Lecture #6

Factorial designs continued

Start thinking about the final lab project

- Individual presentation (everyone proposes an idea)
- Group work (form groups, complete experiment for one idea)
- Group presentation (present your findings)

2x2 Design

- All final projects must employ a 2x2 design
- You will reproduce an effect from the literature (IV1), then attempt to manipulate the effect (IV2)
- Important to have a reason why IV2 would influence the IV1 effect

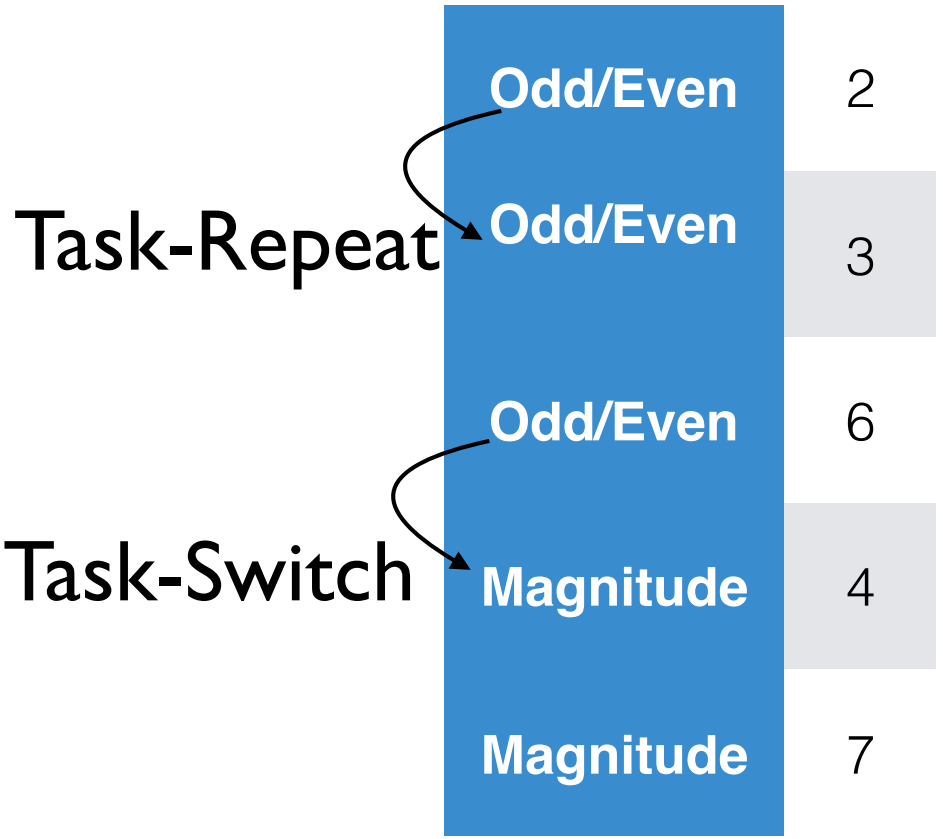
Individual Presentations

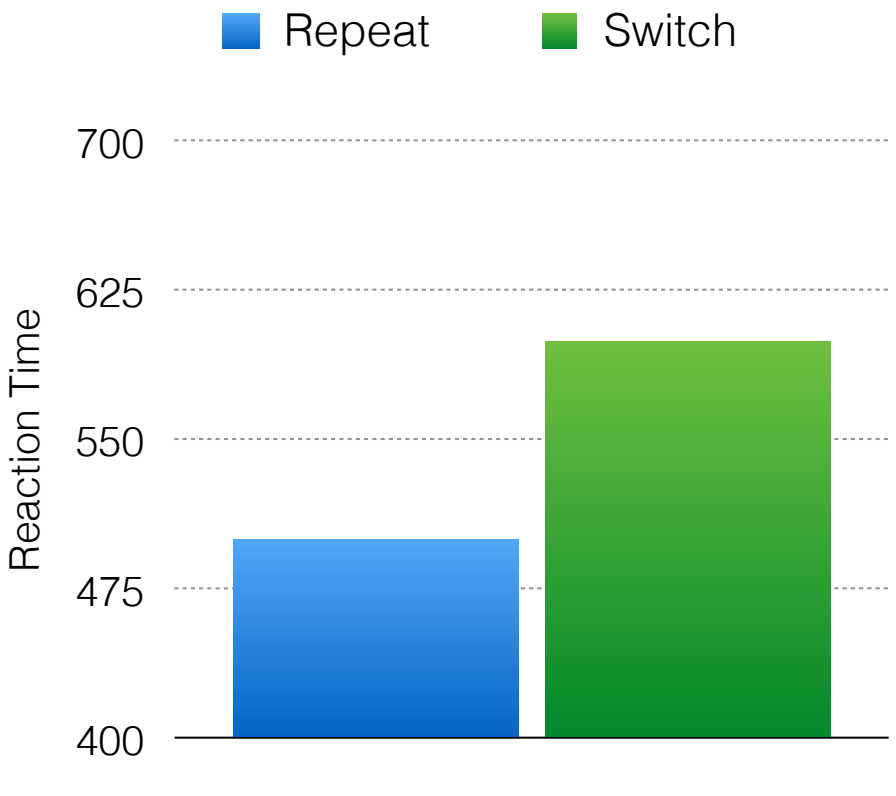
- 5 minutes each
- Explain the effect (IV1) you are measuring
- Describe the manipulation (IV2) you will use to manipulate the IV1 effect (explain why)
- Show predicted results

Does practice with switching reduce or eliminate the task-switching cost?

Matthew Crump

Switching between tasks is known to slow performance





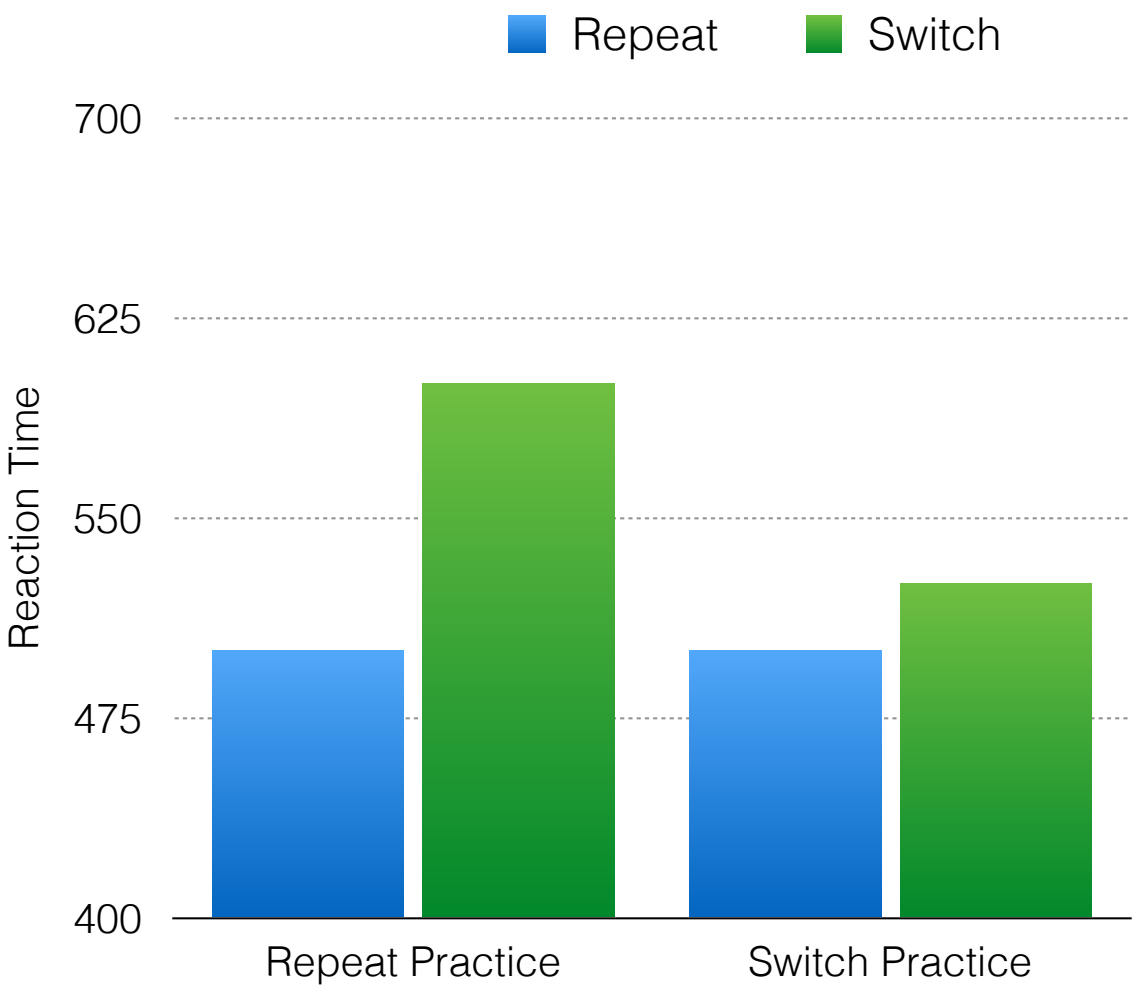
Hypothesis: People are slower on switch trials because they have less practice with switching between tasks.

Logic: The switch-cost should be reduced or eliminated when people have more practice at switching between tasks

Design

Practice Phase	Post
Repeat Task Practice	measure switch-costs
AAAABBBB	ABABABAB
Switching Task Practice	measure switch-costs
ABABABAB	ABABABAB

Predicted Results



Lecture #6

Factorial designs continued

What is a factorial design?

