Example of a 3-way Factorial

The purpose of the design was to examine the individual and joint effects of Stimulus Type (shape vs. Texture stimuli), Modality (vision vs. touch) and Practice (0 vs. 10 practices) upon discrimination performance. The DV is given as %-correct.

Effects Examined in the Design

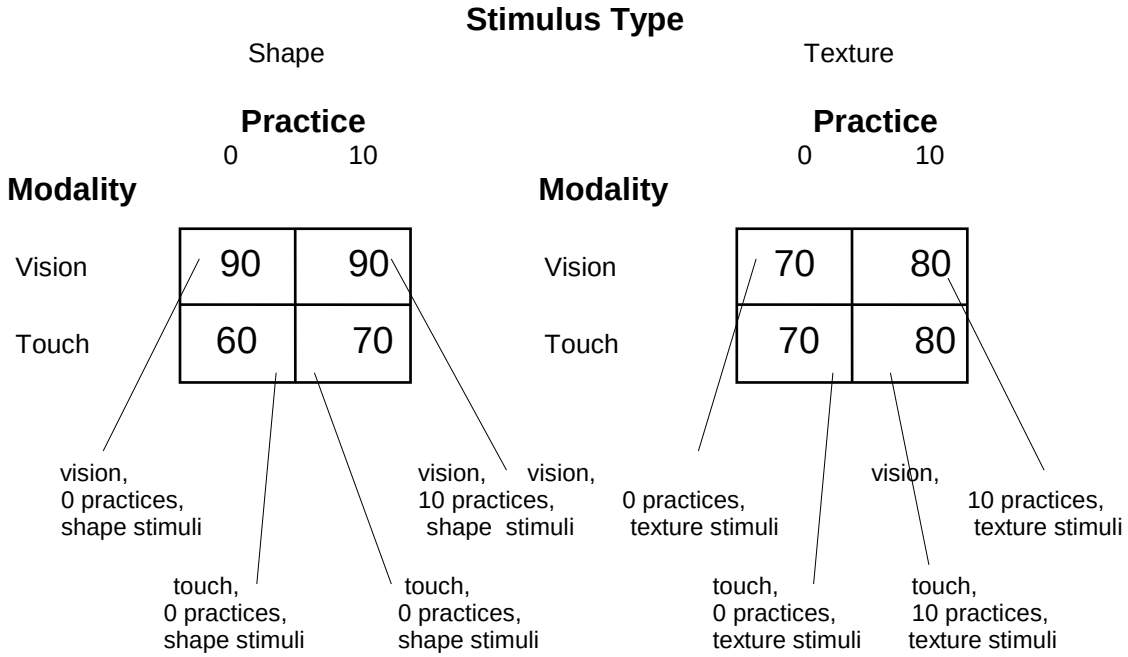
- Main effects – the effect of one IV, ignoring the other two IVs (based on comparisons among marginal means that are formed for each condition of the IV, aggregating across levels of the other two IVs).
  - there are three main effects in this design
    - Stimulus Type
    - Modality
    - Practice

- 2-way Interaction Effects – the joint effect of two IVs, ignoring the third IV (based upon comparisons among semi-marginal means that are formed for each joint condition of the two IVs, aggregating across the levels of the third IV)
  - there are three 2-way interactions in this design
    - Stimulus Type x Modality
    - Stimulus Type x Practice
    - Modality x Practice

- 3-way Interaction Effect -- the joint effect of three IVs (based upon comparisons among cell means)
  - there is one 3-way interaction – Stimulus Type x Modality x Practice

Each "cell" or "condition" in the design is defined by three attributes:

- What Modality was used -- vision or touch?
- How many Practices were completed before testing – 0 or 10?
- What type of Stimulus was involved – shape or texture?



3-way Interaction → Stimulus Type x Modality x Practice

How do we choose how to consider and describe this 3-way? This really comes down to "how ya thinking about" the IVS? Which are "most important"? What's "old vs new" about the design and IVs? Stuff like that…

This was a study about "perceptual practice effects". Many people were studying whether "perception got better with practice", with different labs were getting all sorts of different answers! After working through a stack of papers (yes, real, stapled-together papers – it was the 80s) it became apparent different studies used different combinations of modalities and stimuli. I was interested in vision and touch – because they can be presented with exactly the same shape and texture stimuli so that seemed like an interesting 3rd IV.

