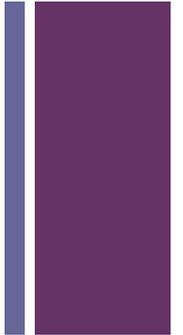


# Factorial Designs

PSY250

# + What are factorial designs?

- The effect of two or more independent variables (factors) is assessed on a dependent variable
- Several hypotheses can be tested simultaneously
- Factorial designs let you see how variables interact



# + Main & Interaction effects

- Main effects: The effect each factor alone has on the dependent measure
  - Whether IV1 effects DV or, separately, whether IV2 effects DV
- Interaction effects: If one IV effects each level of the other IV
  - Whether IV1 interacts with IV2 to have an effect on DV



# + Higher order designs

- 2 IV:
  - 2 x 2 designs
    - 2 IVs, 2 levels each
  - 2 x 3 designs
    - 2 IVs, one has 2 levels, one has 3 levels
- 3 IV:
  - 2 x 2 x 3 designs
- 4 way interactions (and beyond) can get quite complicated
  - 4 main effects, 6 two-way interactions, 4 three-way interactions, and one 4-way interaction



# + Experiment example

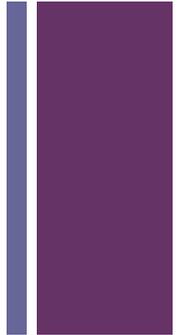


- Testing performance on a test
- Personality type
  - Introverts
  - Extroverts
- Room setting
  - Alone
  - With other people
- Response time on Stroop
- Stroop test difficulty
  - Easy, congruent test
  - Hard, incongruent test
- Noise condition
  - Quiet condition
  - Annoying sound condition

# + 2 x 2 design

- 2 IV each with 2 levels = 2 x 2 design
- Looking at differences in response time
  - Stroop difficulty (easy, hard)
  - Noise condition (quiet, annoying sound)
- Experiment has 4 conditions

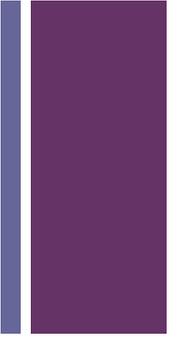
Easy, quiet	Hard, quiet
Easy, annoying	Hard annoying



# + ANOVA

- One Way ANOVA
  - Used to compare the *means* between multiple groups (3 or more – typically for 2 groups, you would use a t-test). Running multiple t-tests increases your chances of type 1 error.
  - A one-way ANOVA is used for independent (unrelated) groups.
  - Looking at reaction time and task – looking at each task as a whole (not separating by noise or Stroop test).
- Two Way ANOVA
  - A two-way ANOVA compares mean differences between groups *that have been split on two independent variables* to see if there is an interaction between the two independent variables and the dependent variable.
  - In our case, we are looking at reaction time (dependent variable) and two IVs – difficulty of Stroop test (easy, difficult) and noise (with sound, without).

+ TO BE CONTINUED...



# + 2 x 2 design

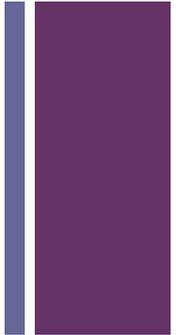
- 2 IV each with 2 levels = 2 x 2 design
- Looking at differences in test scores
  - Personality (Introverts vs. Extroverts)
  - Room setting (Alone vs. With people)
- Experiment has 4 conditions

Introverts, alone

Extroverts, alone

Introverts, with people

Extroverts, with people





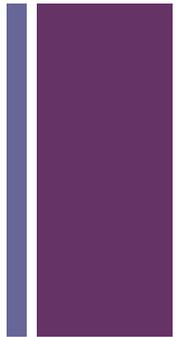
# Main Effects



- One effect for each IV
- A significant main effect means there is a difference among the means of that particular IV.
  - Difference between room settings
- If there is NO interaction between the 2 IVs, then the main effect can be generalizable
- If there IS an interaction, main effect may not be consistent and these observations must be made with care



