REPORTING RESULTS FOR ANOVA

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The most important aspect of reporting experimental results is to provide both (1) descriptive results so that readers can appreciate the actual pattern of differences among the means, and (2) inferential results for the statistical significance of the various effects. A common error is to provide inferential statistics, but not the descriptive statistics that allow for meaningful interpretation. We will illustrate reporting ANOVA results with the descriptive and inferential statistics from a study of bar-pressing as a function of amount and quality of reinforcement. Descriptive statistics for this study are shown in Box 1. Note that SPSS's defaults tables are generally *not* appropriate for APA manuscripts.

```
Variable .. PRESS
     FACTOR    CODE      Mean  Std. Dev.          N
 QUAL          1
  AMOUNT         1     2.000      1.000          3
  AMOUNT         2     3.000      1.000          3
  AMOUNT         3     4.000      1.000          3
 QUAL          2
  AMOUNT         1     3.000      1.000          3
  AMOUNT         2     5.000      2.000          3
  AMOUNT         3     8.000      2.000          3
For entire sample     4.167      2.333         18
```

Box 1. SPSS Printout of Descriptive Statistics.

Presentation in Text

Report sufficient descriptive statistics (*M*s usually) so that readers can see the actual pattern of results. Means can be presented as text, tables, figures, or some combination of these. Presentation of descriptive statistics in the text can often be integrated with presentation of inferential statistics, and is illustrated below. Normally, there is little reason to present means in more than one format. Refer to material on APA style for a partial list of statistical abbreviations that do not need to be defined in the text (e.g., *M*, *SD*, *F*, *MSE*, *p*, η^2), and for other aspects of APA writing style as it applies to reporting results.

With respect to inferential statistics, readers should normally see: (1) the inferential statistics that support the conclusion of significance or non-significance such as *F* or *t*, (2) the *df*s for those statistics, (3) some measure of the random or error variation in the data such as *SD*s or *MSE*, (4) the significance of the effect or *p*, and (5) often a measure of the strength of the relationship such as r^2 or η^2. Both main effects and interactions will generally be reported, although primary attention may focus on one or the other. It is somewhat easier to present means for the main effects in the text than means for interactions, which can be presented more effectively as a table or figure (as illustrated later). Below are some sample results for this study (Tables and Figures are described later).

----------*Start of Example*----------

Results

The low (M = 2.50), medium (M = 4.00), and high (M = 6.00) amounts of reinforcement differed significantly, $F(2, 12) = 9.25$, $MSE = 2.00$, $p = .004$, $\eta^2 = .40$. Planned contrasts demonstrated a significant linear increase in rate of bar-pressing, $F = 18.38$, $p = .001$, and no significant quadratic effect, $F = .12$, $p = .73$. The difference between low (M = 3.00) and high (M = 5.33) quality reinforcement was also significant, $F(1, 12) = 12.25$, $p = .004$, $\eta^2 = .26$.

As shown in Table 1 (or Figure 1), these main effects were qualified somewhat by an interaction between amount and quality of reinforcement, although the predicted interaction was not significant, $F(2, 12) = 1.75$, $p = .22$, $\eta^2 = .08$. However, planned contrasts revealed that the linear component of the interaction was significant at the .10 level of significance selected for this pilot study, $F(1, 12) = 3.37$, $p = .09$. Planned simple effects revealed that the linear effect of amount of reinforcement was very significant for the high quality reinforcer, $F = 18.75$, $p = .001$, but only marginally significant for the low quality reinforcer, $F = 3.00$, $p = .11$. Neither quadratic effect was significant, ps > .62.

----------*End of Example*----------

Note several features in the above passage. Some statistics are redundant across the various effects and do not need to be repeated (e.g., *MSE* when a common error term is used for all tests). Unimportant effects may be largely omitted, with only a minimal presentation of some basic statistics (e.g., the non-significant quadratic effects above). The writing is quite concise, with superfluous material and text omitted. Integrating statistics and text is one effective way of tightening up the writing (e.g., *M*s presented after corresponding words, *F*s presented after relevant phrases). The use of polynomial contrasts also helped keep the writing brief (i.e., it allowed use of well-known terms such as "linear"), but other contrasts might require more effort to find a concise and meaningful wording. You will also want to learn how to enter the various symbols (e.g., η^2) in your word-processing software (WordPerfect, MS Word, ...).

Presentation in Tables

Box 2 (Table 1)

Table 1.

Effect of Amount and Quality of Reward on Bar-pressing.

	Quality of Reward		
Amount	Low	High	*M*
Low	2.00	3.00	2.50
Medium	3.00	5.00	4.00
High	4.00	8.00	6.00
M	3.00	5.33	

Box 2. Presenting ANOVA Results in Table Format.

shows the results presented in table format. One strength of the table format is that it is often possible to easily present both interaction and main effects in a single table. In the present example, for instance, readers see the main effect of quality, the main effect of amount, and the interaction between these two variables. Figures and text presentations do not so readily represent both main effects and interactions. Sometimes (e.g., when numerous effects are being reported), tables will also be used to present inferential statistics (e.g., columns for *F*s or *p*s). In preparing a table, use either a fixed font (Courier as in Box 2) or (preferred) the decimal tab to align values on the decimal point.

