

## Candidate 1 evidence

The Impact of Sleep Deprivation on Reaction Rate

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2705

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### Introduction

The restoration theory was devised by Oswald. This theory stated that the function of sleep was to restore the mind and body. The brain did this by removing waste products, performing protein synthesis and raising the production of growth hormone. The removal of waste products was also done during sleep because the brain was overloaded with information while people were awake, leading to the brain not having sufficient energy or time to get rid of waste in the brain. But, when we are asleep, our body temperature decreases thus less calories are burned. This resulted in excess energy for the cleansing process.

It was important to sleep because it increased attention and concentration which were necessary for majority of learning. The more information that emerged about sleep, the more evidence that suggested that sleep improved majority of cognitive functions. Insufficient sleep negatively impacted cognitive functions because the brain had trouble working efficiently on little sleep because the <sup>brain</sup>neurons became overloaded. The short-term side effects of sleep deprivation varied from excessive sleepiness to a poor attention span. It has been found that insufficient sleep could cause a person to behave drunk, which leads to reduced cognitive functions: thinking and reaction rate. One factor that affected cognitive functions in relation to sleep was sleep disorders. For example, obstructive sleep apnea, this negatively affected an individuals' cognitive performance in tasks like attention, thinking, memory, and communication. Studies have shown that adults and women were found to respond better to the effects of insufficient sleep. The reason why women coped better with sleep deprivation has yet to be determined. However, for adults it was thought that teenagers struggled with sleep deprivation more than adults due to the constant development of their brains.

A factor that could have affected the effects of sleep deprivation was caffeine. Throughout the day adenosine was released, building up as the day went on and caused people to feel tired. Caffeine prevents this process and would cause a person to be alert even if they were sleep deprived. Caffeine was renowned for improving cognitive function in sleep deprived individuals, for example, their memory and attention. If consumed caffeine later on in the day, these effects could persist into the night and disrupt sleep.

M. Taheri and E. Arabameri (2012), aimed to establish the impact of a single night of sleep deprivation on reaction time the following morning. This experiment used eighteen male college athletes. The participants were studied two times in a randomised design. Their reaction time were measured. It was found that there was a notable difference in reaction time. The researchers concluded that short-term sleep deprivation had no impact on anaerobic performance but negatively impacted reaction time.

There were multiple studies that researched variations of the Stroop task in the context of acute sleep deprivation. However, the results rarely distinguished between the overall impact of sleep deprivation on performance and its specific effects on interference in the Stroop task. S. Cain et al. (2011), aimed to study the effect of sleep deprivation on the Stroop task. The sample was thirty healthy participants—nineteen men and eleven women—who were examined over a period of 21 days in the Intensive Physiological Monitoring Unit of the Center for Clinical investigation at the Brigham and Women's Hospital. The participants were observed over a 40-hour period in which they stayed awake under constant conditions and completed a Stroop colour-naming task every two hours. It was discovered that the more sleep deprived participants were, the worse their performance on the Stroop task. The researchers concluded that a single night of sleep deprivation slowed down the reaction time in the Stroop task, however, it had no effect on the underlying processes of interference or facilitation.

#### Aim

The aim of this study was to determine the relationship between hours of sleep and reaction rate.

#### Hypothesis

The hypothesis was that as the hours of sleep decrease, the reaction rate will increase.

## Method

### Design

This experiment was a laboratory experiment because it allowed the researcher to control extraneous variables. For example, during the reaction rate test, participants had to concentrate. If the experiment had been conducted in a noisy corridor, external noise could have distracted the participant and delayed their reaction time. However, since the reaction rate tests were conducted in a quiet classroom, participants were not at risk of distraction.

### Variables

An independent measures design was used for this experiment since different participants were assigned to each condition: Condition A and Condition B. In Condition A, the participants were sleep deprived, having under 7 hours of sleep the night before. In Condition B, the participants had sufficient sleep, with 7 or more hours the night before.

The independent variable in this study was total hours of sleep the participant had the night before. The dependent variable was the how quick the participants had caught the ruler. An extraneous variable the researcher controlled was maintaining the same time of day the reaction rate test was conducted, as levels of sleepiness and alertness vary throughout the day.

### Participants

The sampling method used was opportunity sampling. All participants in this experiment were between the ages of 16 years old and 17 years old. There were 12 participants, 5 participants in condition A and 7 participants in condition B. In condition A, 1 male participant, and 4 female participants. In condition B, 2 male participants, and 5 female participants. All participants were from Edinburgh, Scotland.

