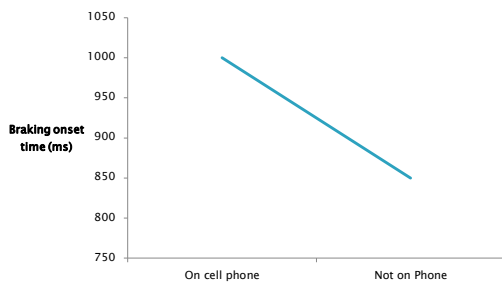


Complex Experiments

Basic Experimental Designs: 1 Independent Variable only

- Simplest experimental design: 1 independent variable, 2 levels/conditions
 - Compares only two groups

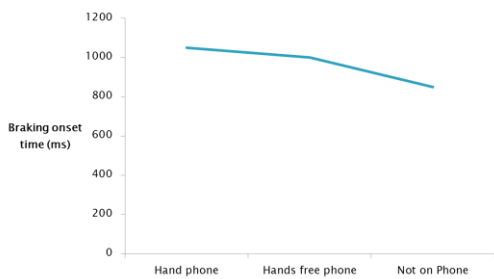
Strayer and Drew (2004)



Basic Experimental Designs: 1 Independent Variable only

- Can add more levels of the IV
 - 3, 4, or more IV levels may tell us more about the relationship between the IV and the DV

1 IV, 3 levels



Factorial Designs: Increasing the Number of Independent Variables

- Typically, two or three independent variables are operating simultaneously (in the real world)
- Factorial designs are studies with more than one independent variable
 - Factor = Independent variable
 - Level = subdivision of factor

Notation of factorial designs

Example: a 2 X 3 design

- ▶ The *number* of numbers tells us how many independent variables (or factors) there are in the design
- ▶ The *value* of each number tells us how many levels there are of each independent variable
- ▶ Multiplying the two tells us how many different *conditions (or combination of treatments)* there are in the study

Example:

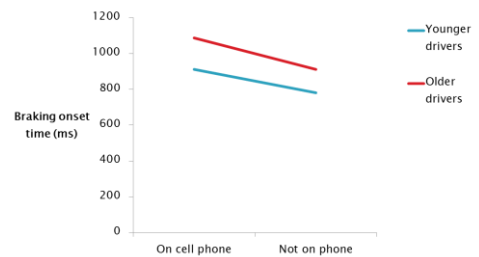
- Does driving while using a cell phone impair driving, and is age a factor?
- Independent variable 1: cell phone vs. control
- Independent variable 2: Age (young vs. old)

The dependent variable is brake onset time

This is a 2x2 factorial design

DV: Brake Onset Time (ms)		IV: Cell Phone Condition	
		On Phone	Not on Phone
IV: Driver Age	Younger Drivers	912	780
	Older Drivers	1086	912

2x2 design results



Other Factorial Designs

3 X 4 Factorial Design

2 X 3 Factorial Design

2 X 2 X 2 Factorial Design

Note: The order of numbers does not make a difference. Therefore a 3x2 design could also be called a 2x3 design.

A Tasty Example 😊

2 X 2 Factorial Design

Factor A (IV1):

Type of Topping

Level 1 = Ketchup

Level 2 = Salsa

Factor B (IV2):

Type of Food

Level 1 = French Fries

Level 2 = Tortilla Chips

DV: Taste

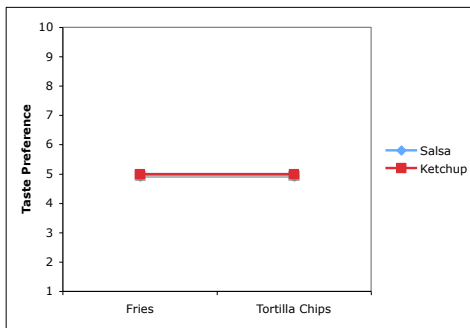
What are the possible outcomes of a factorial design?