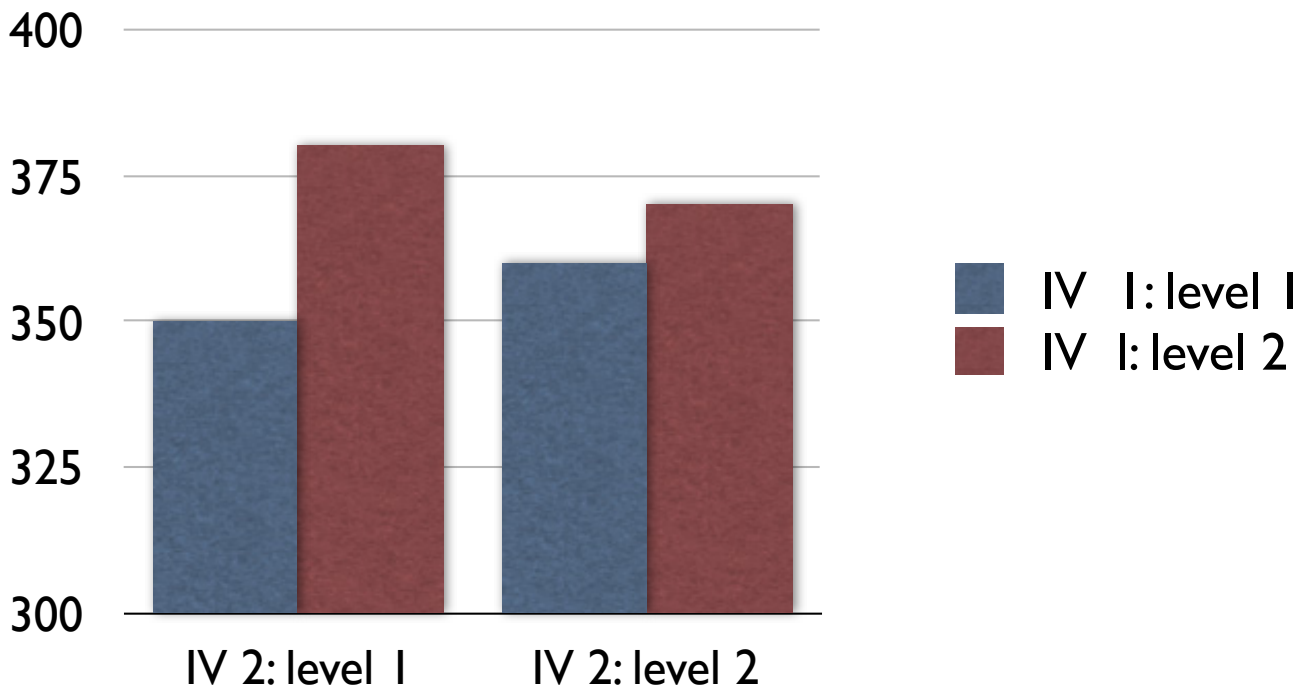
- Any experiment with more than one IV

- Fully factorial designs ensure that each level from each IV is crossed with each level from every other IV

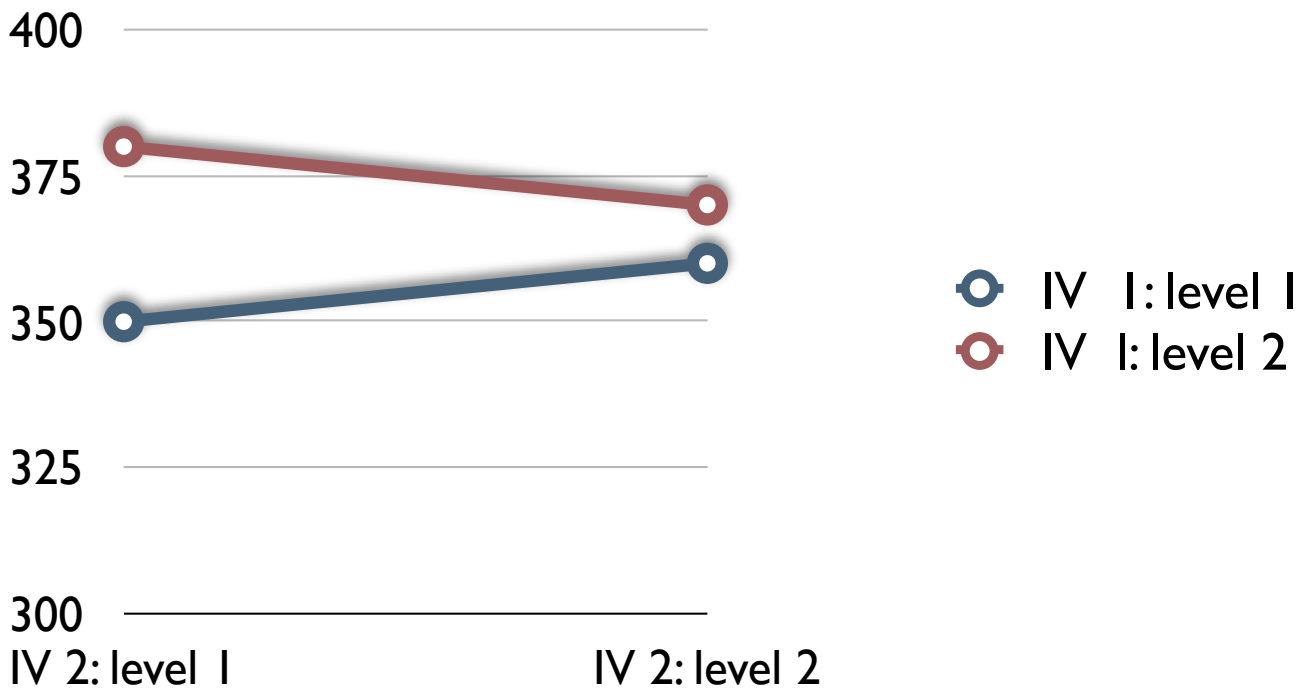
What's in store

		Factor 1	
		level 1	level 2
Factor 2	level 1	823	847
	Level 2	810	897

What's in store



What's in store



Reminder: IVs, Factors, & levels

- IV = independent variable or factor
- Factor and IV are interchangeable terms

- Levels = the number of different manipulations for each factor (or IV)

One factor
2 levels

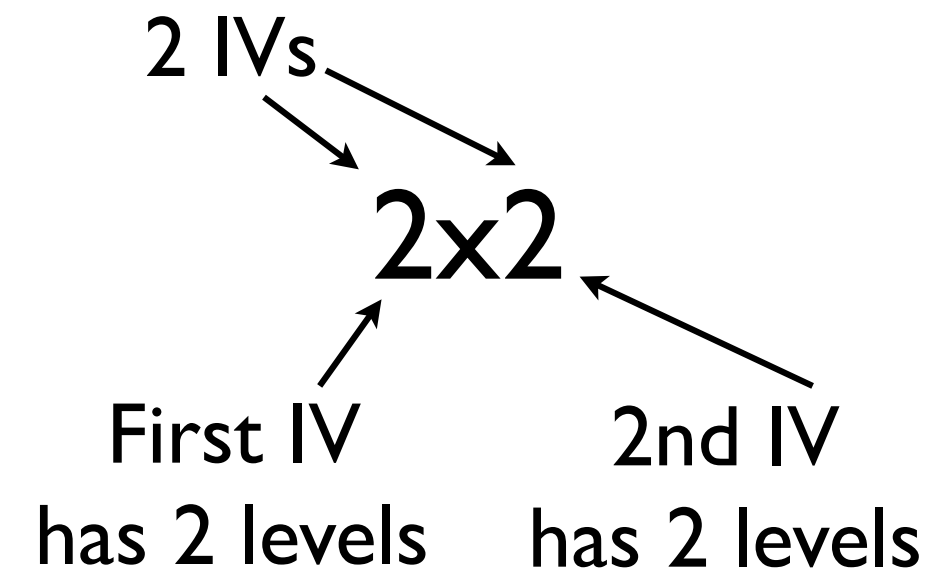
Independent Variable 1 (Factor)	
Level 1	Level 2
DV	DV

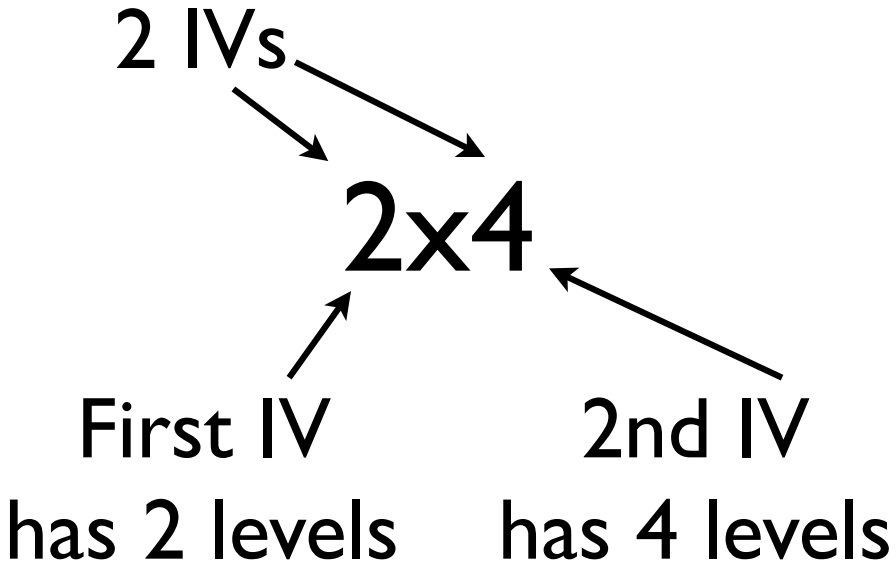
Independent Variable 1 (Factor)		
Level 1	Level 2	Level 3
DV	DV	DV

One factor
3 levels

Formally describing Factorial designs

- The numbering system defines
  - The number of independent variables
  - The number of levels for each variable





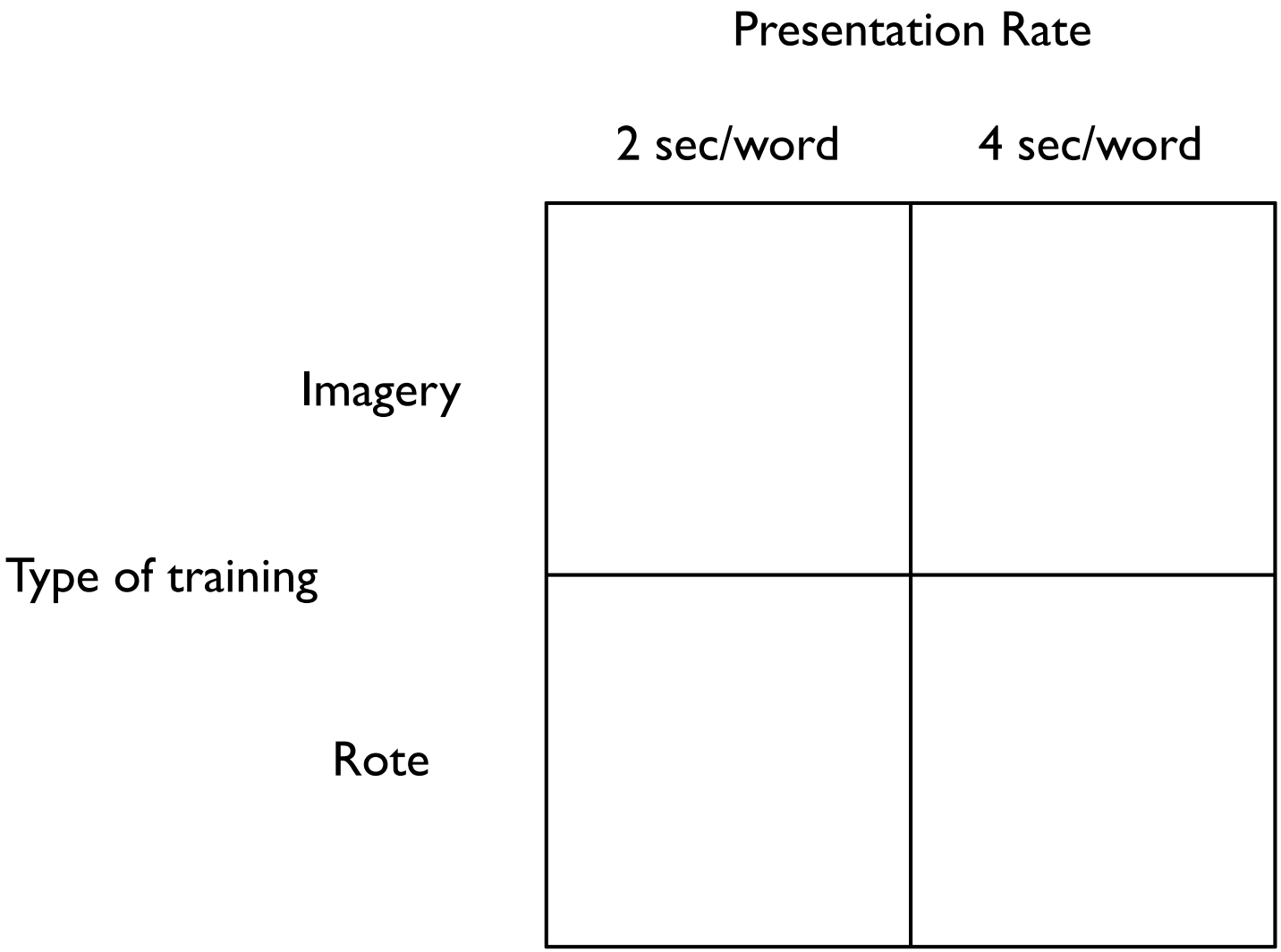
How many IVs? How many levels?

