



# DO PRO GAMERS HAVE SUPER-THUMBS?



LEVEL UNLOCKED:  
**THUMB  
STRENGTH!**



ULTRASOUND STUDY — INFORMATION PAGE 1

## 1 BACKGROUND

The thenar muscles at the base of the thumb help move and stabilise the thumb. These muscles are used repeatedly when operating a games controller.

Researchers used high-resolution ultrasound images to compare the dominant-hand thumb muscles of professional competitive video gamers with those of people who did not regularly play video games.



## 2 TRAINING

The professional gamers had competed and trained for at least two years.

They practised rapid controller movements for many hours each week.



## 3 RESULTS

The gamers had a significantly greater average thickness of the dominant-hand thenar muscles than the non-gamers.

Within the gamer group, muscle thickness showed a positive correlation with the total number of years spent training.



## 4 CONCLUSION

The results support the idea that repeated skilled thumb movements may produce a local structural change in the muscles of the hand.

However, the study shows an association and does not prove that gaming caused the difference.





# DO PRO GAMERS HAVE SUPER-THUMBS?

QUESTIONS — PAGE 1



Use the information from the study to answer the following questions.



1(a)

State the aim of this investigation.

[1]

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1(c)(i)

In an investigation of this type, which involves human participants, state one thing the researchers must obtain from the participants before beginning the study.

[1]



1(c)(ii)

State one other ethical consideration the researchers would have to make.

[1]



1(b)

Which of the following statements (A, B or C) provides an appropriate hypothesis for Experiment 1 in this investigation?

[1]

A

Professional gamers will have more gaming experience than non-gamers.

B

The dominant-hand thenar muscles in professional gamers will have a different thickness from those in non-gamers.

C

The more gaming experience a professional gamer has, the thicker their thenar muscles will be.

Statement \_\_\_\_\_





# DO PRO GAMERS HAVE SUPER-THUMBS?

## QUESTIONS — PAGE 2



Use the information from the study to answer the following questions.

INDEPENDENT  
VARIABLE (IV)



DEPENDENT  
VARIABLE (DV)



2

Which of the following statements best describes the independent variable in this investigation?

[1]

A

The sex, medical health and handedness of the participants.

B

The thickness of the thenar muscles in the participants.

C

Whether or not the participant was a professional gamer.

Statement \_\_\_\_\_



3

Explain why the researchers chose professional competitive gamers as one of the experimental groups in their study of thumb-muscle thickness.

[1]

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# DO PRO GAMERS HAVE SUPER-THUMBS?



## ANSWERS — PAGE 1

1(a)

To investigate the effect of gaining video-gaming experience/training on the thickness of the dominant-hand thenar muscles.

OR

To compare the thickness of the dominant-hand thenar muscles in professional gamers and non-gamers. [1]



1(b)

Statement B: The dominant-hand thenar muscles in professional gamers will have a different thickness from those in non-gamers. [1]



1(c)(i)

Informed consent.

[1]



1(c)(ii)

Assess risk of procedure/procedure must do no harm/confidentiality/right to withdraw.

[1]



2

Statement C: Whether or not the participant was a professional gamer. [1]



3

Professional gamers must carry out rapid, repeated and skilled thumb movements during extensive controller training. [1]





# DO PRO GAMERS HAVE SUPER-THUMBS?

## QUESTIONS – PAGE 3



Use the information from the study to answer the following questions.



=



GAMER ?

CONTROL ?

4(a)

Describe how the researchers demonstrated that their method was a well-established technique for making measurements from ultrasound images.

[1]

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4(b)

Explain why the non-gamer group in this investigation can be described as a control group.

[1]

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4(c)

State two variables that the researchers identified as important to consider when selecting participants for the control group.

[2]

- 1 

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- 2 

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4(d)

State why it was an important feature of the study design that the person analysing the ultrasound images did not know whether an image came from a gamer or a member of the control group.

[1]

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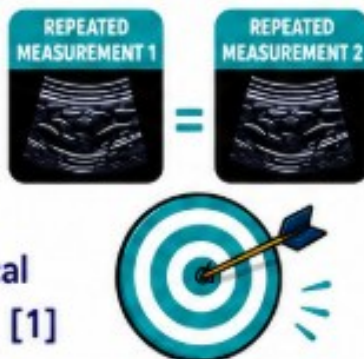
# DO PRO GAMERS HAVE SUPER-THUMBS?



## ANSWERS — PAGE 2

4(a)

By repeating measurements of six randomly selected ultrasound images and obtaining almost identical results.



[1]

4(b)

They provide results in the absence of the 'treatment'—being a professional gamer.

