

Date: \_\_\_\_\_

## Nervous System Investigation

Name: BROOKLYN DRAYTON

Investigation: Reaction Time

Your Task: Design an experiment to illustrate the effect of stimulus on response times.

SECTION	COMPONENT	Possible Marks	Mark allocated
PLANNING	Aim:	1	
	Variables		
	<i>Independent Variable:</i>	1	
	<i>Dependent Variable:</i>	1	
	<i>Controlled Variables: at least 5 are listed</i>	5	
	<b>Prediction:</b> The student states what they thought would happen and why	2	
	<b>Hypothesis:</b> A hypothesis is presented that states the effect of the independent variable on the dependent variable	2	
	<b>Equipment:</b> Listed correctly	1	
	<b>Method:</b> Detailed numbered steps are written. Instructions are clear and can be followed exactly at another time. Variables are clearly controlled. A diagram is used and labelled appropriately that clearly enhances the method	5	
RESULTS	<b>Results:</b> Displayed appropriately. Tables are used observations are adequately documented. Figures written to the same decimal place. Repeats or replicates are used. The mean is shown in the table. Units are used.	5	
	<b>Graphing (if applicable):</b> Results are graphed on the correct axis and the scale is correct. The correct type of graph has been used without any aid from the teacher. Labelling of units is correct and the graph is easy to interpret	5	
CONDUCTING	<b>Practical Application:</b> Safety, behaviour, laboratory skills and application during the investigative process can not be faulted	4	3.5
DISCUSSION Analysis Evaluation	The results are summarised in a mature manner and pattern/trends in the results are identified and commented on.	2	
	Inconsistencies in the results are identified and explained.	2	
	The experiment is classified as: valid; accurate; reliable. Valid reasons are given for the classification.	3	
	Problems and difficulties within the experimental design are identified and the student describes improvements.	4	
	The results of the experiment have been explained based on sound scientific principles taught in class or by doing extra research.	4	
	The discussion must make sense.	1	
CONCLUSION	Major findings are summarised.	1	
	Statement of whether hypothesis has been supported or not	1	
TOTAL		50	



## NERVOUS SYSTEM INVESTIGATION

### Aim

To determine if one's response time to a visual stimulus varies between their dominant right and non-dominant left hand.

### Variables

**Independent:** Dominant (right) or non-dominant (left) hand used

**Dependent:** How fast one's nervous system stimulates their skeletal muscles to respond to a visual stimulus.

**Controlled:**

- Colour of visual stimulus
- Laptop used
- Brightness of the screen
- Participant starting position
- Time of the day
- Size of the stimulus

### Prediction

It is my prediction that when the participants are using their dominant right hand, they will be able to react to the visual stimulus at a faster rate, in comparison to their non-dominant left hand. This is because as the participants are right handed, the neurons that carry messages from the brain to their right hand, are used more frequently and the communication process is familiar.

### Hypothesis

When a dominant right hand is used, one's nervous system will stimulate their skeletal muscles to respond to the visual stimulus at a faster rate, in relation to their non-dominant left hand.

### Equipment

- Laptop
- Textbooks/paper to record results
- Pen or pencil
- Desk
- Chair

#### Key

**Observer:** Person recording results and ensuring the method is precisely followed.

**Participant:** Dominant right, non-dominant left

### Method

1. Log into the laptop, open internet explorer or google chrome.
2. Go to the web address bar and type in:  
<https://faculty.washington.edu/chudler/java/redgreen.html>
3. Place the laptop on the edge of the bench so both edges are flush with one another.
4. Place an appropriate sized chair, in comparison to the bench size, in front of the laptop.  
(Participants elbow crease should nearly be in line with the edge of the bench)
5. Once seated, the participant should be able to loosely fit two closed fists in between them and the bench. (Fists sideways)
6. The participant places both hands on their lap. They will conduct the first round with their dominant hand, then repeat using their non-dominant.
7. When the traffic light changes colour, the participant responds by clicking the space bar. They then proceed to place their hand back on their lap.
8. Once the participant acknowledges they are ready, the observer initiates the trial by pressing any key.



9. The participant completes the 5 trials and the results are then recorded in the graph. The trials are then repeated using their non-dominant hand and recorded.
10. Ensure that the brightness of the screen is the same for the remaining participants and the experiments are conducted consecutively after one another. This is so the participants are tested at the same time of the day and no other lurking factors, such as tiredness etc, affect the results.
11. Steps 5-9 are then applied to the next participant and the experiment is conducted on them.

