

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

## Nervous System Investigation

Name: Anri van Niekerk

Investigation: \_\_\_\_\_

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	4
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 how response times are affected by whether the stimulus is visual or auditory

## VARIABLES

- Independent Variable:

Type of stimulus - visual stimulus  
- auditory stimulus

- Dependent Variable:

Response time - how long it takes after a stimulus for the test subject to click a computer mouse

- Controlled Variables:

- type of visual stimulus - colour change
- type of auditory stimulus - quick beep
- computer mouse (therefore same resistance)
- environment in which tests were completed (therefore same level of noise and distraction)
- test subject age - 17 years
- test subject sex - female
- test subject dominant hand - right
- test subject capabilities - no hearing or visual impairments

PREDICTION

Subjects will respond to auditory stimuli faster than they will to visual stimuli. This is because the nerve pathway from photoreceptors in the retina to the primary visual cortex (visual stimulus nerve pathway) is longer and more complex than the auditory stimulus nerve pathway, from the cochlea to the auditory cortex.

HYPOTHESIS

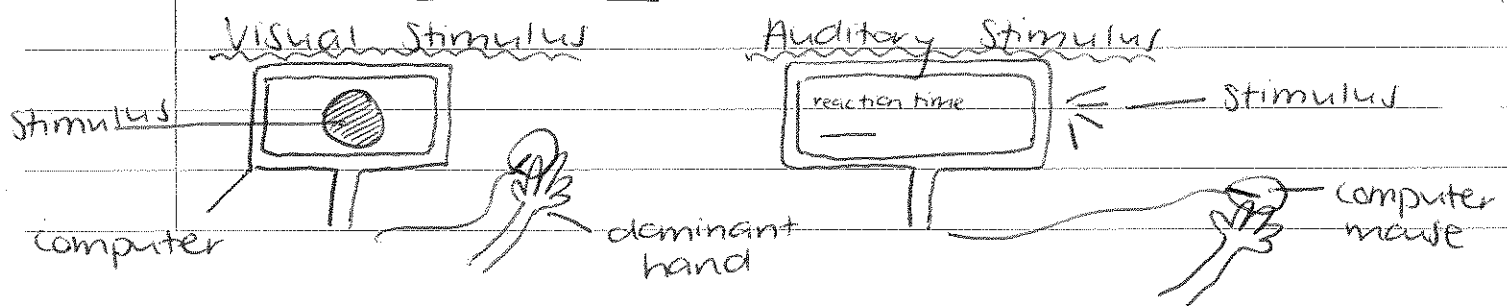
Auditory stimuli will produce a faster response time than visual stimuli.

EQUIPMENT

- <http://cognitivefun.net/>  
(visual and auditory online stimulus and reaction timer)

- computer
- computer mouse
- test subjects → right hand dominant  
→ 17 years of age  
→ female

\* variables kept the same ~~just~~ to just see effect of type of stimulus not other factors.

METHOD DIAGRAM

METHOD

1. Select five participants who will act as the test subjects — ensure they are of the same age, gender, and dominant hand
2. go to [cognitivefun.net](http://cognitivefun.net) on a computer and access the visual test
3. in the visual test, participants click on the computer mouse when the green dot appears on the screen
  - each of the five participants gets three attempts or trials
4. go to [cognitivefun.net](http://cognitivefun.net) on the computer and access the auditory test
5. in the auditory test, participants click the computer mouse when a sound (beep/buzz) is heard
  - each of the five participants gets three trials or attempts

PRACTICAL APPLICATION

- This experiment does not have any safety issues therefore no safety equipment must be worn
- Attempt to find an environment free of distractions
- Ensure the participants don't have visual or auditory impairments, or disorders (eg. epilepsy) which could be aggravated by the experiment's noise and light
- Repeat trials and average them to minimise the effect of outliers — do not include results that are outliers caused by obvious distractions

RESULTS

Table of Results: The effect of stimulus type (auditory or visual) on response time.

TYPE OF STIMULUS	RESPONSE TIME (milliseconds)				Test Subject
	Trial 1	Trial 2	Trial 3		
Visual Stimulus	307.064	242.706	237.027		1
	258.524	292.760	275.084		2
	234.124	228.144	303.211		3
	271.721	287.007	312.686		4
	311.376	352.091	379.199		5
	276.562	280.542	301.441		Average
Auditory Stimulus	243.669	216.226	294.325		1
	299.606	270.069	307.471		2
	201.147	289.065	181.360		3
	296.940	302.091	284.216		4
	200.855	220.956	221.753		5
	248.443	259.681	257.825		Average

