Factor and level

- **Factors:** are the variables (treatments) in the study that we believe will influence the results.
- **Levels:** are the "values" of that factor in an experiment.

Example: antihypertensive drug

Group	
Experimental	Drug: 1 unit/d
	Drug: 3 unit/d
Control	Placebo

Types of experimental design

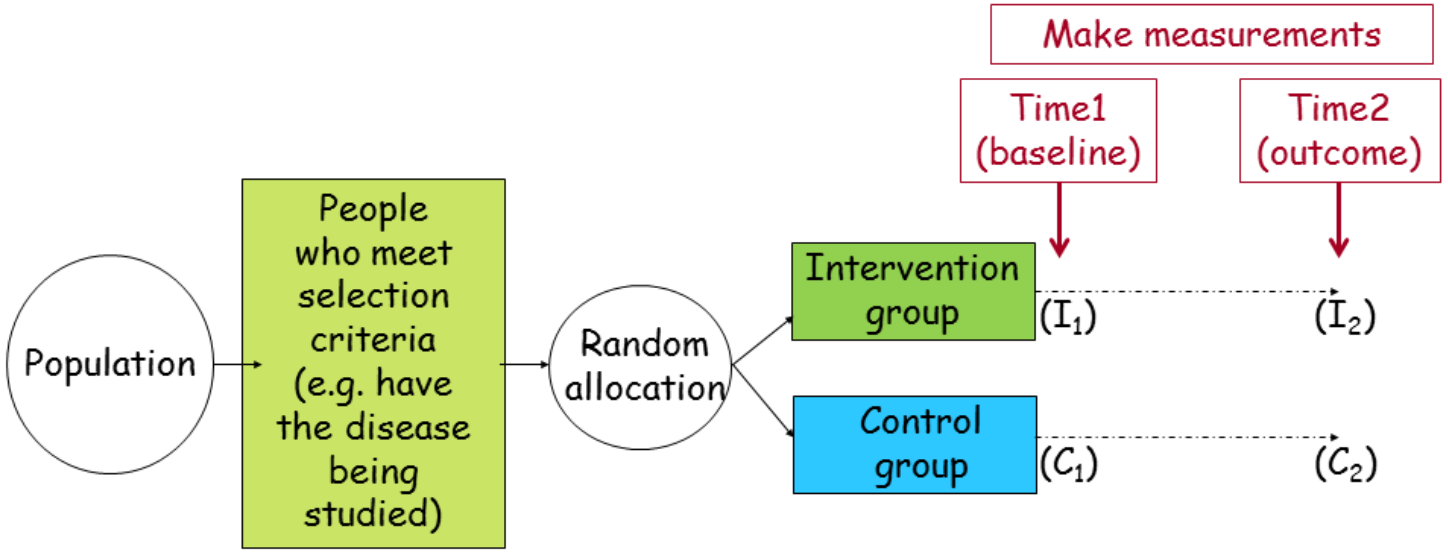
- **Randomized controlled trial**
- **Completely randomized design**
- **Paired design**
- **Randomized block design**
- Cross-over design
- Factorial design
- Repeated measurement design/within-subject design

One factor study design

Randomized Controlled Trials (RCTs)

the "gold standard" of research designs
provides most convincing evidence of relationship between exposure and effect

Randomized Controlled Trial



Statistic = difference in outcome scores = $(I_2-I_1) - (C_2-C_1)$

This shows the experimental change minus the change in the control group.