[1]



4(c)

Handedness/sex/age range/health level.

Any two.

[2]



4(d)

Make sure that the person analysing the ultrasound images did not introduce any bias into their interpretation of the data.

[1]





# DO PRO GAMERS HAVE SUPER-THUMBS?

## RESULTS & QUESTION 5 — PAGE 1



### RESULTS

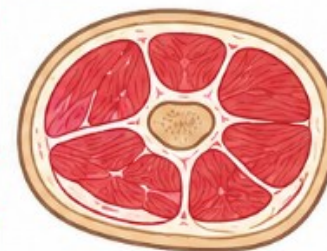
The results in Tables 1 and 2 are mean thickness values for the thumb muscles of 8 people from each group. Muscle thickness was measured from an ultrasound image taken at the same point on each participant's dominant hand.

TABLE 1 — whole thenar muscle group

| Group               | Mean muscle thickness (mm) |
|---------------------|----------------------------|
| Professional gamers | $14.2 \pm 0.5$             |
| Control group       | $13.9 \pm 0.6$             |

TABLE 2 — main thumb-flexor muscle

| Group               | Mean muscle thickness (mm) |
|---------------------|----------------------------|
| Professional gamers | $8.6 \pm 0.2$              |
| Control group       | $7.8 \pm 0.3$              |



### Q5(a)



In an investigation, the data collected should be presented in a clear, logical way that is suitable for analysis.

Suggest an alternative, appropriate method for presenting the data in Tables 1 and 2 that would enable easier analysis. [1]





# DO PRO GAMERS HAVE SUPER-THUMBS?

## QUESTION 5 & EXPERIMENT 2 – PAGE 2



**5(b)**

Statistical analysis of the data in Tables 1 and 2 showed that:

- ◆ the mean thickness values for the whole thenar muscle group were not significantly different between the two groups
- ◆ the mean thickness values for the main thumb-flexor muscle were significantly different between the two groups

(i) Describe the evidence from Tables 1 and 2 that supports each of the statements above. [2]

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(ii) Explain what the term 'significant difference' indicates about the reason for an apparent difference in results. [1]

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### EXPERIMENT 2 – THUMB-MUSCLE CHANGES WITH GAMING EXPERIENCE

#### Method

In a second study, the researchers investigated the relationship between the thickness of the main thumb-flexor muscle, measured using ultrasound, and the length of time each professional gamer had competed. A small computer program was used to adjust the measurements for natural variation in hand size and body size.

#### Results

Figure 1 shows the adjusted relative thickness of the main thumb-flexor muscle plotted against time spent as a professional gamer.



