Example Context Elaboration: Memory Test

Focus: Experimental design

Achievement objective S8-1

In a range of meaningful contexts, students will be engaged in thinking mathematically and statistically. They will solve problems and model situations that require them to:

Carry out investigations of phenomena, using the statistical enquiry cycle:

A conducting experiments using experimental design principles, conducting surveys, and using existing data sets

B finding, using, and assessing appropriate models (including linear regression for bivariate data and additive models for time-series data), seeking explanations, and making predictions

C using informed contextual knowledge, exploratory data analysis, and statistical inference

D communicating findings and evaluating all stages of the cycle.

Paired comparison

Students are expected to inform themselves on the context for the investigation. They should be introduced to some key information about memory and memory processes e.g. working memory, short-term memory etc., and then asked to find out information about research that has been conducted into memory of different things such as words, objects, faces, and sounds. Students could also participate in online memory tests, such as face recognition tests. This will enable them to have some background knowledge about memory tests.

Problem

Discuss with students whether some words are easier to remember than others. Examples to compare could be: Are concrete words easier to remember than abstract words? Are "real" words easier to remember than nonsense words? Are short words easier to remember than long words? Research reports that nouns tend to be easier to recall than non-nouns.

The problem for this investigation will be "How many more nouns than non-nouns do Year 13 students at this school tend to remember?"

Plan

This problem will be investigated using an experiment. The design for this experiment will involve a paired comparison. Each student will be given a list of 15 nouns to memorise, and a list of 15 non-nouns to memorise.

Discuss with the students why you would do paired comparison e.g. some students are better at remembering words than others. In a comparison of two independent samples, information about whether each student can remember more nouns than non-nouns is lost. Designing the experiment so that the increase/decrease in words remembered can be measured for each student, which will allow an estimate for the average difference between the number of nouns and non-nouns recalled.

Discuss other factors that might influence a person's ability to memorise words e.g. gender, age, familiarity with words, previous experience with memorising words (actors).

Discuss how the words for the test will be selected and the order they will be presented on the test. Discuss how some words may be more familiar to students, and how some groups of words might be more easily remembered (e.g. if they can be linked to make a story). Words should be randomly ordered to minimise these kinds of bias.

Discuss which test students should get first? Should they all get the nouns test first, and then the non-nouns test? Discuss "carry-over" effects – doing the first test might help them to better on the second test by having an opportunity to practice memory skills. Students should be randomly assigned which test they do first to balance the carry-over effects. If all students completed the non-nouns test first, the increase in words remembered on the noun test could be explained by the fact they had practice at a memory test, not just the change of word type.

Discuss how the memory tests will be carried out. Will they be paper tests or online tests? Will the words be read out to students, or will they read them themselves? Can the test be completed anonymously? For this type of experiment, you must be able to pair up the results for each student for each test.

Discuss how long there should be in between the two tests. Discuss how the conditions for each test need to be the same (same teacher, same room, same level of noise etc.)

<u>Procedure for each test:</u>
All students will be given one minute to memorise as many words as possible. All students will be asked to turn over the list and then write down as many words as they can recall. They will be given two minutes to do the recall.

Data

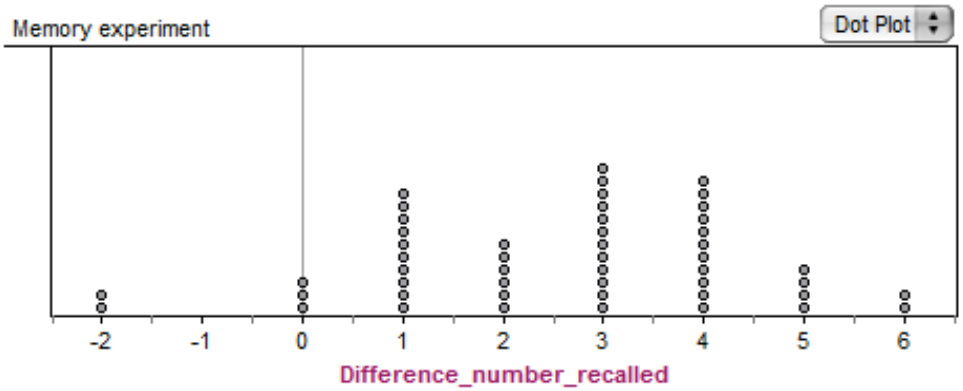
Discuss how they will collect the data – will students self-report their score? Or will they hand their sheets in for scoring?

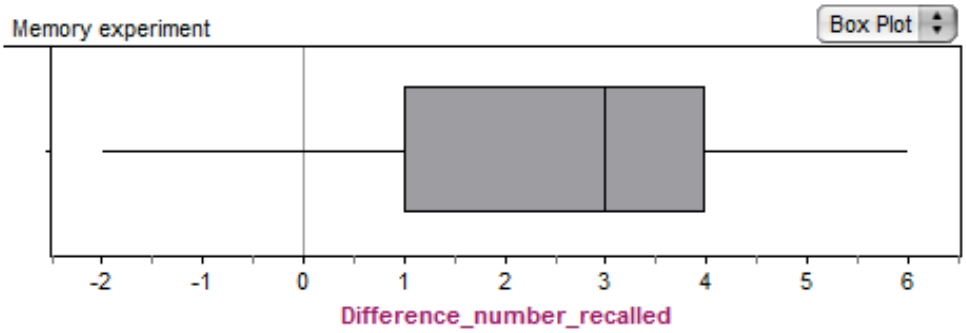
Structure the data in a spreadsheet with four columns: student, nouns recalled, non-nouns recalled, and difference in words recalled e.g.

