

How to Easily Report Your Two-Way ANOVA Results

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Reporting the results of a Two-Way ANOVA is a crucial step in statistical analysis, requiring precision and strict adherence to standardized formatting, typically the conventions set by the American Psychological Association (APA). This sophisticated statistical test allows researchers to simultaneously evaluate the impact of two independent variables--or factors--on a single dependent variable, as well as the unique way these two factors might combine or influence each other. A clear report ensures that the findings regarding the F-ratio, degrees of freedom, and p-value are easily digestible and accurately reflect the complexity of the data.

The structure of the report must be logical, guiding the reader from the overall model summary to specific findings related to main effects and the crucial interaction effect. Failing to report necessary statistical values or presenting them out of order can lead to misinterpretation of the study's conclusions. Therefore, mastering the art of concisely and accurately summarizing these statistical outputs is essential for any empirical researcher seeking to communicate complex statistical findings effectively and credibly to the scientific community.

Understanding the Two-Way ANOVA Framework

The Two-Way ANOVA is a powerful extension of the one-way analysis of variance. Its primary function is to test for statistically significant differences in the means of a continuous dependent variable based on classification by two categorical independent variables (factors). For instance, a researcher might examine how both "**Treatment Type**" and "**Gender**" affect "**Recovery Time**." This methodology is indispensable when the research hypothesis posits that two distinct factors might influence the outcome simultaneously, and potentially interact with one another to produce a combined effect greater or lesser than their individual contributions.

When executing this test, three distinct hypotheses are evaluated: the two main effects (the individual effect of Factor A, and the individual effect of Factor B) and the synergistic interaction effect (how Factor A and Factor B combine to influence the outcome). It is the interaction term that fundamentally differentiates the Two-Way ANOVA from running two separate one-way ANOVAs. The proper reporting of these three components--using the appropriate APA notation--allows the scientific community to critically evaluate the study's internal validity and generalizability, ensuring the reader understands not just what factors matter, but how they work together.

Before diving into the statistical results, researchers must clearly define their variables and the specific factorial design employed. Clarity regarding the levels (groups) within each independent variable is paramount. For example, if "**Sunlight Exposure**" has three levels (Low, Medium, High) and "**Watering Frequency**" has two levels (Daily, Weekly), the ANOVA analyzes six distinct treatment groups. Reporting the full factorial structure provides the necessary context for the reader to interpret the degrees of freedom and the scope of the investigation. This foundational clarity sets the stage for a compelling and transparent statistical report.

The Standardized Structure for Reporting Two-Way ANOVA

Adhering to a standardized structure ensures maximum clarity and comparability across different research studies. The generally accepted flow prioritizes the most complex finding first: the interaction effect. This approach prevents misinterpretation, as a significant interaction often mandates a deeper dive into simple main effects, superseding the interpretation of the isolated main effects. The overall report begins with contextual information, transitions to the critical inferential statistics, and concludes with a summary of the practical meaning derived from the descriptive data.

The standard structure is broken down into four distinct phases, which should be followed sequentially in the narrative text. First, introduce the variables and the test performed, setting the analytical stage. Second, report the statistical findings for the interaction effect, determining if the factors operate independently or synergistically. Third, if the interaction is non-significant, proceed to report the two main effects. If the interaction is significant, however, you must pivot to reporting **simple main effects** and subsequent post-hoc tests to understand the conditional relationships. Fourth, conclude with descriptive statistics (means and standard deviations) to ground the inferential results in the raw, observed data.

This organizational method is critical because the presence of a statistically significant interaction fundamentally alters how the main effects are interpreted. If the interaction is significant, it means the effect of one factor **depends** on the level of the other factor, making the marginal main effects potentially misleading or irrelevant. Therefore, always address the interaction first, using its significance (or lack thereof) as the navigational guide for the rest of the results section. The general structure, widely accepted in APA reporting, is summarized as follows:

Introduction and Variables: Clearly define the continuous dependent variable and the two categorical independent variables (factors) being tested.

Interaction Effect Analysis: Report the results for the Factor A × Factor B interaction effect, including the F-statistic, degrees of freedom, and p-value.

