Interactions

An interaction occurs when the differences between group means of one variable change at different levels of another variable. Consider a blood pressure example. Suppose the average blood pressure changes over different drug doses were plotted and then connected for Disease A and B. Let's consider some possible outcomes.

The left plot (with two parallel lines) would be produced if different types of disease show the same change in the response variable, BloodP, across different levels of DrugDose. 50mg of the drug lowers blood pressure approximately 10 points relative to the placebo, and this is consistent whether the patient has Disease A or B. The blood pressure of patients with Disease B is five points higher than patients with Disease A, regardless of whether they take the drug or a placebo. The effect of one factor does not depend on the other factor. Graphically, this is indicated by parallel lines.

Alternatively, suppose that as the dose increases, average blood pressure decreases for those with Disease A, but increases for those with Disease B, as represented in the plot on the right. This indicates an interaction between the variables DrugDose and Disease. The effect is highly different moving across drug dose levels.

This is only one possible illustration of an interaction, but any non-parallel lines indicate an interaction. Because of this, it's important to interpret any significant interactions that are found in your analyses. Instead of just saying, "The interaction was significant," it's necessary to take the time to understand and explain any interaction effect that you find. We'll show you three ways to explain interactions in the upcoming demonstration. When you analyze an n-way ANOVA with interactions, you should first look at any tests for interaction among factors. If there is no interaction between the factors, the tests for the individual factor effects, or main effects, can be interpreted as true effects of that factor. If an interaction does exist between any factors, the tests for the individual factor effects might be misleading. These are known as tests of marginal effects and tell only part of the story about the overall effect of that variable. This is especially true for unbalanced data, that is, data with different sample sizes for the groups.

So, what should you do if you determine that an interaction is not significant? You can analyze the main effects with the model in its current form, as originally written.

$$Y_{ijk} = \mu + a_i + \beta_j + (\alpha\beta)_{ij} + \varepsilon_{ijk}$$

This is generally the method that you use when you analyze designed experiments. But even in designed experiments, some statisticians suggest that if the interaction is not significant, you can delete it from your model, rerun the model, and then analyze the main effects. This increases the power of the main effects test. The approach that you choose might depend on your subject-matter knowledge and whether you think you should include the non-significant interaction term. If the interaction term is significant, it's a good practice to keep the main effect terms that constitute the interaction in the model, whether they are significant or not. This preserves model hierarchy.