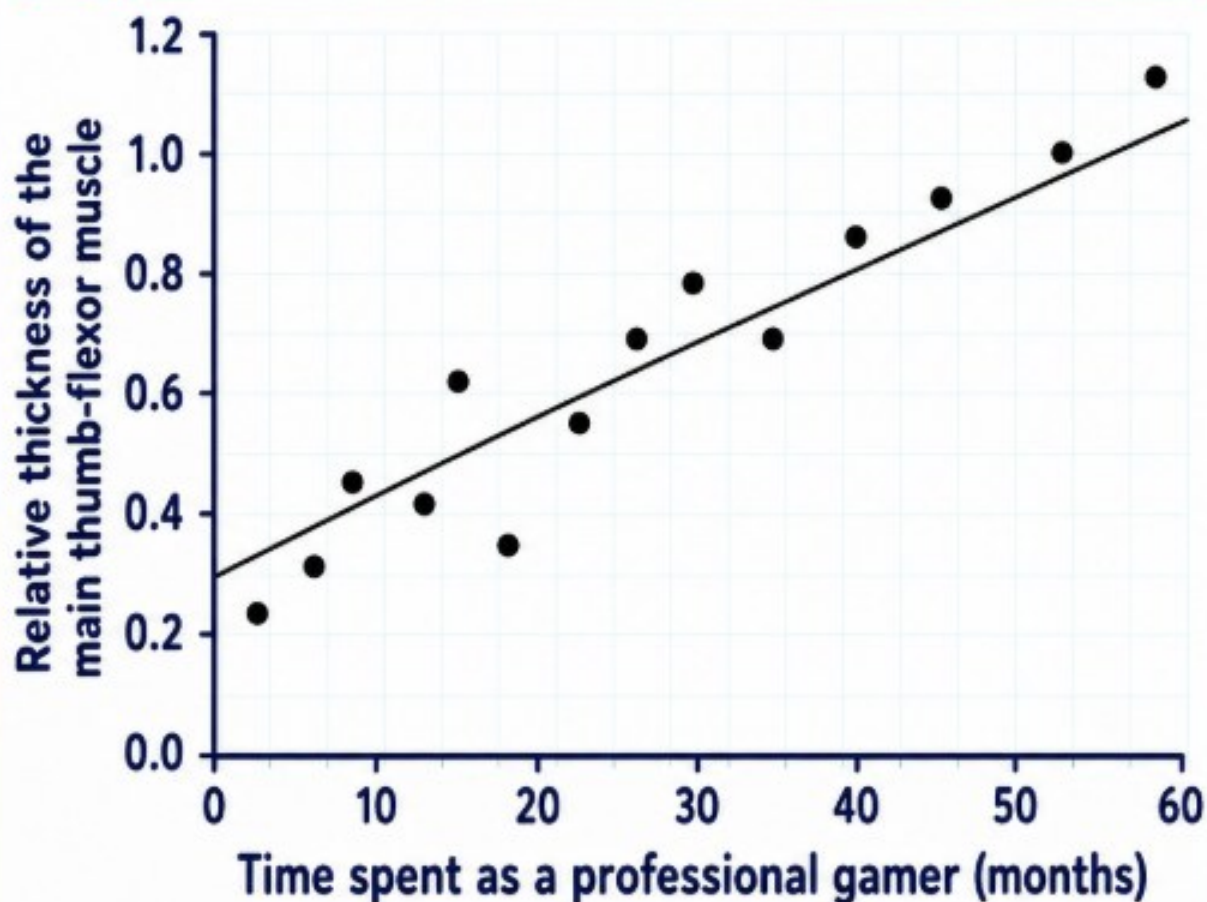


# DO PRO GAMERS HAVE SUPER-THUMBS?

## FIGURE 1 & QUESTION 6 – PAGE 3



Figure 1 — relative thickness of the main thumb-flexor muscle



It was found that the length of time spent as a professional gamer showed a positive correlation with the relative thickness of the main thumb-flexor muscle.

6(a)



Explain the term 'positive correlation' using the results of this experiment.

[2]

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# DO PRO GAMERS HAVE SUPER-THUMBS?

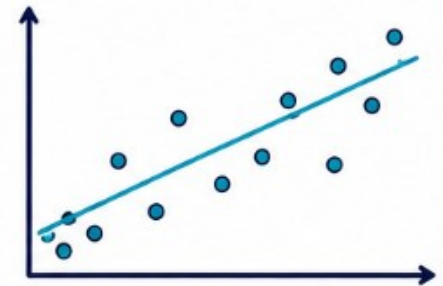
## QUESTIONS 6-7 — PAGE 4



6(b)

In their conclusion, the researchers suggested a possible link between the number of years of professional gaming experience and the thickness of the main thumb-flexor muscle.

Use the data in Figure 1 to suggest one reason why this conclusion might not be valid. [1]



7(a)

One assumption made by the researchers was that the average thickness of the main thumb-flexor muscle of professional gamers prior to beginning intensive gaming was the same as that of the control group.

Explain why this assumption might produce a false positive result. [1]



7(b)

Suggest how using a group of new professional gamers, about to start intensive training, might allow the researchers to obtain more valid conclusions about the effect of gaming on thumb-muscle thickness. [1]



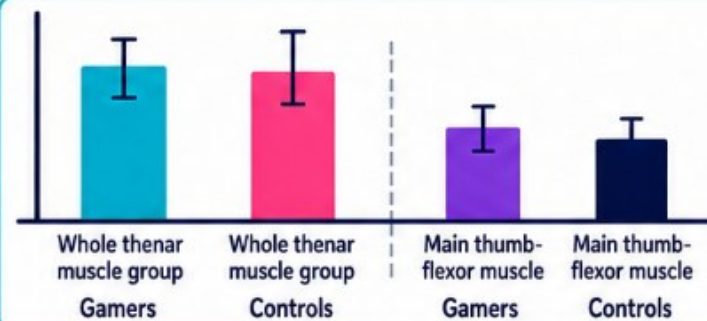


# DO PRO GAMERS HAVE SUPER-THUMBS?

## ANSWERS — QUESTION 5



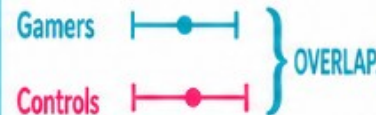
### 5(a) Bar graph. [1]



### 5(b)(i)

- The error ranges for the whole thenar muscle group overlap, so there is no significant difference. [1]
- The error ranges for the main thumb-flexor muscle do not overlap, so there is a significant difference. [1]

Whole group: 13.7–14.7; 13.3–14.5



Mean muscle thickness (mm)

