Describing Factorial Effects

- Kinds of means & kinds of effects
- Interactions as “non-additive joint effects”
- Inspecting tables to describe factorial data patterns
- Inspecting line graphs to describe factorial data patterns
- Inspecting bar graphs to describe factorial data patterns
- Choosing among tables & graphs

The importance of “conditional” & “non-additive” effects…

Brownies – great things… worthy of serious theory & research!!!

The usual brownie is made with 4 blocks of chocolate and 2 cups of sugar. Replicated research tells us that the average rating of brownies made with this recipe is about 3 on a 10-point scale.

My theory? People don’t really like brownies! What they really like is fudge! So, goes my theory, making brownies more “fudge-like” will make them better liked.

How to make them more fudge-like, you ask?

Add more sugar & more chocolate!!!

So, we made up several batches of brownies and asked people to taste a standardized amount of brownie after rinsing their mouth with water, eating an unsalted saltine cracker and rinsing their mouth a second time. We used the same 10-point rating scale; 1 = this is the worst plain brownie I’ve ever had, 10=this is the best plain brownie I’ve ever had.

Our first study:

2-cups of sugar	4-cups of sugar
3	5

So, far so good!

Our second study:

	4 blocks of choc.	8 blocks of choc.
	3	2

What???? Oh – yeah! Unsweetened chocolate…

Then the argument started..

One side: We have partial support for the theory – adding sugar helps, but adding chocolate hurts!!!

Other side: We have not tested the theory!!!

What was our theory?

Add more sugar & more chocolate!!! We need a better design!

	4 blocks of choc.	8 blocks of choc.
2-cups of sugar	3	2
4-cups of sugar	5	

What do we expect for the 4-cup & 8-block brownies?

	standard brownie	3
+	sugar effect	+ 2
+	chocolate effect	- 1
	expected additive effect of choc & sugar	1
	expected score for 4&8 brownies →	4

	4 blocks of choc.	8 blocks of choc.
2-cups of sugar	3	2
4-cups of sugar	5	9

The effect of adding both simultaneously is 6 … not 1???

How do we account for this ?

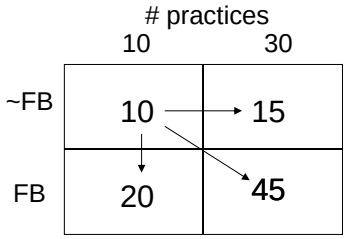
There is a non-additive joint effect of chocolate and sugar!!!!

The joint effect of adding chocolate and sugar is not predictable as the sum of the effects of adding each!!!

Said differently, there is an interaction of chocolate and sugar that ***emerges*** when they are added simultaneously.

This leads to the distinction between two "kinds" of interactions…

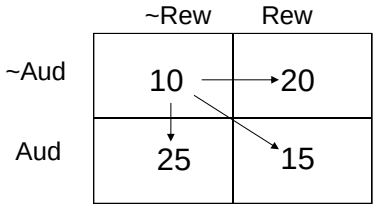
"Augmenting" Interaction



The combined effect is ***greater*** than would be expected as the additive effect!

Practice effect = 5
Feedback effect = 10
Expected additive effect = 15
Joint effect = 35

"Interfering" Interaction



The combined effect is ***less*** than would be expected as the additive effect!

Reward effect = 10
Audience effect = 15
Expected additive effect = 25
Joint effect = 5

Interpreting Factorial Results based on "Inspection"

Now that we have the basic language we will practice examining and describing main effects and interactions based on tables, line graphs and bar graphs portraying factorial results.

Once you know how to describe the results based on "inspection" it will be a very simple task to learn how to apply NHST to the process.

As in other designs we have looked at "an effect" as a numerical difference between two "things", in factorial analyses…

Main effects involve differences between marginal means.

Simple effects involve differences between cell means.

Interactions involve the differences between simple effects.