2x4x2

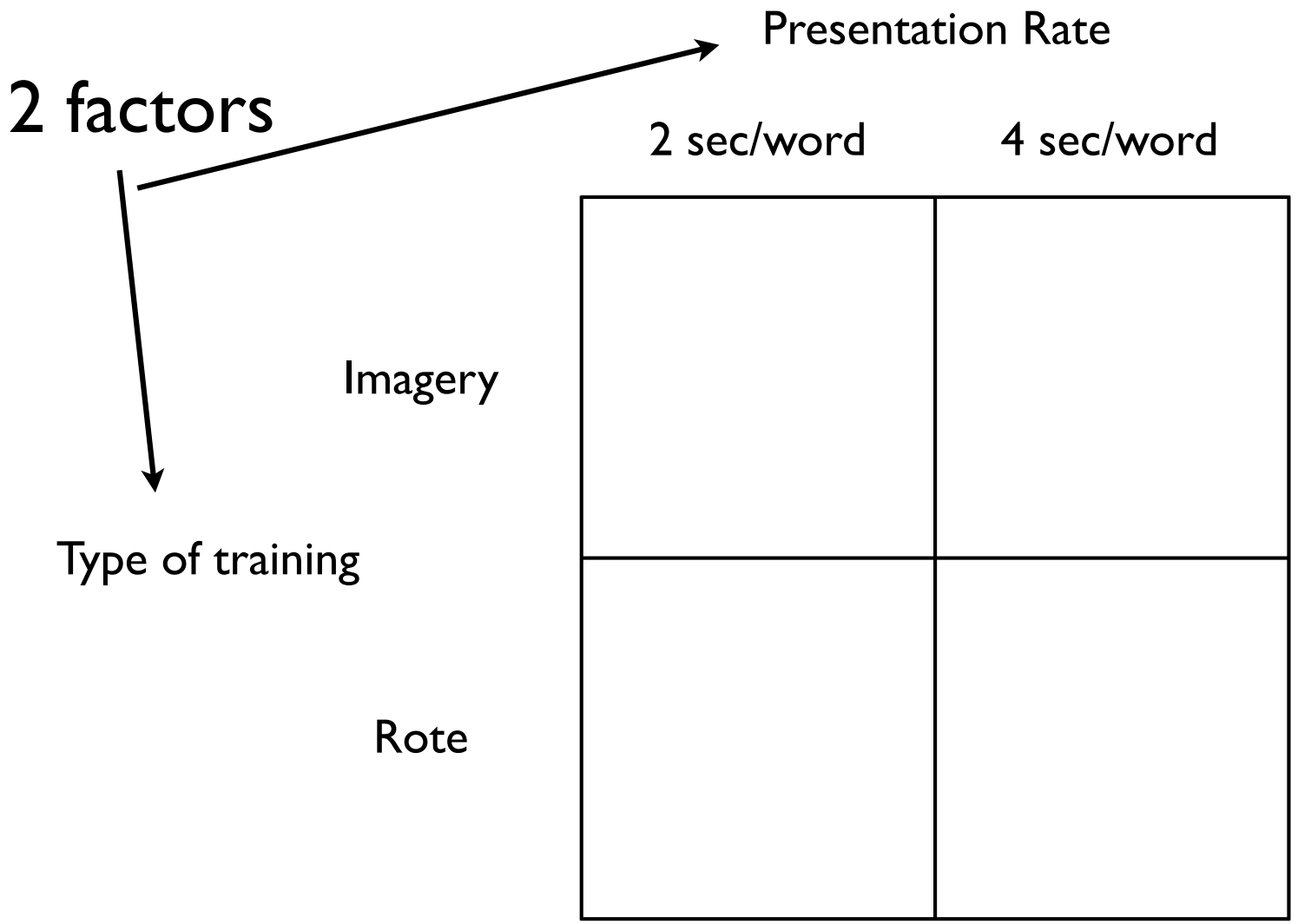
3x6x4x2

2x3x2x2x4

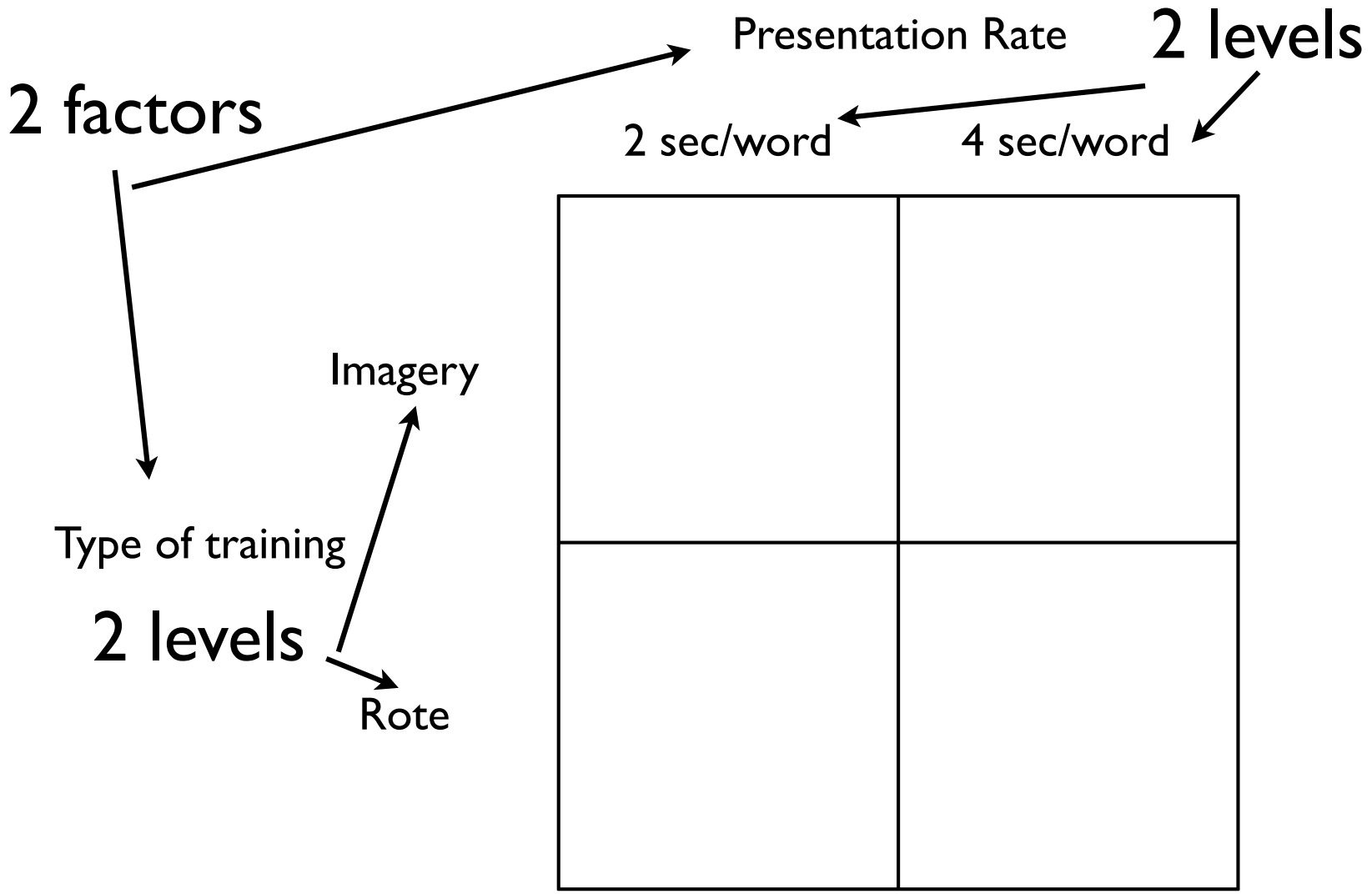
Factors, Levels, conditions



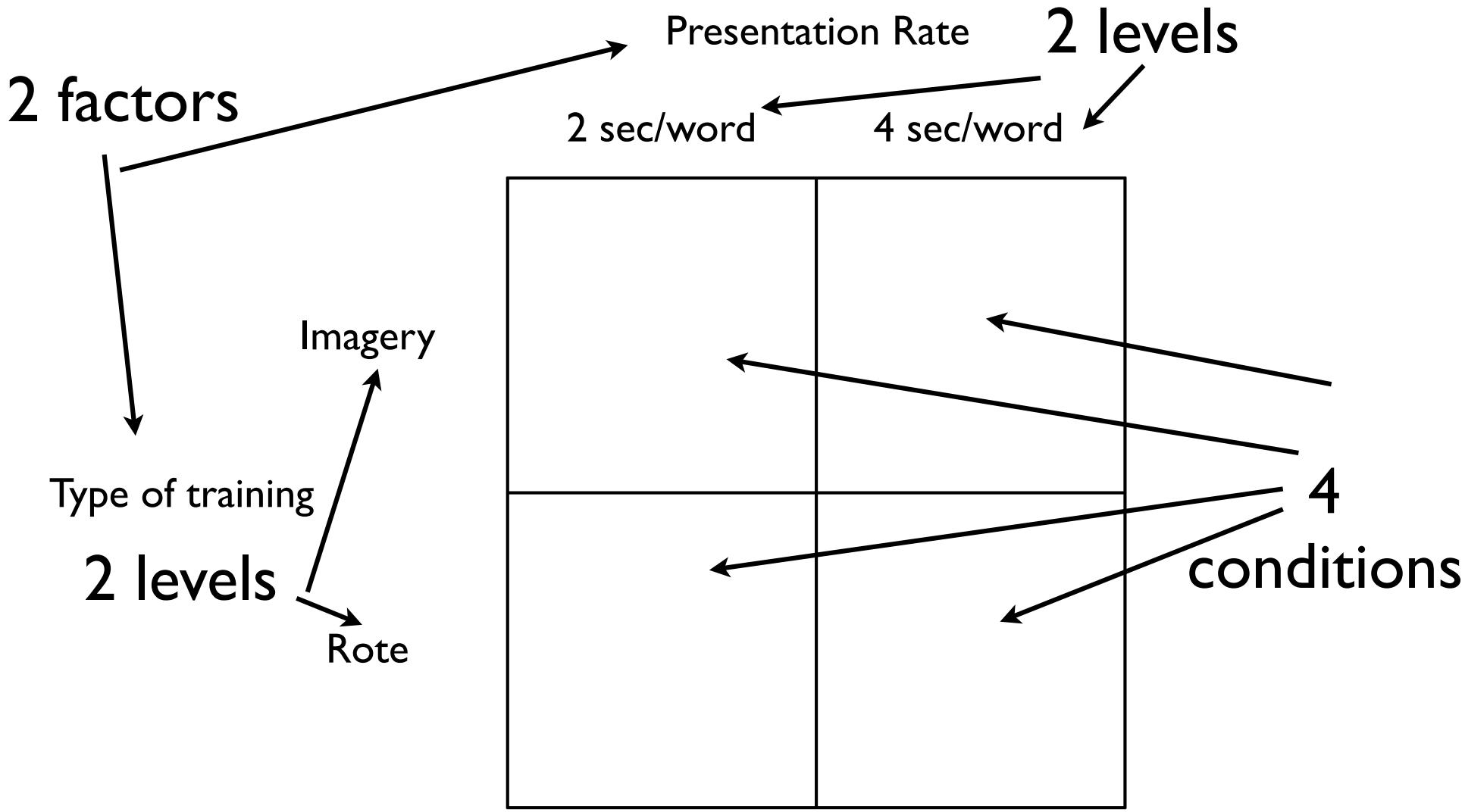
Factors, Levels, conditions



Factors, Levels, conditions



Factors, Levels, conditions



Conditions

- Conditions = the number of combinations of the different levels of each independent variable

- Calculate the possible number of combinations by multiplication
  - 2x2 = 4
  - 2x3 = 6
  - 2x2x2= 4x2 = 8
  - 2x6x3= 12x3 = 36

Main effects & Interactions

- Main Effect:
  - The influence of a single independent variable, collapsed across all other independent variables

- Interaction
  - When the influence of one independent variable **depends** on the level of another independent variable

2x2 Walk through

- Identify and compute main effects for each IV from a table of means
- Identify and compute the interaction from a table of means
- Describe the pattern of each effect in a sentence

Example means from a 2x2 design

		IV1	
		1	2
IV2	A	5	15
	B	10	30

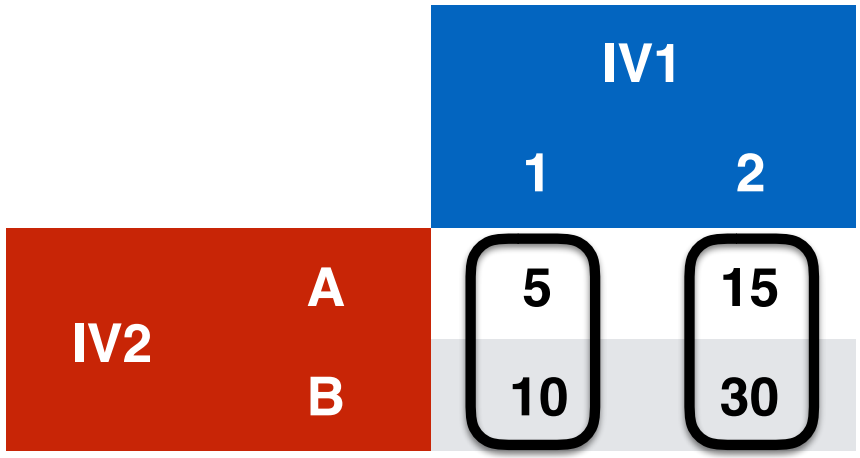
Main Effect for IV1

Question: On average is there a difference between the levels of IV 1?

		IV1	
		1	2
IV2	A	5	15
	B	10	30

Main Effect for IV1

The average effect of IV 1, collapsed over IV 2



	5+10	15+30	Main Effect for IV1
	15	45	
Means	7.5	22.5	22.5-7.5=15

Describing the pattern of IV1 Main effect

The main effect for IV1 was significant. The mean for level 1 (7.5) was 15 points lower than the mean for level 2 (22.5).

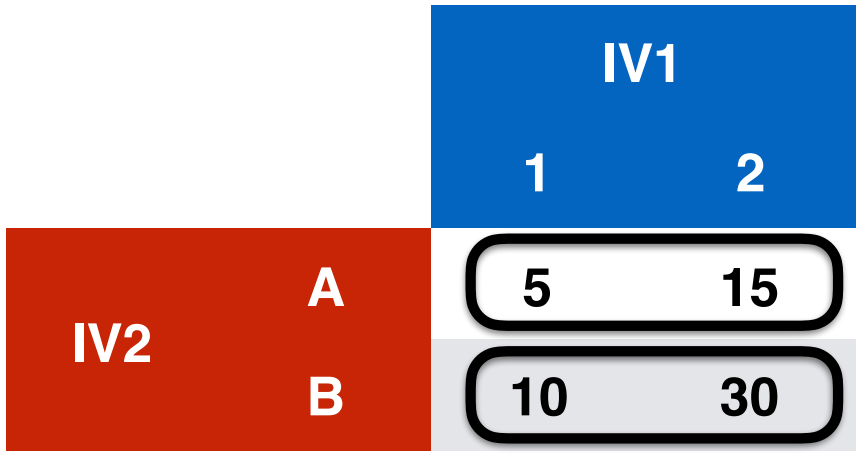
Main Effect for IV2

Question: On average is there a difference between the levels of IV 2?

		IV1	
		1	2
IV2	A	5	15
	B	10	30

Main Effect for IV2

The average effect of IV 2, collapsed over IV 1



			Means
5+15	20	10	
10+30	40	20	

Main Effect for IV1

20-10=10

Describing the pattern of IV2 Main effect

The main effect for IV2 was significant. The mean for level 1 (10) was 10 points lower than the mean for level 2 (20).