Thumb flexor: 8.4–8.8; 7.5–8.1



Mean muscle thickness (mm)

### 5(b)(ii)

The difference is unlikely to be due to chance, or may result from the independent variable. [1]





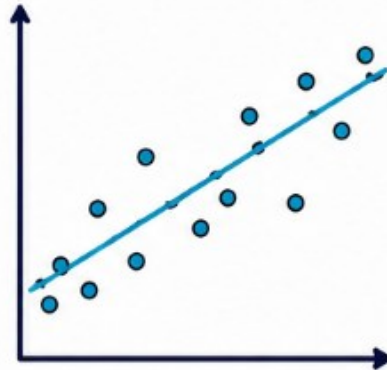
# DO PRO GAMERS HAVE SUPER-THUMBS?

## ANSWERS — QUESTIONS 6–7



### 6(a)

- There is a connection between the two variables. [1]
- As time spent as a professional gamer increases, the relative thickness of the main thumb-flexor muscle generally increases. [1]



### 6(b)

Accept any one:

- small sample
- many points lie away from the line of best fit
- the cause of the increase has not been determined
- people with thicker thumb muscles might be more likely to become professional gamers [1]



### 7(a)

The professional gamers may already have had thicker thumb muscles before intensive gaming began. [1]



### 7(b)

Measure thumb-muscle thickness before intensive training and again after a period of training, then compare the measurements for the same gamers. [1]





# DO CHILLI CHAMPIONS KEEP THEIR COOL?

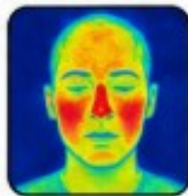


## THERMAL-CAMERA STUDY – INFORMATION PAGE 1

### 1 BACKGROUND

Thermal cameras detect infrared radiation emitted from the skin and display differences in surface temperature as coloured images.

Researchers used thermal images to compare changes in facial skin temperature in competitive chilli eaters and people who rarely ate spicy food.



### 2 PROCEDURE

Each participant rested in the same temperature-controlled room for 15 minutes. A thermal image of the face was taken before they tasted exactly 5 ml of the same mild chilli sauce.

A second thermal image was taken five minutes later.



### 3 RESULTS

The non-chilli eaters showed a significantly greater average increase in cheek and nose temperature than the competitive chilli eaters.

Within the chilli-eater group, the temperature increase showed a negative correlation with the number of years spent training.



### 4 CONCLUSION

The results support the idea that repeated exposure to chilli may reduce the facial heat response.

However, the study shows an association and does not prove that chilli training caused the difference.



**SOME LIKE IT HOT...  
THEIR FACES DISAGREE!**





# DO CHILLI CHAMPIONS KEEP THEIR COOL?



## SUBJECTS AND METHOD — INFORMATION PAGE 2

### 1 CHILLI CHAMPIONS

Sixteen competitive chilli eaters were selected.

All had trained for more than two years and had no history of cardiovascular, skin or chilli-related medical problems.

Their mean age was 31 years.



### 2 CONTROL GROUP

Fifty people who rarely ate spicy food were selected from an existing participant database.

Sixteen controls were chosen to match the chilli eaters for:

- ✓ SEX
- ✓ AGE
- ✓ GENERAL HEALTH
- ✓ USUAL ROOM-TEMPERATURE  
SKIN TEMPERATURE



### 3 THERMAL METHOD

Before and after thermal images were collected from the 16 chilli eaters and 16 matched controls using a well-established thermal-imaging technique.

The same conditions were used for every participant:

- SAME CAMERA DISTANCE
- SAME ROOM TEMPERATURE
- SAME CHILLI SAUCE VOLUME (5 ml)
- SAME FIVE-MINUTE INTERVAL



### 4 RELIABILITY AND BLINDING

The thermal-imaging method was taken from a fully cited, peer-reviewed journal article.



The images were analysed by one experienced researcher who did not know whether each image came from a chilli eater or a control participant.



**SAME SAUCE. SAME ROOM.  
NO PEEKING!**





# DO CHILLI CHAMPIONS KEEP THEIR COOL?



## QUESTIONS — PAGE 1



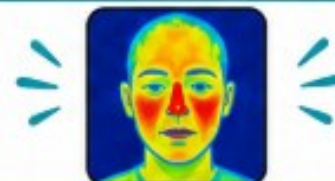
Use the information from the study to answer the following questions.



1(a)

State the aim of this investigation.

[1]



1(b)

Which of the following statements (A, B or C) provides an appropriate hypothesis for Experiment 1 in this investigation?

