



Radio National

## Knockham's razor

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### The Need For Statistical Literacy In Australia

**Summary:** Jane Watson is convinced that we not only need to have Australians who are good at words and can read, they also need the numbers as well.

**Transcript:**

**Robyn Williams:** It's Science Week, with events in Canberra and broadcasts all over Australia, including this one. The point of the exercise is to show that science is immensely interesting, often fun, and invariably useful. And it's the useful part we concentrate on today.

Jane Watson is convinced that we not only need to have Australians who are good at words and can read, they also need the numbers as well. Don't believe that you can get away these days with only the vaguest feeling for fractions or roots, with the smug excuse that there are lies, damn lies, and statistics. If you do, you'll find yourself being hoodwinked. You may also miss out on some fun.

Jane Watson is Reader in Mathematical Education at the University of Tasmania.

**Jane Watson:** For some time, there has been a widespread concern about literacy in our community, and in recent Federal Government statements, numeracy has been added to the 'basics' agenda as well. But unfortunately there is much less concern about an area which incorporates both of these, namely statistical literacy.

Today I want to tell you some humorous stories. At least they will be humorous if you are statistically literate. So this is a bit of a test. Whether you chuckle or not throughout these few minutes, I hope you will take on my plea for a concern about improving the statistical literacy of the Australian community.

H.G. Wells voiced the following prophecy at the end of the last century: 'Statistical thinking will one day be as necessary for efficient citizenship as the ability to read and write.'

Here we are at the end of another century and the question arises as to whether we are close to the required standard for good citizenship.

Some of my stories were meant to be jokes by those who initiated them, and others became a joke to me because of their statistical illiteracy.

You probably remember the series of commercials produced by the Ford Motor Company to advertise its Ford Laser automobile, with the announcer saying in a deep voice, 'The average young Australian family has 2.3 children.' Then a child appears with a point-3 on his windcheater and says, 'Yeah, and I'm the point-3.' What follows is a discussion of Point-3's size and the size of the car which will hold his parents and his two older siblings.

I thought it was a very clever ad. And the follow-up advertisement when Point-3 turned Point-4 embellished the myth about a child growing and increasing in decimal value.

My interest in the advertisement increased when I was involved in a research study of children's understanding of 'average', a few months after the advertisement appeared. It became immediately apparent that the ad. had helped shape the concepts of children who did not already have a sophisticated understanding of a decimal number like 2.3 representing an average. When asked, 'What does it mean when we say the average Australian family has 2.3 children?' it was not at all unusual for a child to reply, 'It means they have two older children and one younger one, that sort of gets left out.'

In fact one Grade 9 student offered a quite detailed explanation that 'A child counts as point-1 when it is one year old, and will count as 1.0 when it is 10.'

I found this rather frightening. Not because it wasn't a clever explanation, it was, but because as educators we had failed in our job of teaching the concept of average. When asked if this is how the Bureau of Statistics would count family size, the student replied, 'Well, probably not.'

To get over the dilemma of a child counting as 1 once it is born, several children explained the average of 2.3 children as 'It could be that a mum has two children and she is pregnant.'

This is another point where you should chuckle. One child, after giving this response however, paused in great cognitive conflict and said, 'But that's not the way they did it on the ad.'

It appears that the Ford Motor Company has more influence on how many people conceive of average than the old 'add-'em-up-and-divide' algorithm we were all taught in school.

Let me move on to another story which was again meant to be humorous, to catch the attention of newspaper readers and influence their consumption of fish. The story appeared as a result of a press release from John West foods. The sentence of interest to us at the moment is the following:

'Seven in ten men who frequently eat canned tuna, sardines, salmon, mackerel or kippers admit to being ambitious.'

While this might encourage many wives to rush out and purchase tinned fish, I was intrigued about the study which might have produced such a result. After some correspondence with John West and its advertising agency, I managed to obtain the report upon which the press release was written.

Detailed reading of the report was like solving a mystery. The sample for the study was 250 people, quite respectable. Of these, half were men and half women - still OK. But then the analysis of the questions asked began. People were asked about their fish consumption in four levels: frequent, regular, infrequent, and never. And then they were asked their feelings of ambition compared to others around them. When it came to sorting out the responses into the 16 overlapping

categories, lo and behold, only six men ate fish frequently and of these, four considered themselves more ambitious than their colleagues.

We can see that a judicious rounding  $4/6$  to  $.7$  produced the claim of "7 in 10 men" in the article. But surely it is very misleading to imply that "7 out of 10" means "7 out of every 10" or 70% of a large number of men. It would have been more honest to say "4 out of the 6 men we interviewed", but who would have published such a non-significant finding?