IV1 x IV2 Interaction

Question: Does the effect of one IV depend on the levels of the other IV?

		IV1	
		1	2
IV2	A	5	15
	B	10	30

IV1 x IV2 Interaction

Compare the effect of IV1 for each level of IV2

		IV1		IV 1 Effects (Difference Scores)		Interaction
		1	2			
IV2	A	5	15	15-5	10	20-10 =10
	B	10	30	30-10	20	

Describing the pattern of the IV1xIV2 Interaction

The IV1 x IV2 interaction was significant.
The difference between level 1 (5) and 2 (15) of IV1 in level A of IV2 was 10 points smaller than the difference between level 1 (10) and 2 (30) of IV1 in level B of IV2.

NOTE: in a 2x2 design there is only one interaction…
But, it can be computed two different ways

IV1 x IV2 Interaction

Compare the effect of IV1 for each level of IV2

		IV1	
		1	2
IV2	A	5	15
	B	10	30

10-5 30-15

IV 1 Effects (Difference Scores) 5 15

Interaction 15-5 =10

Examples from Lab

1) Task-switching
2) Stroop

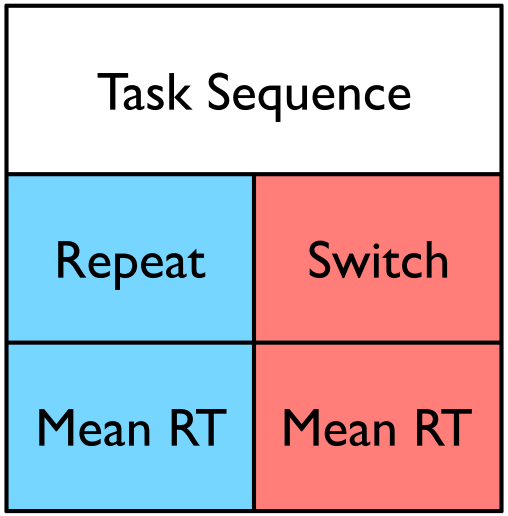
Are task-switching costs smaller for women than men?

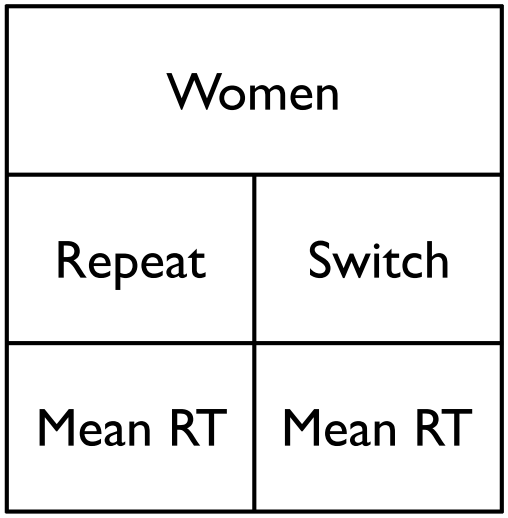
Task Sequence	
Repeat	Switch
Mean RT	Mean RT

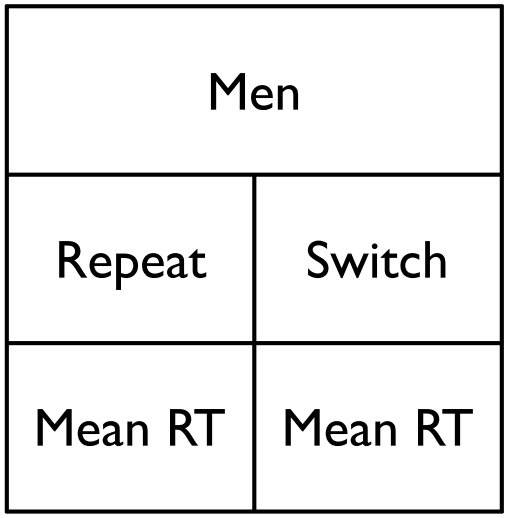
Gender	
Women	Men
Mean RT	Mean RT

Crossing means that each level of one IV, is experienced for each level of the other IV

Paper 2 example
Crossing two IVs







E.g. , Both Women and Men experience repeat and switch trials

Paper 2 example
2x2 table

IV 1: Task

IV 2: Gender

		Gender	
		Women	Men
Task Sequence	Repeat	700	700
	Switch	750	800

		Gender	
		Women	Men
Seq	Repeat	700	700
	Switch	750	800

means: 725 750

Main effect
Gender = 25

		Gender	
		Women	Men
Seq	Repeat	700	700
	Switch	750	800

means:

700

775

Main effect
Task-sequence = 75

		Gender	
		Women	Men
Seq	Repeat	700	700
	Switch	750	800

Interaction?

		Gender	
		Women	Men
Seq	Repeat	700	700
	Switch	750	800

What kind of question is the interaction asking?

Is the switch cost smaller for women than men?