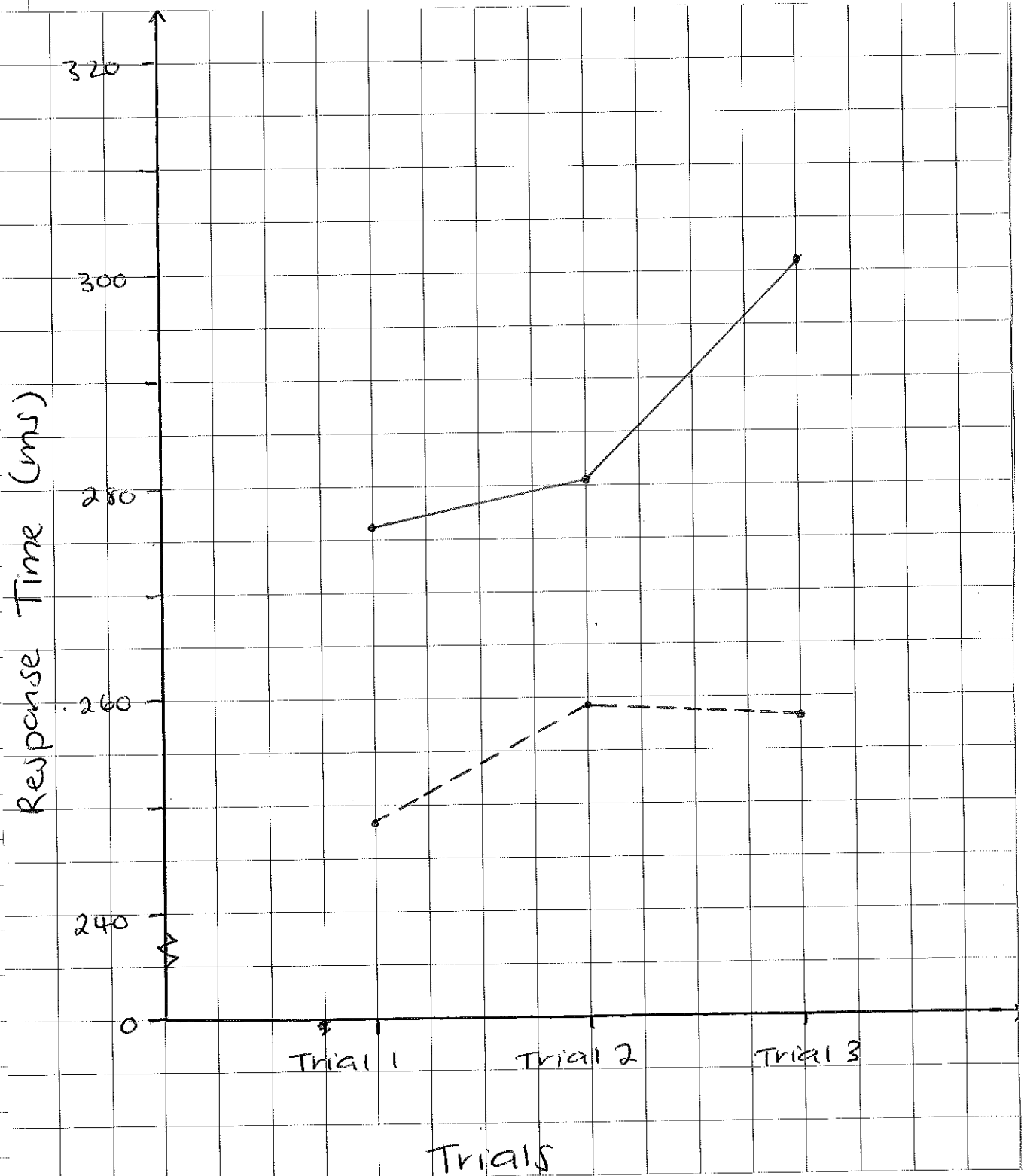
GRAPHING

The difference in response times to visual and auditory stimuli

KEY

— Visual Stimulus

- - Auditory Stimulus



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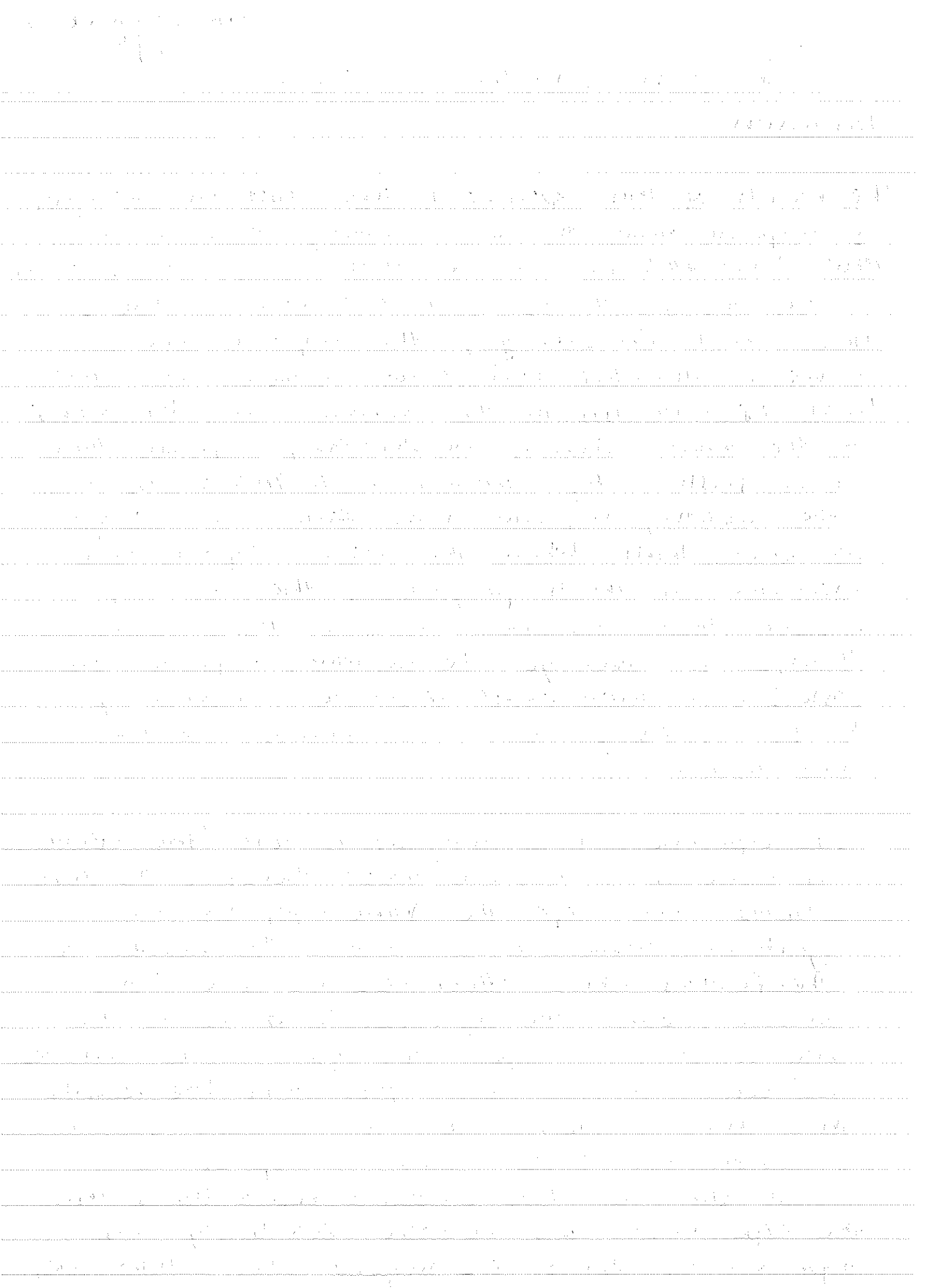


## In Class Validation: Task 2

Discussion

The results of this experiment show that on average, the response time to an auditory stimulus was ~~248.443~~ 248.443 ms in the first trial, 259.681 ms in the second trial, and 257.825 for the third trial. On average, the response time for a visual stimulus was 276.562ms in the first trial, 280.542 ms in the second and 301.441ms in the third. Overall, the auditory response time was faster by around 30 milliseconds, and the auditory response was faster on average for each trial. Where the visual response time increased as trials progressed, the auditory response time decreased in the third trial. Although on average the auditory response was faster, each individual responded differently to the auditory and visual stimuli over the three trials.

The experiment was designed to test "the effect of stimulus on response time" therefore the test subjects were kept the same age, sex and righthand dominant to reduce the number of other factors which affect response time. This however means the experiment's results are only valid for 17 year old right handed females, not valid for the entire population. The results show that a response to an auditory stimulus is consistently faster than a response to a visual stimulus. This constant result shows that the experiment was reliable. Reliability was improved by testing five subjects rather than one,



and doing three trials with each which was then averaged ~~to~~ to reduce the effect of outliers on the results. Due to the experiment being done on a computer which calculated the response time immediately, ~~the~~ the true response time of the person was accurate as a second person with a stop watch didn't add their reaction time to the result. The experiment was however done in a classroom with many distractions, therefore the simple reaction time became a selection or choice ~~response~~ response, so each response time calculated isn't the true time taken for a simple response.

Due to the experiment being conducted in a classroom, there ~~were~~ were distractions which made the simple response time a choice or recognition response time. To improve the experiment and its accuracy, each test subject should do the visual and auditory response time tests in a separate free of distractions. More trials could improve the accuracy and reliability of the experiment. To improve validity, the experiment must be conducted on more ~~the~~ subjects who vary in gender, age, right or left hand dominant, ambidextrous people,

sedentary or active lifestyles; the testing of response by people with hearing disabilities to a visual stimulus or ~~the~~ people with ~~seeing~~ sight issues to auditory stimuli could be done to compare and to see if they ~~are~~ respond faster or slower than average. Also, to expand on this experiment which was a simple response time, choice and selection response

1.1

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tasks should also be completed.