- Design: 2x2 factorial design (type of topping x type of food)
 - DV is taste on a scale of 1-10
- Possible Outcomes:
 - Null outcome
 - Significant or not significant Main effects
 - Significant or not significant Interactions

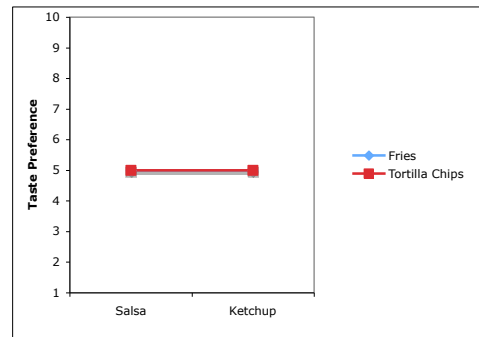
- **Null Outcome: No differences across conditions**

	Fries	Tortilla Chips	
Salsa	5	5	$X = 5$
Ketchup	5	5	$X = 5$
	$X = 5$	$X = 5$	

Null Outcome: Graph 1



Null Outcome: Graph 2



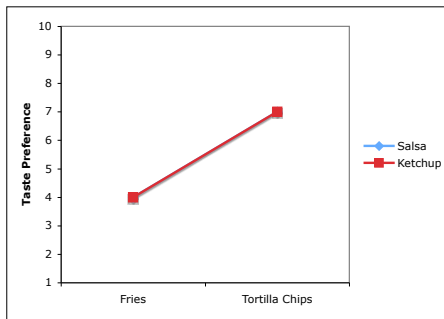
Main Effects

- A **main effect** tells us the *overall effect* of one IV on the DV, averaging over the levels of the other IV.
 - There are as many main effects as there are IVs in the design (which may or may not be significant)
 - We look at the **marginal means** to determine main effects

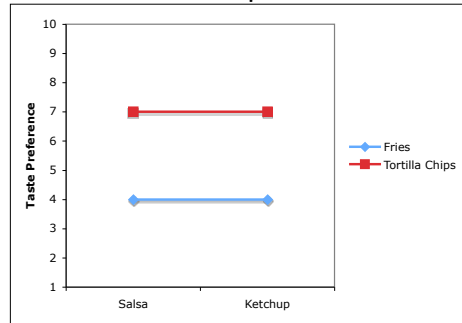
Main effect for Type of Food, no main effect for Type of Topping

	Fries	Tortilla Chips	
Salsa	4	7	$X = 5.5$
Ketchup	4	7	$X = 5.5$
	$X = 4$	$X = 7$	

Main effect for Type of Food: Graph 1



Main effect for Type of Food: Graph 2

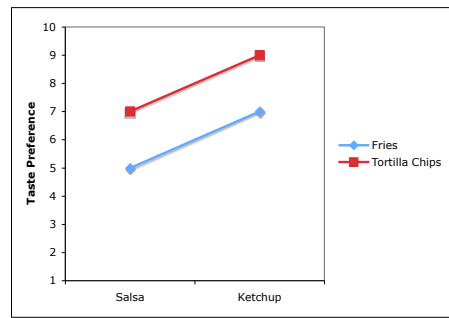


Two Main effects

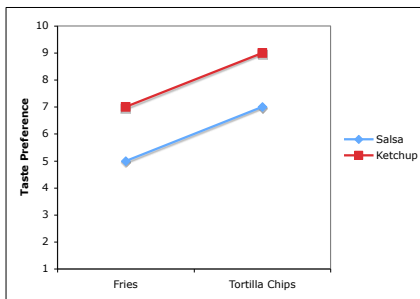
- You can also have a main effect for BOTH variables

	Fries	Tortilla Chips	
Salsa	5	7	$X = 6$
Ketchup	7	9	$X = 8$
	$X = 6$	$X = 8$	

2 Main Effects: Graph 1



2 Main Effects: Graph 2



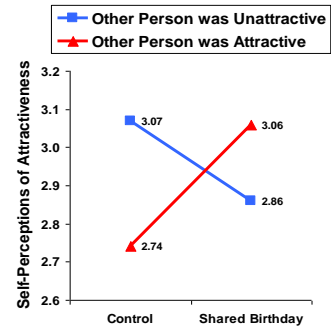
Interactions

- An **interaction** tells us that the effect of one independent variable *depends* on the particular level of the other.
- NOTE: We describe interactions in terms of factors, not levels

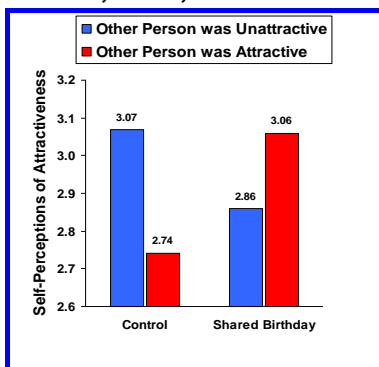
Real world example of an interaction

- Brown, Novick, Lord, and Richards (1992) examined self-attractiveness ratings when expecting to meet someone else
- 2 Factors:
 1. Person was either attractive or unattractive
 2. Person either shared same birthday or did not share same birthday