Inspecting a Table to determine simple effects & interaction…

Task Difficulty	Task Presentation: Paper	Task Presentation: Computer
Easy	90	90
Hard	50	70

We'll look at describing the interaction using each set of simple effects in turn. Then we'll look at describing each main effect (and checking if each is descriptive or misleading)

Inspecting a Table to determine simple effects & interaction…

Simple Effects of Task Presentation

Task Difficulty	Task Presentation: Paper	Task Presentation: Computer
Easy	90	90
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SE of Task Pres for EasyTasks

90 vs. 90 SE = 0

SE of Task Pres for HardTasks

50 vs. 70 SE = 20

There is an interaction of Task Difficulty and Task Presentation as they relate to performance. There is no effect of presentation for easy tasks, however for hard tasks computer presentations led to higher scores than did paper presentations.

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Inspecting a Table to determine main effects …

marginal means for Task Difficulty

90 vs. 60 Easy > Hard

Task Difficulty	Task Presentation: Paper	Task Presentation: Computer	
Easy	90	90	90
Hard	50	70	60

This main effect is descriptive..

Easy > Hard for BOTH

Paper & Computer tasks

Overall, easy tasks were performed better than hard tasks.

Inspecting a Table to determine main effects …

marginal means for Task Presentation
70 vs. 80 Paper < Computer

Task Difficulty	Paper	Computer
Easy	90	90
Hard	50	70
	70	80

This main effect is potentially misleading ...

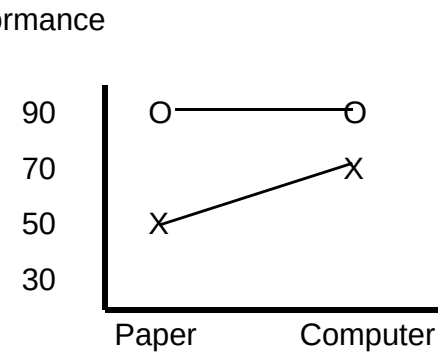
Paper < Computer only for hard tasks

Paper = Computer for easy tasks

Overall, there was better performance on computer than paper tasks. However, this was not descriptive for easy tasks.

Inspecting a line graph …

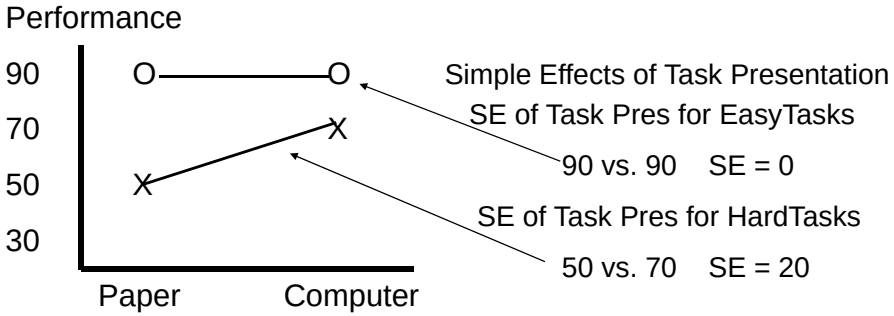
"Different differences" and "Differential Simple Effects" both translate into NONPARALLEL LINES in a figure.



Key for Task Difficulty
O = Easy X = Hard

	P	C
Easy	90	90
Hard	50	70

Inspecting a line graph to determine simple effects & interaction…



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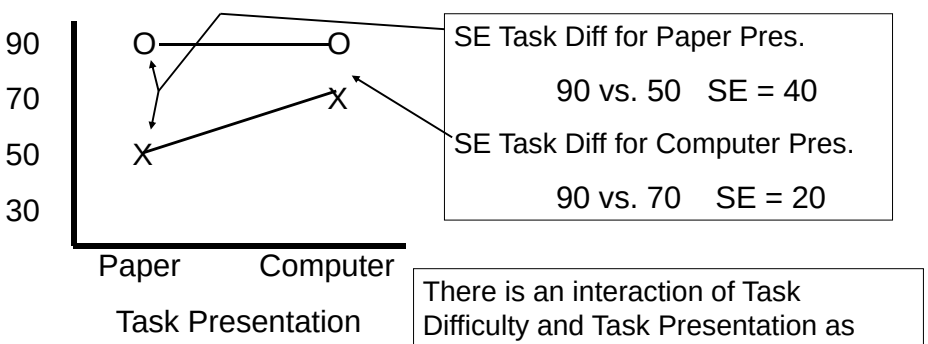
Inspecting a line graph to determine simple effects & interaction…

