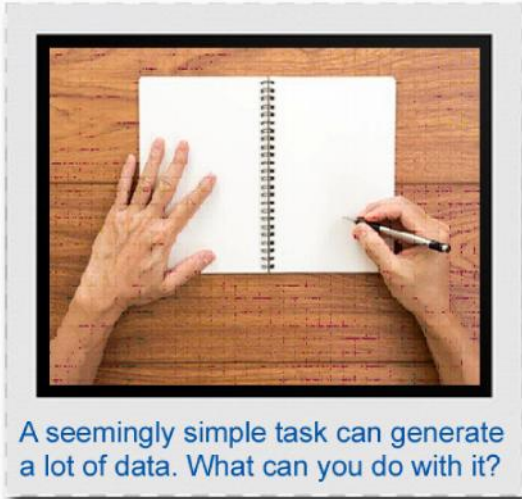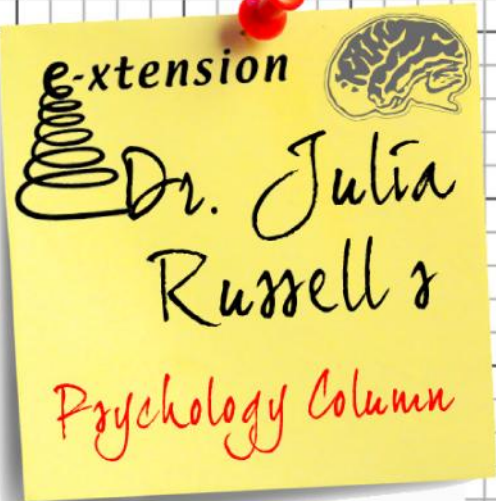## MATHS, STATS AND RESEARCH METHODS FOR THE NEW SPECIFICATIONS

Number 1: The Apple Logo

Before you do anything else, draw the Apple logo, then rate your confidence in the accuracy of your drawing (1= not confident, 10= very confident)

A seemingly simple task can generate a lot of data. What can you do with it?

Blake et al (2015) investigated people's ability to correctly recall the Apple logo. They found people couldn't! In experiment 1A, 85 participants were asked to draw the logo and rate their confidence. Their drawings were scored out of 14 (by two experimenters). Just one of 85 participants got it right. The participants also had to identify the logo amongst seven other images, and even when given this easier recognition task, less than half were able to do so.

1. Of the participants in experiment 1A, 52 were Apple-only users, 10 were PC-only users and 23 used both. Present these data on a **pie chart** and show your working. [2]

2. The images for the recognition task were arranged so that the variations (of leaf direction, bottom shape and bite location) were **counterbalanced**. What does 'counterbalanced' mean and why is it important in this case? [3]

3. The table gives the results of the drawing task.

a) Draw a **bar chart** of the mean accuracy data. [3]
b) Explain what the **mean** results show. [2]
c) i) What does a '**standard deviation**' measure?[1]
   ii) What do these standard deviations tell us? [1]

user	mean accuracy of drawing	standard deviation
Apple only	8.27	2.42
PC only	7.2	2.62
mixed	6.96	2.46

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4. There were no significant differences between the confidence ratings of drawings by each of the three user groups. What is meant by 'no significant difference'? [1]

In experiment 1B, the participants rated their confidence before and after drawing. Participants were more confident before than afterwards and the findings for drawing accuracy and recognition were similar to experiment 1A.

5. In experiment 1B, 16 participants were Apple-only users, 8 were mixed users and two were PC-only users. Express these participant numbers as a **ratio**. [2]

6. What does the similarity of the results in experiments 1A and 1B say about the **reliability** of the procedure? [1]

7. A statistical test found that the difference in confidence before and after drawing was **significant at p≤0.001**. What does this mean? [1]

8. The researchers looked for a correlation between the participant's confidence and their recognition (using only 24 of the participants' data). Assume that they did not know whether more confident participants would be more or less accurate. Their observed value of r was 0.59, and they used a significance level of p≤0.01.
Use the table below to find the **critical value**, then work out whether there was a significant correlation. [2]

number of participants	Level of significance for a one-tailed test			
	0.05	0.025	0.01	0.005
	Level of significance for a two-tailed test			
	0.10	0.05	0.02	0.01
22	0.359	0.428	0.508	0.562
24	0.343	0.409	0.485	0.537
26	0.329	0.392	0.465	0.515

Extension:
1. Why was it important that two experimenters rated the drawings and what else should they have done?
2. At which significance level, p≤0.001or p≤0.01, would a type one error be more likely?
3. Devise an experiment to compare recall of the logos of other computer makes with the Apple logo.