# Main Effect

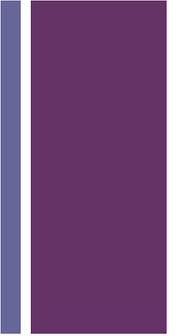


- Effect of a single IV on the DV
- Our study could have 2 main effects:
  - Personality (Introverts vs. Extroverts)
  - Room setting (Alone vs. With people)

<b>Personality (IV-A)</b>	<b>Room setting (IV-B)</b>		<b>Means (Main Effect A)</b>
	<b>Alone</b>	<b>With people</b>	
<b>Introverts</b>	91	80	<b>85.5</b>
<b>Extroverts</b>	90	85	<b>87.5</b>
<b>Means (main effect B)</b>	<b>90.5</b>	<b>82.5</b>	

# + Main Effects

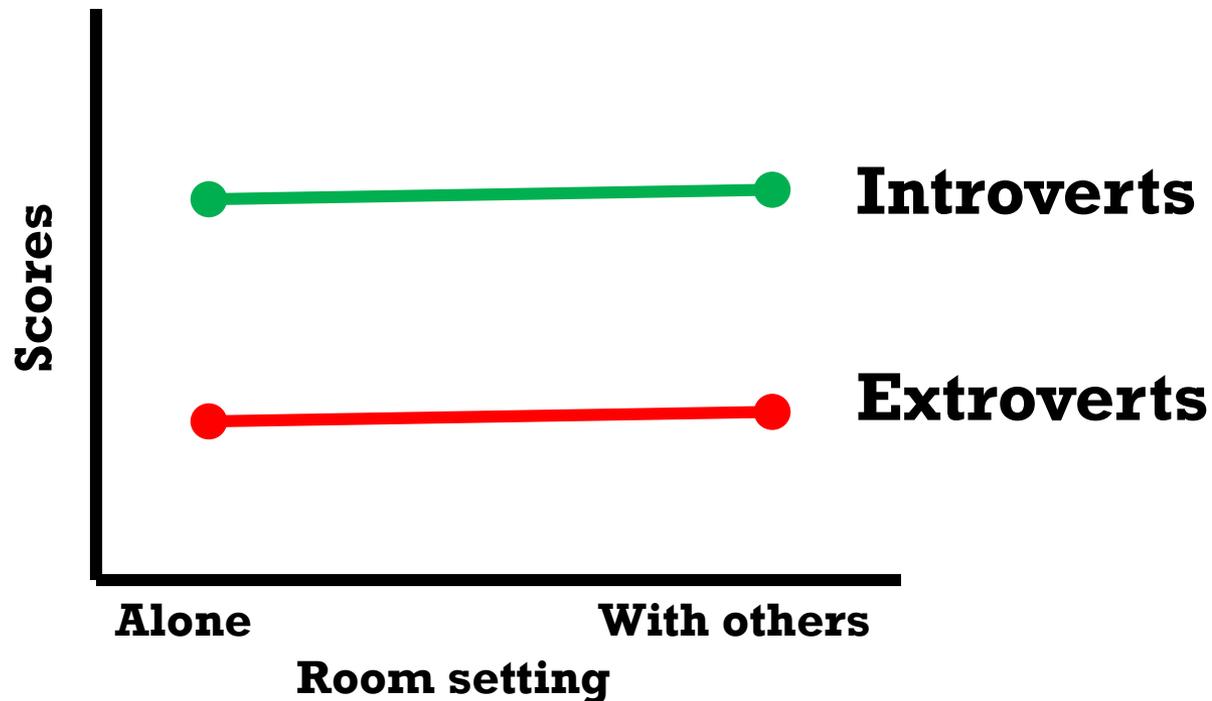
- Overall, participants scored higher when they were alone, but introverts' scores drop more steeply than extroverts' scores when they are with others