		Gender	
		Women	Men
Seq	Repeat	700	700
	Switch	750	800

Switch Cost (Switch-Repeat)

50 100

...this difference?

Is this difference...

Different from

One more time...

2x2 design for Stroop

		Congruency	
		Congruent	Incongruent
Suggestion to view words as nonsense symbols	Suggestion		
	No Suggestion		

Main effects

- Main Effect:
  - The influence of a single independent variable, collapsed across all other independent variables

Main effects

- Main Effect:
  - The influence of a single independent variable, collapsed across all other independent variables
  - The number of main effects in a design corresponds to the number of IVs in the design

Overall predictions for Stroop

		Congruency	
		Congruent	Incongruent
Suggestion to view words as nonsense symbols	Suggestion	310	310
	No Suggestion	350	380

Note: these are fake data

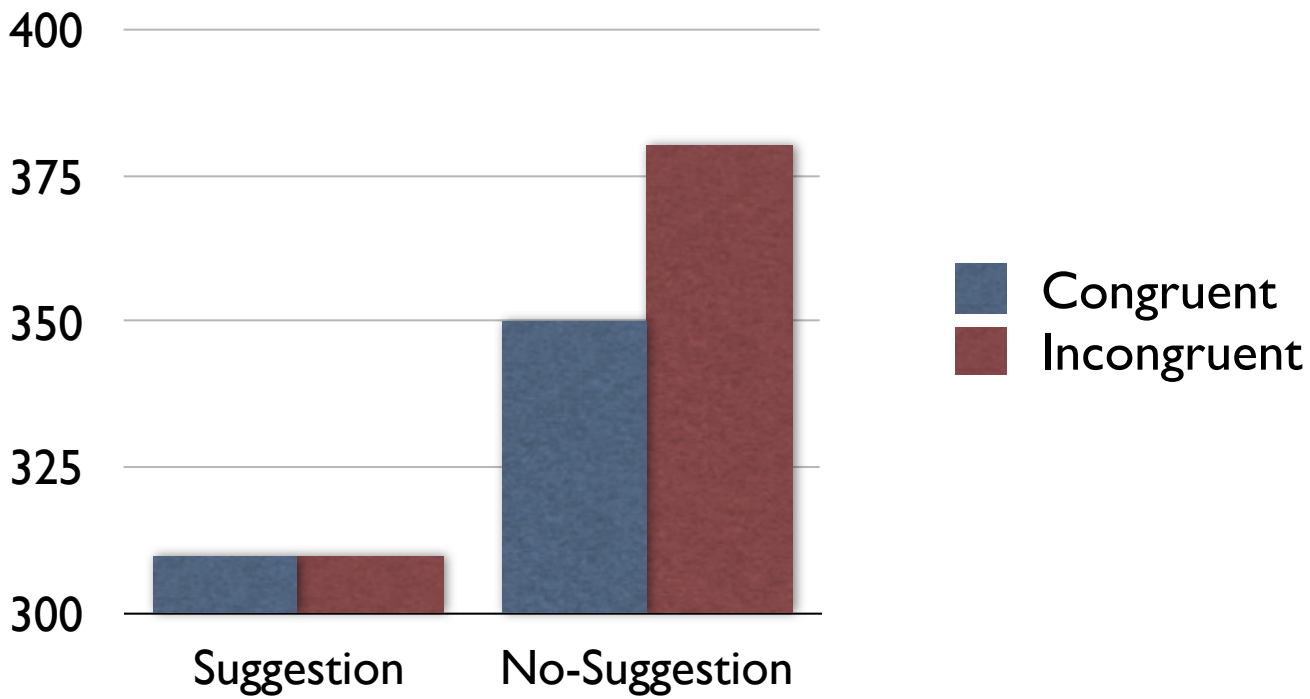
Main effect of Congruency

		Congruency	
		Congruent	Incongruent
Suggestion to view words as nonsense symbols	Suggestion	310	310
	No Suggestion	350	380
		330	345

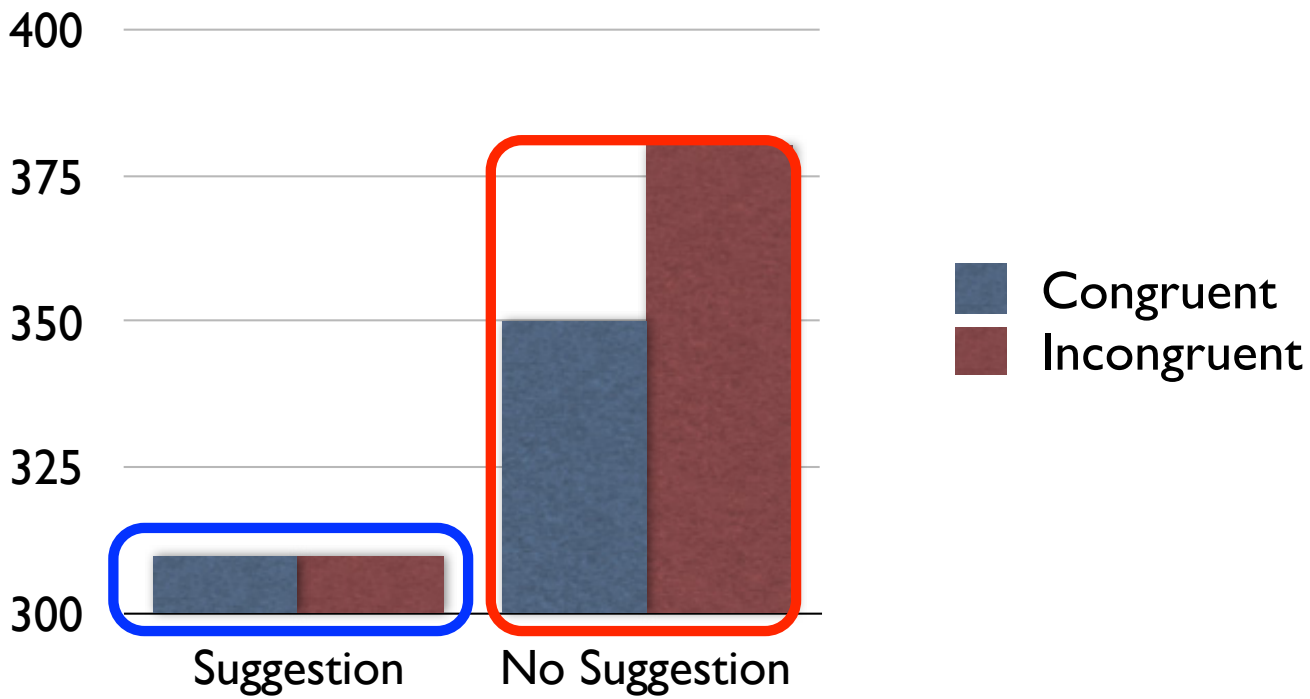
Main effect of Task

		Congruency		
		Congruent	Incongruent	
Suggestion to view words as nonsense symbols	Suggestion	310	310	310
	No Suggestion	350	380	365