### Materials

- Ruler
- Information sheet (see appendix A)
- Consent form (see appendix B)
- Debrief sheet (see appendix C)
- Digital results table (see appendix D)
- Pen

### Procedure

Participants were taken individually into a silent room and thanked for their participation. They were then provided with an information sheet and consent form. The consent form ensured that they were comfortable participating and confirmed that they were over the age of 16 years old. The researcher left the room while the participant was reading over and signing the information sheet and consent form. This was so the participant didn't feel pressured to participate. Once completed, the researcher re-entered and checked to see if they consented. If they consented the experiment proceeded. If they didn't give consent, they were thanked for their time and allowed to leave. If the experiment proceeded, the researcher asked them how many hours of sleep they had the night before. Depending on their response, they were then categorised as either sleep deprived or having sufficient sleep in a digital results table. The researcher then held a ruler up and on a count from 3 to 1 the researcher dropped the ruler. The participant had to catch the ruler as fast as possible. This test was repeated three times, with the length at which the ruler was caught in centimetres recorded into digital results table. At the end of the experiment, the participants were asked again if they were happy with their results being used. They were then given a debrief sheet and asked again if they were happy with their results being averaged and published. If they said yes, they were thanked and reminded if they changed their mind to contact the psychology department. If they said no their results were discarded and they were thanked for coming. At multiple points in the experiment, participants were given the opportunity to withdraw; when they first entered the room, after they read the information and consent sheet, after completing the reaction rate test, and after reading the debrief sheet. The final opportunity was when they were leaving, they were reminded if they wished to withdraw their data, they could contact the psychology department.

### Ethics

An ethical guideline that was considered was protection from harm. The reaction time test was conducted individually so participants were unaware of others' results. This protected them from feelings of embarrassment, as they had no other results to compare to their own.

Another ethical guideline that was followed was the participants' privacy, participants' identities were kept anonymous at all times during the experiment. To protect the participants' personal information, their data was coded using numbers in place of their names. For example, 'participant 10'. Only the consent and debrief sheets had their

signature. This was kept securely on the researcher's person in an opaque folder kept away from the reach of others.

The right to withdraw was another ethical guideline that was taken into consideration by the researcher. At multiple points in the experiment, participants were given the opportunity to withdraw. If they decided against being a part of the study the researcher thanked them for coming, allowed them to leave and disposed of their results. If they complied with being a part of the study their data was used and were thanked when the experiment was over.

Informed consent was an ethical guideline followed by the researcher. At the start of the experiment, they were provided an information sheet. This sheet described the reaction rate test, the reaction rate test was a ruler being dropped and the participant had to catch it as fast as possible. The sheet stated this was going to be repeated three times and their results were calculated into an average that was going to be published. Also, throughout the experiment the researcher asked if they had any questions. When they finished reading the information and consent form, after the reaction rate test and finally after they read the debrief sheet. The participants were reminded at the end of the experiment to contact the psychology department if they had any more questions.