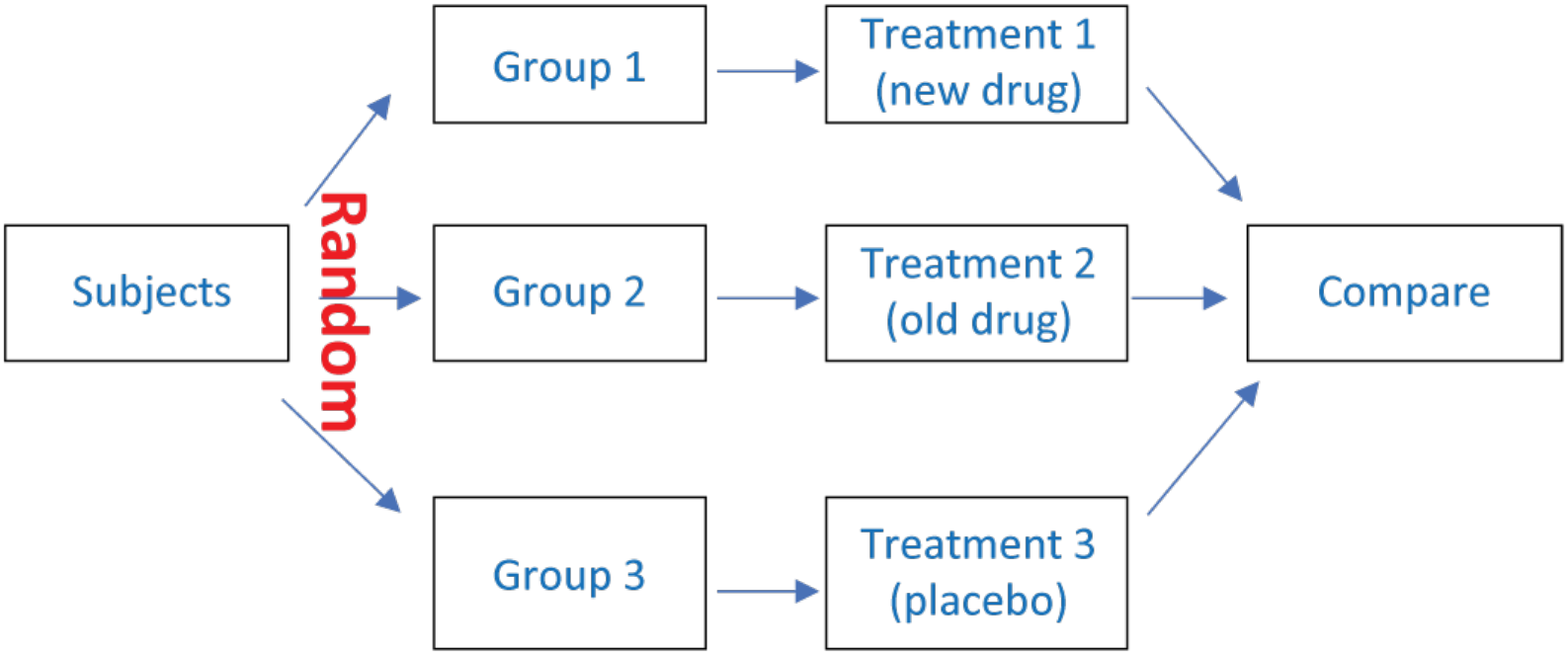
Note: random allocation should make $I_1 = C_1$, but these values are included in analyses to correct for any minor differences.

Randomized Controlled Trials

- Disadvantages
  - Very expensive
  - Not appropriate to answer certain types of questions
    - it may be unethical, for example, to assign persons to certain treatment or comparison groups

Completely Randomized Design

- It means that we assign the subjects to experiment group or control groups in random.
- We have concrete methods such as drawing straw or randomized number table.



