

Two-Way ANOVA

Thus far, ANOVA with 1 IV

Can have 2 or more IVs

Example:

IV1= workbook for study

IV2 = caffeine (1 cup java 30 min before exam)

DV = test score on exam.

An IV is called a *factor* in ANOVA.

Our design would look like this:

	Workbook (Factor A)	
Caffeine (Factor B)	No	Yes
Yes	Caffeine Only	Both
No	Neither (Control)	Workbook Only

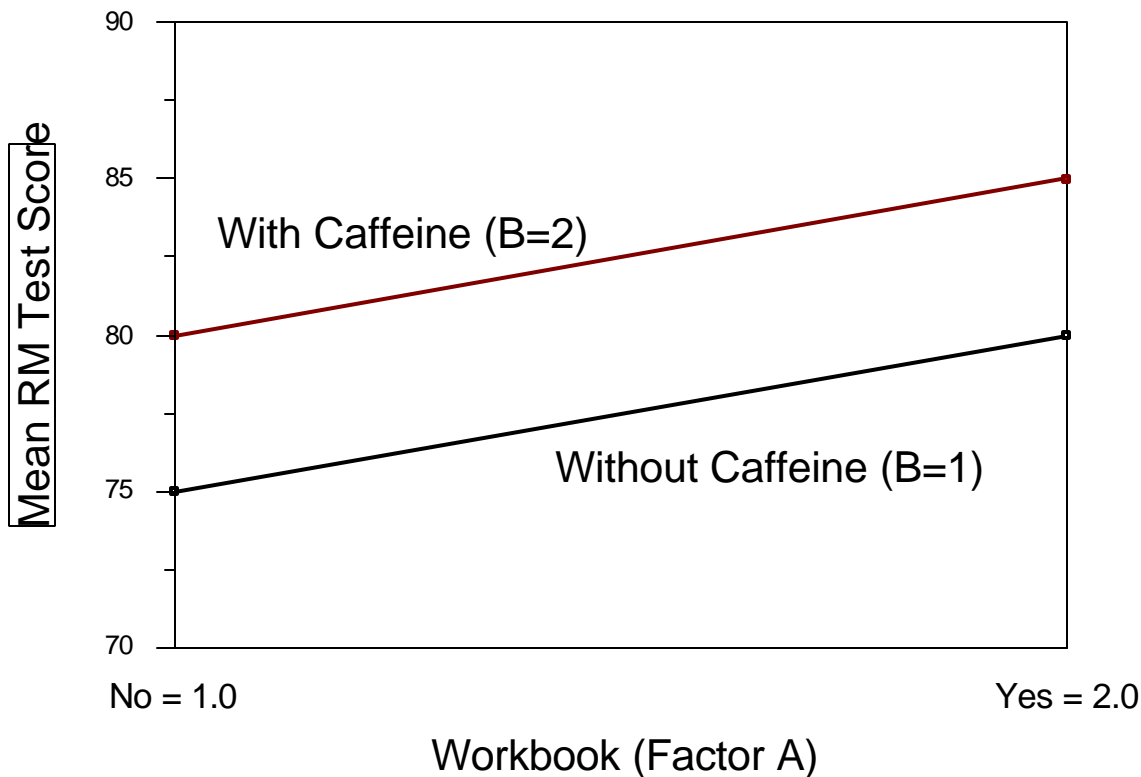
Gather data for $N=30$ per cell, analyze for mean differences using analysis of variance. We might find that the use of the workbook has an effect on test performance. This would be called a *main effect* for workbook (or more generally, a main effect for A). We might also find that caffeine has an effect on test performance. This would be called a *main effect* for caffeine (or more generally, a main effect for B). It might also happen that the influence of the workbook on test performance varies depending on whether a person has caffeine (suppose, for example that the workbook only helps for people who drink coffee). In such a case, there would be an *interaction* between workbook and caffeine (an A by B interaction).