Performance



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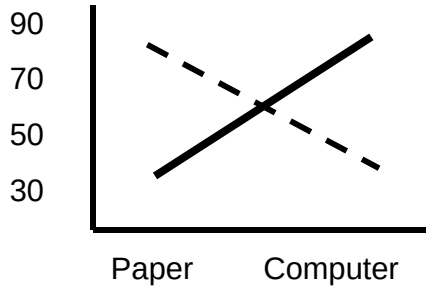
How ***not*** to Inspect a line drawing to determine if there is an interaction…

This is a "cross-over" interaction -- it certainly IS an interaction but it IS NOT the only kind !!

Performance



Key for Task Difficulty

Easy Hard

Inspecting a line graph to determine if there are main effects…

marginal means for Task Difficulty

Performance

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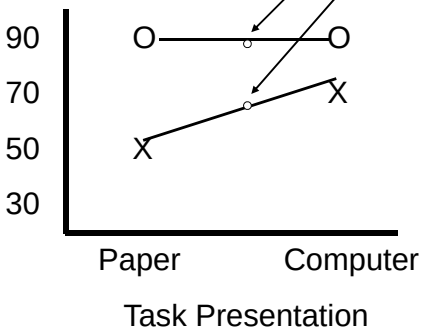

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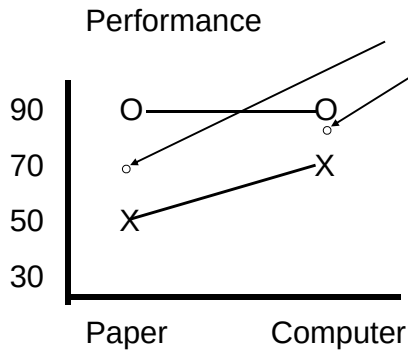

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Inspecting a Bar Graph …

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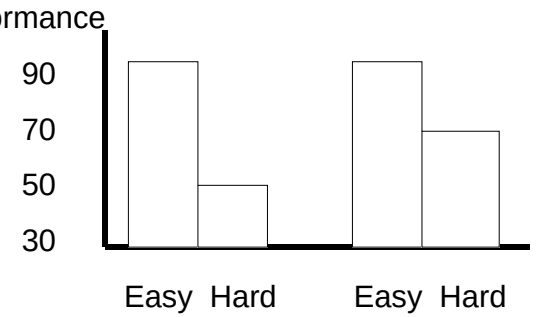

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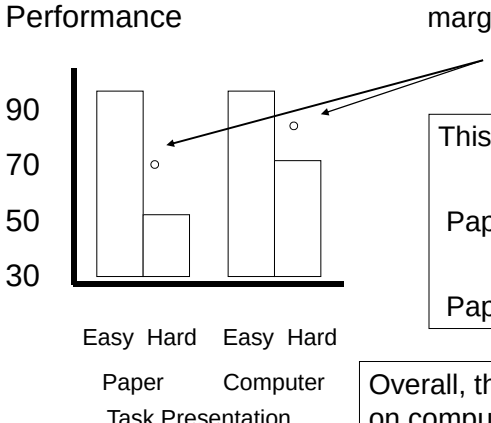