*FIGURE: 1*

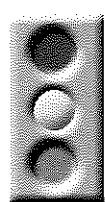

**RED LIGHT - GREEN LIGHT Reaction Time Test**

**Instructions:**

1. Click the large button on the right to begin.
2. Wait for the stoplight to turn green.
3. When the stoplight turns green, click the large button quickly!
4. Click the large button again to continue to the next test.

Instructions →

Visual stimulus →

Test Number	Reaction Time	The stoplight to watch.	The button to click.
1			
2			
3	→		
4			
5			
AVG.			
<div style="border: 1px solid black; display: inline-block; padding: 2px 10px;">Start Over</div>			

Times are recorded and averaged out →

Button to initiate test. Can be used to respond to visual stimulus and stop timer or alternate method is space bar. →

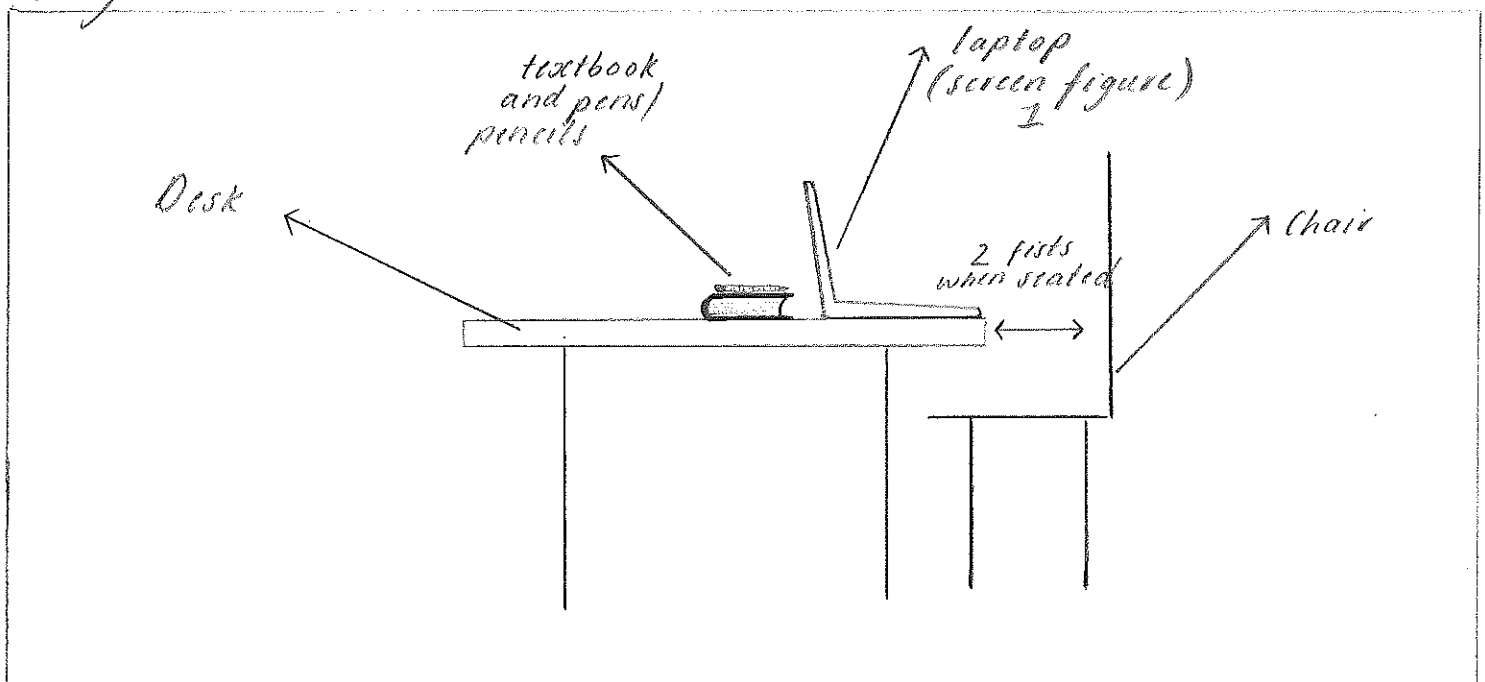
**Hints:**

- The stoplight may take up to seven seconds to change.
- You may press any key, instead of clicking on the button, if you prefer.
- You will be tested five times, and your average reaction time will be calculated.