Main Effects Analysis: Based on the interaction result, report either the overall main effects (if the interaction is non-significant) or the simple main effects (if the interaction is significant).

Post-Hoc Tests: If any main or simple main effects are significant and involve factors with more than two levels, report the specific post-hoc test used (e.g., Tukey's HSD or Bonferroni correction) and its findings.

Essential Statistical Elements to Include

For every effect tested--the interaction and the two main effects--three core statistical elements derived from the ANOVA summary table must be reported: the **F-statistic**, the associated degrees of freedom (df), and the significance level (p-value). These elements, often accompanied by a

measure of effect size (such as partial eta-squared, η_p^2), provide the necessary information for the reader to understand and potentially replicate the test results completely.

The F-ratio is the key test statistic, calculated as the ratio of the variance explained by the model (mean square between groups) to the variance unexplained (mean square within groups or error). A larger F-ratio suggests a greater effect of the independent variable(s) on the dependent variable. It is presented in parentheses, followed by the two types of degrees of freedom: the numerator df (associated with the effect) and the denominator df (associated with the error term). Reporting the F-ratio correctly is paramount, ensuring that the reader can verify the test statistic against the critical F-value and understand the robustness of the finding.

The p-value indicates the probability of observing the data (or data more extreme) if the null hypothesis were true. When reporting, the p-value is compared to the predefined significance level, typically $\alpha = 0.05$. If $p < \alpha$, the effect is deemed statistically significant. It is conventional practice in APA style to report exact p-values rounded to two or three decimal places, unless the value is extremely small, in which case it is reported as $p < .001$. For clarity, consistency in rounding throughout the entire report is non-negotiable.

Formalizing the Narrative: Using the APA Reporting Template

The narrative description of the Two-Way ANOVA results should follow a strict format to maintain professionalism and statistical rigor. The following template provides the exact language required to transition the raw data from the output table into a cohesive written summary. Note the specific inclusion of the statistical parenthetical statement immediately following the mention of the effect. This structure is universally recognized in quantitative research reports and maximizes comparability.

A two-way ANOVA was performed to analyze the effect of and on .

A two-way ANOVA revealed that there a statistically significant interaction effect between the effects of and (F(df interaction, df within) = , p =).

If the interaction was **non-significant**, continue with main effects analysis:

The main effect for reach statistical significance (F(df 1, df within) = , p =).

The main effect for reach statistical significance (F(df 2, df within) = , p =).

If the interaction was **significant**, pivot to simple main effects analysis:

Simple main effects analysis showed that have a statistically significant effect on at specific levels of IV2 (e.g., for Level A of IV2, p =).

Simple main effects analysis showed that have a statistically significant effect on at specific levels of IV1 (e.g., for Level B of IV1, $p =$).

When implementing this template, ensure that the variable names are specific and consistent throughout the text. For the statistical reporting within the parentheses, remember that the F-ratio (F) must be italicized, and the degrees of freedom (df) are separated by a comma. The overall format $F(\text{df}_{\text{effect}}, \text{df}_{\text{error}}) = X.XX, p = .XX$ is non-negotiable for valid APA documentation.

Practical Example: Analyzing Plant Growth Data

To illustrate the reporting process, consider a study conducted by a botanist examining factors influencing plant growth. The goal is to determine whether different levels of **sunlight exposure** and **watering frequency** significantly affect the average height (plant growth) of 40 seedlings over a one-month period. In this scenario, Plant Growth (measured in cm) is the continuous dependent variable, while Watering Frequency and Sunlight Exposure are the two independent variables (factors).

The botanist utilized a factorial design where Watering Frequency had two levels (Daily, Weekly) and Sunlight Exposure had four levels (Zero, Low, Medium, High). This results in $2 \times 4 = 8$ distinct experimental conditions (though the example table below suggests 4 conditions, $3+1$ vs 1). Assuming the summary table provides the essential degrees of freedom for the analysis, a Two-Way ANOVA was performed, generating the summary statistics shown in the output table below. Note that the analysis focuses on three lines from the output: the interaction term, the main effect for Watering Frequency, and the main effect for Sunlight Exposure, all tested against the error term.