The lesson of course is, that even when you start with a large sample size in a survey, the questions you ask may reduce the information when you cross-tabulate different categories. While I don't want to condemn John West for a publicity exercise, I would be more worried if such statistical analysis took place in an area of more concern to the community, such as workplace safety, or medical research. Let us hope that the statistical literacy and ethics in the rest of the research community are of a higher level.

Remaining with newspapers, I want to give you a thought problem about averages, but without calculations. A report in one of our major metropolitan newspapers recently reported on average home loan repayments. The context of the story was about them falling, I think, but that isn't the issue. A table with the article gave the average repayment for the whole of Australia and then under it, the average repayment for each of the States and Territories. Now to find the overall average for Australia is what is called a 'weighted average' problem. That is, we need to weight the average for each State and Territory by its size, in order to get the overall Australian average. The same thing is done for unemployment rates. Hence Tasmania and the Northern Territory would have less impact on the national average than New South Wales or Victoria. In looking at the numbers in the table, the average for Australia was \$599. While the average for Tasmania was \$493, the averages for the other States and Territories ranged from \$602 in Victoria to \$822 in the Australian Capital Territory. Can you imagine a number line with \$493 at the left end representing small Tasmania? Then move along to \$599 as the balance point for all of Australia. And then all of the other seven States and Territories with their larger total population spread out to the right of the line. Even though we cannot precisely calculate the average because we don't know the exact weights of the States and Territories, our intuition should tell us that there is no way the national average can balance at \$599.

An example which is easier to follow is one which appeared on the front page of one of our most famous national financial newspapers. It was a pie chart, which you will recall should be circular and represent the partitioning of a whole into its component parts using some criterion. In this case, the splitting was in relation to market share of groceries in Australia. One glance at the chart, however, showed that a piece of the pie much less than half of its total was labelled 61%. How unusual. A quick sum of all of the percentages in the chart yielded a total of 128.5%. This is indeed worrying. I found myself smiling, because our leaders in financial reporting had succumbed to such a fundamental error. They would probably blame a computer graphics package, but I would be suspicious of the level of statistical literacy of the user of the package.

I started out with an example which displayed a lack of statistical literacy in our schoolchildren, but I rapidly moved on to the adults, with examples from our news media. I could of course give you many more examples. But what do we need to do to ensure that the next generation of Australian citizens does not succumb to the same sort of statistical illiteracy demonstrated in these media examples? Obviously an education program is one avenue, through our schools. Certainly recent curriculum documents in Australia are supportive if we can implement them.

It seems to me that there are three stages in the development of statistical literacy of which we need to be aware, as parents, as teachers, and as citizens. Every opportunity should be taken at each stage to ensure children, or even adults, develop the required skills to lead on to the next.

At the first stage is the basic understanding of statistical terminology. There are obviously some words like 'average' which we need to define carefully for students, and ensure their understanding. For instance, by giving the opportunity to work backwards from an average to a data set. If you were told that 10 numbers had an average of 2.3, could you find 10 numbers producing this average? This is the type of exercise being suggested for today's classroom.

At the second stage is the understanding of statistical language and concepts when they are embedded in the context of wider social discussion. Students may very well be able to calculate the average of their scores on the last 10 maths tests, but what about meeting the average in the Ford advertisement or in a newspaper article where some understanding of weighting is required? In fact, moving the mathematics into wider social contexts may even make it more interesting. Let me ask you again: If you were told that 10 families had an average of 2.3 children, could you create ten families satisfying the average?

There is great opportunity for teaching statistical literacy in context now that curriculum statements for the other subjects, such as health and physical education, technology, studies of society and the environment, and science, all include components which rely on statistical literacy for their full understanding. To take advantage of this opportunity requires that teachers possess the statistical literacy skills themselves.

At the third stage, there is the development of a questioning attitude which can apply more sophisticated concepts to contradict claims which are made without proper statistical foundation. This is our ultimate aim. We want people who read about ambition and fish-eating to immediately question the survey and its results. They may not be able to find the source, but they should still be cautious in accepting the results. We also want people to write letters to the editors of newspaper to tell them their pie charts don't add up to 100%.

I know that it takes confidence to question the authority which we feel imposed upon us by the media; but as confidence in statistical literacy grows, perhaps there will be much less need to do it. And we may have the whole population laughing at the Ford Laser commercials for the right reason.

**Robyn Williams:** And I think it's important to laugh at commercials, don't you?

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