It is easier for readers to compare numerical values down a column, rather than across rows. This is one factor to consider in deciding which variable should be the row variable and which the column variable. In Box 2, for example, it is easier for readers to see that the effect of amount of reward is stronger for High Quality rewards than for Low Quality rewards. The difference between Low and High Quality rewards as a function of Amount of reinforcement is less salient. The arrangement in Box 2 would be ideal for a simple effects analysis of Amount as a function of levels of Quality, rather than the inverse.

Aligning on the decimal value (rather than on the first character in the column) can best be done using decimal tabs that align columns on the decimal place, rather than the first or last character. Essentially, a decimal tab is inserted *immediately* prior to the column of numbers that we want to align. The resulting alignment is shown in Box 3 for a different data set. A less desirable option is to use spaces, which general works better with a fixed font.

Condition	*M*	*SD*
Control	15.23	5.84
Praise Only	4.90	1.17
Shaping	1.17	.98

Box 3. Use Decimal Tabs to Align Numbers.

ANOVA results often include pairwise comparisons among means. Box 4 illustrates one method that can be used to report the results of multiple post-hoc comparisons. Such comparisons can be difficult or awkward to convey in the text, and perhaps even impossible with a figure. The shared letters in Box 4 indicate which groups are *not* significantly different from each other.

Table 1.
Mean Response Rate as a Function of Amount of Reinforcement.

Amount of Reinforcement (*mg*)	*M*
0	13.00_{a}
10	16.93_{ab}
20	18.21_{b}
30	24.54_{c}
40	26.27_{c}

Note. Means that do not share subscripts differ at $p < .05$ by the Least Significant Difference test.

Be sure to refer to your Table (or Figure) in the text at the most appropriate point.

Presentation as Figure

Figures are also called graphs, plots, or charts. We can create such a figure in SPSS. First we need to enter the data (e.g., using the raw scores from our ANOVA). Use the Graph | Legacy | Line | Multiple option to open the dialogue box shown in Figure 1. Then, specify the appropriate variables for the horizontal axis, the lines, and the vertical axis (think carefully about the impression you want readers to get from the figure and experiment with different variables specified for the axis and the lines). When these values are entered, click on Ok to create the graph.

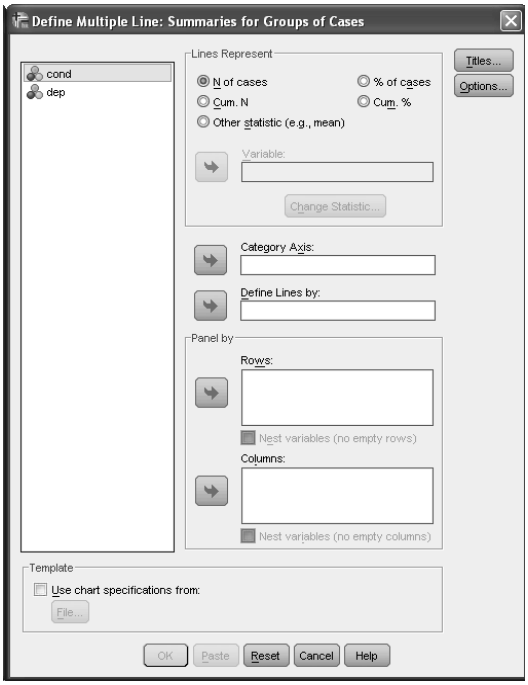

Figure 1. Line Graph Dialogue Box.

Once the basic figure is created, its various features can be modified to produce a more polished appearance (see example in Figure 2). Double-click on the figure to put SPSS into graph edit mode, which gives access to numerous graph features that can be modified (e.g., line style and thickness, font style and size, annotations). Once in its final form, a graph can be copied and pasted into your wordprocessing program, powerpoint, or other software. SPSS cannot always plot means directly, as was done here (e.g., for within-subject or mixed desings). It may be necessary to read the means back in to SPSS as a new data file, and then have those means plotted. Be sure to refer to your Figure in the text at the most appropriate point.

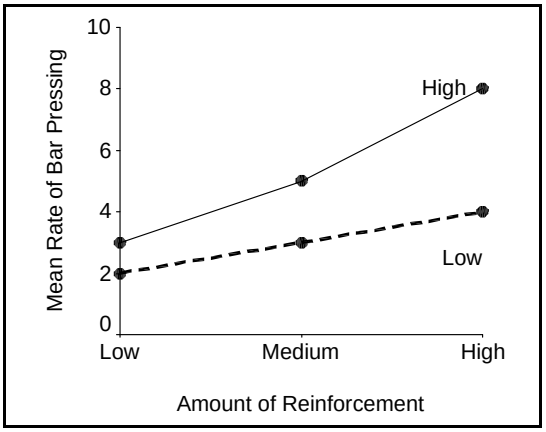

Figure 2. Results of Reinforcement Study.

Conclusion

Presentation of results in a meaningful way is an important aspect of scientific writing (and perhaps even more critical for spoken presentations of results). For additional information on preparing Tables and Figures, refer to the material presented last term in Chapter 12 on Tables and Figures. Chapter 12 also discussed Text tables, which can be very important for papers, and perhaps even more valuable in spoken presentations.