

The Mathematics of Psychology

Correlational Study

Teacher Notes

An experiment (10 mins)

You may want to do this experiment in a lesson before the one in which the data is analysed. This will allow you time to enter the data into a spreadsheet.

Equipment needed: rulers, a copy of An Experiment for each student.

Ensure students know that they need to measure their own hands and that they should measure the index and ring fingers of right and left hands in cm.

Student names are on the front sheet for two purposes; so that you can check on any unusual measurements and also so that you can tell whether students are male or female. However, it will help prevent any possible bias if you do not tell students that being male or female may be a relevant factor in the experiment.

Once students have understood the instructions, tell them that you will give them five minutes to complete the 20 questions about rotations. Ask students to put rulers away and tell them to turn over. Let them know when they have two minutes left. You may want to display a timer visible to students.

What was the experiment about? (10 mins)

Show the powerpoint and ask students for their opinions. You might want to give students a printout of all slides to allow them to see all the ideas at once.

Entering data into a spreadsheet (teacher time outside of lesson)

The answers to the rotations questions are as follows.

- | | | | |
|--------|---------|---------|---------|
| 1. No | 2. Yes | 3. Yes | 4. Yes |
| 5. Yes | 6. No | 7. No | 8. Yes |
| 9. Yes | 10. No | 11. No | 12. No |
| 13. No | 14. No | 15. No | 16. No |
| 17. No | 18. Yes | 19. Yes | 20. Yes |

For each person count how many they got correct. Note that missing out a question has the same effect as getting it wrong.

Enter the data in a copy of the Sample Data spreadsheet. Data is entered in columns A to E and column H. Column F is calculated using the formula $2D \text{ left} \div 4D \text{ left}$. Column G does the same thing for the right hand.

	A	B	C	D	E	F	G	H
1	M or F?	2D left	4D left	2D right	4D right	2D:4D left	2D:4D right	no. correct
2		7.7	7.4	7.8	7.5	1.040541	1.04	14
3	M	7.5	7.5	7.4	8	1	0.925	13
4		7.4	7.3	7.3	7.2	1.013699	1.0138889	20
5	F	7.1	7.5	7	7.3	0.946667	0.9589041	20
6		7.6	7.8	7.5	7.3	0.974359	1.0273973	14
7	M	7	6.9	7.2	7.1	1.014493	1.0140845	16
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Checking for correlation (15 mins)

To draw a scatter diagram

- Click on the top of column F to highlight it
- Now hold Shift and click on column G so that both columns are highlighted
- Insert a scatter diagram

To calculate a correlation coefficient

- =CORREL(F:F,G:G) calculates the correlation between the numbers in column F and those in column G.
- The correlation coefficient measures the strength of linear relationship between the pairs of numbers.
- +1 is perfect positive correlation. In this case, all the points on the scatter diagram lie on a straight line with positive gradient.
- -1 is perfect negative correlation. In this case, all the points on the scatter diagram lie on a straight line with negative gradient.
- 0 means there is no correlation.

Students should look at the scatter diagrams and correlation coefficients and answer the following questions.

- Is there a positive correlation between 2D:4D for the right and left hands? It is likely that there is one since each person is likely to have similar shaped hands.
- Is there any correlation between 2D:4D and the number of questions correct? Is the correlation different for right and left hands? Students might also look at whether it is different for males and females.

Is there really any correlation? (15 mins)

Display "Correlation or not" and ask students for their opinions.

Use the exploring correlation spreadsheet. This has a population of 1000 data pairs on sheet 1. There is no correlation in the population.

The Small sample sheet takes a random sample of size 5 from the population. Press F9 to take a new sample. Notice that the correlation coefficient is different for different samples. It can be positive or negative and it can be quite high.

The large sample sheet takes a random sample of size 50 from the population. Press F9 to take a new sample. Notice that the correlation coefficient for large samples from the population does not vary as much as it does for small samples.

The main points which students need to know are in the powerpoint “Is there really any correlation?”. This is also provided as a pdf handout for students to refer to when analysing the results from their experiment.

Analysing the data from their experiment (10 mins)

Students should test whether there is evidence of positive correlation between digit ratios for both hands using their data.

They should test whether there is evidence of negative correlation between digit ratio and number correct in the test. This is the same process as for positive correlation; the coefficients just have a minus sign in front of them.

Critical values for the correlation coefficient can be found in tables such as those at <http://www.numeracy-bank.net/?q=t/stt/pco/3>

For further reading for interested students

Anthropological notes on the human hand, F Baker
<http://onlinelibrary.wiley.com/doi/10.1525/aa.1888.1.1.02a00040/pdf>

Is digit ratio (2D:4D) related to systemizing and empathizing? Evidence from direct finger measurements reported in the BBC internet survey, Manning et al
http://www.autismresearchcentre.com/docs/papers/2010_Manning_digitratio_PersIndDiff.pdf

Tests for systemising and empathy quotients
<http://www.guardian.co.uk/life/news/page/0,,937443,00.html>