Practice Effect is the Primary IV → "does perceptual performance improve with practice"?

Modality is the Primary Moderator → is the "practice effect" different for Vision and Touch ?

Stimulus Type is the Secondary Moderator → does this variable further "change" the relationship between Practice and Performance, as it is moderated by Modality??

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So, looking at the simple effects of Practice, we get…

Stimulus Type

Shape

Modality	**Practice 0**		**Practice 10**
Vision	90	=	90
Touch	60	<	70

Texture

Modality	**Practice 0**		**Practice 10**
Vision	70	<	80
Touch	70	<	80

Look at the Shape conditions

- → No Practice effect for Vision
- → Practice improves performance for Touch
- → Simple effects are "different directions"

So, There is "a simple 2-way interaction of Practice & Modality for Shape Stimuli"

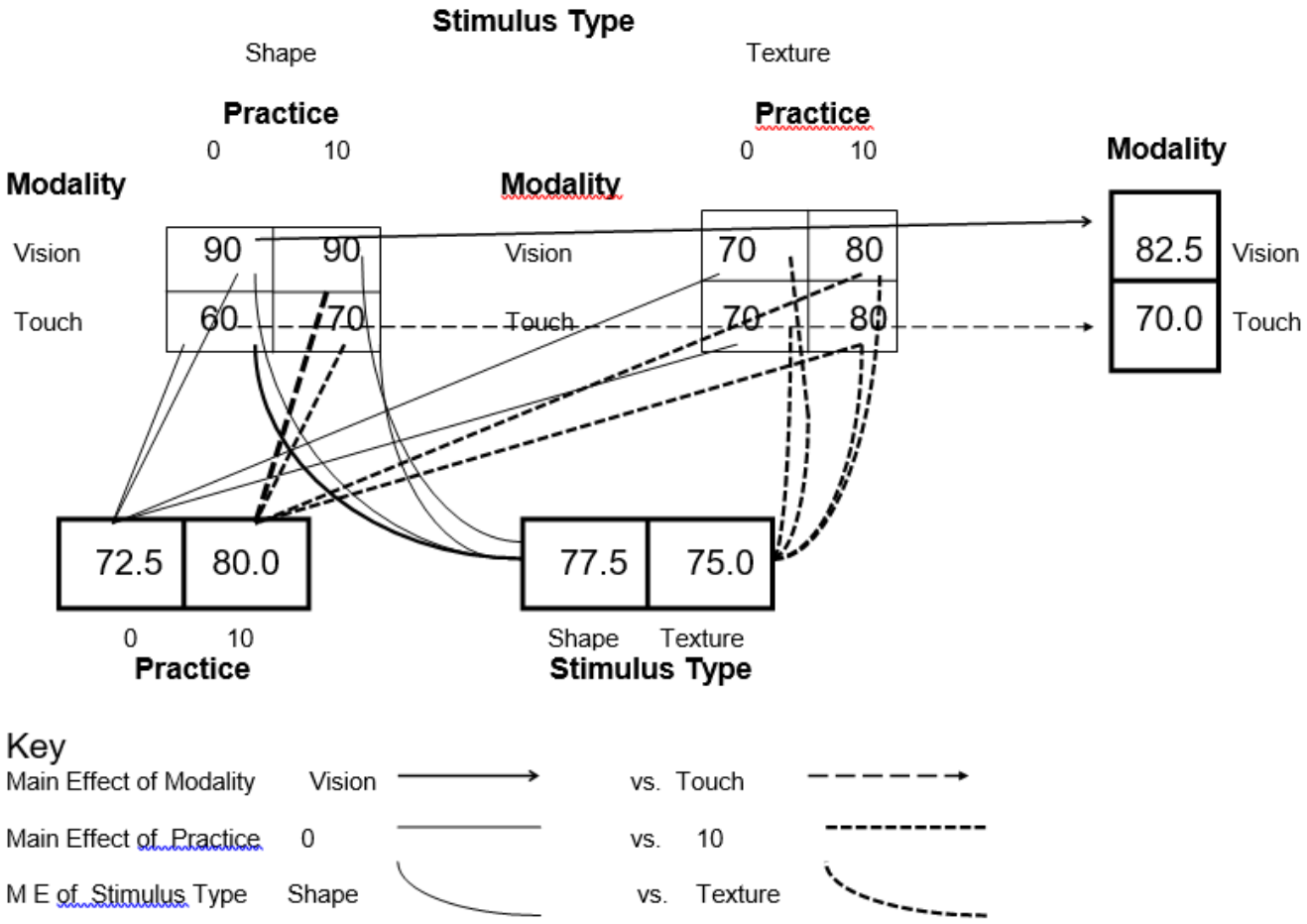
Look at the Texture conditions

- → Practice improves performance for Vision
- → Practice improves performance for Touch
- → Simple effects are in "same direction and same size"

So there "NO simple 2-way interaction of Practice & Modality for Shape Stimuli"

Since the simple 2-way of Practice & Modality is different for Shape and Texture stimuli, we have a 3-way interaction!

Constructing Marginal Means to Examine Main Effects



Checking if main effects are "descriptive or misleading"!!