Advantage /disadvantage

- Advantage
  - ✓ Flexibility
  - ✓ Relatively easy statistical analysis
- Disadvantages
  - Low accuracy
  - Not suited for large numbers of treatments

Paired Design1

- Measuring the same objects at two different time points
- ✓ (1) duplicate measurements

Night height

morning height

Paired Design1

- Measuring the same objects at two different time points

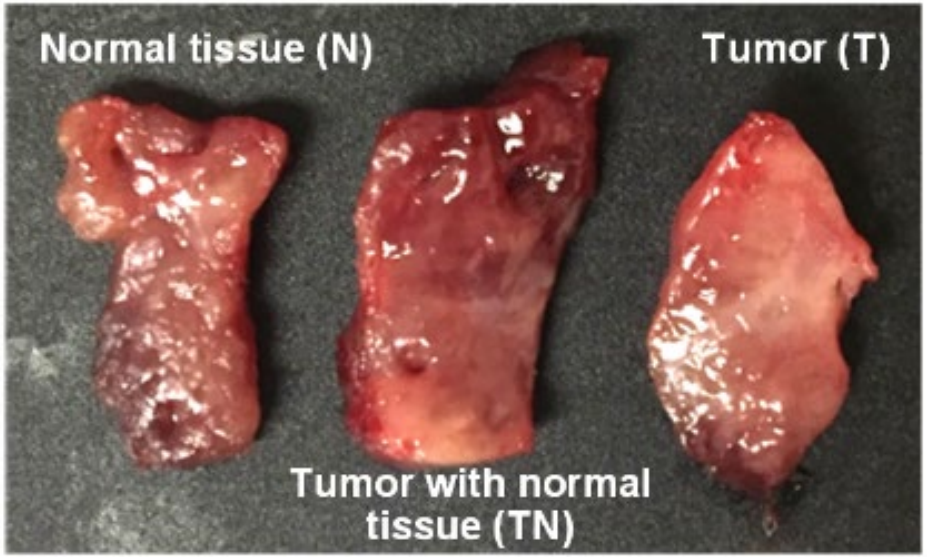
✓ (1) Duplicate measurements

✓ (2) Pre-Post Measurements

Blood Pressure Before		Blood Pressure After
Patient #1	Pair #1	Patient #1
Patient #2	Pair #2	Patient #2
Patient #3	Pair #3	Patient #3
Patient #4	. . .	Patient #4
Patient #5		Patient #5
Patient #6		Patient #6
Patient #7		Patient #7
Patient #8		Patient #8
. . .		. . .
Patient #20		Patient #20