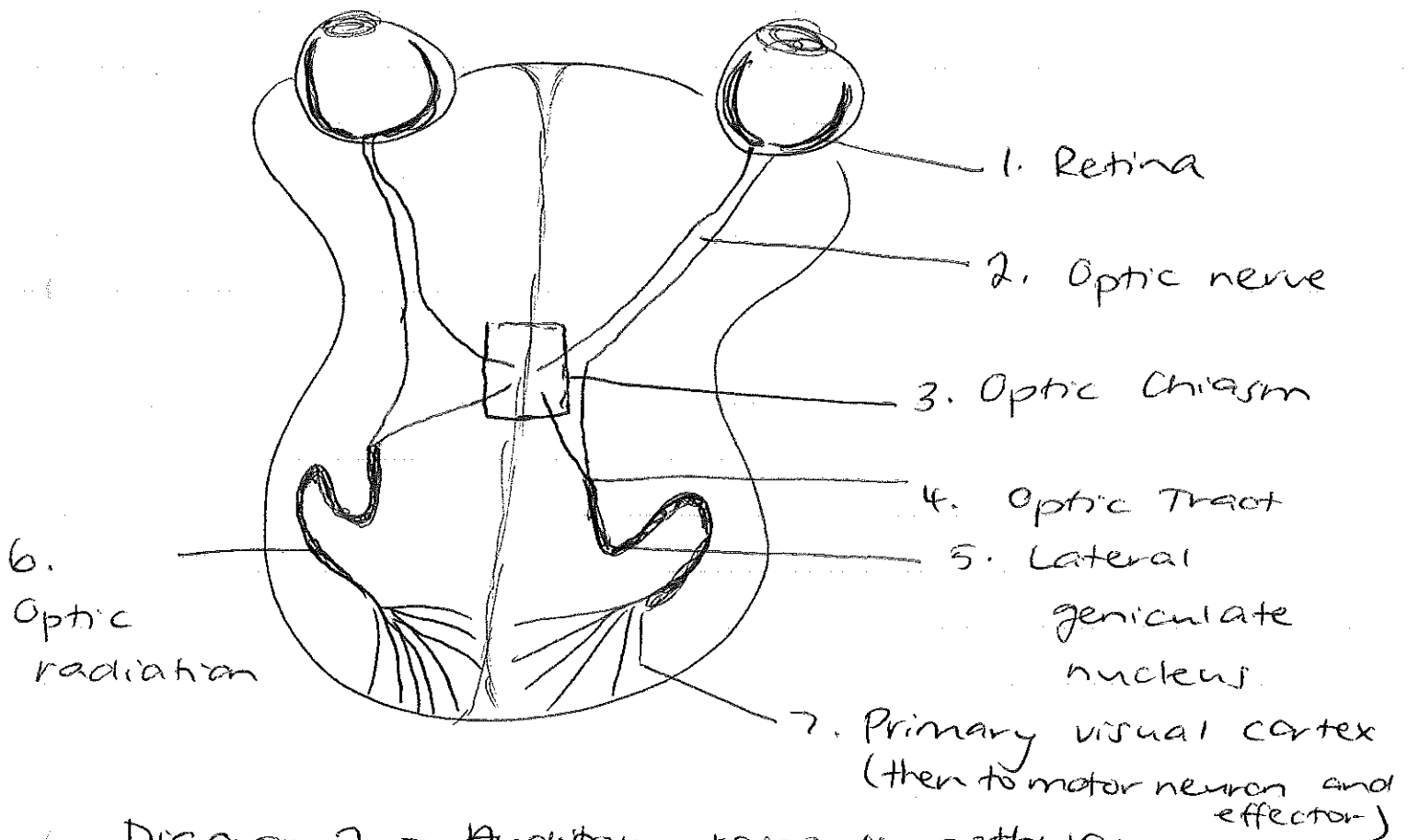
The experiment's results show that for a simple response ~~these~~ time, people respond faster to auditory stimuli than to visual stimuli. Uncontrolled variables such as the distractions made the experiment more of a choice or recognition response task, and as Hick's Law states: as the number of stimuli increase, so does the time taken to respond. Auditory and visual response times differ due to the arrival of the stimulus at the sensory organ, the reception of the stimulus, the transmission and processing of the information and muscular activation.

Worldwide, the average time taken to respond to a simple ~~response stimulus~~ auditory stimulus is 100 milliseconds faster than to a simple visual stimulus. This is due to an auditory stimulus ~~taking 2-20ms to be~~ causing a nerve impulse from the sensory organ of the ear in the ear to the auditory cortex in the temporal lobe within 8-10 ms. This is much faster than the nerve impulse created by a visual stimulus from the photoreceptors in the retina to the primary visual cortex in the occipital lobe of the brain, which takes 20-40 ms. These times differ ~~due to~~ due to a number of factors: the visual response ~~path~~ pathway is longer than the auditory pathway, and the auditory pathway is mainly myelinated fibres which ~~through~~ produces a faster nerve transmission than ~~many~~ unmyelinated fibres ~~an~~ or synapses. Refer to diagram 1 for the visual