We have a significant 3-way, so all lower order effects are "suspect" and have to be checked!

Main effect of Practice is "0Pract < 10Pract" – this is misleading…

- ➔ It is descriptive for Shape-Touch (60<70), Texture-Vision & Texture-Touch (both 70<80)
- ➔ But… it is misleading for Shape-Vision (90=90)

Main effect for Stimulus Type is "Shape > Texture" – this is misleading…

- ➔ It is descriptive for Vision-0Pract (90>70) & Vision-10Pract (90>80)
- ➔ But.. it is misleading for both Touch-0Pract (60<70) & Touch-10Pract (70<80)

Main effect for Modality is "Vision > Touch" – this is misleading…

- ➔ It is descriptive for Shape-0Pract (90>60), Shape-10Pract (90>70)
- ➔ But… it is misleading or both Texture-0Pract (70=70), Texture-10Pract (80>80)

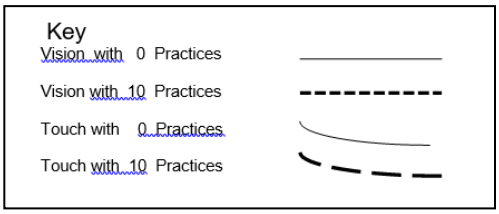
When you have a significant 3-way interaction, descriptive main effects are relatively uncommon – the marginal mean pattern has to hold up across at least four combinations of the other 2 IVs. This is also why they are really kinda cool!!! They are "an effect" that has already shown some "generalizability"!

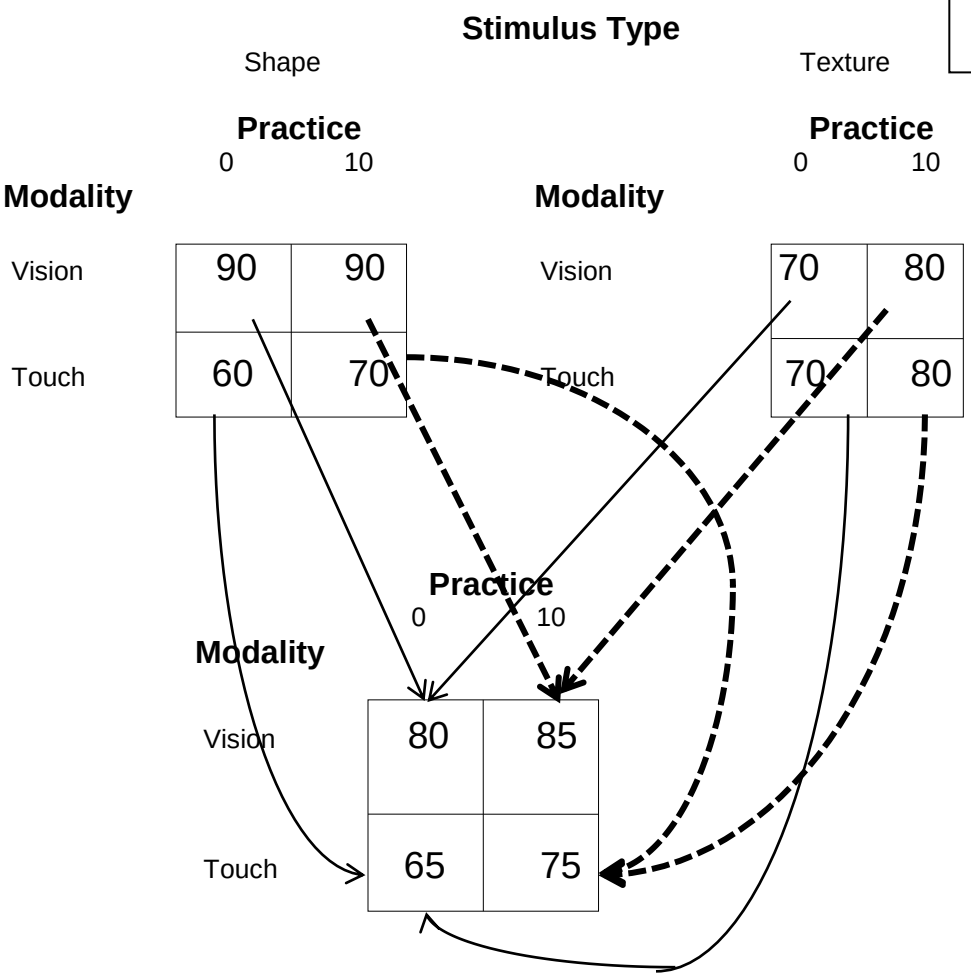
The other really cool 3-way finding is a significant 3-way and no other significant effects! Why Cool?? Because any design simpler than the 3-way – studying any one IV or any pair of the IVs -- would have missed the importance of all three IVs!!