# + 2 x 2 (different possible outcomes)

- No Main effect of A;
- **Main effect of B;**
- No interaction effect

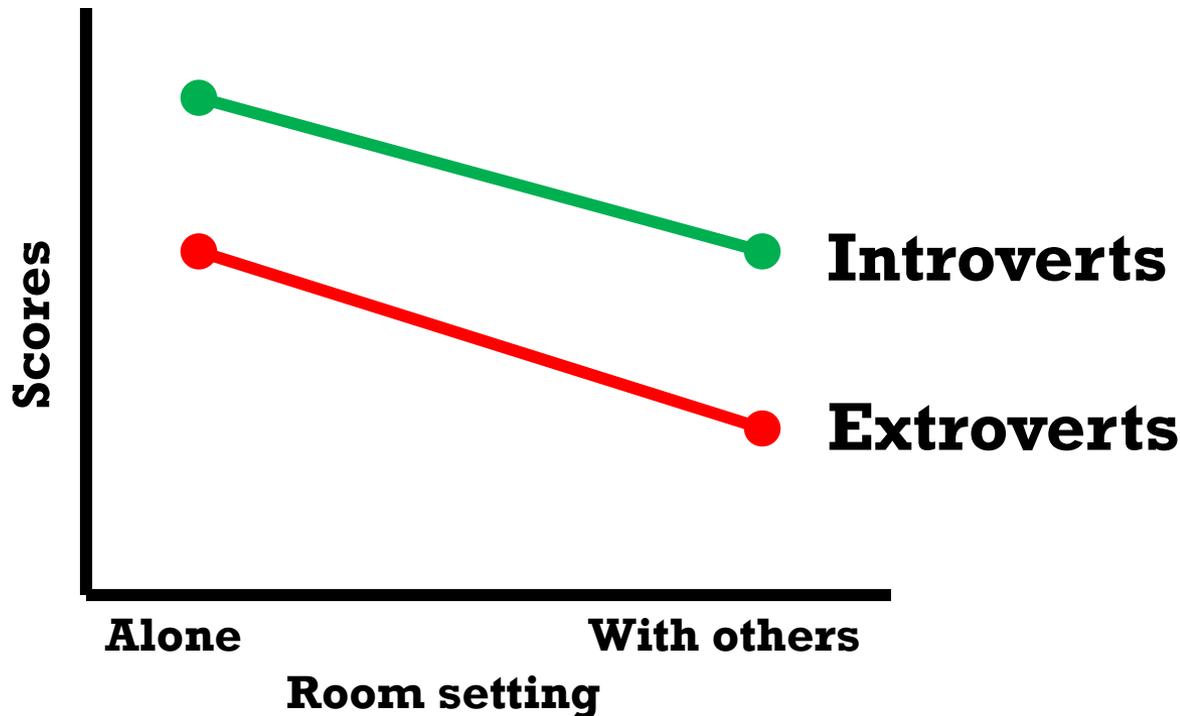
		B	
		A	O
Personality	I	80	80
	E	60	60



# + 2 x 2 (different possible outcomes)

- **Main effect of A;**