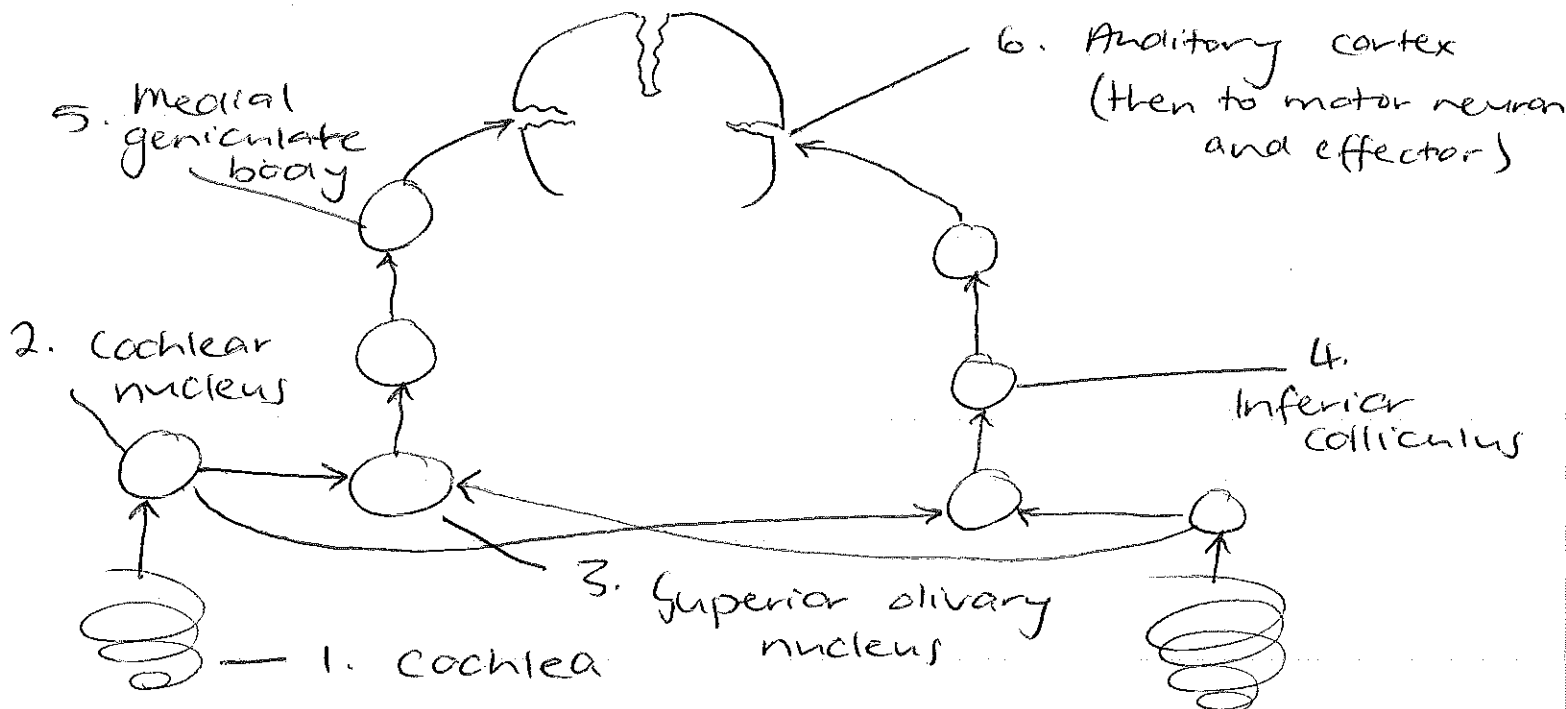


pathway and to diagram 2 for the auditory pathway.