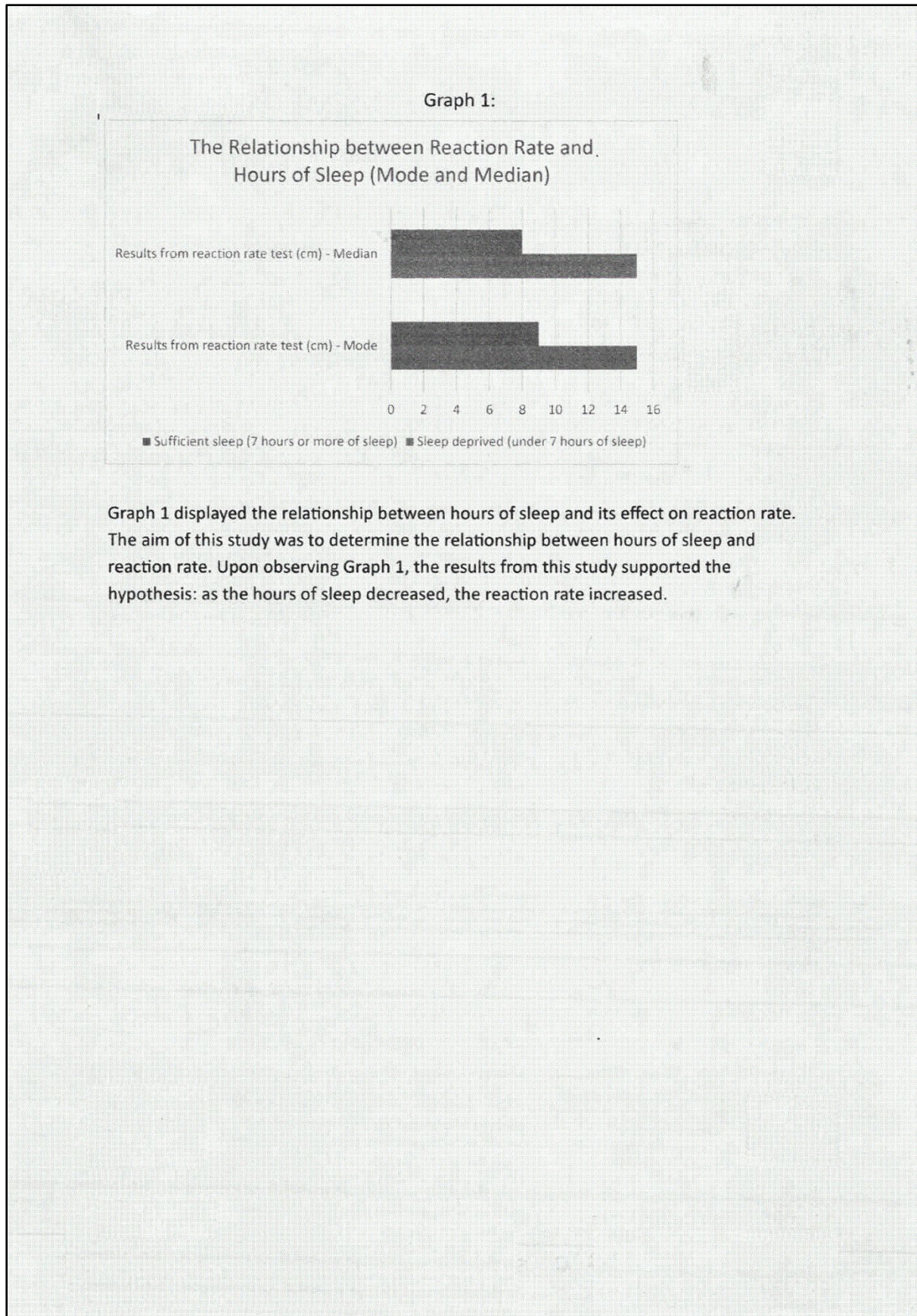
### Results

The statistics the researcher decided were most appropriate for this experiment was the mode and mean. The mode represents the number that occurred most often in a data sets. The mode was appropriate as some of the results from the reaction rate test were the same in their respective sets of data. For example, in the sufficient sleep group, '10cm' appeared multiple times. A downside of using the mode was that it was not representative of the full data set. To resolve this, the researcher also calculated the mean. The mean was calculated by adding all the numbers in a set of data together then dividing by the total number of values. The mean took into account all of the numbers present in a data set, but it could have been affected by large or small values. However, since the data were very close in number—for example, '10cm' and '9cm'—this did not affect the validity of the mean.

Table 1:

The Relationship between Reaction Rate and Hours of Sleep (Mean and Mode)

	Mode (cm)	Median (cm)
Sufficient Sleep (7 hours or over)	9	8
Sleep Deprived (under 7 hours)	15	15



Graph 1 displayed the relationship between hours of sleep and its effect on reaction rate. The aim of this study was to determine the relationship between hours of sleep and reaction rate. Upon observing Graph 1, the results from this study supported the hypothesis: as the hours of sleep decreased, the reaction rate increased.

## Discussion

### Analysis

The aim of this study was to determine the relationship between hours of sleep and reaction rate. The results supported the hypothesis, as hours of sleep decreased, the reaction rate increased. The statistics showed that the average reaction rate for the sufficient sleep group was 8cm and the average reaction rate for the sleep deprived group was 15cm. The fewer hours of sleep the participants had, the higher their reaction rate was.

An extraneous variable that could have impacted the results was the participants' caffeine intake. During the day, adenosine is released in our brain's neurons. This chemical is what causes us to feel fatigued, however, caffeine prevents this process. Thus, someone if who was sleep deprived that consumes caffeine they would still be alert. This meant participants in the sleep deprived group who consumed caffeine would have had a faster reaction rate, negatively impacting the validity of the results. However, the researcher did not control the participants' caffeine intake, as it would have breached protection from harm. If the researcher required the participants to consume caffeine it could have negatively impacted their mental and physical state.

Another extraneous variable that could have impacted the results was whether the participants had a sleeping disorder. Specifically, obstructive sleep apnea (OSA), a disorder linked to daytime sleepiness and cognitive problems such as attention. If a participant in the sufficient sleep group had OSA, they would have struggled with paying attention to catching the ruler, causing them to have a slower reaction rate, negatively impacting the results. But, the researcher was unable to ask the participants whether they had a sleep disorder because it breached the protection from harm. It could have breached this guideline because the question could have felt invasive and embarrassing for the participant.

As mentioned before, the restoration theory suggests that sleep restores our minds and bodies. This theory supported this study's results because those who were sleep deprived would have had less REM sleep to restore their minds compared to those who had sufficient sleep. This would have negatively impacted the sleep deprived groups' cognitive function. The results showed that participants who were sleep deprived had a slower reaction rate in comparison to participants with sufficient sleep. This indicated that participants with more sleep had a stronger cognitive performance, which aligns with how the restoration theory supports the results obtained.