- **Main effect of B;**
- No interaction effect

		B	
		A	O
Personality	I	90	80
	E	80	70

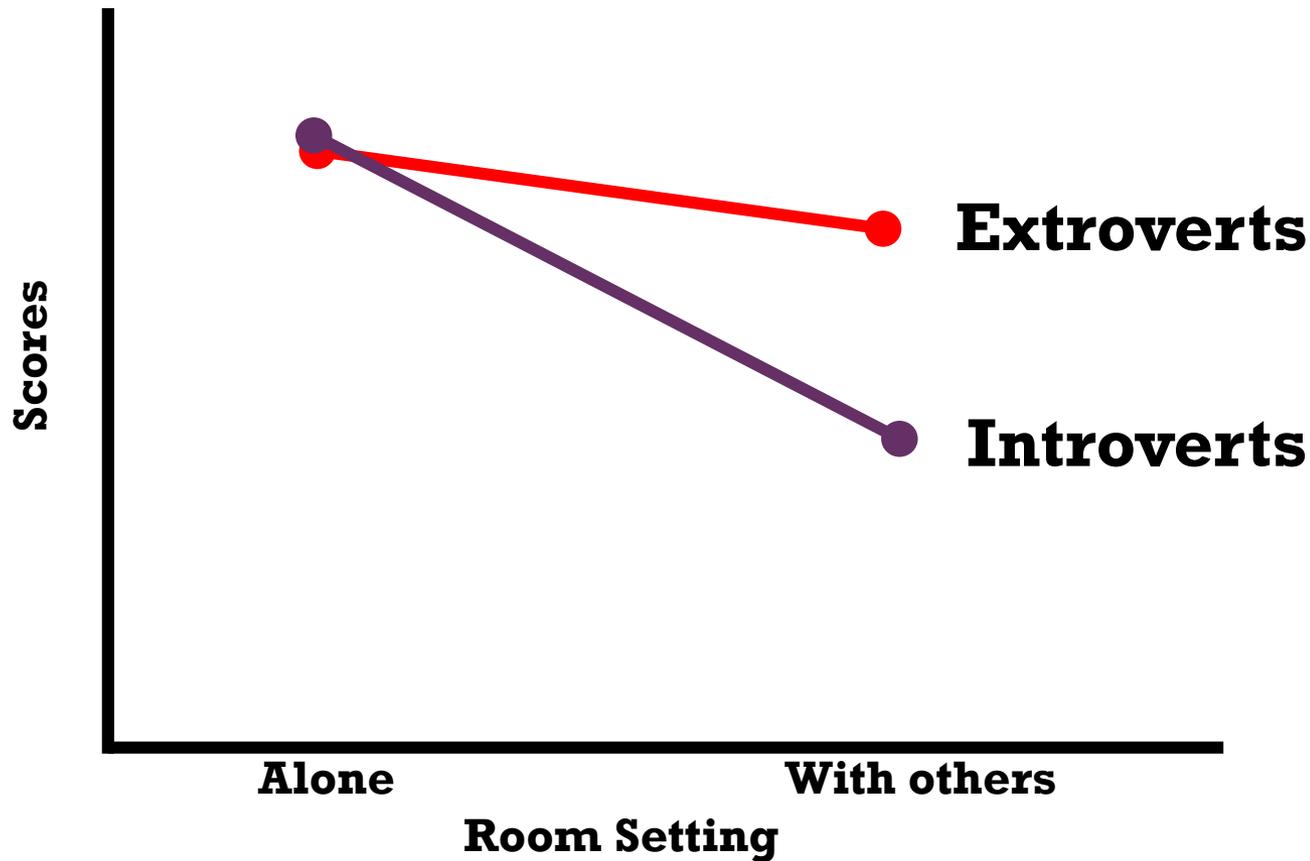


# + Interaction Effects

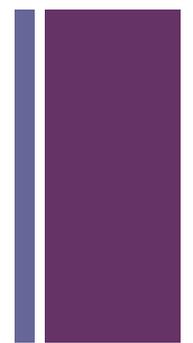
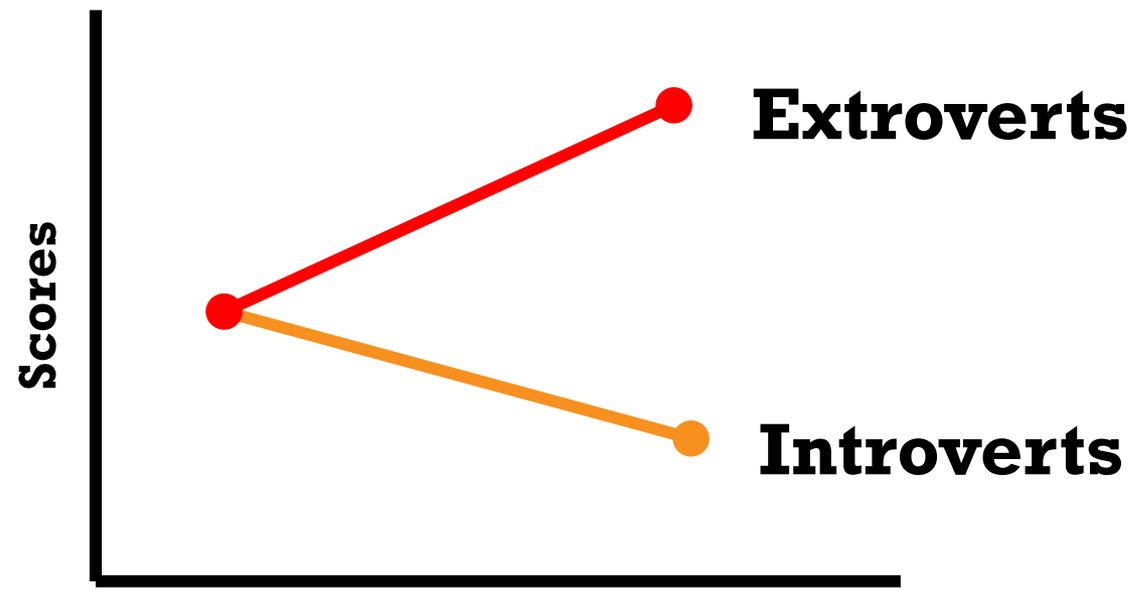
