

### 3-way Factorial Designs

- Expanding factorial designs
- Effects in a 3-way design
- Defining a 3-way interaction
- BG & WG comparisons
- Experimental & Non-experimental comparisons
- Causal Interpretations
- "Descriptive" & "Misleading" effects
- Identifying "the replication"

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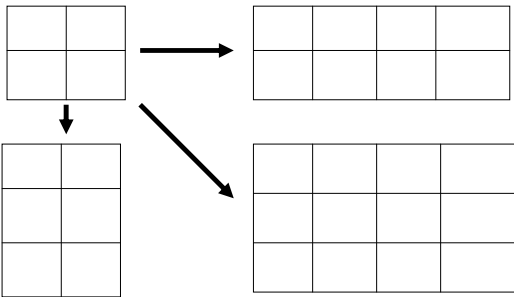
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### 3-way Factorial Designs

The simplest factorial design is a 2x2, which can be expanded in two ways:

1) Adding conditions to one, the other, or both IVs




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2) Add a 3rd IV (making a 3-way factorial design)

	Learning Psyc Methods		Learning Psyc Content	
	Ugrads	Grads	Ugrads	Grads
Computer Instruction				
Lecture Instruction				

Identify the three IVs in this design . . .

Specify the properties of each condition/cell of this design . . .

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### 3-Way Factorial Designs

There are 7 effects involved in a 3-way factorial

- 3 main effects (one for each IV)
- 3 2-way interactions (one for each pair of IVs)
- 1 3-way interaction

For the example name the ...

- main effects 1. Topic 2. Instruction Method 3. Ed. level
- 2-way interactions
  1. Topic X Inst. Method
  2. Topic X Ed. Level
  3. Inst. Method X Ed. Level
- 3-way interaction Topic X Instruction Method X Ed. level

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What does a 3-way interaction look like?

- Remember that a 2-way interaction is, "when the effect of one IV is different for different levels of a 2nd IV"
- Extending this to a design with 3 IVs, a 3-way interaction is, "when the interaction of two IVs is different for different levels of a 3rd IV"

		Practice	
Difficulty		1	10
Easy		70	90
Hard		20	70

SE of Practice is different for Easy and Hard Tasks

		Practice	
Difficulty		1	10
Easy	Familiar Task	50	90
Hard	Familiar Task	25	60
Easy	Unfamiliar Task	90	90
Hard	Unfamiliar Task	15	80

The 2-way interaction of Practice and Difficulty is different for Familiar and Unfamiliar Tasks

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Considering BG and WG comparisons...

... there are four different kinds of 3-way designs.

Completely Between Groups 3-way

Completely Within-Groups 3-way (each either repeated measures of matched-groups)

Mixed 3-way with 2 BG and 1 WG (either repeated measures of matched-groups)

Mixed 3-way with 1 BG and 2 WG (each either repeated measures of matched-groups)

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Considering Experimental & Nonexperimental comparisons ...  
... there are four different kinds of 3-way designs.

- All 3 IVs are RA & Manip, etc.
- All 3 "IVs" are measured (subject) variables
- 1 IV is RA & Manip, etc. -- other two "IVs" are measured (subject) variables
- 2 IVs are RA & Manip, etc. -- other "IV" is a measured (subject) variables

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Causal Interpretations of 3-way Designs

- When can a main effect be causally interpreted ?  
When the conditions of that IV are RA, Manip, Etc.
- When can a 2-way interaction be causally interpreted ?  
When the conditions of both the involved IVs are RA, Manip, Etc.
- When can a 3-way interaction be causally interpreted ?  
When the conditions of all three IVs are RA, Manip, Etc.

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"Descriptive" effects in a 3-way

The 3-way -- significant or not -- is always descriptive !

If the 3-way is significant, all 2-way & main effects are "suspect"

If the 3-way is significant, a 2-way is only descriptive if that 2-way has the same pattern for each condition of the 3<sup>rd</sup> IV

If the 3-way is significant, a main effect is only descriptive if that main effect has the same pattern for each combination of the other two IVs

If the 3-way is non-significant, all three 2-ways are descriptive

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"Descriptive" effects in a 3-way

If a 2-way is significant, the main effects of those IVs are "suspect"

If a 2-way is significant, the main effect of an IV involved in that interaction is only descriptive if that main effect has the same pattern for each condition of the other IV

The main effect of an IV that is not involved in any 2-way or 3-way interaction is always descriptive

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When do you need a LSDmmd value ???

General rule: You will need an LSDmmd value to compare pairs of means whenever a significant effect has  $k > 2$  conditions

#1 Whenever an interaction is significant → LSDmmd for the cell means/semi-marginal means is needed to :

- describe the pattern of the SEs to describe the interaction pattern
- describe the pattern of the SEs to determine whether each lower order effect (ME or Int) is descriptive or misleading

#2 Whenever a ME is significant → LSDmmd for those marginal means is needed to

- describe the patter of that ME

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Identifying "the replication"

With 7 main effects and interactions (and myriad simple effects) you have to be careful to get the correct part of the design that is "the replication" of an earlier study.

Example: You want to check if your recent 3-way study replicated an earlier effect that people who had 10 practices did about 40 points better than those who had only one practice (same DV).

As you can see, there is much variability in the effect of practice -- depending upon the conditions of the other IVs

		Familiar Task		Unfamiliar Task	
		Practice		Practice	
Difficulty		1	10	Difficulty	
Easy		50	90	Easy	
Hard		25	60	Hard	

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