Paired Design1

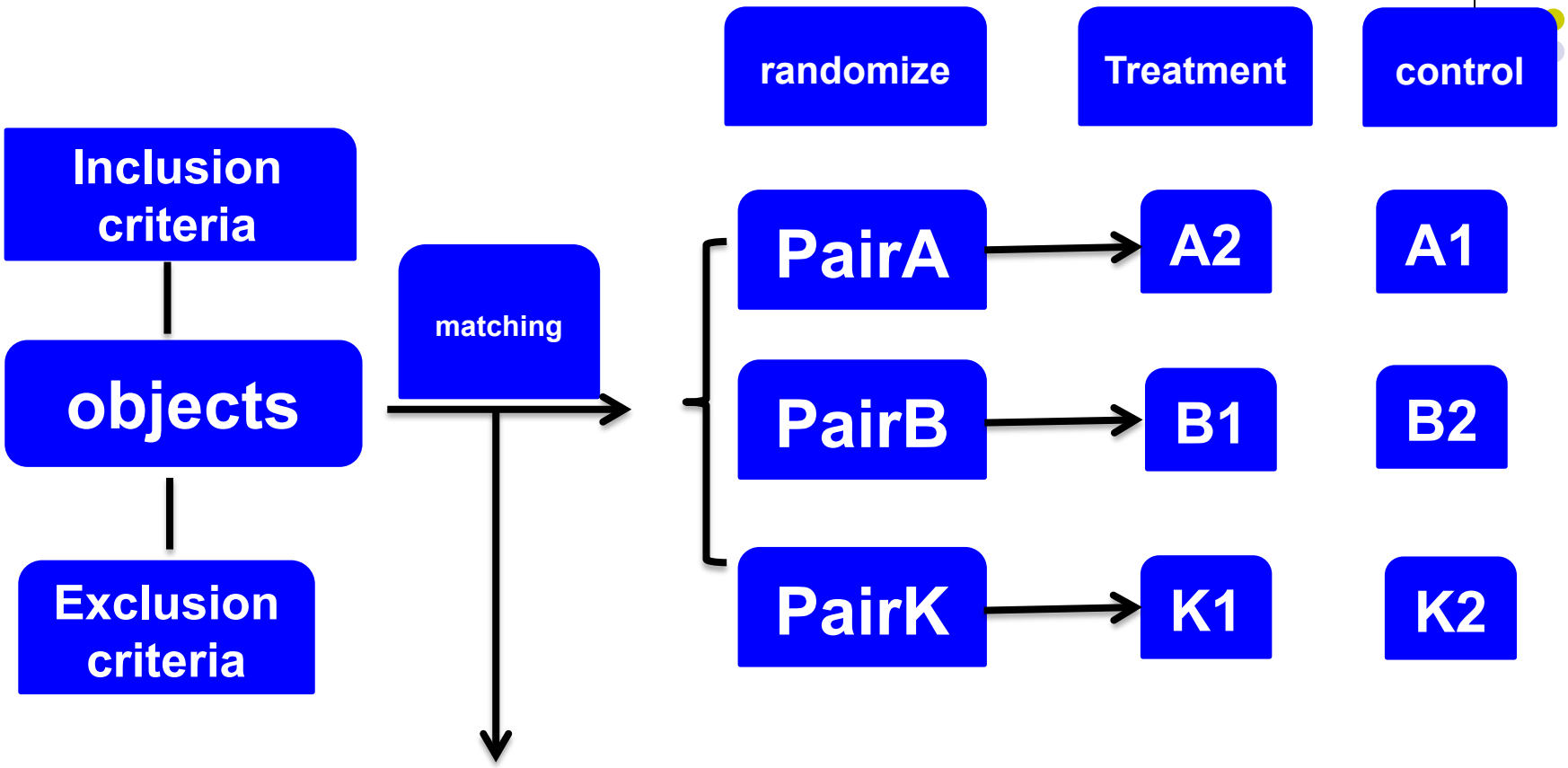
- Measuring the same objects at two different time points
- Different parts of the same object



Paired Design1

- Measuring the same objects at two different time points
- Different parts of the same object
- Two binary diagnostic test: Measured the same objects with two different methods