The Online Reaction Time Test. © 2002 by Jim Allen. [getyourwebsitehere.com](http://getyourwebsitehere.com)

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*Diagram*





**Results** *Figure: 2*

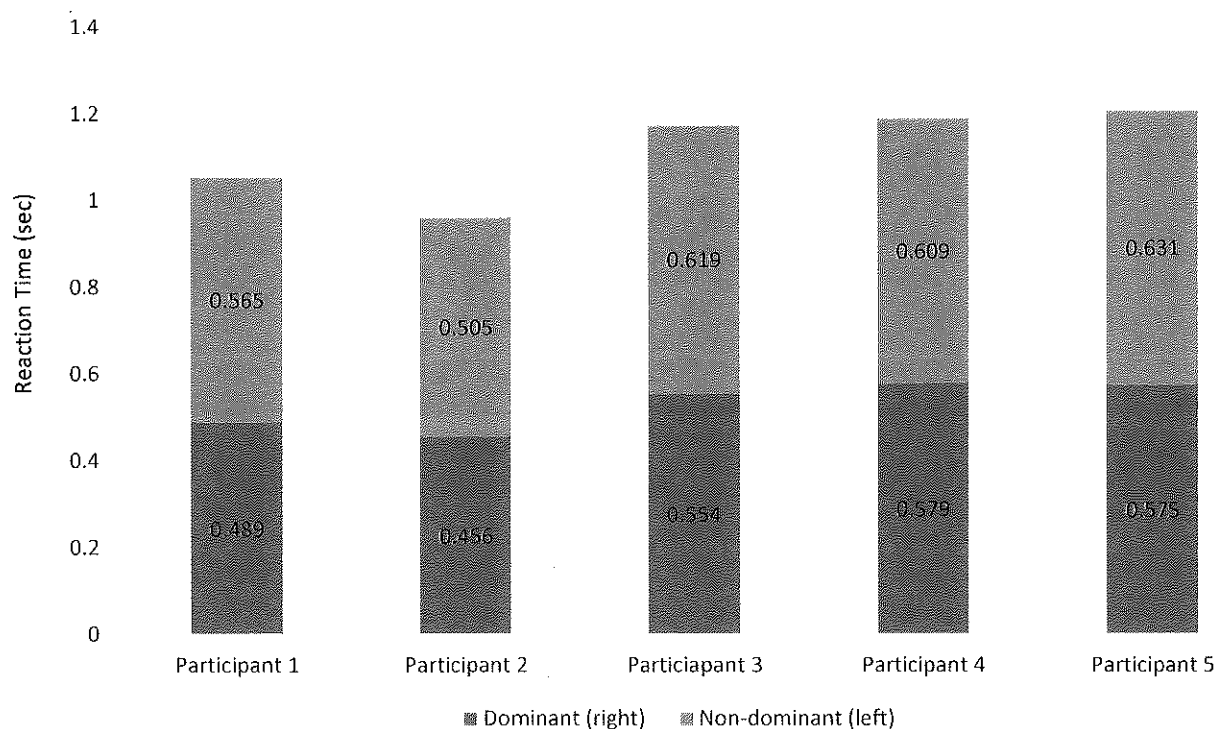
	REACTION TIME TO A VISUAL STIMULUS (sec)										
PARTICIPANT	DOMINANT (RIGHT)					NON-DOMINANT (LEFT)					AVG
PARTICIPANT 1	0.476	0.514	0.469	0.491	0.494	0.565	0.654	0.578	0.531	0.497	0.489
											0.565
PARTICIPANT 2	0.434	0.455	0.484	0.432	0.454	0.478	0.489	0.514	0.501	0.541	0.452
											0.505
PARTICIPANT 3	0.624	0.562	0.566	0.481	0.537	0.588	0.623	0.617	0.649	0.620	0.554
											0.619
PARTICIPANT 4	0.442	0.458	0.882	0.583	0.531	0.631	0.562	0.608	0.653	0.590	0.579
											0.609
PARTICIPANT 5	0.584	0.483	0.610	0.594	0.602	0.669	0.597	0.599	0.584	0.708	0.575
											0.631

*Figure: 3*

OVERALL AVERAGES	
DOMINANT (right)	0.530
NON-DOMINANT (left)	0.586

**Graph**

One's response time to a visual stimulus using their dominant and non-dominant hand



*Figure: 4*





After conducting the experiment; to determine if one's response time ~~varied~~ to a visual stimulus varied between their dominant (right) and non-dominant (left) hand, the results suggest that there is a correlation between using one's dominant hand and ~~was~~ a faster reaction time.