[1]

- A Competitive chilli eaters will have more experience of spicy food than non-chilli eaters.
- B Competitive chilli eaters will show a different change in facial skin temperature from non-chilli eaters after tasting the chilli sauce.
- C The more years of chilli training a person has, the smaller their facial temperature increase will be.

Statement \_\_\_\_\_



1(c)(i)

In an investigation of this type, which involves human participants, state one thing the researchers must obtain from the participants before beginning the study.

[1]



1(c)(ii)

State one other ethical consideration the researchers would have to make.

[1]





# DO CHILLI CHAMPIONS KEEP THEIR COOL?

## QUESTIONS — PAGE 2



Use the information from the study to answer the following questions.

2

Which of the following statements best describes the independent variable in this investigation? [1]

A

The sex, medical health and usual skin temperature of the participants.

B

The change in facial skin temperature after tasting chilli sauce.

C

Whether or not the participant was a competitive chilli eater.

INDEPENDENT  
VARIABLE (IV)



DEPENDENT  
VARIABLE (DV)



Statement \_\_\_\_\_

3

Explain why the researchers chose competitive chilli eaters as one of the experimental groups in their study of facial temperature response. [1]

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# DO CHILLI CHAMPIONS KEEP THEIR COOL?

## QUESTIONS — PAGE 3



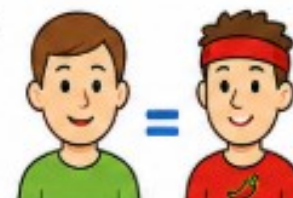
**Q4(a):**

Describe how the researchers demonstrated that their method was a reliable technique for making measurements from thermal images. [1]



**Q4(b):**

Explain why the non-chilli eater group can be described as a control group. [1]



**Q4(c):**

State two variables that the researchers identified as important to consider when selecting the participants for the control group. [2]



1

2

**Q4(d):**

State why it was important that the person analysing the thermal images did not know whether an image was from a competitive chilli eater or a non-chilli eater. [1]



# DO CHILLI CHAMPIONS KEEP THEIR COOL?

## ANSWERS — QUESTIONS 1–3



**1a**

1(a) To investigate whether competitive chilli eaters show a different change in facial skin temperature from non-chilli eaters after tasting chilli sauce.

[1]



**1b**

1(b) Statement B: Competitive chilli eaters will show a different change in facial skin temperature from non-chilli eaters after tasting chilli sauce.

[1]



**1ci**

1(c)(i) Informed consent.

[1]



**1cii**

1(c)(ii) Assess risk of harm from the chilli sauce / check allergies or health conditions / allow participants to withdraw. Accept any one.

[1]



**2**

2 Statement C: Whether or not the participant was a competitive chilli eater.

[1]

**3**

3 Competitive chilli eaters had extensive experience of eating spicy food.

[1]



# DO CHILLI CHAMPIONS KEEP THEIR COOL?



## ANSWERS — QUESTION 4

4a

4(a) The researchers used a method published in a fully cited, peer-reviewed journal article.



[1]

PEER REVIEWED

4b

4(b) The non-chilli eaters provide results in the absence of competitive chilli-eating experience.



[1]

4c

4(c) Any two:

- sex
- age
- general health
- usual room-temperature skin temperature



[2]

4d

4(d) To prevent the researcher's expectations from biasing the measurements or interpretation of the thermal images.



[1]



# DO CHILLI CHAMPIONS KEEP THEIR COOL?



## RESULTS & QUESTION 5 — PAGE 1

### RESULTS

The results in Tables 1 and 2 show mean temperature increases for 8 people from each group.

Thermal images were taken before tasting the sauce and after 1, 3 and 5 minutes.

TABLE 1 — whole face

| Time after sauce (minutes) | Competitive chilli eaters: mean increase (°C) | Control group: mean increase (°C) |
|----------------------------|-----------------------------------------------|-----------------------------------|
| 0                          | 0.0                                           | 0.0                               |
| 1                          | $0.8 \pm 0.3$                                 | $1.0 \pm 0.4$                     |
| 3                          | $1.4 \pm 0.4$                                 | $1.6 \pm 0.5$                     |
| 5                          | $1.8 \pm 0.4$                                 | $2.0 \pm 0.5$                     |

TABLE 2 — cheeks and nose

| Time after sauce (minutes) | Competitive chilli eaters: mean increase (°C) | Control group: mean increase (°C) |
|----------------------------|-----------------------------------------------|-----------------------------------|
| 0                          | 0.0                                           | 0.0                               |
| 1                          | $0.6 \pm 0.2$                                 | $1.0 \pm 0.3$                     |
| 3                          | $1.0 \pm 0.2$                                 | $1.7 \pm 0.3$                     |
| 5                          | $1.2 \pm 0.2$                                 | $2.1 \pm 0.3$                     |

