TOPIC 13: SINGLE FACTOR AND FACTORIAL DESIGN

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BETWEEN-SUBJECTS design:

different subjects get different levels of the independent variable

independent variable → 2 levels
‖
2 groups
(1 experimental + 1 control for example)

→ **ADVANTAGE**

There is no chance that one level of the independent variable effects performance under the other level of the independent variable.

↓

So the performance measurements on the dependent variable under one value of the independent variable are not affected by the independent variable.

→ **DISADVANTAGE**

there is the chance that groups differ

↳ in respective of the manipulation of the independent variable
‖
avoid group differences, selection effect by randomly assigning subject to different groups, that is to different levels of the independent variable.
↳ you can also match participants across the different levels of the independent variable, you match them on one of the most likely confounding variables.

SINGLE-FACTOR DESIGN

Random assignment:
list of participants randomly assigned to different groups

Matching
create match groups: participants sorted from the lowest to the highest on some variable, and then grouped into sets of two.
Individuals of each set are assigned at random to either one of the two groups.

When do you need to use it?
(I) when the independent variable has a permanent effect.
(II) large risk of order effects

WITHIN-SUBJECT DESIGN

All subjects receive all levels of the independent variable.

→ **ADVANTAGES**

no group differences: each subject serves as his own control.

→ **DISADVANTAGE**

there is a chance of order effects
↳ the exposure to one condition changes the participants respond to a later condition.

how to prevent it?
- complete counterbalance design (full counterbalancing)
- Latin Square design
- Balanced Latin Square design } Partial counterbalancing
- Random order

(I) complete counterbalanced design
in which all possible treatment orders are used.
→ reduction of potential effect of confound with order.
‖
best option but not always possible.

Example:
4 levels → 4! different orders (at least 24 participants)

Why not always possible? Example: 5! = 120 orders and 120 participants required
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too many!

(II) Latin-square design
each condition happens equally often at each ordinal position

Example: 4 levels = 4 (at least) participants
↳ usually not enough: use multiple of 4

BUT
You can't find differences between one level and another.

(III) Balance Latin-square design
each condition happens equally often at each ordinal position;
each condition preceeds each other condition equally often.
↳ and follows.

(IV) Random order
when many conditions, many levels of the independent variable
↳ you randomly determine the order in which levels are presented to participants.

When do you use it?
(I) indep. var. does not have a permanent effect.
(II) order effects (practice, carryover) can be avoided by counterbalancing or random order.

WITHIN-SUBJECT DESIGNS ARE MORE EFFICIENT THAN BETWEEN-SUBJECTS DESIGNS (more power).
↳ probab. that the test will give statistically significant results; when the indep. variable truly has an effect in the population

FACTORIAL DESIGN

Design in which a level of every independent variable occurs with all levels of the other independent variable.

↳ multiple independent var. ⇒ multiple factors

Example: 1 indep. var. A → 3 levels
1 indep. var. B → 2 levels
→ 3x2 = 6 conditions
↳ number of cells in table
→ "3x2 factorial design"

not confounded: vary independently
‖
useful to distinguish what results from a single variable and what from the combination.

Letters = factors (indep variable)
Figures (numbers) = levels

3 factors → general format: 2 levels each
⇒ 2x2x2 factorial design
↓
8 conditions

Example:

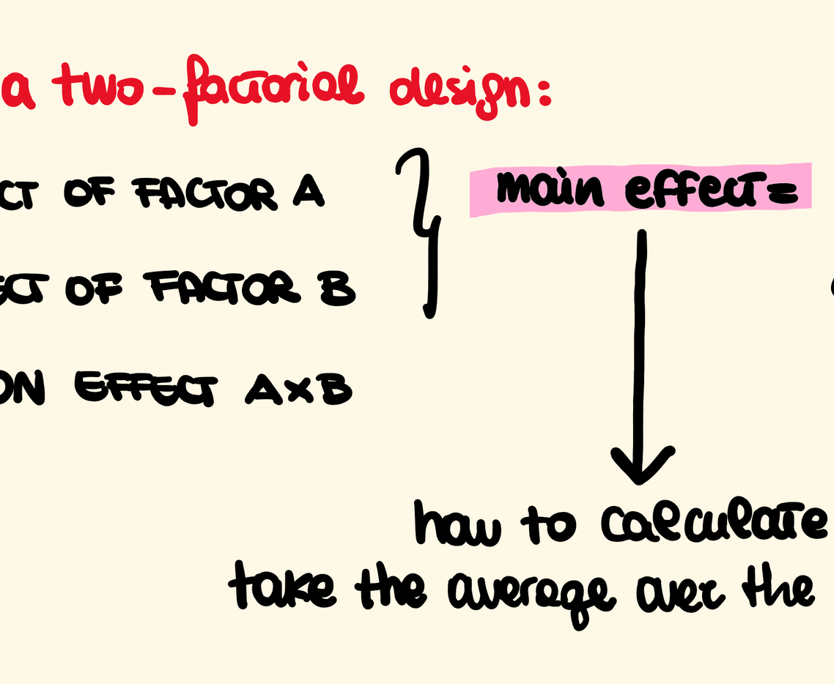
	A1	A2	A3
B1	A1B1	A2B1	A3B1
B2	A1B2	A2B2	A3B2

Different designs:

- **between-subjects design**: A and B are both between-subjects factors. 6 groups of participants.
- **within-subjects design**: A and B are both within-subjects factors.
You have to present different conditions in (six) sequences across different participants.
↳ example: latin square
- **Mixed design**: one factor → between-subjects
one factor → within-subjects
⇒ 3 different groups and each group performs in two different conditions corresponding to the two levels of B.

Advantages of Factorial Design:

- EFFICIENCY = one experiment with two factors instead of two experiments, each with one factor
- GENERALIZATION = you can generalize your results
- INFORMATION ON INTERACTION BETWEEN FACTORS



A = 3 levels
B = 2 levels (presence or not)

		A: 0	0.5	1.0
B	with	40	45	55
	without	35	40	50
	MEAN	37.5	42.5	52.5

} for main effect of A!

Effects in a two-factorial design:

(I) MAIN EFFECT OF FACTOR A
(II) MAIN EFFECT OF FACTOR B
} **main effect** = the overall effect of one independent variable on the dependent variable, averaged over the levels of the other independent variable.
↓
how to calculate it:
take the average over the different levels of B

(III) INTERACTION EFFECT AxB

In this case, there is a main effect of factor A because on average, deviation of B increases as a function of the manipulation of A.

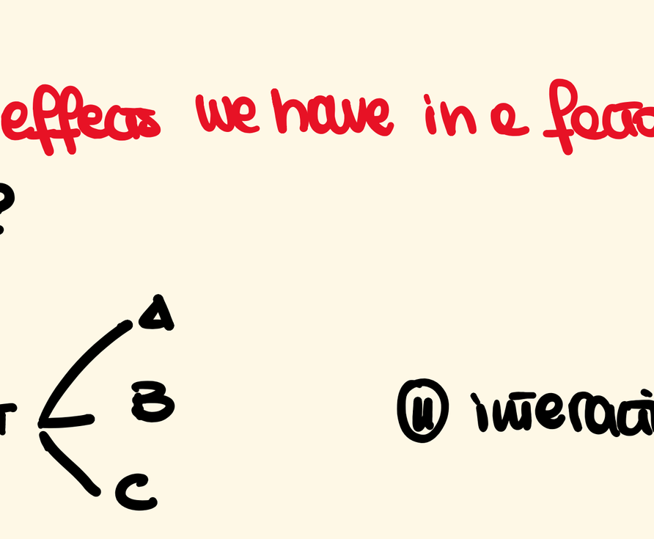
For factor B:

		A: 0	0.5	1	mean
B	with	40	45	47	47
	without	35	40	42	42
	DIFFERENCE	5	5	5	

} As these two numbers are different, we have a main effect of factor B

interaction effect: when the effect of one independent variable depends on the level of the other independent variables.
↳ symmetrical:
$A \times B = B \times A$

In this case, the effect of B does not depend on A (its levels) (they are equal) → GRAPH: parallel lines = no interaction!



main effect of A ✓
main effect of B ✓
interaction AxB ✗

main eff. of A ✗
main eff. of B ✗
interaction AxB ✓

How many effects we have in a factorial design with 3 independent variables?
A, B, C → ?

(I) main effect: A, B, C

(II) interaction: AxB, AxC, BxC, AxBxC (three-way interaction)