### Diagram 1 - Visual response pathway



### Diagram 2 - Auditory response pathway



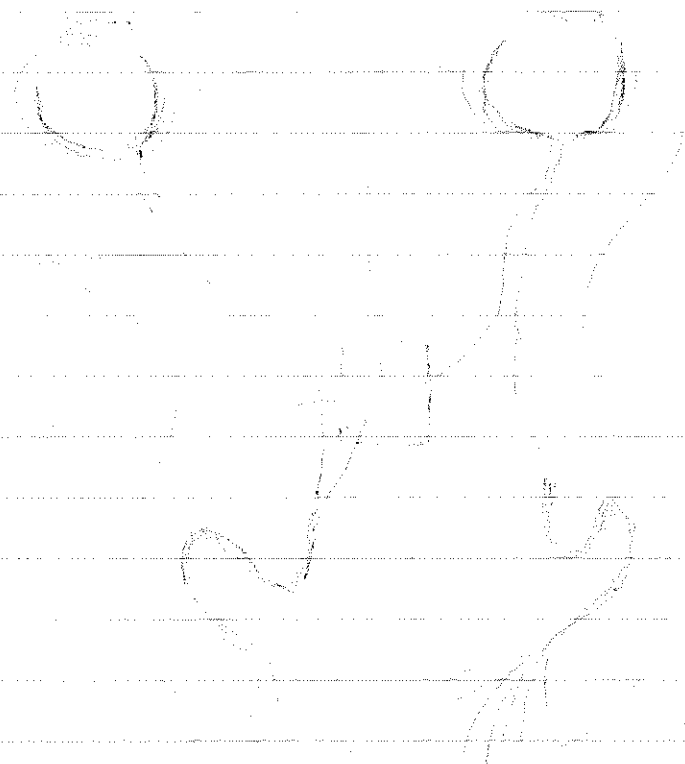
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