Bar Graph format

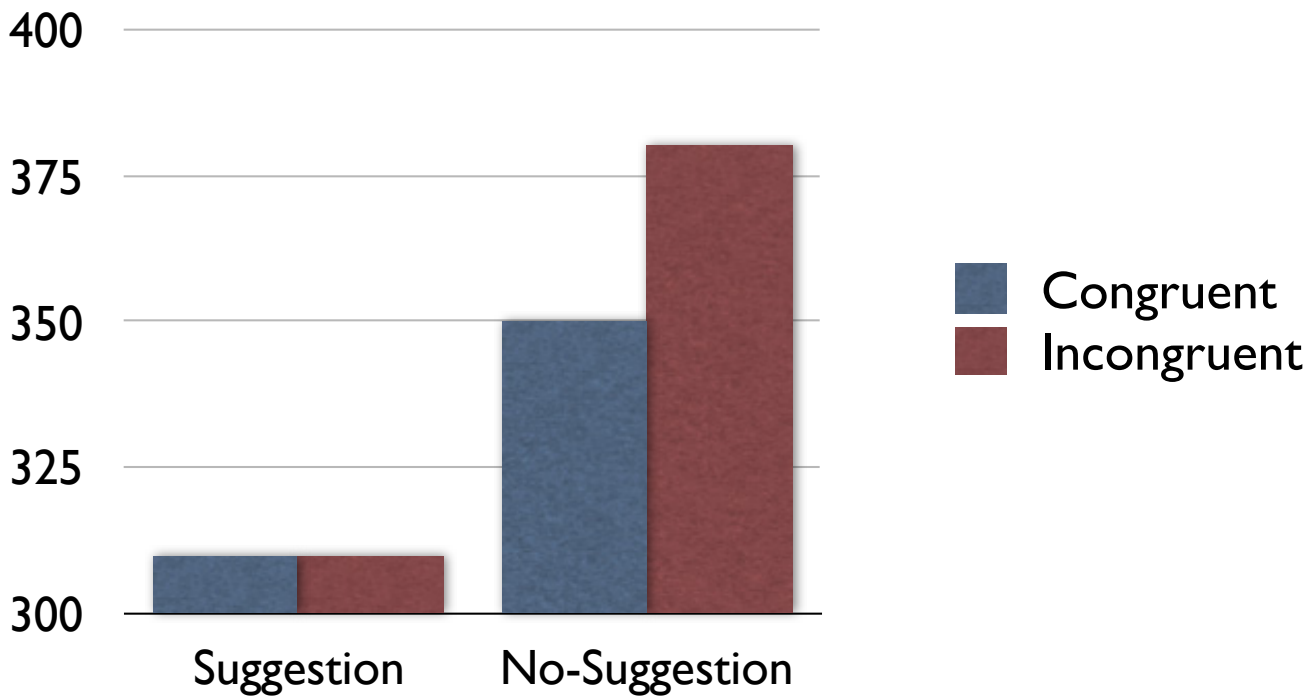


Main effect of Suggestion



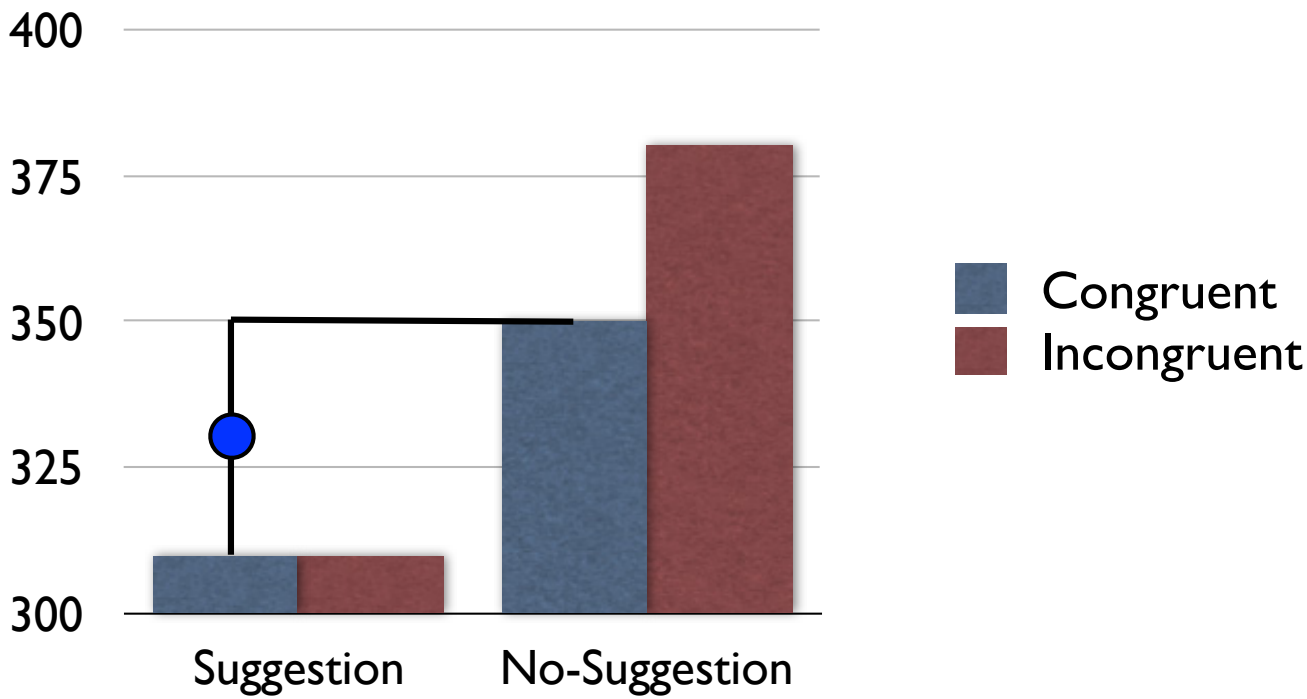
Main effect of Suggestion compares the average of all Suggestion conditions (congruent & incongruent) against the average of all No-Suggestion conditions (congruent & incongruent)

Main effect of congruency



Main effect of congruency compares the average of both congruent scores against the average of both incongruent scores

Main effect of congruency



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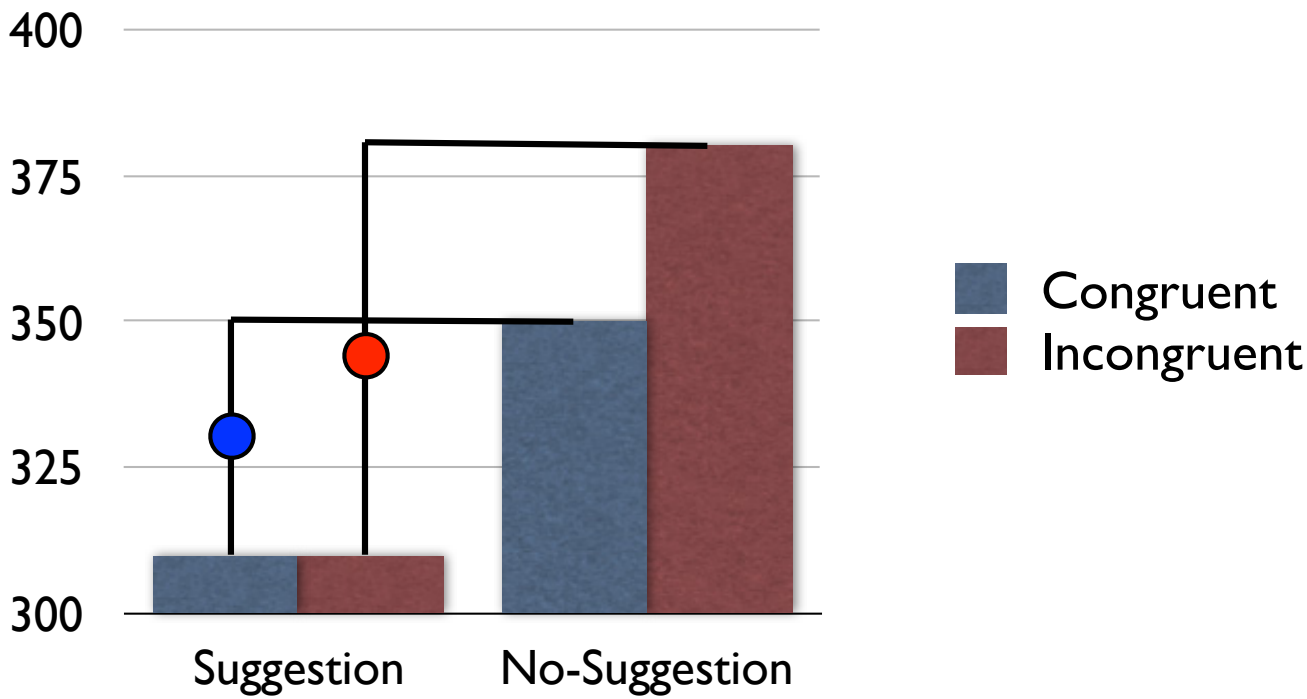

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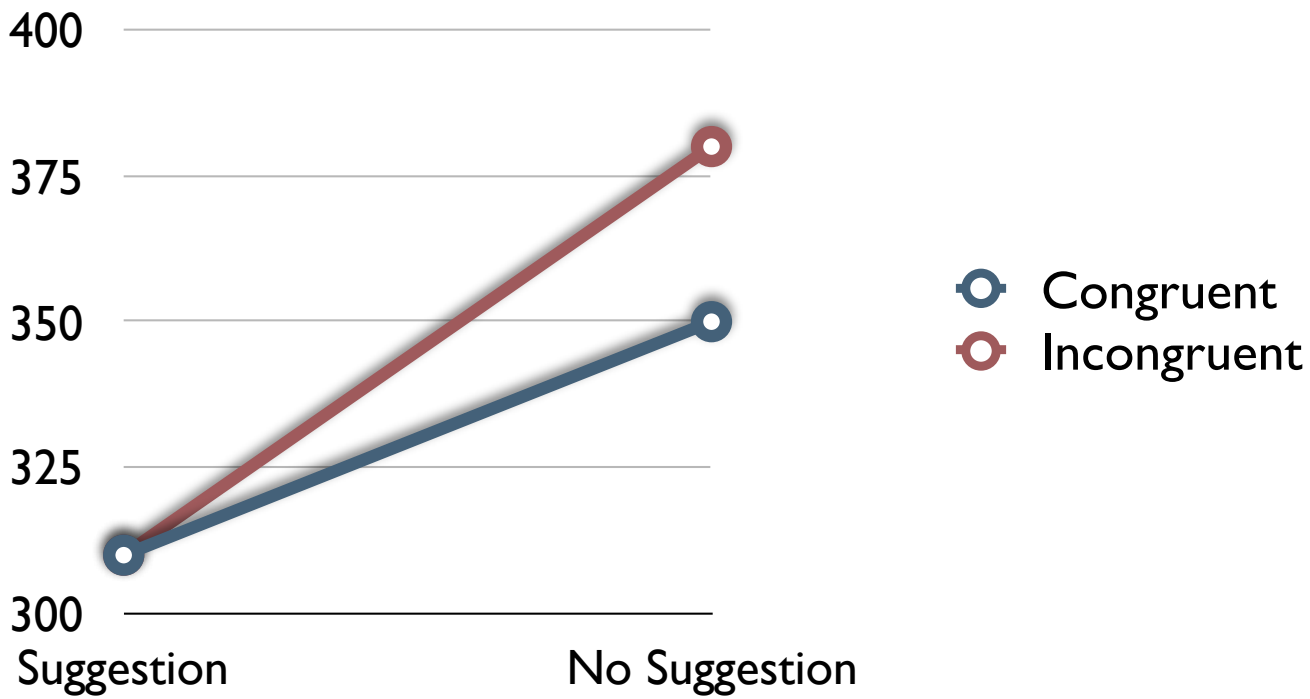
Line Graph Format



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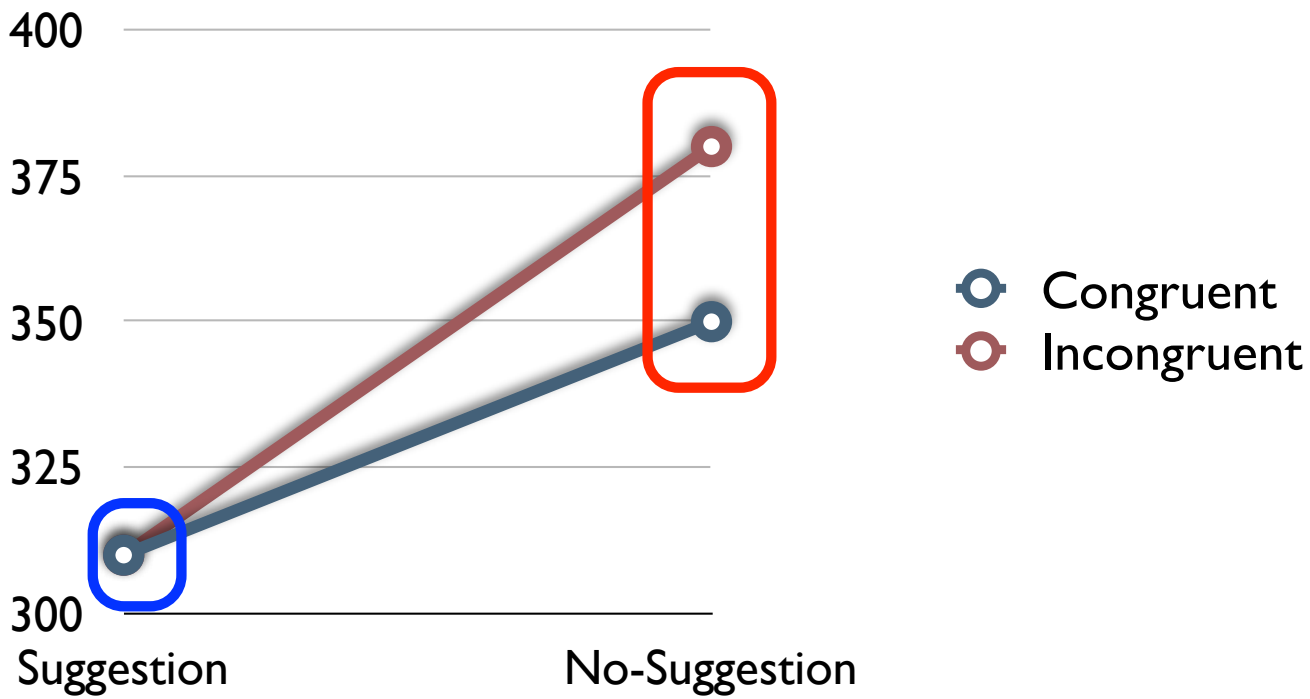