Taheri and Arabameri's (2012) results, which were mentioned in the introduction, supported this study's results. Taheri and Arabameri found that short-term sleep deprivation negatively impacted cognitive function, for example, reaction time. Taheri and Arabameri's results supported the results obtained in this study because both results suggested that fewer hours of sleep negatively affected reaction rate.

All of the participants in this study were between the ages 16 to 17 years old; however, research has found that adults have a higher tolerance to the effects of sleep deprivation. As a result of this, it was not guaranteed that the same results would have been obtained if this experiment were repeated with adults.

The majority of the participants were females, but several studies discovered that females were better at dealing with sleep deprivation than males. Since most of the participants were female, if this experiment was repeated with an equal split between males and females, the results obtained might have been different.

In conclusion, these results indicated that less sleep caused a decrease in the reaction rate to catch an object as fast as possible. This was shown through the mean of the reaction rate of sleep-deprived participants being 15cm, while the mean reaction rate for participants with sufficient sleep was 8cm. Also, the results aligned with the hypothesis that as hours of sleep decreased, reaction rate increased.

#### Evaluation

A weakness of this study was that the reaction test was not accurate, as the researcher had limited resources. The reaction rate test involved participants trying to catch a ruler as fast as possible. This was not accurate because when they caught the ruler, their hand could have slipped. To improve the accuracy of the reaction rate test, the researcher should have chosen the Stroop task.

A strength of this study was it was easy to replicate. The researcher measured the participants reaction rate by making them catch a ruler as fast as possible and recorded their hours of sleep by asking the participants, then inserting the data into a digital table. This method was simple and fast, making the study easy to replicate.

A weakness of this study was that the participants self-reported their hours of sleep. The participants could of lied about how much they slept due to embarrassment about how little or how much they slept. This would have impacted the results because the participants could have been placed into the wrong group, negatively impacting the validity of the results.

A weakness of this study was the sample size. There was 12 participants and all the participants were between the ages of 16 to 17 years old. This meant that the results can not be generalised to people outside of this age range.

## Appendices

### Appendix A

#### *Information sheet*

Thank you for your participation in this study. You will be taken into a room individually and asked how many hours of sleep you had the night before. Depending on your response you will be grouped into one of two conditions: sleep deprived or sufficient sleep. Then, you will be asked to perform a reaction rate test, this test involves catching a ruler as fast as possible. Your score will then be recorded into an average. At the end of this experiment, you will receive a debrief sheet to ensure you are comfortable being in this study and to provide further information. A reminder that you have the right to withdraw at any point in this study, and your identity will be anonymous and your results confidential.

### Appendix B

#### *Consent Form*

Thank you for participating in this experiment, it is much appreciated. This experiment will only be a few minutes long. Your hours of sleep from the night before will be recorded and after you will perform a reaction rate test. This reaction rate test is a ruler being dropped from the count of 3 and you have to try and catch it as fast as possible. At the end of the experiment, you will be provided with a debrief sheet to guarantee you are happy with your results being used. Also, your identity will remain unknown throughout this report.

By signing this, I comply:

- I am over the age of 16 years old
- I am aware I have the right to withdraw at any point during the experiment
- My identity will be unknown, but my results will be used in an average which will be published

Signed:

Date:

### Appendix C

#### *Debrief sheet*

Thank you for participating in this study.

The aim of this study was to determine the relationship between hours of sleep and reaction rate. It was expected that the more sleep you get the lower your reaction rate will be. The data gathered from this study will be averaged and used in my higher psychology assignment. If you decide you no longer want your readings to be used or have any questions, please contact the psychology department.

**References**

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## Appendix D

<b>Sleep Deprived (under 7 hours of sleep)</b>	<b>Results from reaction test (sleep deprived)</b>	<b>Sufficient Sleep (over 7 hours of sleep)</b>	<b>Results from test (sufficient sleep)</b>
Participant 1	14cm	Participant 2	7cm
Participant 5	15cm	Participant 3	7cm
Participant 6	17cm	Participant 4	9cm
Participant 9	15cm	Participant 7	9cm
Participant 12	16cm	Participant 8	8cm
		Participant 10	5cm
		Participant 11	9cm

## Appendix E

**SAMPLE CALCULATION**

~ Sleep deprived means ~

$$\text{mean} = \frac{14 + 15 + 17 + 15 + 16}{8} = 15.4 = 15$$

$$\text{mode} = 14 \text{ (15) } 17 \text{ (15) } 16 = 15$$

~ sufficient sleep ~

$$\text{mean} = \frac{7 + 7 + 9 + 9 + 8 + 5 + 9}{7} = 7.714 \dots = 8$$

$$\text{mode} = 7 \text{ 7 } \text{ (9) } \text{ (9) } 8 \text{ 5 } \text{ (9) } = 9$$