As shown in figure 3, the overall average time for both the individual trials and the five (5) participants as a whole, was 0.530 seconds. In comparison to the non-dominant hand, the response time was slightly slower at 0.586 seconds.

It can also be observed in figure 2, that all the individual participant averages for using their dominant hand were faster in responding to the visual stimulus.

In terms of inconsistencies, participant 4's third trial using their dominant (right) hand was recorded at 0.882 seconds. On a larger scale, this time doesn't seem to greatly differ from the rest of the values and isn't considered an outlier. However, as reaction times are relatively fast, when put into perspective with all the other response times, the significance of its high value can be comprehended. This ~~will~~ response time value not only alters the overall averages, but is slower than all the non-dominant hand times by all participants. This inconsistency can be addressed by conducting more trials.

1. The first part of the report deals with the general  
situation of the country and the progress of the  
work. It is a very interesting and valuable  
contribution to the knowledge of the country and  
the work. The second part of the report deals  
with the details of the work and the results  
of the investigations. It is a very detailed and  
thorough account of the work and the results.  
The third part of the report deals with the  
conclusions and recommendations. It is a very  
clear and concise summary of the work and the  
results. The fourth part of the report deals  
with the appendixes. It contains a list of the  
specimens collected and a list of the references.  
The fifth part of the report deals with the  
index. It is a very complete and accurate  
index of the report. The sixth part of the  
report deals with the plates. It contains a  
series of illustrations of the specimens collected.  
The seventh part of the report deals with the  
figures. It contains a series of diagrams and  
graphs illustrating the results of the  
investigations. The eighth part of the report  
deals with the tables. It contains a series of  
tables showing the results of the investigations.  
The ninth part of the report deals with the  
maps. It contains a series of maps showing the  
localities where the specimens were collected.  
The tenth part of the report deals with the  
photographs. It contains a series of photographs  
of the specimens collected. The eleventh part  
of the report deals with the drawings. It  
contains a series of drawings of the specimens  
collected. The twelfth part of the report  
deals with the text. It contains a series of  
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results. The thirteenth part of the report  
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the report deals with the figures. It contains a  
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the report deals with the maps. It contains a  
series of maps showing the localities where the  
specimens were collected. The eighteenth part  
of the report deals with the photographs. It  
contains a series of photographs of the  
specimens collected. The nineteenth part of  
the report deals with the drawings. It contains  
a series of drawings of the specimens collected.  
The twentieth part of the report deals with the  
text. It contains a series of pages of text  
describing the work and the results.

In terms of accuracy, the result times that were accumulated in the experiment were obtained by the clicking of the space bar. As the times were generated by the experiment itself, the results times are precise and accurate as they were not recorded by a third party. Therefore, as a whole, the experiment can be classified as accurate, however, more trials can always improve on this.

The results are relatively valid as the experiment tested what it was supposed to; to determine if one's response time to a visual stimulus varied between their dominant (right) and non-dominant (left) hand. The results related to the independent and dependent variables and provided results which addressed the aim. However, the experiment cannot be classified as completely valid as ~~the~~ the investigation was conducted on humans. When conducting investigations on humans, there are uncontrolled variables that can impact the results, such as the diverse variation of genetic make-up or simply individual focus.

The results are considered reliable as the measuring method, as stated above, ~~was~~ <sup>was</sup> not faulty and consistent throughout the whole investigation. ~~There~~ To improve the reliability of the experiment repetition and ~~the~~ replication could be conducted to accumulated a larger ~~a~~ quantity of results and identify stronger patterns.

1. The first part of the document discusses the importance of maintaining accurate records. It emphasizes that proper record-keeping is essential for ensuring the integrity and reliability of the data collected. This section also outlines the various methods used to collect and analyze the data, highlighting the challenges faced during the process.