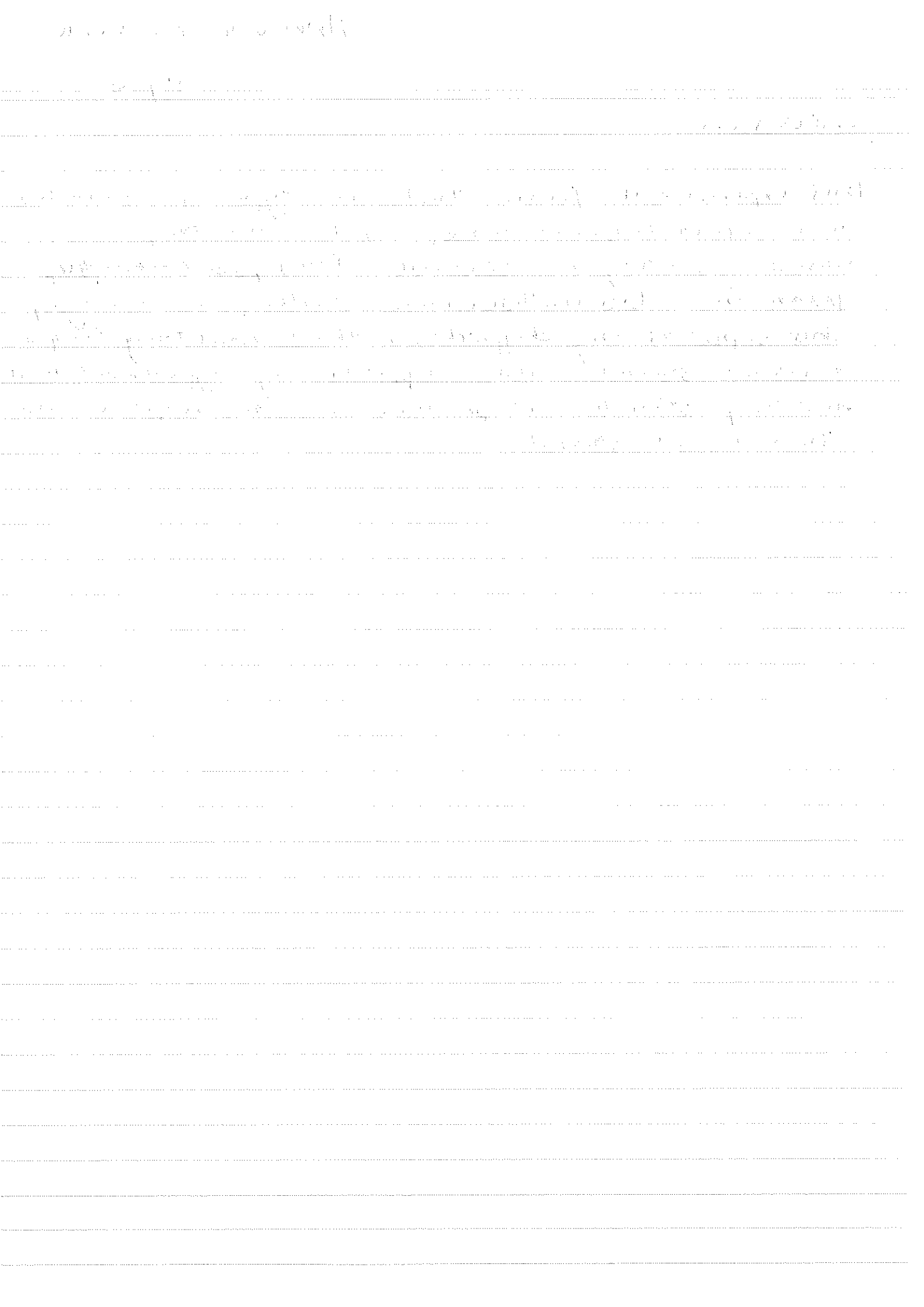
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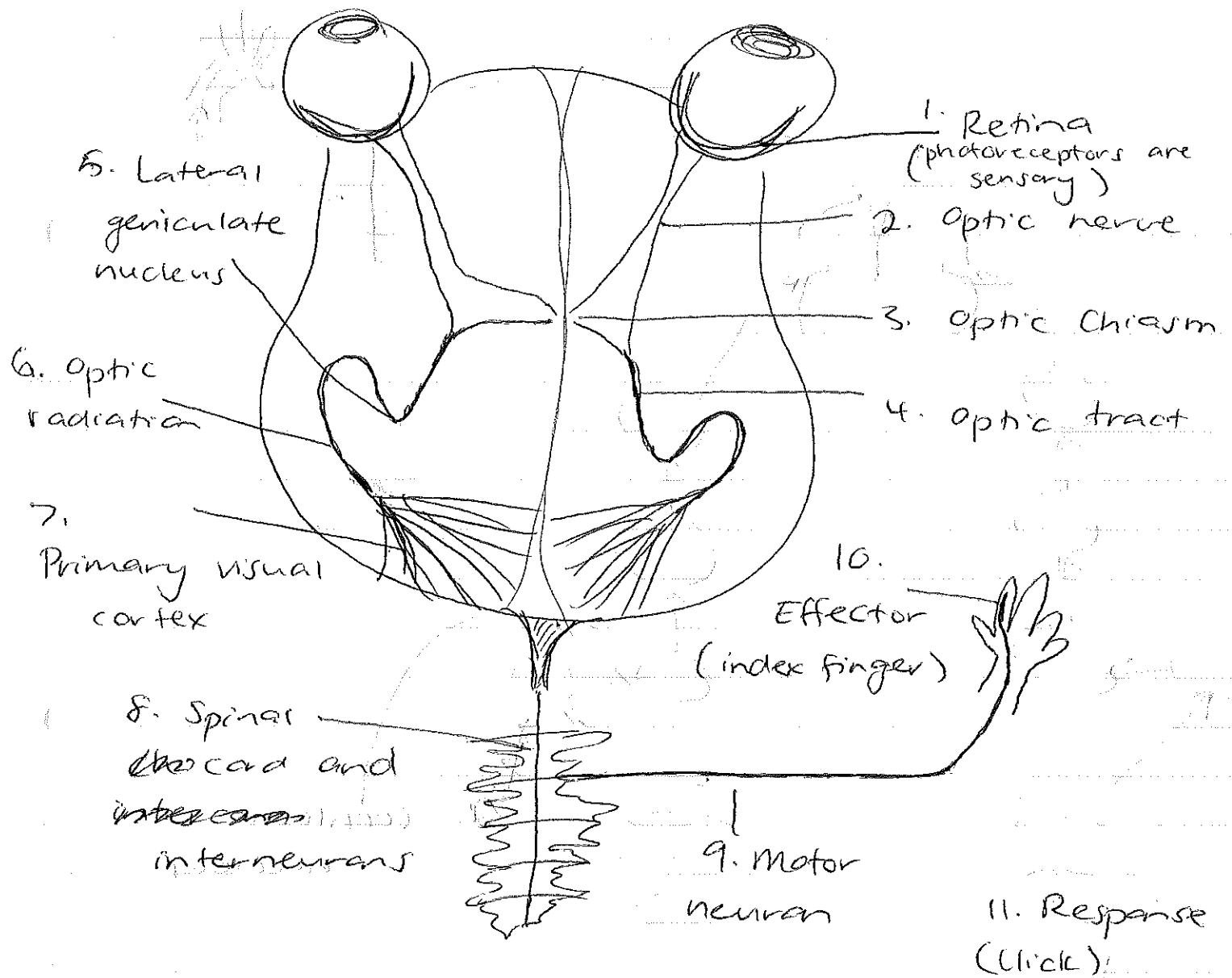
Conclusion