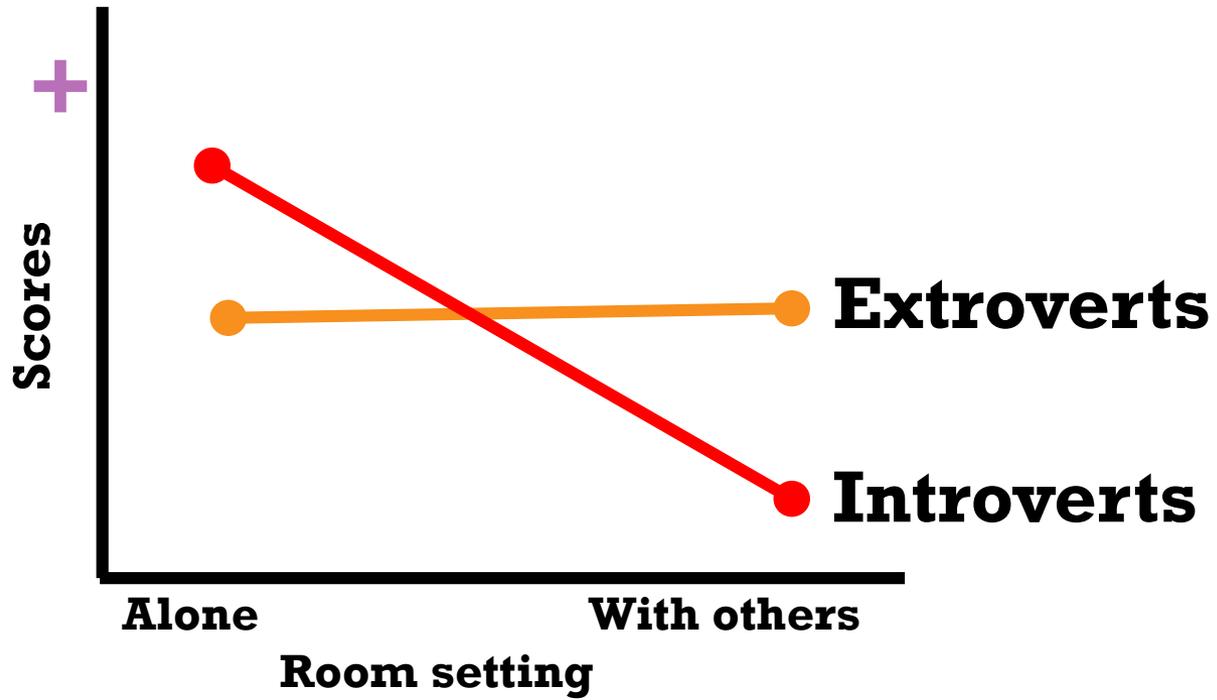
<b>Personality (IV-A)</b>	<b>Room setting (IV-B)</b>		<b>Means (Main Effect B)</b>
	<b>Alone</b>	<b>With people</b>	
<b>Introverts</b>	91	80	85.5
<b>Extroverts</b>	90	85	82.5
<b>Means (main effect A)</b>	90.5	82.5	