Reference: Blake AB, Nazarian M & Castel AD (2015) The Apple of the mind's eye: Everyday attention, metamemory, and reconstructive memory for the Apple logo. Quarterly Journal of Experimental Psychology, accessed online 16/4/15:
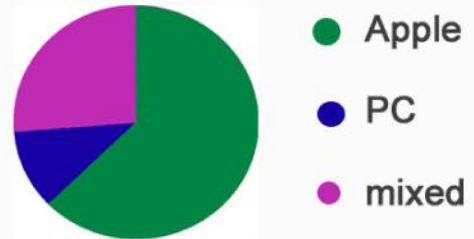http://castel.psych.ucla.edu/papers/BlakeNazarianCastel2015-Apple.pdf

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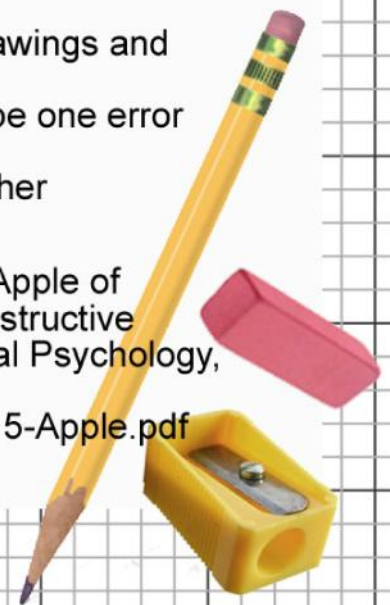
Suggested answers
1. Calculations:

user type	number	percentage	degrees of circle
Apple only	52	61	220
PC only	10	12	43
mixed	23	27	97
Total	85	100	360

number of participants

- Apple
- PC
- mixed

2. 'Counterbalanced' means that the options (eg experimental conditions or stimuli) were arranged in every possible order (for presentation to participants). This is important because it ensures that possible bias caused by seeing the stimuli in any particular order is evened out, for example in this case seeing a particular Apple logo such as the real one first or last might give the participant an advantage at identifying it.

3. a) (see graph)
b) Apple users were slightly more likely to be able to draw the logo accurately than the others, but not much. PC users were slightly better than mixed users, but not much.
ci) The standard deviation shows the average spread of data from the mean.
cii) That the spread in all the groups is quite similar / that the PC-only group is more varied than the other two / that the PC-only group is the most varied in terms of accuracy, followed by the mixed users and the Apple-only group are most similar in terms of accuracy.

4. 'No significant difference' means that (according to an inferential/statistical test) the differences between the groups were small enough to have arisen by chance (at a given probability).

5. 16:8:2 Apple-only: mixed: PC-only users is 8:4:1 Apple-only: mixed: PC-only users.

6. The procedure is reliable as the same test (on a similar participant group) has produced the same results.

7. Significant at $p \leq 0.001$ means that there is only a 0.001% possibility that the results found could have arisen by chance.

8. The observed of r (0.59) is larger than the critical value at $p \leq 0.01$, n=24, two-tailed (0.537) so there is a significant positive correlation.

number of participants	Level of significance for a one-tailed test			
	0.05	0.025	0.01	0.005
	Level of significance for a two-tailed test			
	0.10	0.05	0.02	0.01
22	0.359	0.428	0.508	0.562
24	0.343	0.409	0.485	0.537
26	0.329	0.392	0.465	0.515

Some other useful links:
https://www.psychologytoday.com/blog/everybody-is-stupid-except-you/201304/do-you-know-where-the-nearest-fire-alarm-is
http://dcity.org/brain-games/memory-for-pennies
http://gnodevel.ugent.be/memory-logo/

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