The following table presents the key results from the statistical analysis, specifically focusing on the Sum of Squares, Degrees of Freedom, Mean Square, F-ratio, and p-value for the relevant effects:

Source of Variation	SS	df	MS	F	p-value
Watering Frequency	0.0003	1	0.0003	0.0009	0.975
Sunlight Exposure	18.7648	3	6.2549	23.0489	0
Interaction	1.0108	3	0.3369	1.2415	0.311
Within	8.684	32			
Total	28.4597	39			

Based on the data presented in the table above, the following is the appropriate narrative report, strictly following APA conventions. This example demonstrates a case where the interaction is non-significant, allowing for a straightforward interpretation of the main effects.

A two-way ANOVA was performed to analyze the effect of watering frequency and sunlight exposure on plant growth (measured in centimeters).

A two-way ANOVA revealed that there was **not** a statistically significant interaction effect between the effects of watering frequency and sunlight exposure ($F(3, 32) = 1.24, p = .311$). Since the interaction was non-significant, the interpretation of the main effects can proceed directly without further decomposition.

The main effect for watering frequency was not statistically significant, indicating that plant growth did not differ significantly between daily and weekly watering groups ($F(1, 32) = 0.00, p = .975$).

Conversely, the main effect for sunlight exposure was statistically significant ($F(3, 32) = 12.00, p < .001$). This suggests that the level of light received had a substantial, independent impact on plant height.

Follow-up analysis (e.g., Tukey's HSD, if required by the factor levels) would confirm which specific sunlight exposure groups differed significantly from one another. In summary, plant growth is solely influenced by sunlight exposure, regardless of watering frequency.

Key Considerations for Data Presentation

Beyond the strict reporting of inferential statistics, expert content writers ensure that the presentation of supporting data enhances clarity. Inferential results (the F-ratios and p-values) tell the reader if differences exist, but descriptive statistics (means, standard deviations, and group sizes) tell the reader the nature and magnitude of those differences. Always pair the statistical report with strong descriptive evidence, usually in the form of well-formatted tables or figures,

especially interaction plots.

1. Incorporate Descriptive Statistics: A comprehensive report should always include a table detailing the mean and standard deviation for the dependent variable across every level combination of the two independent variables. This descriptive statistics table (often called a marginal means table) is especially vital when a significant interaction effect is observed, as it visually demonstrates the non-parallel relationships between the factors. Presenting these raw summary metrics allows the reader to ground the abstract statistical significance in concrete, practical differences observed in the sample data.

2. Consistency in Rounding: Statistical reporting demands meticulous consistency. The standard APA guideline recommends rounding the F-ratio and p-value to two decimal places, unless the p-value is less than .001. While three decimal places is also acceptable, the crucial rule is to maintain the chosen level of precision uniformly throughout the entire document, including all tables and figures. Never mix rounding standards within a single report, as this can confuse the reader and suggest a lack of rigor in the analysis process.

3. Reporting Effect Size: While not explicitly mandated in every context, reporting a measure of effect size, such as partial eta-squared (η_p^2), is highly encouraged. The F-ratio and p-value only address statistical significance (whether an effect exists), whereas effect size addresses practical significance (how large the effect is). Including η_p^2 provides essential context for the magnitude of the variance accounted for by each factor and the interaction term, allowing for meaningful comparison with previous research.

Moving Beyond the Analysis

Accurately reporting the Two-Way ANOVA is the final validation of your statistical work. By prioritizing the interaction effect, maintaining strict APA formatting for the F-ratio and degrees of freedom, and supporting your findings with clear descriptive statistics, you ensure that your research is transparent and replicable. Always remember that the ultimate goal of the report is not just to state the results, but to communicate the complex relationship between your variables effectively, allowing future researchers to build upon your conclusions.

For researchers seeking to expand their knowledge of standardized reporting procedures, the following tutorials provide guidance on other common statistical analyses:

[How to Report Pearson's Correlation \(With Examples\)](#)