2. The second part of the document focuses on the results of the study. It presents a detailed analysis of the data collected, showing the trends and patterns observed. The results indicate that there is a significant correlation between the variables studied, which supports the hypothesis of the research.

3. The third part of the document discusses the implications of the findings. It suggests that the results have important implications for the field of study, and that further research is needed to explore the underlying mechanisms. The document also provides recommendations for future studies and for the application of the findings in practice.

4. The fourth part of the document provides a summary of the key findings and conclusions. It reiterates the importance of accurate record-keeping and the significance of the results. The document also includes a list of references to the sources used in the study, and a list of figures and tables that are included in the document.

5. The fifth part of the document is a conclusion. It summarizes the main points of the document and provides a final statement on the importance of the research. The document also includes a list of references to the sources used in the study, and a list of figures and tables that are included in the document.

6. The sixth part of the document is a list of references. It includes a list of the sources used in the study, including books, articles, and websites. The references are listed in alphabetical order, and each entry includes the author's name, the title of the work, and the publisher or source.

7. The seventh part of the document is a list of figures and tables. It includes a list of the figures and tables included in the document, and a brief description of each. The figures and tables are listed in alphabetical order, and each entry includes the figure or table number, the title, and a brief description.

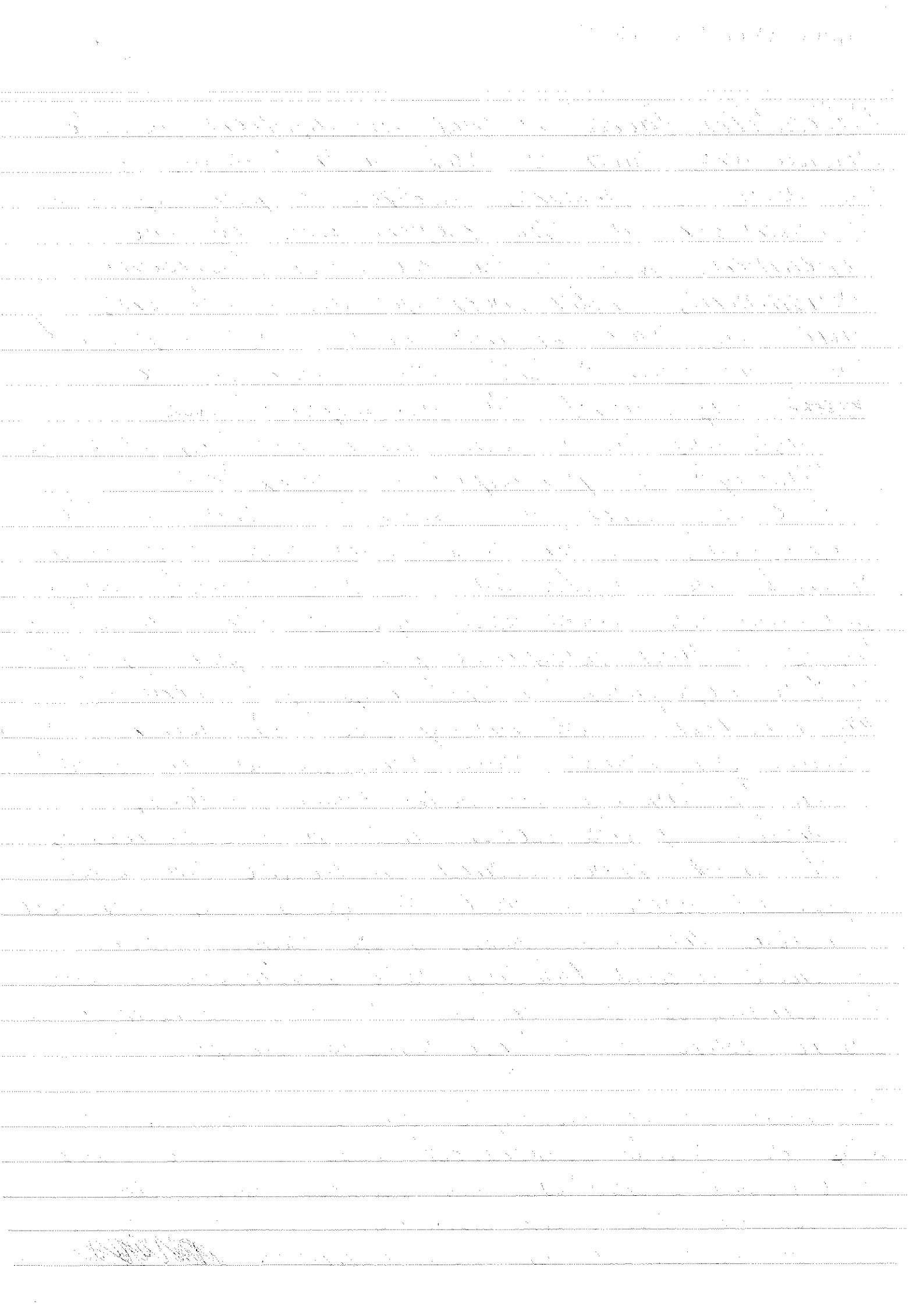
8. The eighth part of the document is a list of figures and tables. It includes a list of the figures and tables included in the document, and a brief description of each. The figures and tables are listed in alphabetical order, and each entry includes the figure or table number, the title, and a brief description.

