

## Example: $\chi^2$ (CHI-SQUARED) TEST FOR ASSOCIATION

This example uses material from the STARS project ([www.stars.ac.uk](http://www.stars.ac.uk))

This example uses data collected from a junior school in the UK. Pupils were asked questions about bullying. We are going to look at whether there are differences between boys' and girls' experience of being bullied. The results were produced using SPSS and have not been edited.

### Presenting your findings

The table below shows how children answered when asked if they were bullied by boys or girls. As we are interested in the experience of being bullied, only children who had been bullied are included in the analysis. You can see that 54 boys and 55 girls had been bullied, 70 children had only been bullied by boys and 21 had only been bullied by girls, 18 children had been bullied by both boys and girls.

gender \* sexbully Crosstabulation

Count		sexbully			Total
		Girls	Boys	Both	
gender	Boy	0	51	3	54
	Girl	21	19	15	55
Total		21	70	18	109

The table shows the numbers of children in each category but comparisons between the experiences of boys and girls are clearer when percentages are used. In this example, the row percentages are used:

gender \* sexbully Crosstabulation

% within gender		sexbully			Total
		Girls	Boys	Both	
gender	Boy		94.4%	5.6%	100.0%
	Girl	38.2%	34.5%	27.3%	100.0%
Total		19.3%	64.2%	16.5%	100.0%

The percentages show that in this sample of children, most boys (94.4%) were bullied by other boys but a few (5.6%) had been bullied by both girls and boys. None had been bullied by girls but not boys. Amongst the girls in the sample, experiences were more varied, some (38.2%) had only been bullied by girls, some (34.5%) only by boys and

others (27.3%) by both. Clearly in this sample of children, boys and girls had different experiences, but is the same is true for all boys and girls of this age? The table on its own is not enough to decide this.

### **Taking it further: testing hypotheses**

To test whether the differences between boys and girls' experiences in the sample provide statistically significant evidence of a difference between boys' and girls' experiences in the population, the chi-squared test is used.

The chi-squared test is appropriate because:

- (1) we are comparing independent samples (boys v girls)
- (2) the measurement being compared ("who have you been bullied by?") is one that puts individuals into one of a number of categories

The null hypothesis can be expressed either in terms of the comparison between boys and girls:

"The proportions of children who were bullied by boys, girls or by both sexes are the same for boys and girls"

or in terms of an association:

" There is no association between the sex of the victim of bullying and the sex of the children who bullied them"

The test result, from SPSS is shown below. The key figures, the test statistic (43.623), degrees of freedom (2) and P-value (shown as .000), have been circled:

**Chi-Square Tests**

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	43.623 <sup>a</sup>	2	.000
Likelihood Ratio	53.022	2	.000
N of Valid Cases	109		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 8.92.

SPSS displays the P-value to 3 decimal places. Values that are very small, but not actually zero, will appear as 0.000 but would be better reported as  $P < 0.001$ .

The footnote to the table provides information that can be used to check whether the data meets the conditions for using the test. For the  $\chi^2$  test to be reliable, less than 20% of cells in the table should have expected values of less than 5. The footnote records whether this is a problem. As the percentage of cells with expected values of less than 5 is zero, the condition is met.

### **Interpreting the test**

As  $P < 0.05$ , the null hypothesis is rejected – there is statistically significant evidence that girls and boys differ in terms of who bullies them. As a statistically significant effect has been found, the pattern needs to be reported – here the ‘effect’ is that girls’ experience of being bullied is more varied – spread between boys, girls or both whereas boys are almost exclusively bullied by other boys and only a few children report being bullied by girls or both boys and girls.

### **What can you say?**

*There is statistically significant evidence that girls and boys differ in terms of who bullies them ( $\chi^2 = 43.62$ ,  $df = 2$ ,  $P < 0.001$ ). While girls are likely to report being bullied by boys, other girls or both boys and girls, all but a small proportion of boys report being bullied only by other boys.*