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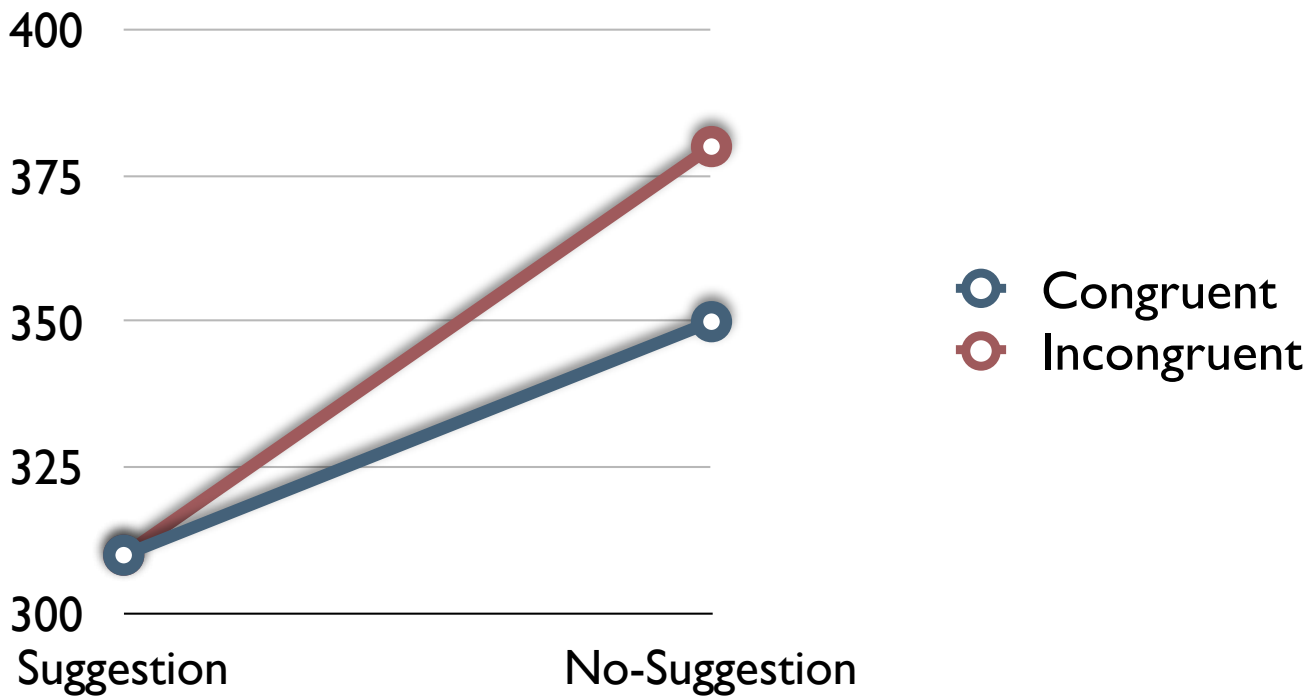
Main effect of congruency



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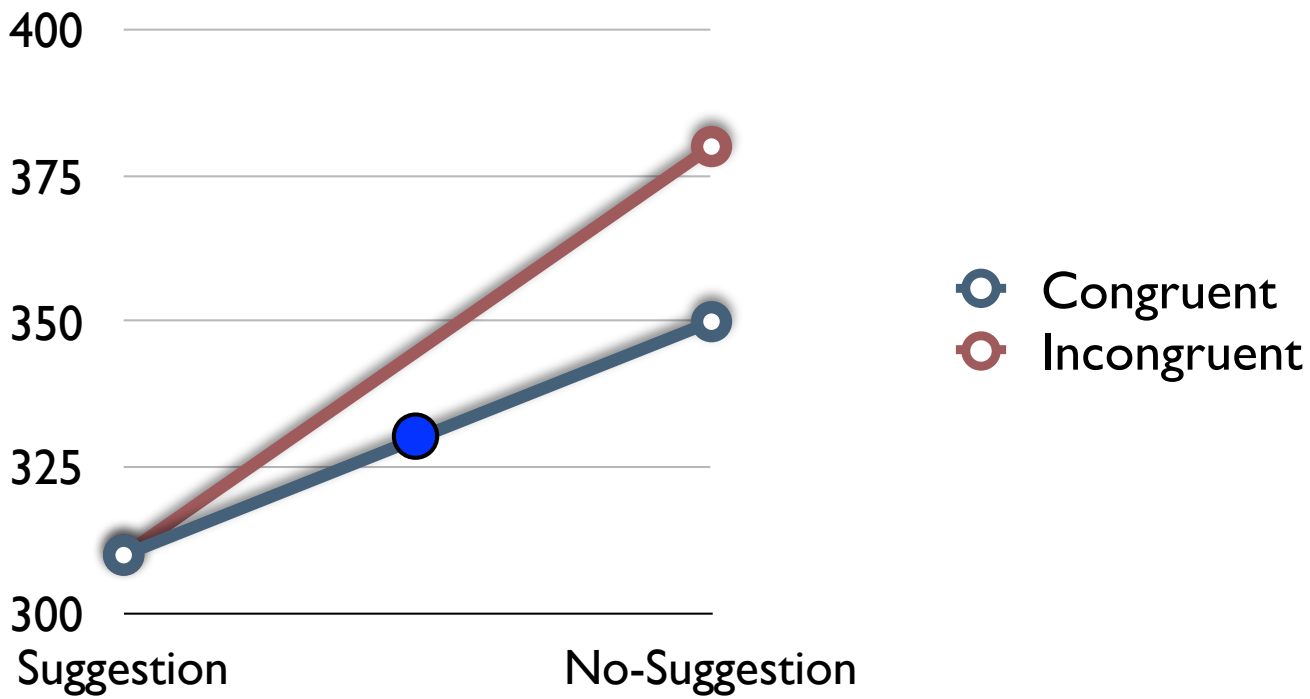
Main effect of congruency



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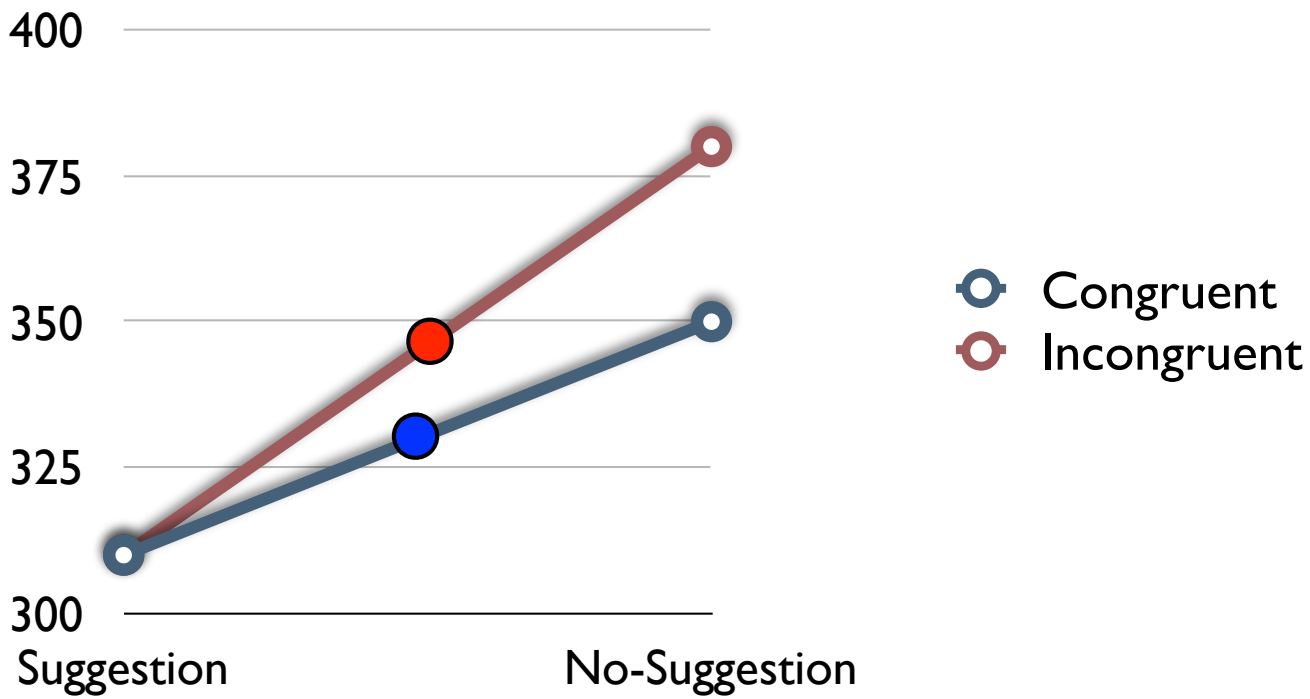
Main effect of congruency



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Main effects & **Interactions**

- Main Effect:
  - The influence of a single independent variable, collapsed across all other independent variables

- **Interaction**
  - When the influence of one independent variable **depends** on the level of another (or several other) independent variable(s)

Remember: Main effects refer to differences between row means, or column means

		Congruency		
		Congruent	Incongruent	
Suggestion to view words as nonsense symbols	Suggestion	310	310	310
	No Suggestion	350	380	365
		330	345	

Remember: Main effects refer to differences between row means, or column means

		Congruency		
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Interaction?

Interactions occur when the difference between levels of one factor, depends on the level of another factor