9. The ninth part of the document is a list of figures and tables. It includes a list of the figures and tables included in the document, and a brief description of each. The figures and tables are listed in alphabetical order, and each entry includes the figure or table number, the title, and a brief description.

10. The tenth part of the document is a list of figures and tables. It includes a list of the figures and tables included in the document, and a brief description of each. The figures and tables are listed in alphabetical order, and each entry includes the figure or table number, the title, and a brief description.

Difficulties faced in this investigation include distractions, such as back-ground noise, and the issue in finding adequate participants to volunteer in the experiment. As the experiment was conducted in a classroom environment, under investigation conditions, there was back-ground noise that impaired the participants' full concentration on the ~~experiment~~ experiment. The participant was competing with visual and auditory stimuli. Although all participants attempted to block out cues that weren't relevant to the experiment, further trials can suggest if this altered the results. On the other-hand, whilst planning this investigation, a problem arised in trying to find adequate people to participate in the experiment whilst keeping it ethical. We resulted in obtaining five (5), however, with future ambitions, more participants are hoped for. To improve on both these factors, conducting the experiment in a classroom, at break-time, would eradicate the back-ground noise, without changing any controlled variable, and consequently ~~pi~~ suggest more accurate results. Finding more participants can be arranged earlier on in the investigation to ensure there is a large sample group.

In terms of a scientific explanation, as to why the results suggested one's response time to a visual stimulus, was quicker when the participant used their dominant (right) hand, can be explained by their neurons. ~~neurons~~



In this experiment, the participants were dominant in their right hand, therefore, their neurons are able to carry messages faster from the brain to the hand as they ~~are~~ can transmit electro-chemical signals at a faster rate. When the visual stimulus, being the traffic light, ~~the~~ initiates the visual cortex to stimulate the sensory (afferent) neurons in the eye, a flow of action potentials occur. This is because a threshold ( $-55\text{mV}$ ) has been exceeded. The sensory neurons then carry the message to the associated or interneurons in the spinal cord, to signal the motor (efferent) neurons. At the neuromuscular junction, between the motor neuron and muscle, the neurotransmitter acetylcholine is released and stimulates the movement of the muscles to respond to the visual stimulus. As the participants right hand is their dominant, the neurons have communicated along that pathway repeatedly and has become familiar. Through this continuous process the participants have increased their motor skills and muscle memory in ~~the right~~ their right arm and hand, which consequently enabled a faster reaction time in comparison to their non-dominant left hand.

