

THE NULL HYPOTHESIS: THERE'S NOTHING TO IT

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The previous article in this series explained how to construct a research hypothesis. This article will help you to further understand hypothesis testing by exploring the concept of the 'null hypothesis'.

Imagine you are conducting a study to investigate whether white or dark chocolate is tastiest (for the purpose of this explanation we'll leave to one side that 'tastiness' is really a matter of personal preference). Let's suppose that you have a preference for dark chocolate rather than white and want to reflect this bias in your study. You could select an outcome measure that favours dark chocolate or select research subjects who prefer dark chocolate.

Researchers use the 'null hypothesis' to try to avoid this type of bias when designing studies. The null hypothesis (H_0) is defined as, "a statistical hypothesis that predicts that no difference or relationship exists among the variables studied that could not have occurred by chance alone". The null hypothesis in the above study would therefore be that the two types of chocolate were equally tasty. To test the null hypothesis researchers should include:

- Subjects who have:
 - no preference for either type of chocolate or
 - do have a preference, but the study is designed so that an equal number of people in each group have a preference for dark chocolate
- An outcome measure that will not bias the results towards one type of chocolate over another.

Randomised controlled trials are usually conducted because the researchers believe that a new intervention is at least as beneficial, if not more, than the current intervention. By designing the study to test the null hypothesis the effect of the researchers' initial premise on results will be minimised.

EXAMPLE

Let's use an example from the *Evidence in Practice* section in the September 2008 issue of the journal. The researchers (Almirall J, Bolibar I, Serra-Prat *Met al. Eur Resp J* 2008; 31: 1274-84) investigated if community-acquired pneumonia (CAP) could be prevented by modifying risk factors (eg contact with children, temperature fluctuations, weight, smoking status and alcohol consumption). The null hypothesis was that there is no relationship between risk factors and CAP. As it is known that the incidence of CAP is higher in the elderly than in young adults, they ensured that the sample included a wide range of ages. Not to have done so may have biased the results and led to a relationship being found between the variables that may not have been found if a wider age range was included in the study (a Type I error). In this study they were aware of this potential bias and designed the study accordingly. The data analysis indicated that the null hypothesis was false; ie there was a statistical relationship between certain risk factors and CAP in the sample. The null hypothesis was therefore rejected.

TYPE I AND TYPE II ERRORS

As indicated above, the null hypothesis is sometimes rejected when it should have been accepted; alternatively in some studies it is accepted when it should have been rejected. These are called Type I and Type II errors. We'll explain these terms further using our study of the tastiness of chocolate mentioned above.

- If in the study we had biased the results (eg by only including people with a preference for dark chocolate in the study) and concluded that dark chocolate was tastier than white chocolate, whereas 'in truth' they were equally tasty, this would be a Type I error (false positive). In this case the null hypothesis (which was actually correct) has been rejected.
- If, however, the study concluded that dark and white chocolate were equally tasty, but 'in truth' one was tastier than the other then a Type II error (false negative) has occurred. In this case the null hypothesis (which was false) was not rejected. This may happen if, for example, the sample size was too small to detect a difference.

The figure below demonstrates the difference between Type I and Type II errors.

		True result	
		White and dark chocolate equally 'tasty' (H_0)	White and dark chocolate NOT equally 'tasty' (H_1)
Conclusion drawn	White and dark chocolate equally 'tasty' (H_0)	Correct	Type II error (false negative)
	White and dark chocolate NOT equally 'tasty' (H_1)	Type I error (false positive)	Correct

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