Chapter 8: How can I tell if scores differ between two conditions? Repeated measures *t* test.

Full answers to study questions

1. Given that the sample are the same people at both time points, the difference in variability cannot simply be explained by individual differences between two different groups of people! Therefore, it would be best to look for how the experimental paradigm might have changed between the two time points. Perhaps there was a different experimenter, or testing took place at a different time of day, or perhaps the instructions differed at time two? Any of these, plus many more reasons, might explain the increased random variance at time two.
2. Errors and correct statistics for each example…
   2.1. The degrees of freedom are in the wrong place: t (31) = 2.4, $p < .050$
   2.2. You do not need to write "df =": t (12) = 3.2, $p < .010$
   2.3. The operator sign for the p value should be less than (<), not greater than (>): t (24) = 3.3, $p < .005$
3. To answer each of these questions you need to first work out two things: Is the hypothesis one-tailed or two-tailed? And how many degrees of freedom are there (N-1)? With this information you can look up the critical value for each scenario.
   3.1. Two-tailed. df = 19. Critical value = 2.093.
   3.2. One-tailed. df = 14. Critical value = 1.761.
   3.3. One-tailed. df = 24. Critical value = 1.711.

Full answers for additional dataset

1. What method of analysis will you use to analyse this dataset?

   A repeated measures t test. The IV is whether the stimulus face is expressing a genuine or a posed smile, and the DV is the happiness rating.

2. Suggest a suitable hypothesis for this analysis.

   People will rate genuine smiles as happier than posed smiles. (Note that this is a one-tailed hypothesis).

3. Calculate the *t* statistic and determine whether it is significant.

   Note: The step numbers for calculations in the book chapter are repeated here.

Steps 1, 2, 3 and 5 of the calculations have been completed in the table.

Participant number	Previously seen face (A)	Never seen before face (B)	d (B-A)	d^2
1	7	4	-3	9
2	5	5	0	0
3	6	3	-3	9
4	4	5	1	1
5	7	6	-1	1
6	5	5	0	0
7	6	3	-3	9
8	7	4	-3	9
9	7	5	-2	4
10	5	3	-2	4
Sum ($\sum$)	59	43	$\sum d$ = -16	$\sum d^2$ = 46
Mean ($\bar{x}$)	5.9	4.3		

4: Calculate $(\sum d)^2$

$$\left(\sum d\right)^2 = -16^2$$

$$\left(\sum d\right)^2 = 256$$

6: What is the N in this study? 10

7: First, take all of the values you calculated above and insert them into the equation.

$$t = \frac{-16}{\sqrt{\frac{(10 * 46) - 256}{10 - 1}}}$$

8: Complete the multiplication within the brackets.

$$t = \frac{-16}{\sqrt{\frac{(460) - 256}{10 - 1}}}$$

9: Now complete the two subtractions on the bottom part of the equation.

$$t = \frac{-16}{\sqrt{\frac{204}{9}}}$$

10: Complete the division on the lower part of the equation.

$$t = \frac{-16}{\sqrt{22.667}}$$

11: Calculate the square root.

$$t = \frac{-16}{4.7609}$$

12: Complete the division to calculate the *t* statistic!

$$t = -3.3607$$

df = N - 1

df = 10 - 1

df = 9

4. Interpret and write up your findings using APA standards.

   People rate a genuine smile (M = 5.9, SD = 1.1) as significantly happier than a posed smile (M = 4.3, SD = 1.1; t (9) = 3.4, $p < .005$).

5. Think of two confounding variables that might explain some of the random variance within this dataset. For each one, suggest exactly how this variable might explain some of the variability (i.e., could you specify that a particular kind of person would be better or worse at the task). If you were to write about these within a discussion, you would want to find references to support your ideas, so try to find a reference for each of the three variables.

   There are many possible confounds. These are two that I thought of, but you may have come up with totally different ideas! The important thing for each is that you consider exactly how the confound may have influenced your findings. You also need to support each idea with a reference.

- Sex of the participant: Females are better at emotional face processing than males. Therefore, if there are more females than males in the sample the ability to complete this task might be overestimated.
    - Relevant reference: Hoffmann, H., Kessler, H., Eppel, T., Rukavina, S. & Traue, H. C. (2010). Expression intensity, gender and facial emotion recognition: Women recognize only subtle facial emotions better than men. *Acta Psychologica*, 135 (3), 278-83.
- Age of the participant: Accuracy for recognising facial emotion decreases in later life. If the sample was all university students, the results may be an overestimate of the actual findings as the sample will have been very accurate.
    - Relevant reference: Isaacowitz, D. M., Löckenhoff, C. E., Lane, R. D., Wright, R., Sechrest, L., Riedel, R., & Costa, P. T. (2007). Age differences in recognition of emotion in lexical stimuli and facial expressions. *Psychology and Aging*, *22*(1), 147.

Are p values enough? An additional exercise

$$d = \frac{5.9 - 4.3}{\sqrt{\frac{1.1^2 + 1.1^2}{2}}}$$

$$d = \frac{5.9 - 4.3}{\sqrt{\frac{1.21 + 1.21}{2}}}$$

$$d = \frac{1.6}{\sqrt{\frac{2.42}{2}}}$$

$$d = \frac{1.6}{\sqrt{1.21}}$$

$$d = \frac{1.6}{1.1}$$

$$d = \frac{1.6}{1.1}$$

$$d = 1.4545$$

People rate a genuine smile (M = 5.9, SD = 1.1) as significantly happier than a posed smile (M = 4.3, SD = 1.1; t (9) = 3.4, $p < .005$; d = 1.45) with a large effect size.