



Uni-edit English Writing Tip 011

How to significantly improve your usage of the term 'significant'

Difficulty: Intermediate

How many times have you seen the word 'significant' used in a scientific paper either with statistical results or to discuss the importance of something? Did you know its meaning is different depending on if it is used in a statistical or non-statistical sense?

For example, what's wrong with this sentence from a paper's Discussion section?

Significant levels of bisphenol-A were detected in 47 of the 50 sites sampled (85.0%).

What is clear is that 'significant' is used in a general sense, to indicate degree or extent. What is unclear is whether the author is referring to the levels' importance or relevance, or instead to a statistical, quantitative interpretation.

To make this writing tip easy to follow and distinguish common examples, we divide 'significant' into two categories: 'statistical' and 'non-statistical'.

Statistical Usage

In its statistical sense, 'significant' is commonly used in the Results section to indicate how much a variable differs from a null hypothesis or baseline measurement based on the P-value, usually $P < 0.05$.

There was a statistically significant difference between the experiment and control groups ($P < 0.05$), leading us to reject our null hypothesis.

This means the quantitative difference between the two groups was large enough to satisfy the statistical criteria of the analysis comparing the two groups.

By the way, it is often more effective and natural to combine the adverb form 'significantly' with an adjective, so that readers intuitively understand the axis of measurement.

Okay: **There was a statistically significant difference between the time taken by our nutrient extraction method to extract 1 kg of oleic acid and that taken by the leading conventional method (Robinson et al., 2015) (6.3 ± 1.2 h vs. 8.0 ± 0.5 h; $p = 0.032$).**

Better: Our nutrient extraction method extracted 1 kg of oleic acid significantly faster than the leading conventional method (Robinson et al., 2015) (6.3 ± 1.2 h vs. 8.0 ± 0.5 h; $p=0.032$).

Non-statistical Usage

In its non-statistical sense, 'significant' is commonly used to express the importance or relevance of something, generally speaking.

Iron ore is a significant export contributing to Australia's economy.

This could be rephrased to: Iron is an important export contributing to Australia's economy.

Our finding that rice paddy runoff reduces salinity of adjacent lagoons bears significance on India's aquacultural policy.

This could be rephrased to: Our finding that rice paddy runoff reduces the salinity of adjacent lagoons has relevance to India's aquacultural policy.

The meanings here are general. For example, the first sentence does not mean that all of Australia's exports were analyzed, and our statistical results give us confidence that the quantity of iron was greater than another export. It just means Australia exports a lot of iron (it also exports a lot of wheat and wool, but that's not relevant here).

Resolving ambiguity - Example 1

Significant levels of bisphenol-A were detected in 47 of the 50 sites sampled (85.0%).

Does the author mean that the levels were significantly higher with respect to a standard or baseline measurement? Or that these results were important (and thus cause for concern)? This sentence requires major revision, even if both usages were intended:

- 1.) Based on the grammar alone, a reader is justified in assuming bisphenol-A is good, and that low levels are cause for concern.
- 2.) There is no object of comparison: what are the levels higher (or lower) than?

Important: The high levels of bisphenol-A detected in 47 of the 50 sites samples (85.0%) are cause for concern.

Statistically significant: Levels of bisphenol-A significantly higher ($p < 0.001$) than the amount EPA guidelines consider safe were detected in 47 of the 50 sites sampled (85.0%).

Resolving ambiguity - Example 2

Our results agree with the significant findings of Kang et al. (2006), who found that β -carotene production was more efficient in 5% kerosene-supplemented media than in non-supplemented media.

Does the author mean that the Kang et al.'s findings were statistically significant? This is certainly suggested by the explicit comparison of '5% kerosene-supplemented media' and 'non-supplemented media'. Or does the author mean Kang et al.'s findings were important and ground-breaking? The grammar suggests this interpretation.

The author likely means both! If Kang et al.'s findings were both statistically significant and ground-breaking, this usage is acceptable. However, we can limit the word to one of these usages if warranted (e.g., if Kang et al.'s findings were not particularly novel).

Important: Our results agree with the major findings of Kang et al. (2006), who found that β -carotene production was more efficient in 5% kerosene-supplemented media than in non-supplemented media.

Statistically significant: Our results agree with the findings of Kang et al. (2006), who found that β -carotene production was significantly more efficient in 5% kerosene-supplemented media than in non-supplemented media ($F_{4,15} = 25.6$, $P < 0.001$).

Conclusion

The take-home messages from the above examples are:

- 1.) Significance is used to measure quantity, importance, and relevance; and
- 2.) Its usages can be conveniently categorized as 'statistical' and 'non-statistical'.

END OF TIP