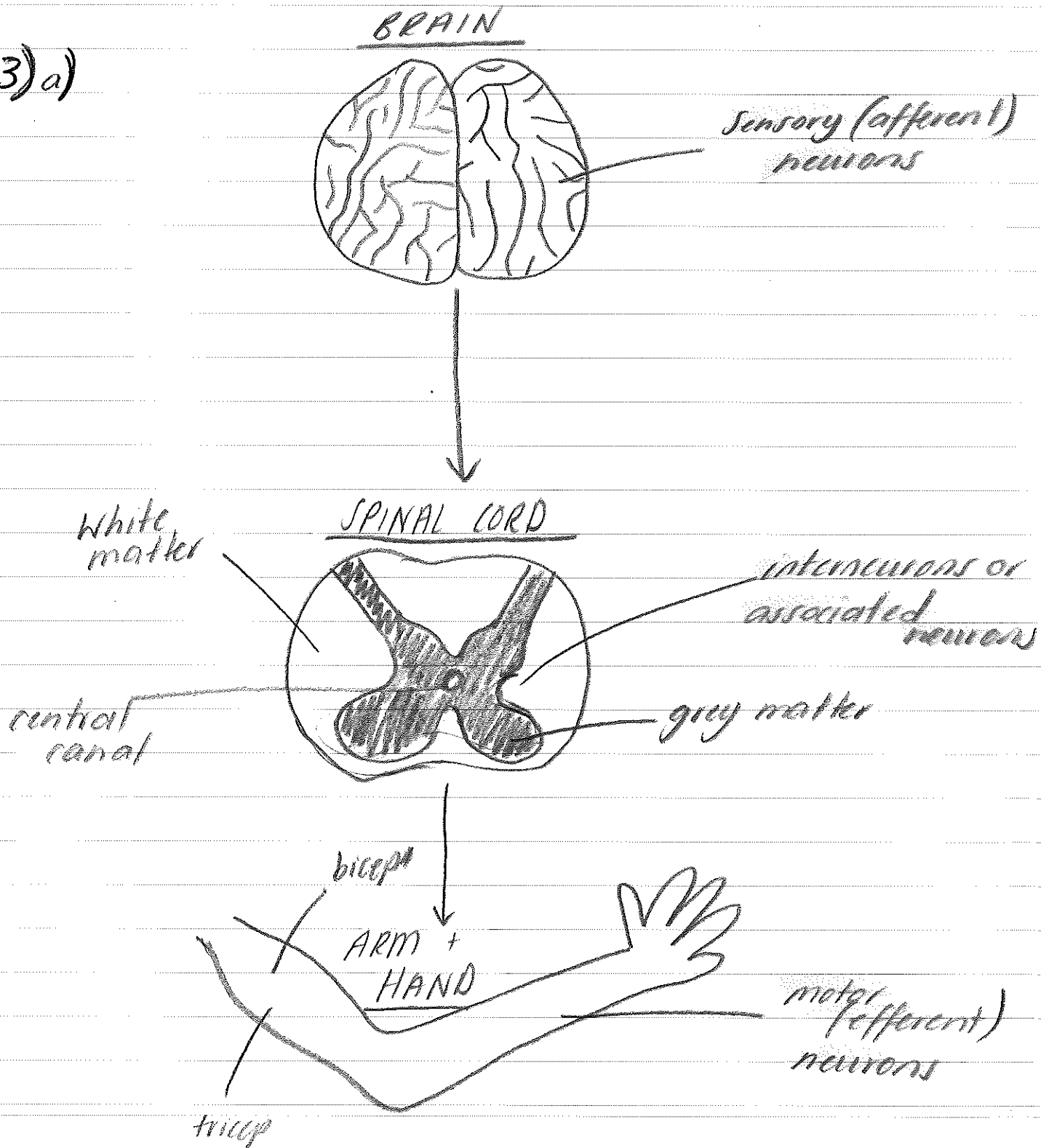
In conclusion, the hypothesis; 'When a dominant right hand is used, one's nervous system will stimulate their skeletal muscles to respond to the visual stimulus at a faster rate, in relation to their non-dominant left hand,' was supported.





The results suggested a correlation between a faster response time, when using their dominant right hand.

3) a)



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b)

Sensory neurons  
carry messages to  
the interneurons  
in the  
spinal cord

Interneurons  
synthesize message  
with the motor  
neurons

\* The brain is bypassed

A sensory stimulus  
is detected. Threshold,  
-55mV is over-come.  
(All-or-none response)  
\* Action potential

the motor (efferent)  
neurons act upon the  
stimulus and  
stimulate a muscles  
to contract and  
regard what was causing  
the stimulus.

The stimulus  
is inhibited and  
the membrane  
returns to its resting  
state.

c) in a response, the message is processed in the brain, the sensory neurons stimulate the interneurons in the spinal cord to carry the message to the brain. The brain then processes the message and it is then carried back down the interneurons where the motor neurons are signalled to act. Therefore, juxtaposed next to a reflex arc, when the sensory neurons pass the message to the interneurons in the spinal cord, the motor neurons are immediately activated and the response is performed.