Paired Design2

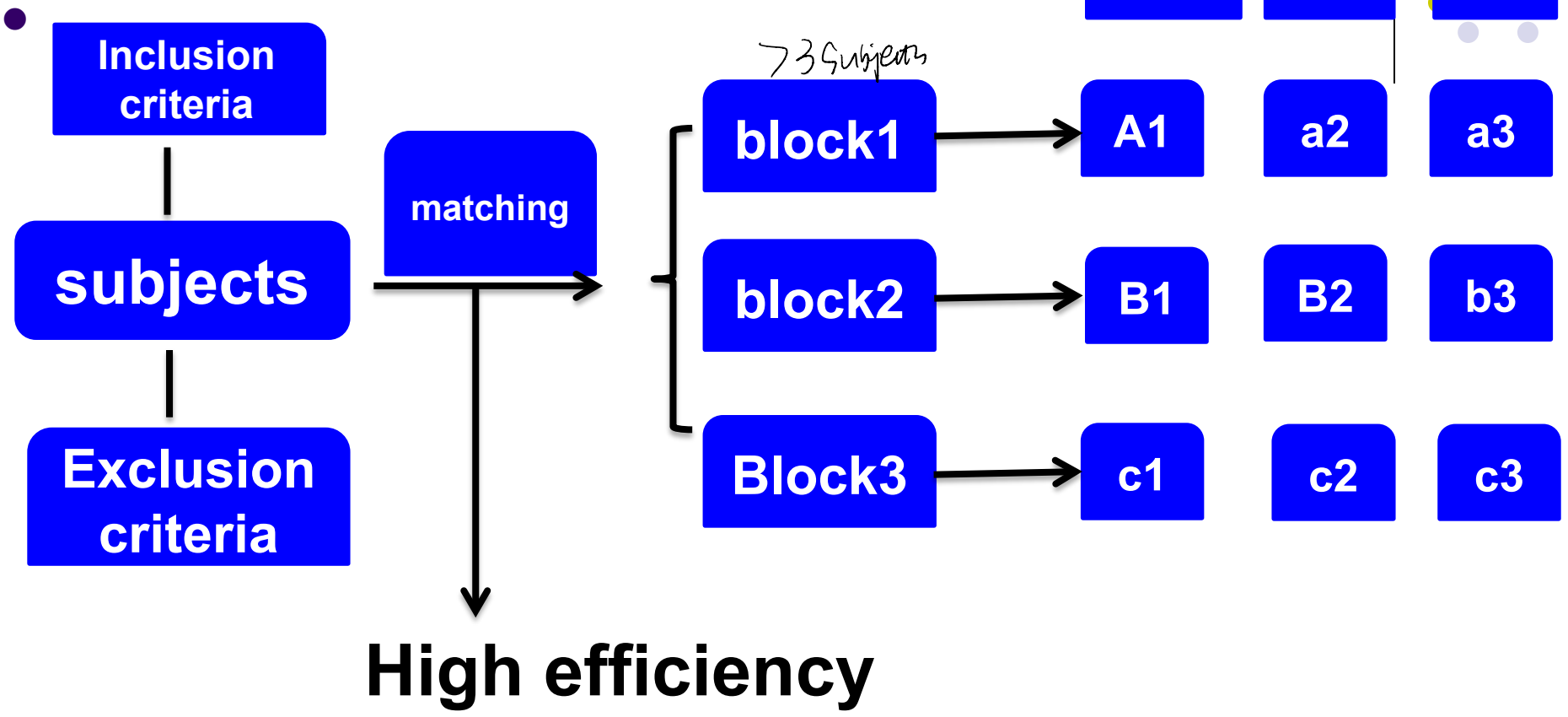


Matching condition：sex、age、BMI and etc

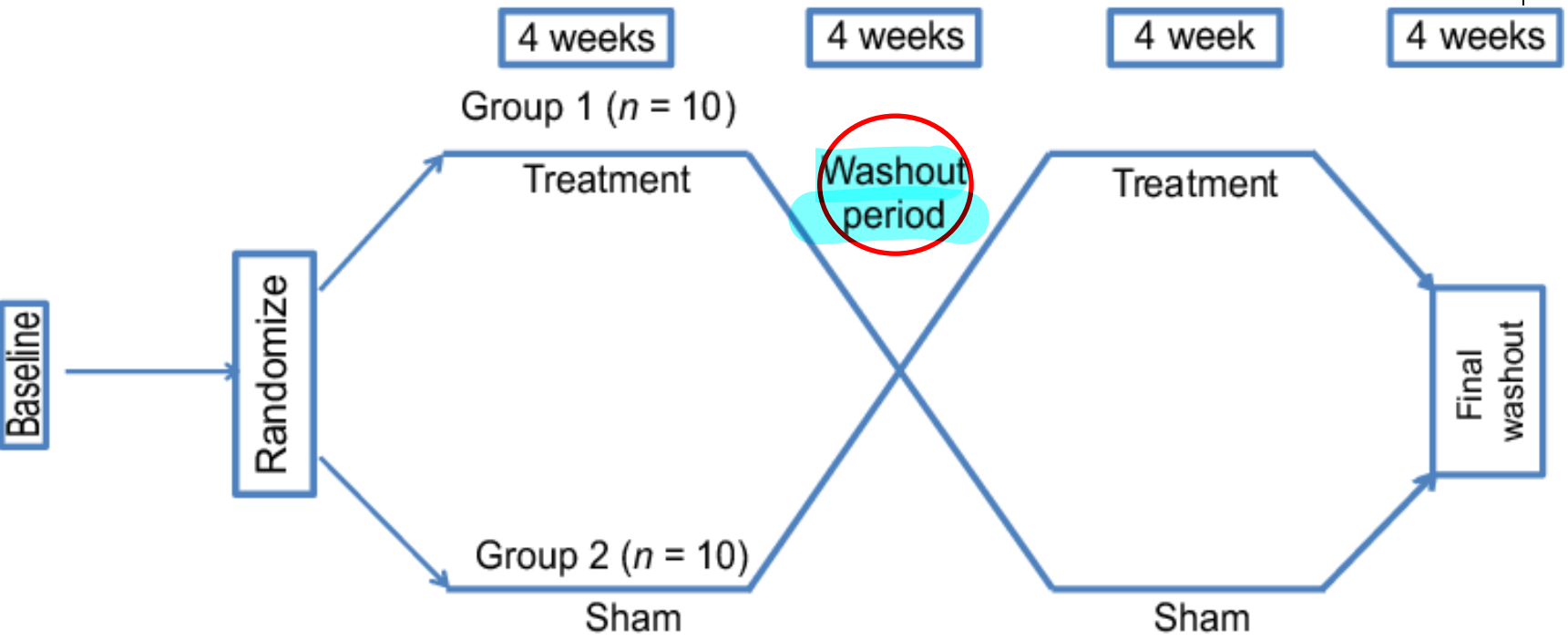
advantage：smaller standard error, higher statistical efficiency and smaller sample size required than CRS