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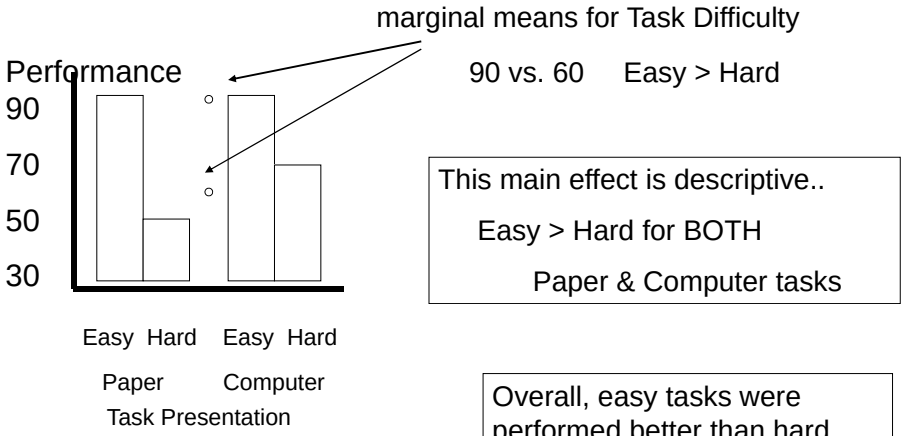

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Choosing Among Tables, Line Graphs and Bar Graphs

Tables

- Provides more detail (exact means and standard deviations)
- Easier to see main effects (can include marginal means)
- Harder to see the interaction

Line Graphs

- Easier to see interaction pattern (than tables)
- Harder to see main effects (than tables)
- "Formally" limited to using when quantitative IV on X axis

Bar Graphs

- Interactions -- easier than tables, not as easy as line graphs
- Mains -- harder to see than tables

Note: Any of these can include std, or SEM "whiskers"

Inspecting a Bar Graph to determine simple effects & interaction…

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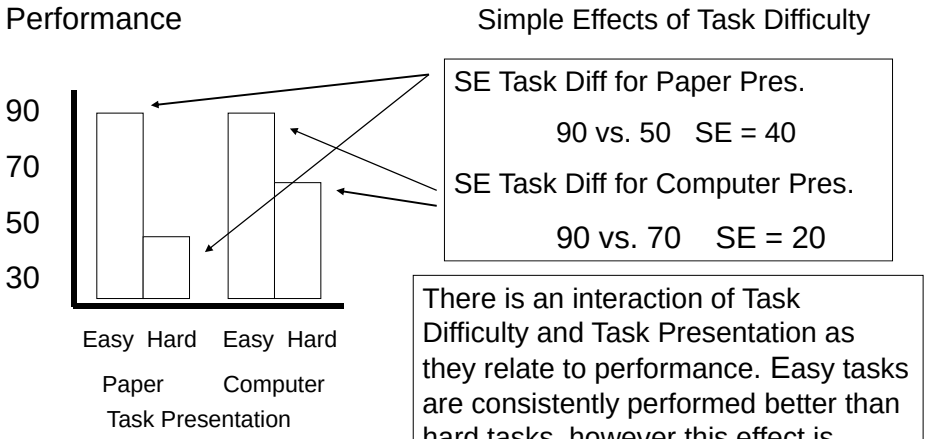

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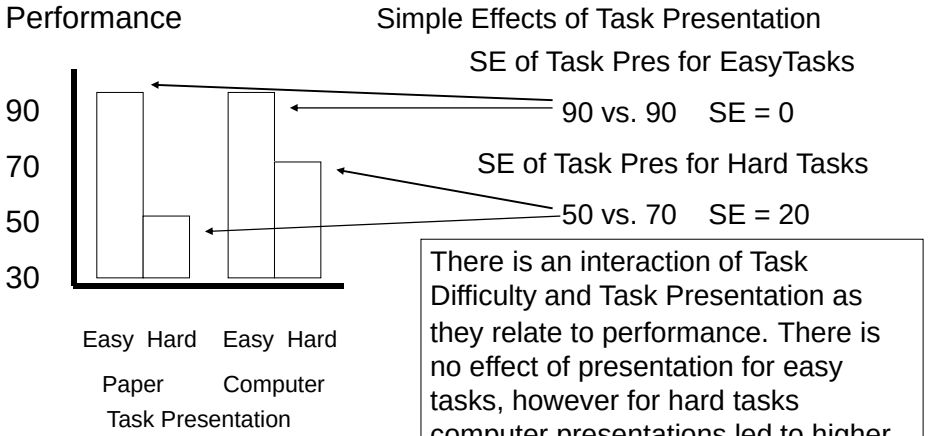

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