

# Older, yes...smarter, maybe?

## - A multiple data set analysis of cognitive development -

As we grow up our mental as well physical abilities develop.

Quantitative and problem solving skills improve as we mature. Our ability to use language increases, but our ability to learn new languages decreases after late childhood. Memory tends to improve with age, but perception is fully developed shortly after birth.



This development is necessary because more and more is asked of our brains as we approach adulthood. This can be seen in schools where, as students get older, they are asked to concentrate for longer and longer periods during assessment and learning tasks.

For this reason it important the ask the question,

*In what way does a student's ability to concentrate change with age?*

This is the type of question that a statistical analysis of data can help answer.

One source of data relating to this question is

[www.abs.gov.au/websitedbs/CaSHome.nsf/Home/students%20Area](http://www.abs.gov.au/websitedbs/CaSHome.nsf/Home/students%20Area)

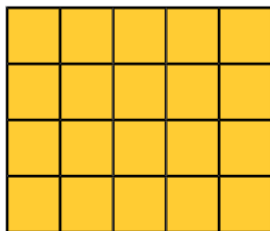
This is the student area of the website for the *Census at School*, an internet based survey conducted by the Australian Bureau of Statistics in 2006.

32. Complete the following concentration exercise. *Uncover all the blocks by successfully matching the image pairs*

This question requires the use of a mouse and the ability to recognise multiple images. If you are unable to do this please skip to question 33.

Click the Start button below to start a new game whenever you want.

Result:  seconds.

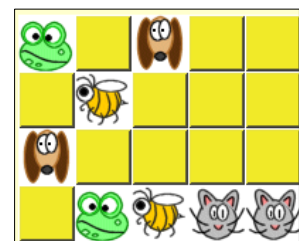


Over 100 000 students of all ages completed this survey. It is possible to obtain samples from the resulting database by visiting the above website. One such sample has been taken and the results from the concentration exercise (see left) have been noted for three groups of students. The analysis of this sample will aim to answer the above question.

In this concentration exercise symbols are revealed two at a time, and the time required find the matching pairs of symbols is recorded. If you would like to complete this type of exercise for yourself, one can be found at

[www.censsonline.net/multi2004/samplesol4.htm](http://www.censsonline.net/multi2004/samplesol4.htm)

By analysing the time taken to complete this activity by random samples of Year 8, Year 10 and Year 12 students conclusions can be drawn about how the ability to concentrate changes over the high school years.



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
## Activity 1 – Having a look at Box Plots.

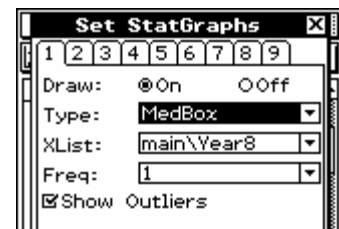
The time taken to complete the concentration exercise by random samples of 24 Year 8, Year 10 and Year 12 students who completed the Census at School are,

Year 8	90	42	49	37	35	71	36	34	26	49	53	26
	60	18	36	71	58	29	67	40	52	35	37	61
Year 10	74	56	38	51	38	24	36	30	26	33	33	46
	26	42	70	55	47	35	43	30	38	99	27	56
Year 12	42	48	41	46	49	24	28	28	45	22	30	45
	48	37	62	44	52	36	35	33	40	39	29	81



A. Enter these three samples into List 1, List 2 and List 3 in the  mode of a CASIO *ClassPad 300* (named if you wish).


B. In Set StatGraphs (tap ) set up StatGraph1 to be a Box Plot of Year 8 completion times, StatGraph2 to be a Box Plot of Year 10 completion times, and similarly for StatGraph3.

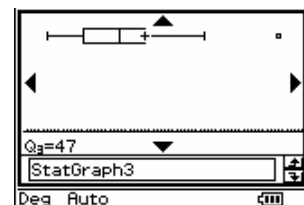


- The (Median) Box Plot (MedBox) has a Show Outliers option. When turned on, it identifies *outliers* in the sample and marks them separately.\*

- Draw a Median Box Plot for the Year 12 concentration time samples with the Show Outliers option *unticked*.
- Draw a Median Box Plot for the Year 12 concentration time samples with the Show Outliers option *ticked*.
- Explain what the Outliers option adds to your understanding of the Year 12 concentration time sample.



C. With Box Plot visible, tap  (or Analysis : Trace) and use the Arrow Pad (or the on-screen arrows) to trace through the Box Plot of the Year 12 sample. The values displayed make up the *Five Number Summary* for this sample.



\* The test that the CASIO *ClassPad 300* uses to determine whether a given score is an outlier or not is whether it lies more than 1.5 times the I.Q.R. before Q1 or after Q3. This can be a handy 'rule of thumb' but ultimately the determination of outlier status is somewhat subjective and should be made with reference to the data set and context from which it originates.

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By using the technique described above,

4. Write down a Five Number Summary for the three samples.
5. Identify any outliers in the three samples.
6. Present an argument for not excluding these outliers from the samples.

Checkpoint





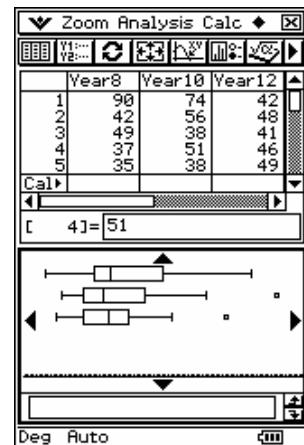
## Activity 2 – Having a look at three samples at once.

To best compare the times recorded in the concentration exercise by our three year levels they should be graphed *side-by-side*.

This can be done using Box Plots.

To do this, return to Set StatGraphs (tap ) and turn all three Box Plots  $\odot$ n.

**Note:** With multiple graphs drawn trace can still be used. Use  and  to move between the graphs displayed.



1. What aspect of these Box Plots suggests that the ability to concentrate of students within a year level varies less as they progress through secondary school?
2. What aspect of these Box Plots could be used to argue that concentration improves as students progress through secondary school?
3. What aspect of these Box Plots could be used to argue that concentration *does not* improve as students progress through secondary school?
4. Reconcile the evidence discussed in questions 2 and 3.