As part of the reporting of the ANOVA results, you should prepare a table of means. The results of a 2-way or 2-factor ANOVA are often illustrated by graphing the cell means. For example, suppose our results looked like this:

	Workbook (Factor A)	
Caffeine (Factor B)	No	Yes
Yes	Caffeine M=80 SD=5	Both M=85 SD=5
No	Neither (Control)	Workbook Only

The results seem to show that both workbook and caffeine are helpful. A graph of the results would look like this:

Effects of Workbook and Caffeine on Test Scores



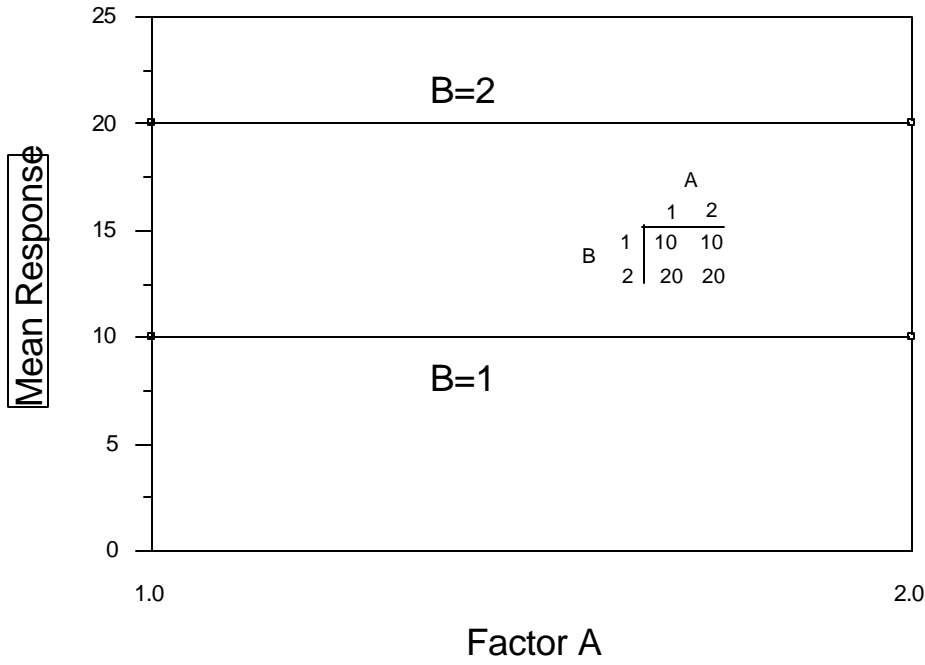
The presence of an interaction shows up in this kind of graph as lines that are *not parallel*.

This lack of parallelism is a signature of the interaction.

Interactions are one of the main reasons to do experiments that have multiple independent variables. By having two (or more) independent variables in a study, we can see if the effects of the independent variables are independent of one another, or whether they interact.

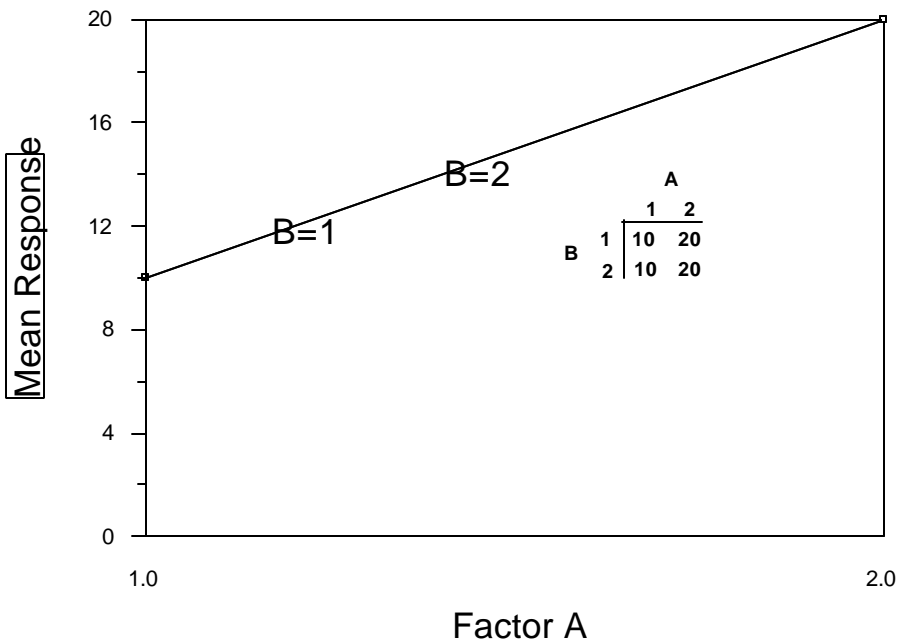
Interpreting graphs of two way ANOVA results:

Single Main Effect



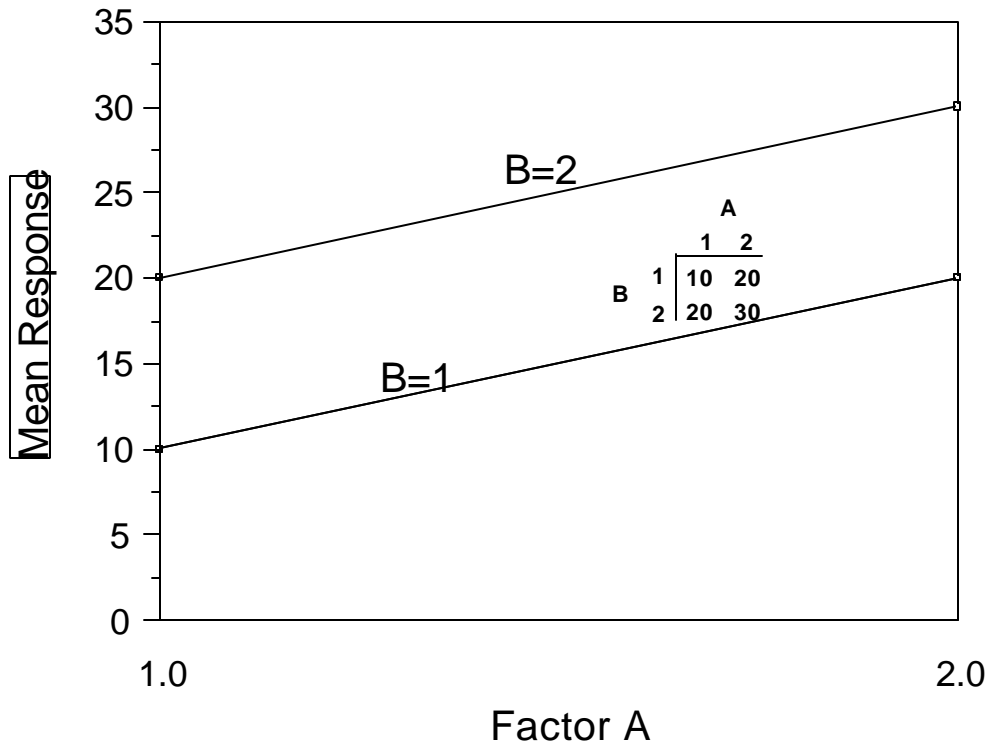
Or

Single Main Effect



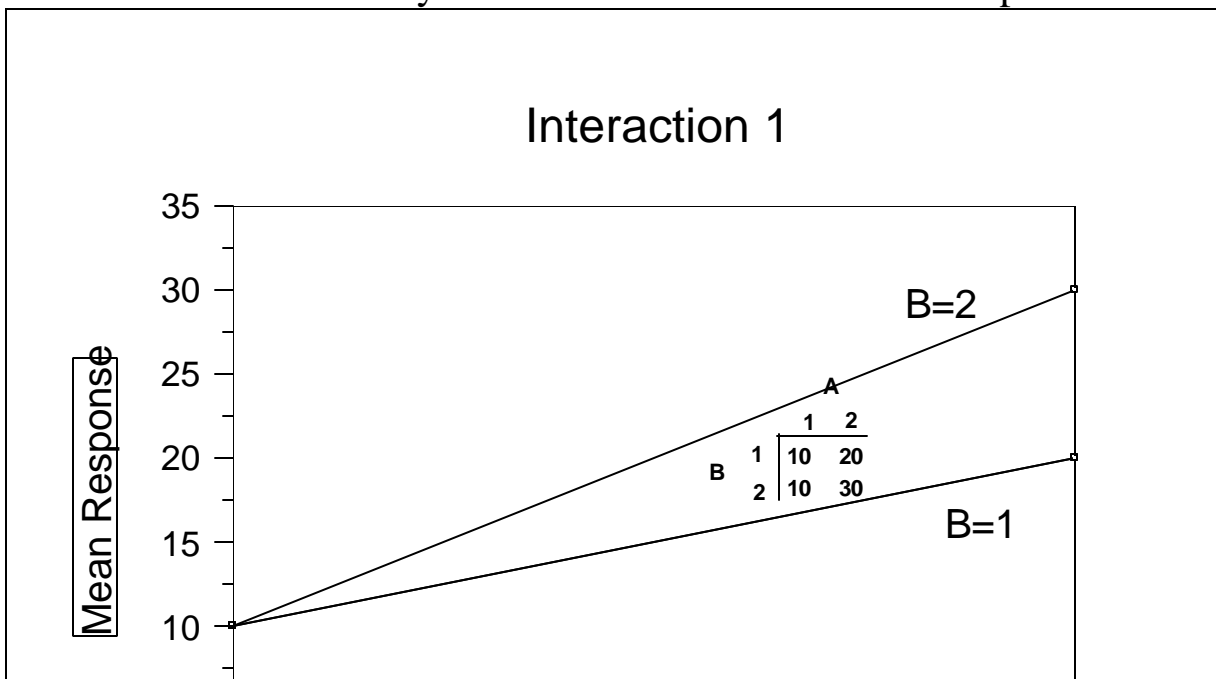
Or both variables can have effects.