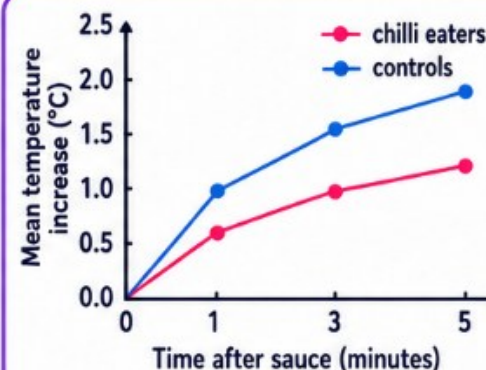


5(a)



In an investigation, the data collected should be presented in a clear, logical way that is suitable for analysis.

Suggest an alternative, appropriate method for presenting the data in Tables 1 and 2 that would enable easier analysis. [1]





# DO CHILLI CHAMPIONS KEEP THEIR COOL?



## QUESTION 5 & EXPERIMENT 2 — PAGE 2

5(b)

Statistical analysis of the five-minute data in Tables 1 and 2 showed that:

- ◆ the mean temperature increases for the whole face were not significantly different between the two groups
- ◆ the mean temperature increases for the cheeks and nose were significantly different between the two groups

(i) Describe the evidence from Tables 1 and 2 that supports each of the statements above. [2]

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(ii) Explain what the term 'significant difference' indicates about the reason for an apparent difference in results. [1]

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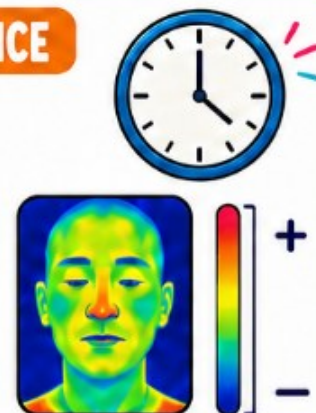
## EXPERIMENT 2 — TEMPERATURE RESPONSE AND CHILLI-EATING EXPERIENCE

### Method

In a second study, the researchers investigated the relationship between the increase in cheek-and-nose skin temperature, measured using thermal imaging, and the length of time each competitive chilli eater had trained. A computer program adjusted the measurements for natural variation in starting skin temperature and body size.

### Results

Figure 1 shows the adjusted relative increase in cheek-and-nose skin temperature plotted against time spent as a competitive chilli eater.