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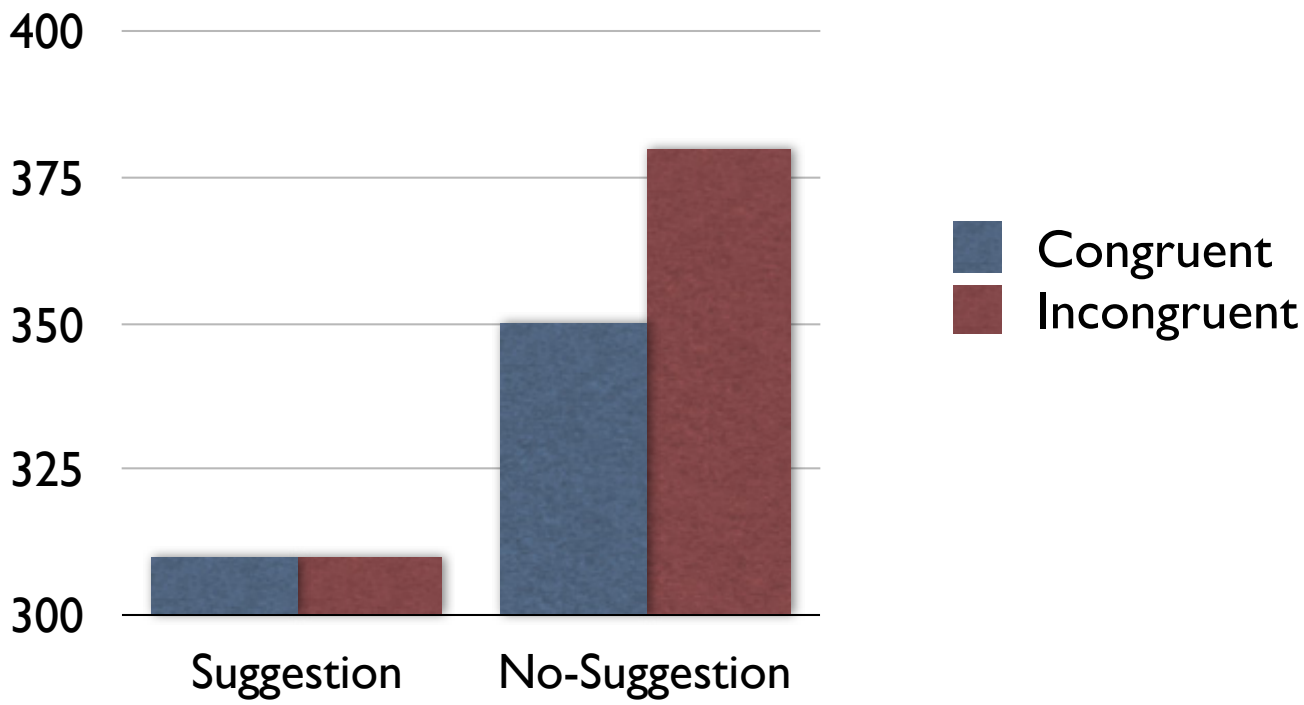
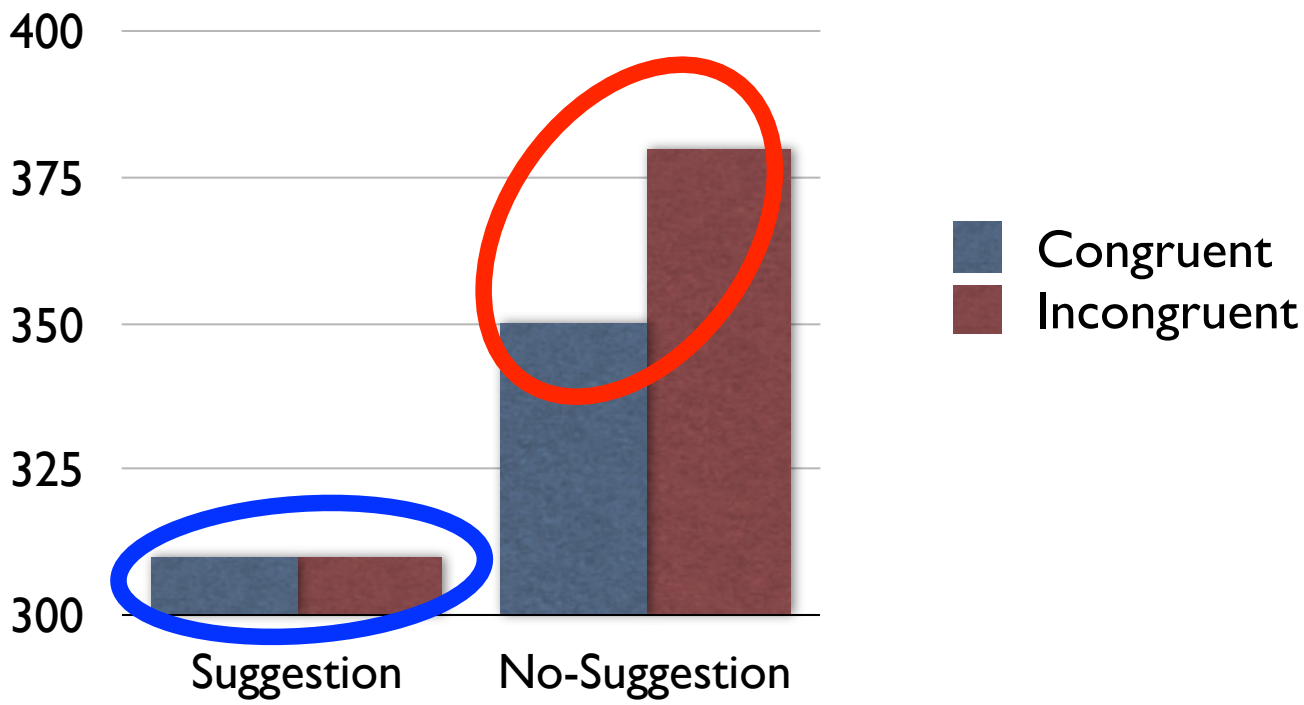
Interactions occur when the difference between levels of one factor, depends on the level of another factor

		Congruency		
		Congruent	Incongruent	Difference between incongruent & congruent
Suggestion to view words as nonsense symbols	Suggestion	310 ⟷ 310		0 (310-310 = 0)
	No Suggestion	350 ⟷ 380		30 (380-350 = 30)

Where is the interaction?

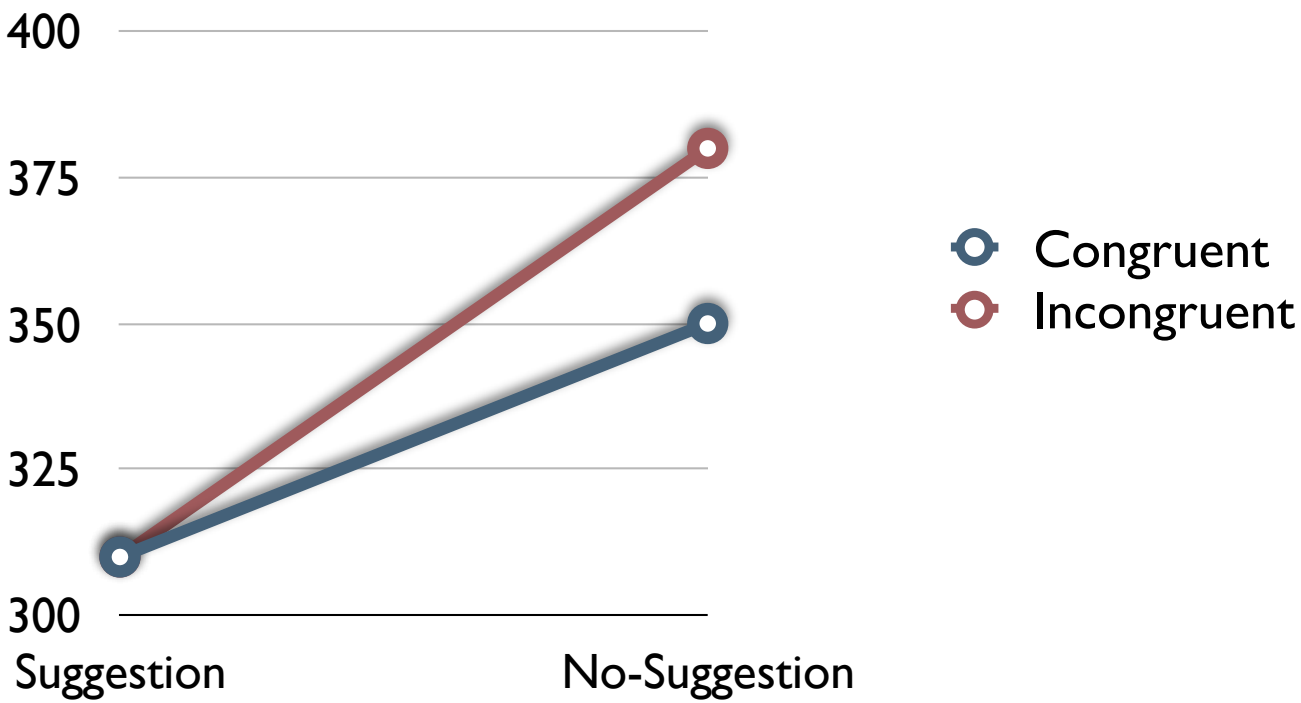


Where is the interaction?



The difference between congruent and incongruent is larger for no-suggestion than suggestion

Where is the interaction?



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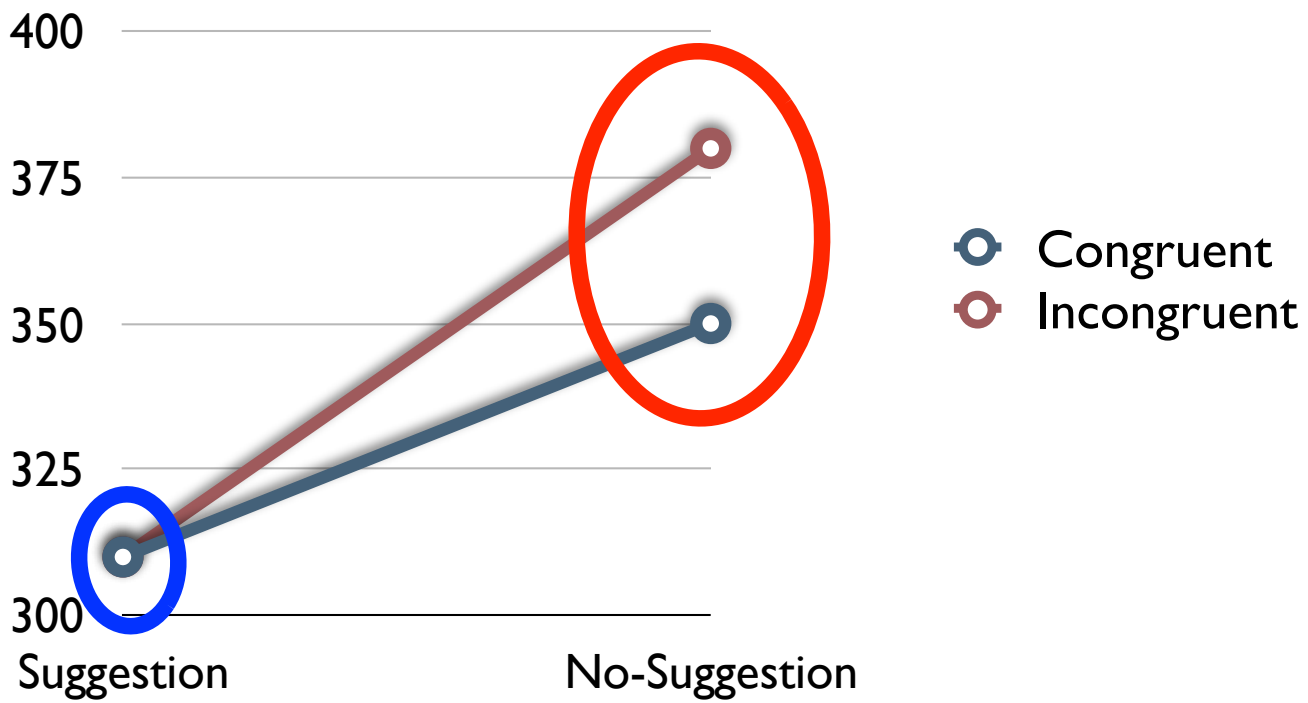

The difference between congruent and incongruent is larger for no-suggestion than suggestion

Main effects & Interactions

- Main Effect:
  - The influence of a single independent variable, collapsed across all other independent variables

- Interaction
  - When the influence of one independent variable **depends** on the level of another independent variable

Main effects & Interactions

- In a simple 2x2, there are 8 possibilities
  - main effect for factor 1 only
  - main effect for factor 2 only
  - main effects for both factors, No interaction
  - main effect for factor 1, and an interaction
  - main effect for factor 2, and an interaction
  - main effects for both factors, and an interaction
  - Only an interaction, no main effects
  - No main effects, and No interaction