Time for 2-ways!!

Much like the main effects, we have to first describe an effect, and then (because we have a significant 3-way) check it to see if it is descriptive or misleading!

Modality x Practice 2-way Interaction





The means used to examine a 2-way interaction within a 3-way design are called "semi-marginal" means – because there is aggregation across the one other IV (Stimulus in this case)

There is a two-way interaction of Modality and Practice, such that Practice produces more improvement for Touch than for Vision.

	Practice 0		Practice 10
Vision		**<**	
Touch		**<<**	

Is this 2-Way Interaction descriptive or misleading?

To check, we have to look at the simple 2-way of Modality and Practice for each Stimulus Type (Shape & Texture).

for **Shape**

	Practice 0		Practice 10
Vision	90	**=**	90
Touch	60	**<<**	70

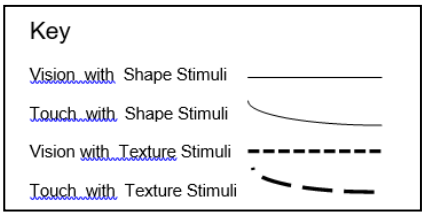
This 2-way interaction pattern is **misleading**!

It corresponds with **neither** of the simple-2way patterns!!

for **Texture**

	Practice 0		Practice 10
Vision	70	**<<**	80
Touch	70	**<<**	80

Modality x Stimulus Type 2-way Interaction



Stimulus Type

Shape

Practice

0 10

Modality

Vision	90	90
Touch	60	70

Texture

Practice

0 10

Modality

Vision	70	80
Touch	70	80

There is a 2-way interaction of Modality and Stimulus, with vision performing better than touch with shape stimuli, but no modality effect for texture stimuli.

Stimulus Type

Shape Texture

Modality

Vision	90	75
Touch	65	75

	Shape	Texture
Vision	90	75
	V	||
Touch	65	75

Is this 2-Way Interaction descriptive or misleading?

To check, we have to look at the simple 2-way of Modality and Stimulus Type for each amount of Practice (0 and 10)