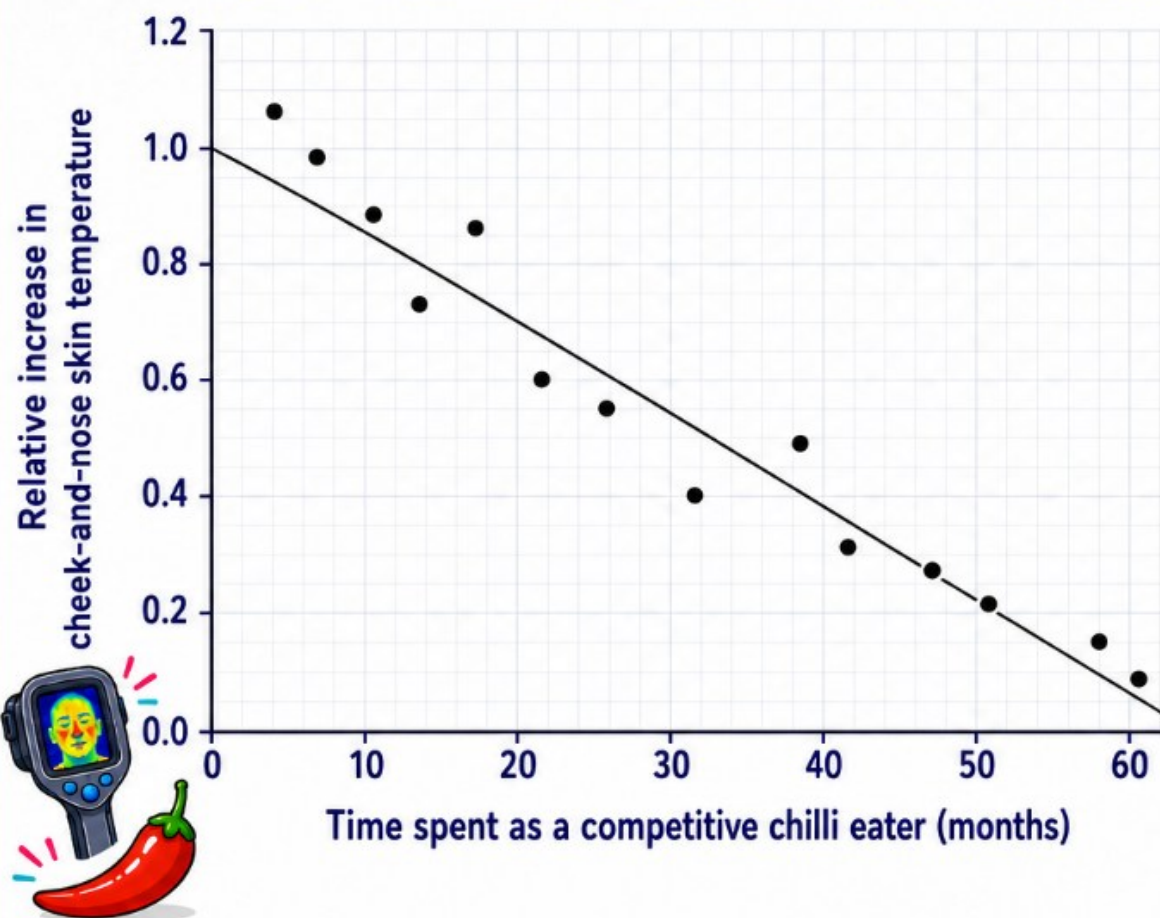


# DO CHILLI CHAMPIONS KEEP THEIR COOL?



## FIGURE 1 & QUESTION 6 — PAGE 3

Figure 1 — relative increase in cheek-and-nose skin temperature



It was found that the length of time spent as a competitive chilli eater showed a negative correlation with the relative increase in cheek-and-nose skin temperature.

**6(a)** Explain the term 'negative correlation' using the results of this experiment. [2]

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# DO CHILLI CHAMPIONS KEEP THEIR COOL?



## QUESTIONS 6–7 — PAGE 4

- 6(b)** In their conclusion, the researchers suggested a possible link between the number of years of competitive chilli-eating experience and the increase in cheek-and-nose skin temperature. Use the data in Figure 1 to suggest one reason why this conclusion might not be valid. [1]

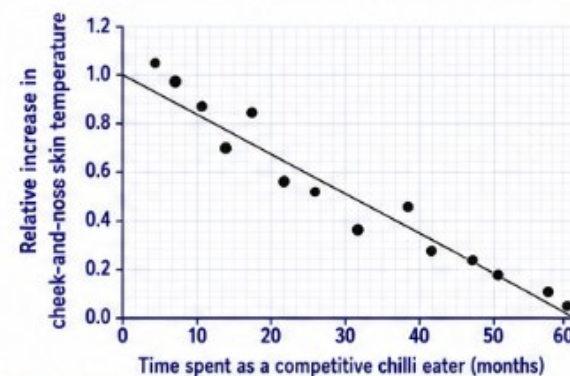
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- 7** One assumption made by the researchers was that the average temperature response of competitive chilli eaters prior to beginning intensive training was the same as that of the control group.

- 7(a)** Explain why this assumption might produce a false positive result. [1]

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- 7(b)** Suggest how using a group of new competitive chilli eaters, about to start intensive training, might allow the researchers to obtain more valid conclusions about the effect of chilli-eating experience on facial temperature response. [1]

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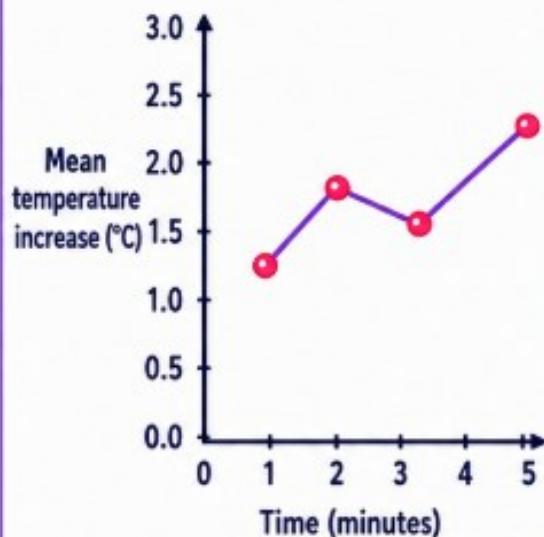