Brown, Novick, Lord, & Richards (1992)



Brown, Novick, Lord, & Richards (1992)



Describing an interaction

- Depends on how you want to frame the findings
 1. Start with one level of the first IV, explain what is happening with the second IV at that level
 2. Move to the next level of the first IV and do the same thing.
- As you move from level to level, make it clear the size of the effect of the other IV is changing.

3 ways of knowing there is an interaction

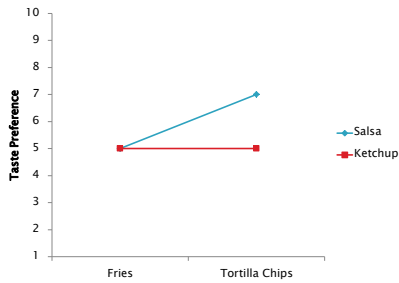
1. Statistical analysis tells you so (ah, computers!)
2. You can't talk about the effect of one factor without talking about another factor.
3. The lines on a graph are not parallel.

Interaction #1

- People like salsa, but only if it's on tortilla chips.

	Fries	Tortilla Chips	
Salsa	5	7	$X = 6$
Ketchup	5	5	$X = 5$
	$X = 5$	$X = 6$	

Interaction #1 Graph

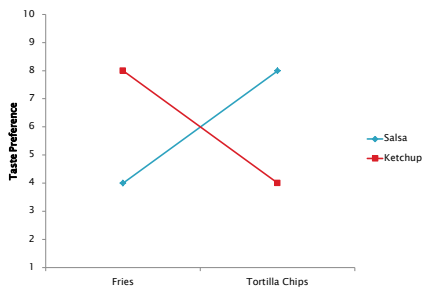


Interaction #2

- People like salsa on tortilla chips and ketchup on fries.

	Fries	Tortilla Chips	
Salsa	4	8	$X = 6$
Ketchup	8	4	$X = 6$
	$X = 6$	$X = 6$	

Interaction #2 Graph



IV x PV Designs

- Factorial designs with manipulated and nonmanipulated variables (sometimes called IV x PV designs)
 - Independent variable (IV) x participant variable (PV)
 - Allows researchers to examine how different individuals respond to the same manipulated IV

PV x PV design

- Forehand and Perkins (2005) studied consumer reactions to ads with celebrity voiceovers. They found that prior attitudes toward the celebrities influenced how much consumers liked or disliked the products, but this influence was greatest when consumers weren't sure which celebrity provided the voice-over.

RESULTS?

- Participants liked the product **more** if:
 - they liked the celebrity doing the voiceover

AND

 - they did NOT recognize the celebrity's voice in the ad

Between and Within Group Designs

- Assignment procedures and factorial designs
 - Two basic ways of assigning participants to conditions
 1. Between (Independent) groups design
 2. Within (Repeated measures) design
- Combination of the two basic ways is called a mixed factorial design

Identifying Factorial Designs in Journal Articles

- If study is described as 2x2, 3x2, 2x3x2, etc.
- Often will include the IV descriptions:
 - “The design was a 2 (Age: Younger vs. Older adults) x 2 (Task: Single vs. Dual-task) factorial. Age was a between subjects factor and single- vs. dual- task condition was a within subjects factor.” (Strayer & Drews, 2004, p.643)
- Results section will discuss whether main effects and interactions are significant.

- “The MANOVA indicated significant main effects of age, $F(4,35) = 8.74$, $p < .01$, and single versus dual task, $F(4, 35) = 11.44$, $p < .01$. However, the Age x Single- versus Dual-task interaction was not significant, $F(4,35) = 1.46$, $p > .23$. This latter finding suggests that older adults do not suffer a significantly greater penalty for talking on a cell phone while driving than do their younger counterparts.” (Strayer & Drews, 2004, p. 644)

Identifying Factorial Designs in the Popular Press

- Journalists gloss over details to make the article simple and understandable.
- May use the phrase “It depends” to highlight an interaction.
- Look for participant variables.