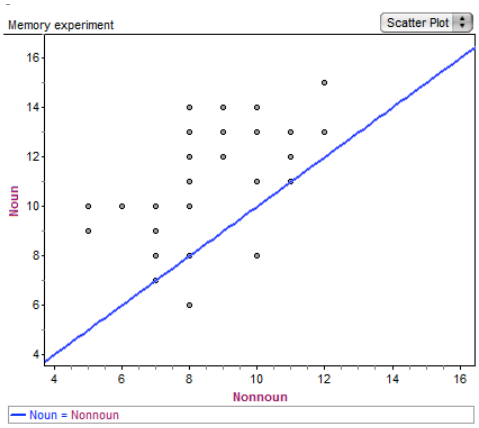
Student	Nouns recalled	Non-nouns recalled	Difference Nouns – non-nouns
1	8	5	3
2	9	11	-2
3	8	8	0

(see example at the end of this document)

Analysis







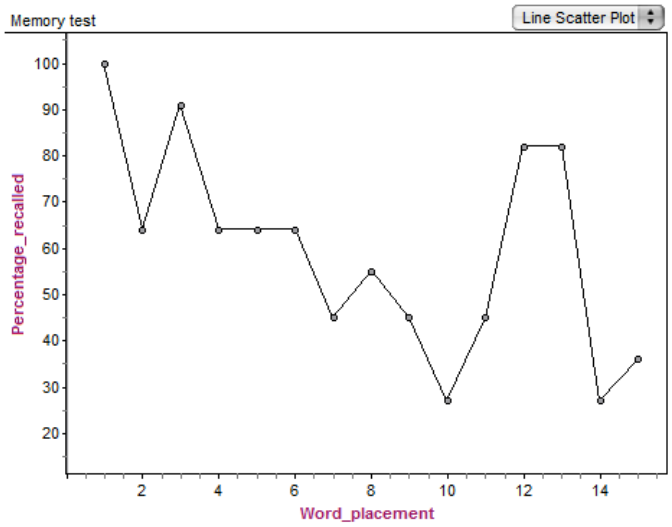
Memory experiment

	Difference_number_recalled
	2.6
	-2
	1
	3
	4
	6

S1 = mean ( )
S2 = min ( )
S3 = Q1 ( )
S4 = median ( )
S5 = Q3 ( )
S6 = max ( )

Students should analyse and interpret the data, including finding the confidence interval for the mean/median difference to estimate the size of the effect. A scatterplot can be produced, with a y = x line added. This can be used to see whether there are more positive differences, across the range of non-noun scores, and glean other information about word recall from any patterns in the variability.

Conclusion

Reflection	Students should compare the results from the comparison of two independent groups experiment and the paired comparison experiment. They should reflect on any differences in estimates made, consider the different designs of the experiment and the analysis that was completed for each type of experiment.
Extension activity	Is gender a factor in the recall of nouns and non-nouns? Are there other variables that should be measured at the time of the experiment (e.g. gender, age, time of day) that could be used to explore the data further. Is the order of words a factor in the recall of nouns and non-nouns? For the same list of words, presented in two different orders…..
Further exploration	Students can consider what other information they can obtain from the experiments. What they would like to explore further may require changes to how they record the data. Does word position related to the percentage of students who recall the word? Research would indicate that words at the beginning of the list are recalled better than words in the middle of the list (primacy effect), and words at the end of the list are recalled better than words in the middle of the list (recency effect). Students would need to record for each individual participating whether they recalled each word on the list.  Were particular words recalled better than other words? Does a word have a particular association for that group of students? (bar graphs can be drawn for each word, with the percentage of the class that recalled it). What was the typical number of words sequentially recalled? Do some students display evidence of using a memory technique? Can you improve memory? Design an experiment where one group learns a memory technique such as chaining visualisations, and one group is a control group.

Sample data

Student	Non-noun	Noun	Difference_number_recalled
1	7	10	3
2	6	10	4
3	5	9	4
4	10	11	1
5	6	10	4
6	8	10	2
7	8	8	0
8	8	13	5
9	7	10	3
10	7	9	2
11	8	14	6
12	10	13	3
13	7	8	1
14	10	11	1
15	5	10	5
16	8	13	5
17	9	12	3
18	6	10	4
19	9	12	3
20	10	11	1
21	10	11	1
22	9	12	3
23	12	13	1
24	11	13	2
25	9	12	3
26	11	12	1
27	9	14	5
28	8	11	3
29	8	12	4
30	5	9	4
31	11	11	0
32	8	12	4
33	9	12	3
34	9	13	4
35	10	11	1
36	7	9	2
37	9	13	4
38	10	11	1
39	8	14	6
40	10	14	4
41	9	12	3
42	5	9	4
43	8	6	-2
44	8	10	2
45	7	7	0
46	7	9	2
47	10	8	-2
48	9	12	3
49	12	13	1
50	12	15	3