- Interaction provides information about differences that aren't apparent by looking at main effects alone
- If the effect of 1 IV depends on the level of the other
  - Effect of 1 IV varies at diff levels of other IV

# + Interaction



Line graph representing interaction between personality and room setting



# + Interactions in Simple Terms

- Lighting a match in itself is not dangerous
- Having gasoline around by itself, not dangerous



+



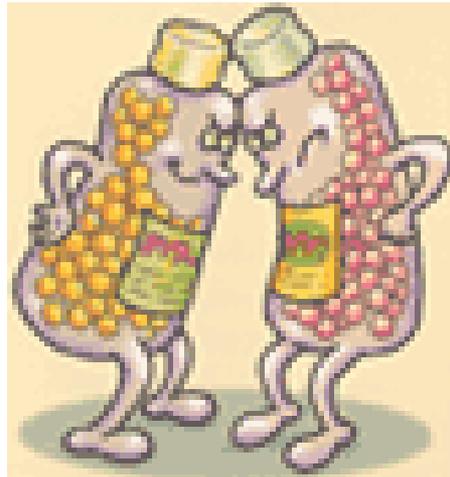
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- The combination of the 2??

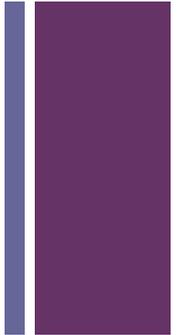
# + Interactions in Simple Terms

- Drug A may be a good, useful drug
- Drug B may be a good, useful drug



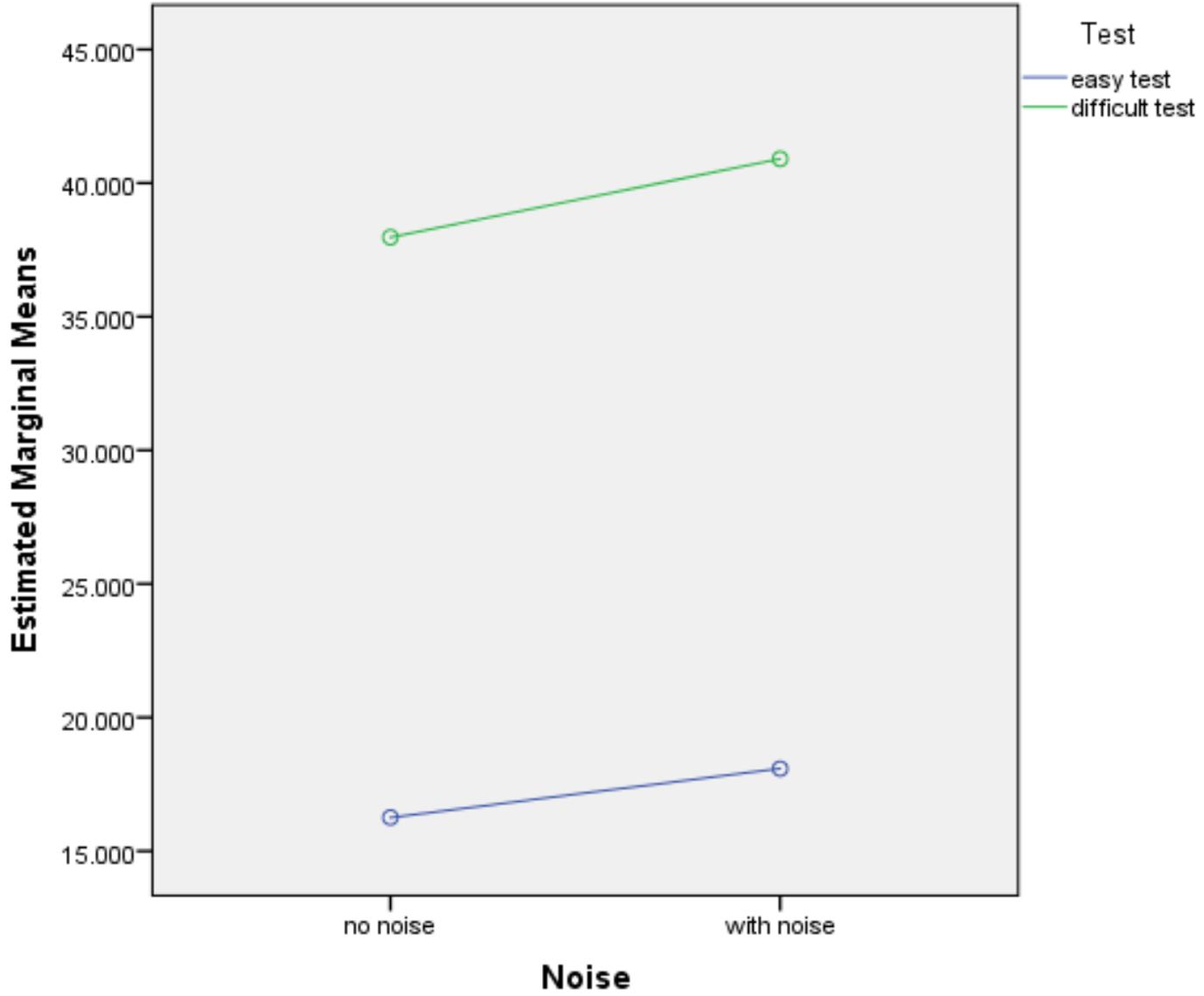
- However, taking Drug A and Drug B together may be harmful.

# + Review

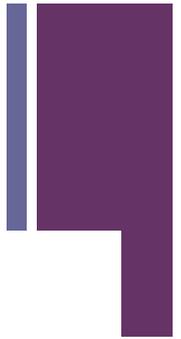


- **Factorial Design:** Design with multiple independent variables (uses ANOVA)
- **Factorial Notation:** Number of levels of each independent variable (# x #)
- **Main Effect:** Effect of a single IV on the DV
- **Interaction:** Effect of each IV at the levels of the other IV

Estimated Marginal Means of ResponseTime



# + Paper #3 2-way ANOVA

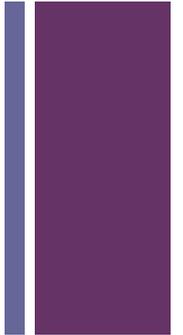


## Tests of Between-Subjects Effects

Dependent Variable: ResponseTime

Source	df	Mean Square	F	Sig.
Corrected Model	3	7192.273	99.392	.000
Intercept	1	137778.551	1903.997	.000
Test	1	21319.962	294.626	.000
Noise	1	243.769	3.369	.068
Test * Noise	1	13.089	.181	.671
Error	168	72.363		
Total	172			
Corrected Total	171			

a. R Squared = .640 (Adjusted R Squared = .633)



## 1. Test

Dependent Variable: ResponseTime

Test	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
easy test	17.169	.917	15.358	18.980
difficult test	39.436	.917	37.625	41.247