Two Main Effects

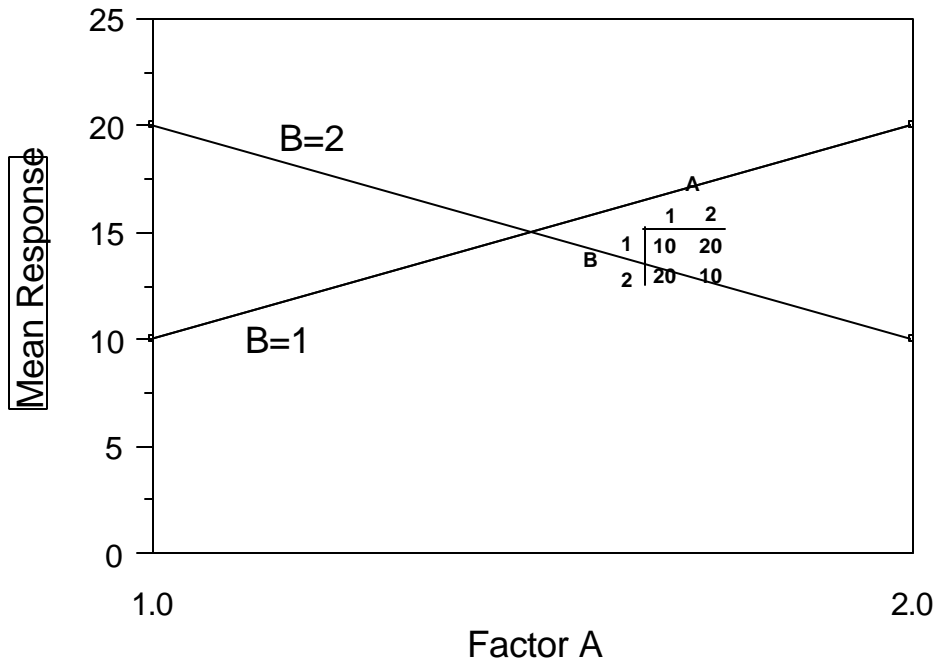


If only one variable has an effect, then either the lines will not change from left to right (no effect for A) or the lines will fall on top of one another (no effect for B).

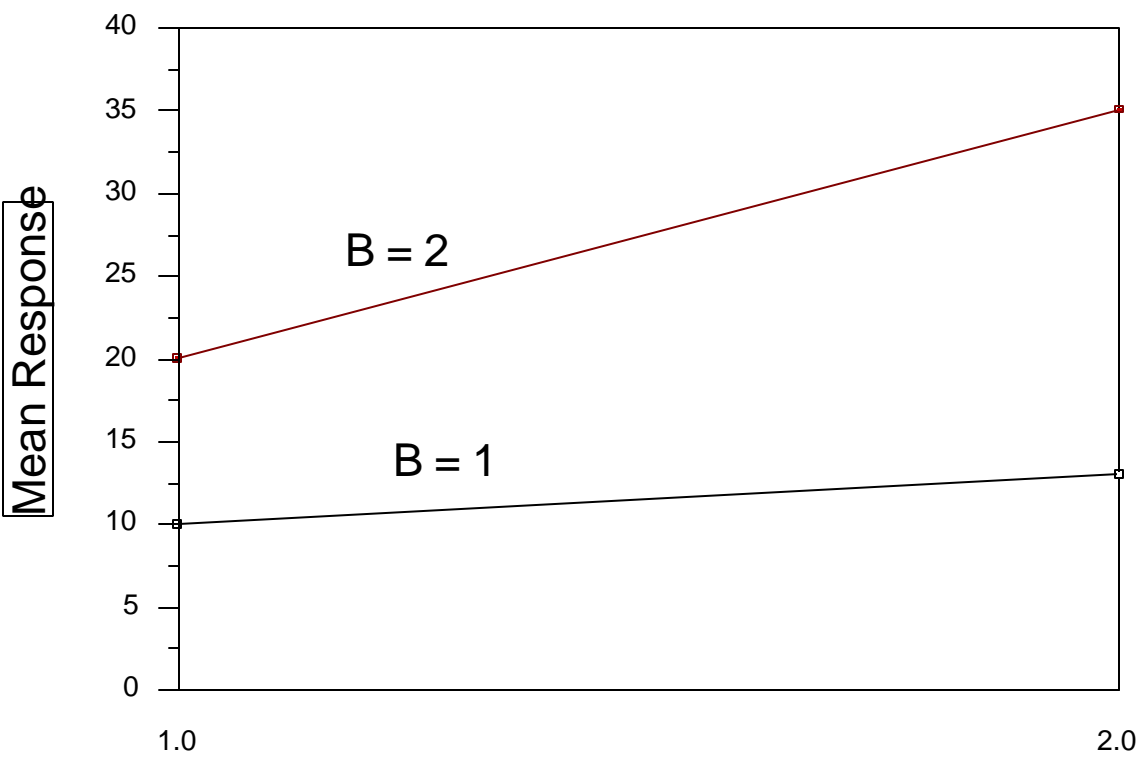
Interactions can take many forms. All of them show lack of parallelism.