This experiment found that the type of stimulus does affect response time, with auditory stimuli resulting in response times ~~on average~~ from 30 - 60 milliseconds faster, on average, ~~this supports my hypothesis that auditory~~ compared to visual stimuli. This supports my hypothesis that auditory stimuli will produce a faster response time than visual stimuli.

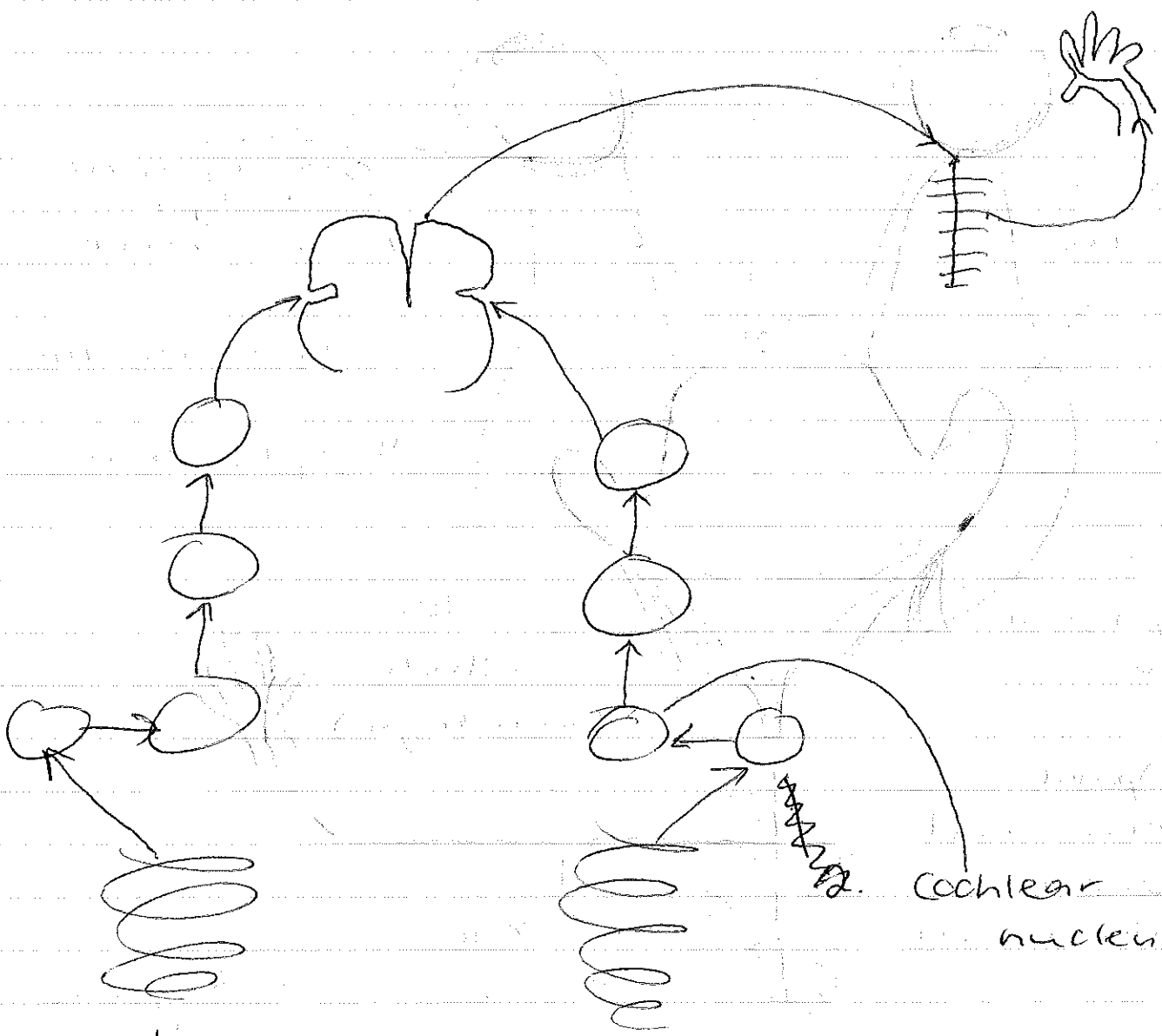


In class Validation : Task 2

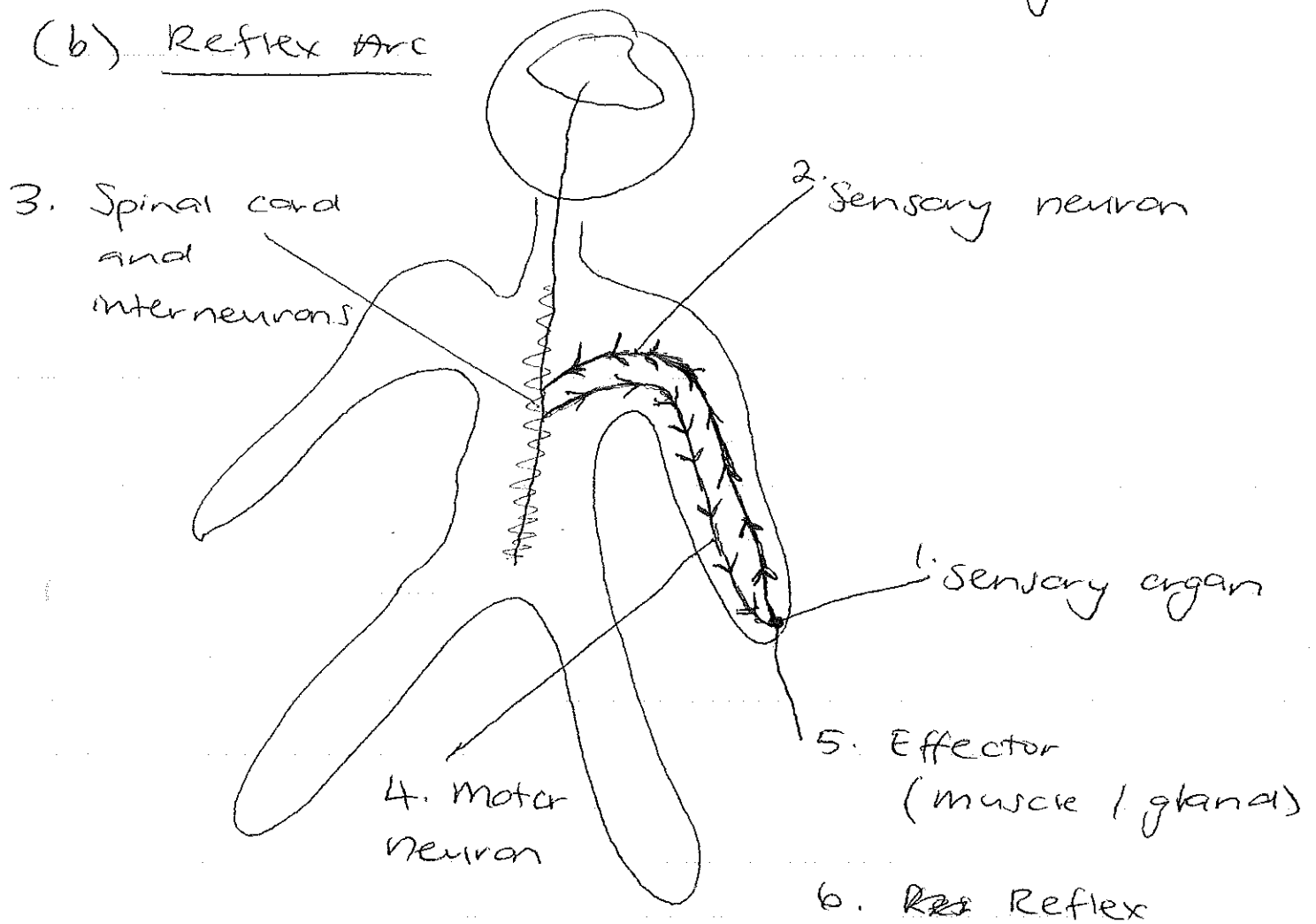
3. (a) Visual pathway



(a) Anatomy Pathway



1. Cochlea (sensory)

(b) Reflex Arc

## (c) My Experiment (Response Time)

## Reflex Arc

Time

- 250-300 ms
- slower
- time taken to process

- faster
- instinctual
- 

Pathway

- sensory organ to visual / auditory cortex in brain
- spinal cord
- motor neuron and effector

- from sensory organ to sensory neuron to interneuron in spinal cord to motor neuron and back to sensory organ (now effector)
- bypass brain - no processing until after reflex.

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