

## Simple Effects, Simple Contrasts, and Main Effect Contrasts

### Simple Effects

Following a significant interaction, follow-up tests are usually needed to explore the exact nature of the interaction. *Simple effects* (sometimes called *simple main effects*) are differences among particular cell means within the design. More precisely, a simple effect is the effect of one independent variable within one level of a second independent variable. In our hypothetical example of the eyewitness study, one simple effect might involve the effect of violence only for individuals within the no training condition. Similar to the contrasts following a significant one-way ANOVA, the simple effect test uses the error term and df from the whole design. Remember that when the error term ( $MS_{s/A}$ ) is derived using all of the cases in the study, it will be much smaller and will result in greater statistical power. Thus, testing simple effects is preferable to using t-tests.

Below, I present the means we obtained from the previous factorial ANOVA where we found a significant interaction ( $F(1,16)=16.00, p<.005$ ). One might wish to determine if the violence manipulation had any effect in the no training group—this is a simple effects hypothesis. In this case, the two means highlighted below are compared.

Table 1. Simple effect comparison for a 2 X 2 factorial ANOVA.

	No training	Training	
No violence	4.0	8.0	6.0
Violence	2.0	2.0	2.0
	3.0	5.0	4.0

The syntax for testing this simple effect in SPSS is discussed in a separate handout called “Simple Effects Test Following a Significant Interaction.”

### Simple Contrasts

In factorial designs with more than two levels of one or more of the independent variables, one can also distinguish between *simple effects* and *simple contrasts*. A simple contrast is a more focused test that compares only two cells.<sup>1</sup> Let’s assume we had a third level of the training factor where a second type of training was used. In the second training, police officers are taught to be less reactive to sudden violent incidents. Below are the hypothetical results from that study, where I highlight the simple effect for training within the no violence group.

Table 2. Simple effect comparison for a 2 X 3 factorial ANOVA.

	No training	Memory Training	Reactivity Training	
No violence	4.0	8.0	9.0	7.0
Violence	2.0	2.0	5.0	3.0
	3.0	5.0	7.0	5.0

As you can see, the simple effect now refers to a test of differences among three means, because the factor being compared has three levels.

The simple contrast is a more specific test and might follow a simple effect test. An example of a simple contrast would be a test to compare the means of just the two training groups within the no violence condition, as illustrated below.

Table 3. Simple contrast for a 2 X 3 factorial ANOVA.

	No training	Memory Training	Reactivity Training	
No violence	4.0	8.0	9.0	7.0
Violence	2.0	2.0	5.0	3.0
	3.0	5.0	7.0	5.0

<sup>1</sup> Contrasts can also compare more than two cells. For example the average of two cells might be compared to a third cell.

The SPSS syntax for this comparison using the MANOVA command would look something like this:<sup>2</sup>

```
MANOVA memory BY violence(1,2) training(1,3)
  /ERROR=WITHIN
  /CONTRAST(training)=SPECIAL (1 1 1,
                               0 -1 1,
                               -1 0 1)
  /DESIGN=training(1) WITHIN violence(1), training(2) WITHIN violence(1).
```

Under the /CONTRAST subcommand, there are three rows of numbers. The first is required to be all 1s. The next two rows represent two contrasts. Even though only one was desired, SPSS requires that there be a contrast for every row. The first contrast, which is represented by the codes 0 -1 1 and is referred to on the /DESIGN subcommand as training(1), compares only the memory and reactivity training conditions within the no violence condition (i.e., the simple contrast shown in Table 3). The second comparison, which was not of interest, is represented by the codes -1 0 1 and is referred to on the /DESIGN subcommand as training(2) and compares the no training and reactivity training groups within the violence condition (not shown in Table 3).

### Main Effect Contrasts

In the circumstance where a main effect is significant for a factor that has more than two levels, one can also compare specific means. This comparison is called a main effect contrast. Remember that a main effect is the difference between or among marginal means, where the levels of the other independent variable are combined. In the table below, the main effect for training is highlighted.

Table 4. Main effect in a 2 X 3 ANOVA.

	No training	Memory Training	Reactivity Training	
No violence	4.0	8.0	9.0	7.0
Violence	2.0	2.0	5.0	3.0
	3.0	5.0	7.0	5.0

The main effect indicates there are differences among these three means, but we do not know exactly where the differences may lie. We might, for instance, have a special interest in knowing whether, overall, the memory and reactivity training groups differed from one another.

Table 5. Main effect contrast in a 2 X 3 ANOVA.

	No training	Memory Training	Reactivity Training	
No violence	4.0	8.0	9.0	7.0
Violence	2.0	2.0	5.0	3.0
	3.0	5.0	7.0	5.0

Because many authors do not recommend interpreting main effects when there is a significant interaction, one would usually only test this contrast using a one-factor ANOVA. The MANOVA syntax for this is below.

```
MANOVA memory BY training(1,3)
  /CONTRAST(training)=SPECIAL(1 1 1, 0 -1 1, 1 0 -1)
  /DESIGN=training(1), training(2).
```

<sup>2</sup> These examples are based on syntax provided by Page, M.C., Braver, S.L., & MacKinnon, D.P. (2003). *Levine's guide to SPSS for analysis of variance* (2<sup>nd</sup> Edition). Mahway, NJ: Erlbaum.