Interaction 2



Interaction 3



Labeling Factorial Designs

Factorial Design - ANOVA with 2 or more IVs

Levels

- each IV is referred to by the number of its levels, e.g., a 2X2 design, a 3 X 2 design, and 2 X 4 X 3 design, etc.

Between, Within, and Mixed Designs

A *between* design is one in which each cell contains independent participants

A *within* design contains dependent, usually the same, participants in all the cells

A *mixed* design has the same (or dependent) participants in all the cells of one factor, but independent participants in the cells of another factor.

Example of factorial designs

Suppose we are interested in automobile driving safety. We decide to study the effects of **fatigue** (IV1) and **alcohol consumption** (IV2) on driving performance (DV).

We will have 2 fatigue conditions:

- (1) rested, meaning proper night's sleep then awake for 4 hours, or
- (2) fatigued, meaning no sleep for the previous 24 hours.

We will have 3 alcohol conditions

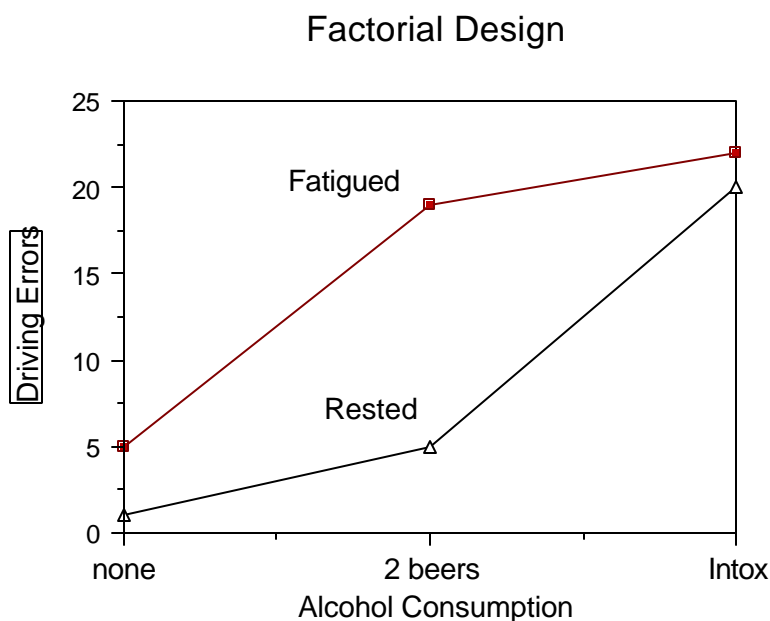
- (1) no alcohol,
- (2) two beers, and
- (3) a dose of alcohol that is expected to result in a just over the legal border (.08%) blood alcohol level.

(We will wait the appropriate time for the alcohol to take effect before testing.) Our design would be a 2 X 3 factorial design with 2 levels of fatigue and 3 levels of alcohol consumption.

What kind of design?

Between, within or mixed.

We might expect to see results something like the following:



What is the story here?

Main Effects?

Interaction?