for **0 Practice**

	Shape	**Texture**
Vision	90	70
	V	**||**
Touch	60	70

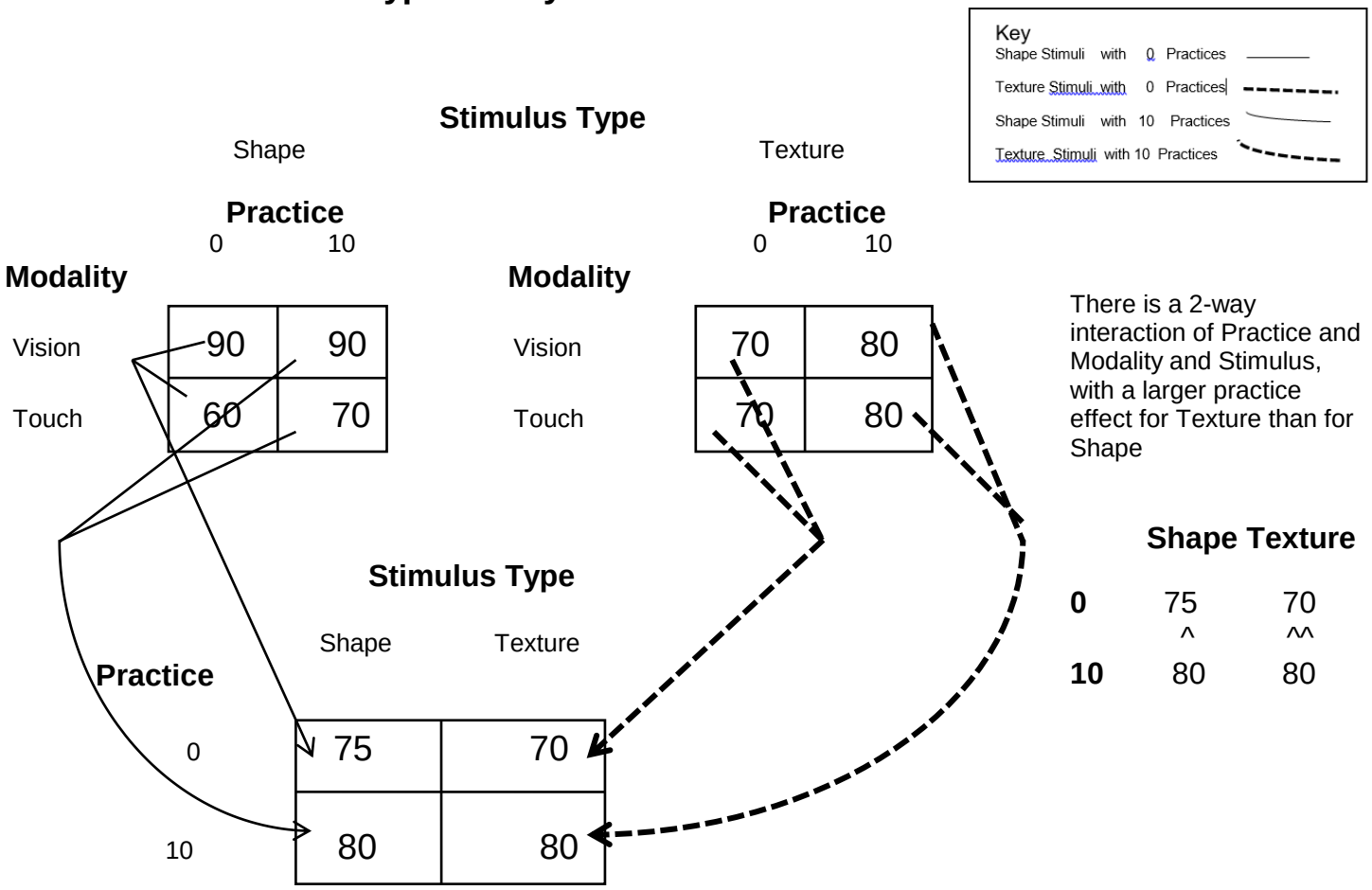
This 2-way interaction pattern is **descriptive**!

It corresponds with **both** of the simple-2way patterns!!

for **10 Practice**

	Shape	**Texture**
Vision	90	80
	V	**||**
Touch	70	80

Practice x Stimulus Type 2-way Interaction



There is a 2-way interaction of Practice and Modality and Stimulus, with a larger practice effect for Texture than for Shape

	Shape	Texture
0	75	70
	^	^^
10	80	80

Is this 2-Way Interaction descriptive or misleading?

To check, we have to look at the simple 2-way of Practice and Stimulus Type for each amount of Modality (Vision and Touch)

for **Vision**

	Shape	Texture
0	90	70
	‖	^
10	90	80

This 2-way interaction pattern is **misleading**!

It corresponds with **neither** of the simple-2way patterns!!

for **Touch**

	Shape	Texture
0	60	70
	^	^
10	70	80