# DO CHILLI CHAMPIONS KEEP THEIR COOL?



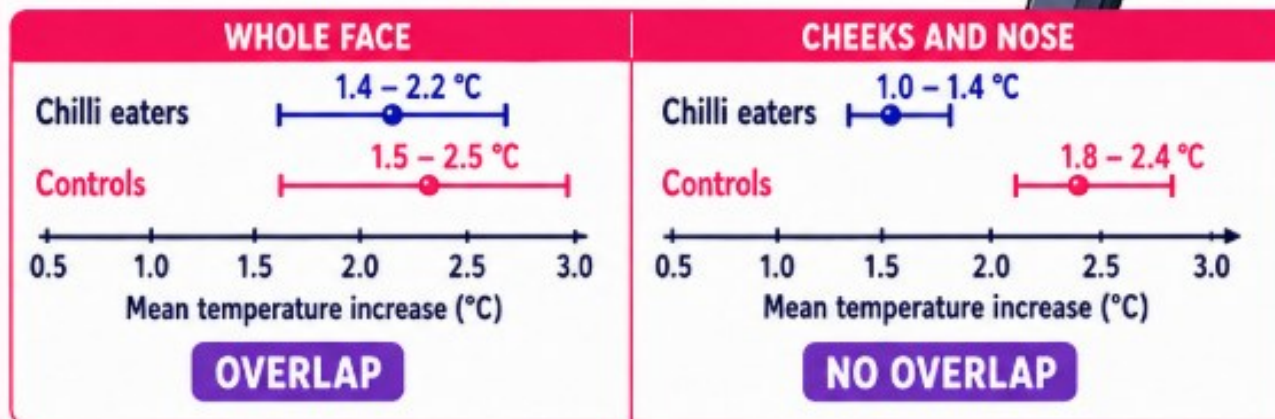
## ANSWERS — QUESTION 5

### 5(a) Line graph. [1]



### 5(b)(i)

- The error ranges for the whole face overlap, so there is no significant difference. [1]
- The error ranges for the cheeks and nose do not overlap, so there is a significant difference. [1]



### 5(b)(ii)

The difference is unlikely to be due to chance, or may result from the independent variable. [1]





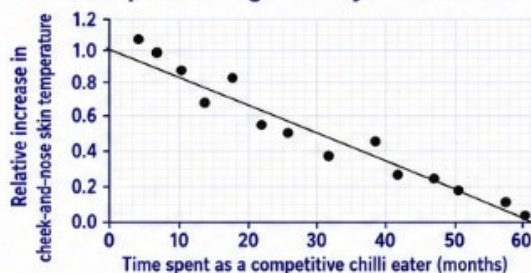
# DO CHILLI CHAMPIONS KEEP THEIR COOL?



## ANSWERS — QUESTIONS 6–7

6(a)

- There is a connection between the two variables. [1]
- As time spent as a competitive chilli eater increases, the relative increase in cheek-and-nose skin temperature generally decreases. [1]



6(b)

Accept **any one**:

- small sample
- many points lie away from the line of best fit
- the cause of the decrease has not been determined
- people with a naturally smaller temperature response might be more likely to become competitive chilli eaters [1]



7(a)

The competitive chilli eaters may already have had a smaller facial temperature response before intensive training began. [1]



7(b)

Measure facial temperature response before intensive training and again after a period of training, then compare the measurements for the same chilli eaters. [1]





# DO CHILLI CHAMPIONS KEEP THEIR COOL?



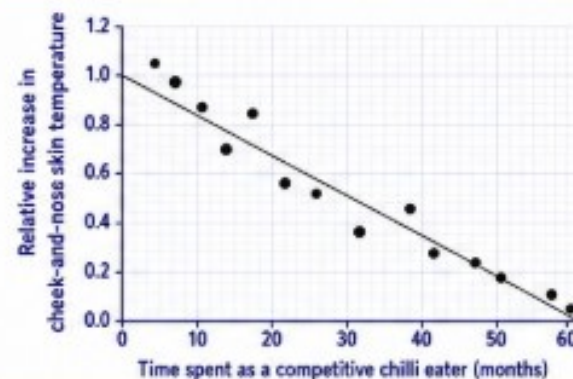
## QUESTIONS 6–7 — PAGE 4

- 6(b)** In their conclusion, the researchers suggested a possible link between the number of years of competitive chilli-eating experience and the increase in cheek-and-nose skin temperature. Use the data in Figure 1 to suggest one reason why this conclusion might not be valid. [1]

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- 7** One assumption made by the researchers was that the average temperature response of competitive chilli eaters prior to beginning intensive training was the same as that of the control group.

- 7(a)** Explain why this assumption might produce a false positive result. [1]

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- 7(b)** Suggest how using a group of new competitive chilli eaters, about to start intensive training, might allow the researchers to obtain more valid conclusions about the effect of chilli-eating experience on facial temperature response. [1]

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