Factorial designs: 2-way ANOVAs

outline:

- 2-way ANOVA
- within-subjects designs
- simple effects, main effects and interaction effects
- interpreting interaction effects

One-way ANOVA: one independent variable (factor)

A two-way ANOVA is used when your design has two independent variables (factors)

Factorial design: the independent variables are crossed (in this example, the design includes every combination of the levels of the two factors A and B)

This example uses a 2x2 design (2 levels of A x 2 levels of B)

	B1	B2
A1		
A2		

There are 4 (2x2) treatment groups

Most of our experiments involve factorial designs, especially 2x2 designs.

Advantages:

1. cheap (reduced cost of subjects, time and effort)
2. less variability (smaller error term)
3. generality (interactions)

We've seen the calculations for one-way ANOVA -- 2-way is similar.

(NB For now we are talking about between-subjects designs)

- MS_{within} as in one-way ANOVA
- between-groups variation = factor A + factor B + their interaction
- work out variation due to A and B as in one-way
- interaction = $SS_{between}$ minus variation due to A and B

$$F = MS_{between} / MS_{within}$$

Things are slightly different in the kind of design we usually use: the within-subjects design. This is where each subject sees items in each condition.

Sources of variability: factor(s), subjects, interaction between factor(s) and subject.

From before: $F = MS_{between} / MS_{within}$

But there is no 'within' score in this design (there is no within-cell variability with one score from each subject)

In a within-subjects design, the error term is the interaction:

for factor A, it is SxA

for factor B: SxB

for the interaction AxB: SxAxB

	B1	B2	mean
A1	0	4	2
A2	6	6	6
mean	3	5	

Simple effects: a factorial design contains within it separate single-factor experiments (e.g. for A1, B1 < B2)

Main effects: average of the single-factor experiments (e.g. on average, is B1 < B2? this is a main effect of B)

Interaction effect: the effect of one factor depends on what level of the other factor we're talking about. (Does B have an effect? Yes, but only for A1, not A2)

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	presup_sat	auch	Type III Sum of Squares	df	Mean Square	F	Sig.
presup_sat	Linear		11008435.9	1	11008435.85	11.578	.003
Error(presup_sat)	Linear		18065892.3	19	950836.437		
auch		Linear	673292.092	1	673292.092	.833	.373
Error(auch)		Linear	15349503.0	19	807868.579		
presup_sat * auch	Linear	Linear	27480470.7	1	27480470.70	26.004	.000
Error(presup_sat*auch)	Linear	Linear	20079029.2	19	1056791.010		

We will see how to do this in SPSS later. The table shows p values for main effects and interaction effect. For simple effects, we need a separate test (t-test).

You can't straightforwardly talk about main effects if there is an interaction.

	B1	B2	mean
A1	0	4	2
A2	6	6	6
mean	3	5	

Even though there is a main effect of B (average of B1 < average of B2), the interaction tells us something important: this only holds in the case of A1, not A2.

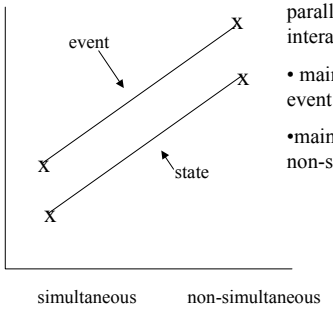
Therefore B1 < B2 is not a meaningful generalization.

Three possibilities:

1. Two main effects, no interaction

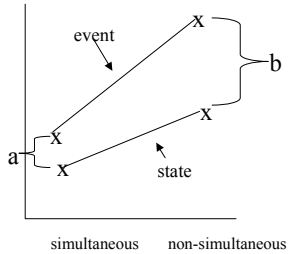
imaginary experiment:

A. state, simultaneous
B. state, non-simultaneous
C. event, simultaneous
D. event, non-simultaneous



- the lines are parallel: no interaction
- main effect: event > state
- main effect: non-sim. > sim.

2. Interaction dominated by main effects (=3 findings)



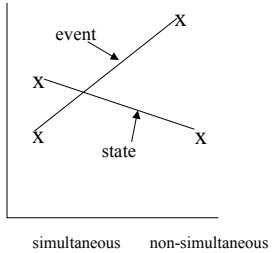
main effect: event > state

main effect: non-sim > sim.

interaction: the sim./non-sim. manipulation has more of an effect in the case of events. (a < b)

3. Interaction dominates main effects

(note how the lines cross)



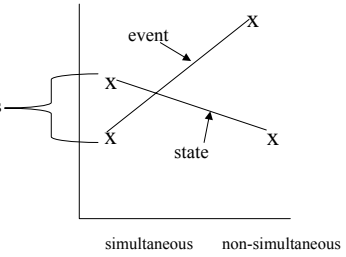
In terms of understanding these results, there is only one finding: the interaction.

	sim.	non-sim.	
state	14	10	12
event	10	22	16
	12	16	

A significant interaction means that the slopes are different.

It <u>does not</u> tell you about simple effects

e.g. Is there a significant difference between states and events in the simultaneous condition?



Use a t-test to answer this question