	0.19	0.20
11	0.17	0.14	0.18	0.19	0.20	0.19
12	0.16	0.17	0.19	0.22	0.21	0.17
13	0.17	0.16	0.17	0.18	0.20	0.18
14	0.20	0.17	0.21	0.19	0.16	0.17
15	0.16	0.19	0.20	0.20	0.19	0.16

Person 1

Anova: Two-Factor With Replication

SUMMARY	0 oz. coffee	6 oz. coffee	12 oz. coffee	24 oz. coffee	Total
<i>Sight</i>					
Count	15	15	15	15	60
Sum	3.11	3.07	2.94	2.71	11.83
Average	0.207333	0.204667	0.196	0.180667	0.197167
Variance	0.000392	0.000198	0.000383	0.000864	0.000546

<i>Sound</i>					
Count	15	15	15	15	60
Sum	3	3.01	2.95	3.04	12
Average	0.2	0.200667	0.196667	0.202667	0.2
Variance	0.001643	0.001507	0.001738	0.000521	0.001288

<i>Touch</i>					
Count	15	15	15	15	60
Sum	2.97	3.34	3.33	3	12.64
Average	0.198	0.222667	0.222	0.2	0.210667
Variance	0.001774	0.000535	0.001303	0.000629	0.001145

<i>Total</i>					
Count	45	45	45	45	
Sum	9.08	9.42	9.22	8.75	
Average	0.201778	0.209333	0.204889	0.194444	
Variance	0.001229	0.000806	0.001239	0.000739	

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Sample	0.006081	2	0.003041	3.176436	0.044252	3.049792
Columns	0.005299	3	0.001766	1.845425	0.14086	2.658399
Interaction	0.009679	6	0.001613	1.685239	0.127429	2.152911
Within	0.160813	168	0.000957			
Total	0.181873	179				

Person 2

Anova: Two-Factor With Replication

SUMMARY	0 oz. coffee	6 oz. coffee	12 oz. coffee	24 oz. coffee	Total
<i>Sight</i>					
Count	15	15	15	15	60
Sum	3.11	2.95	3.05	2.69	11.8
Average	0.207333	0.196667	0.203333	0.179333	0.196667
Variance	0.000521	0.000538	0.000438	0.000364	0.000558
<i>Sound</i>					
Count	15	15	15	15	60
Sum	3.94	3.97	3.56	3.28	14.75
Average	0.262667	0.264667	0.237333	0.218667	0.245833
Variance	0.001092	0.000284	0.000764	0.001027	0.00112
<i>Touch</i>					
Count	15	15	15	15	60
Sum	2.97	2.99	3.04	3	12
Average	0.198	0.199333	0.202667	0.2	0.2
Variance	0.000203	0.000364	0.001021	0.001014	0.00062
<i>Total</i>					
Count	45	45	45	45	
Sum	10.02	9.91	9.65	8.97	
Average	0.222667	0.220222	0.214444	0.199333	
Variance	0.001411	0.001389	0.000975	0.001029	

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Sample	0.090583	2	0.045292	71.23642	3.94E-23	3.049792
Columns	0.014806	3	0.004935	7.762535	6.93E-05	2.658399
Interaction	0.013972	6	0.002329	3.662672	0.001916	2.152911
Within	0.106813	168	0.000636			
Total	0.226175	179				

Conclusion:

For person 1, the p-value was <0.05 and the $F_{crit} > F$, thus strongly indicating that the variable had a significant impact on reaction time. Looking back on the data, it appears that a larger dose of coffee decreased reaction time. However, since the p-value was only slightly less than the alpha of 0.05, further experimentation is recommended to support or reject the hypothesis. Secondly, the p-value for the interaction between the variables was >0.05 , indicating that the coffee did not interact with the differentiation in sense to produce a separate effect. Thus, the null hypothesis can be rejected for the coffee and accepted for the interaction.

For person 2, the p-value was <0.05 and the $F_{crit} > F$ as well, once again indicating that the variable had a significant effect on reaction time. The data suggests that larger dosage of coffee significantly reduces reaction time. This time, however, the p-value was much lower than the alpha of 0.05, thus suggesting with extreme confidence that the variable had a significant effect on reaction time. This time, the p-value for the interaction between variables suggests that there was a significant, independent effect produced by an interaction between the coffee and the different senses. The null hypothesis can be rejected for both the interaction and each variable independently, as it appears that they had a significant effect on reaction time.

As with every experiment, this one had many limitations and possible extensions. Some of the limitations include: the inherent human error when dropping the meter stick and synchronizing it with the auditory or touch signal; the friction between the stick and the wall, and, although only slightly, gravity on earth changes with elevation and distance from the poles, thus making the distance to time calculation contain a slight error; the coffee may not have fully worn off between each set of trials; the two participants may have different tolerances to caffeine, and thus must be evaluated independently of each other rather than averaging their times; and other variable such as sleep, exercise, or diet may have had some sort of an effect on the data. Some extensions include: more trials and/or more test subjects; different amounts of coffee; different types of coffee (for example: decaf, with cream and/or sugar); coffee's effects on performing tasks that are dependent upon reaction time; and coffee's effect on performance since millions of people drink it before going to school or work.

see me about this!