disadvantage：complicated, poorly matching may weaken the efficiency

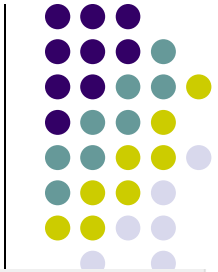
Randomized block Design



Cross-over design



Cross-over design



Advantages

- Reduced influence by confounders since patients serve as their own controls
- Reduced variability in the outcome(s) being measured, thus increasing the precision of estimation
- Smaller sample sizes required
- Having the opportunity to receive both treatments can sometimes be attractive for subjects

Disadvantages

- Cannot be done when the subjects can only receive one treatment
- Assumption of no carryover effects (from washout period) is difficult to sometimes accurately test
- May take longer than a randomized clinical trial since patients have to cross over into each arm after an appropriate washout period
- Can be subject to period effects where differences in the effectiveness of an intervention can occur due to the passage of time. For example:
  - Development of tolerance
  - Resistance
  - Dropouts
  - Changes in the disease process being evaluated or treated

Factorial design

- 2×2 factorial design

Treatment A	Treatment B: Yes	Treatment B: No	
Yes	n, $\bar{X}_{AB}$	n, $\bar{X}_{A}$	2n
No	n, $\bar{X}_{B}$	n, $\bar{X}$	2n
	2n	2n	4n

Main Effect of A : $$\frac{(\bar{X}_A - \bar{X}) + (\bar{X}_{AB} - \bar{X}_B)}{2}$$

Main Effect of B: $$\frac{(\bar{X}_B - \bar{X}) + (\bar{X}_{AB} - \bar{X}_A)}{2}$$

Interactions

A with B : $(\bar{X}_A - \bar{X}) - (\bar{X}_{AB} - \bar{X}_B)$

B with A : $(\bar{X}_B - \bar{X}) - (\bar{X}_{AB} - \bar{X}_A)$

Factorial design

- Advantage
- 1. more efficient mainly due to the smaller sample size required (up to one-half) compared with two separate two-arm parallel trials.
- 2. A factorial design is the only design that allows testing for interaction
- 3. Reduced costs, reduced recourses and management needs are found due to the fact that a smaller sample will be required compared with two separate trials.

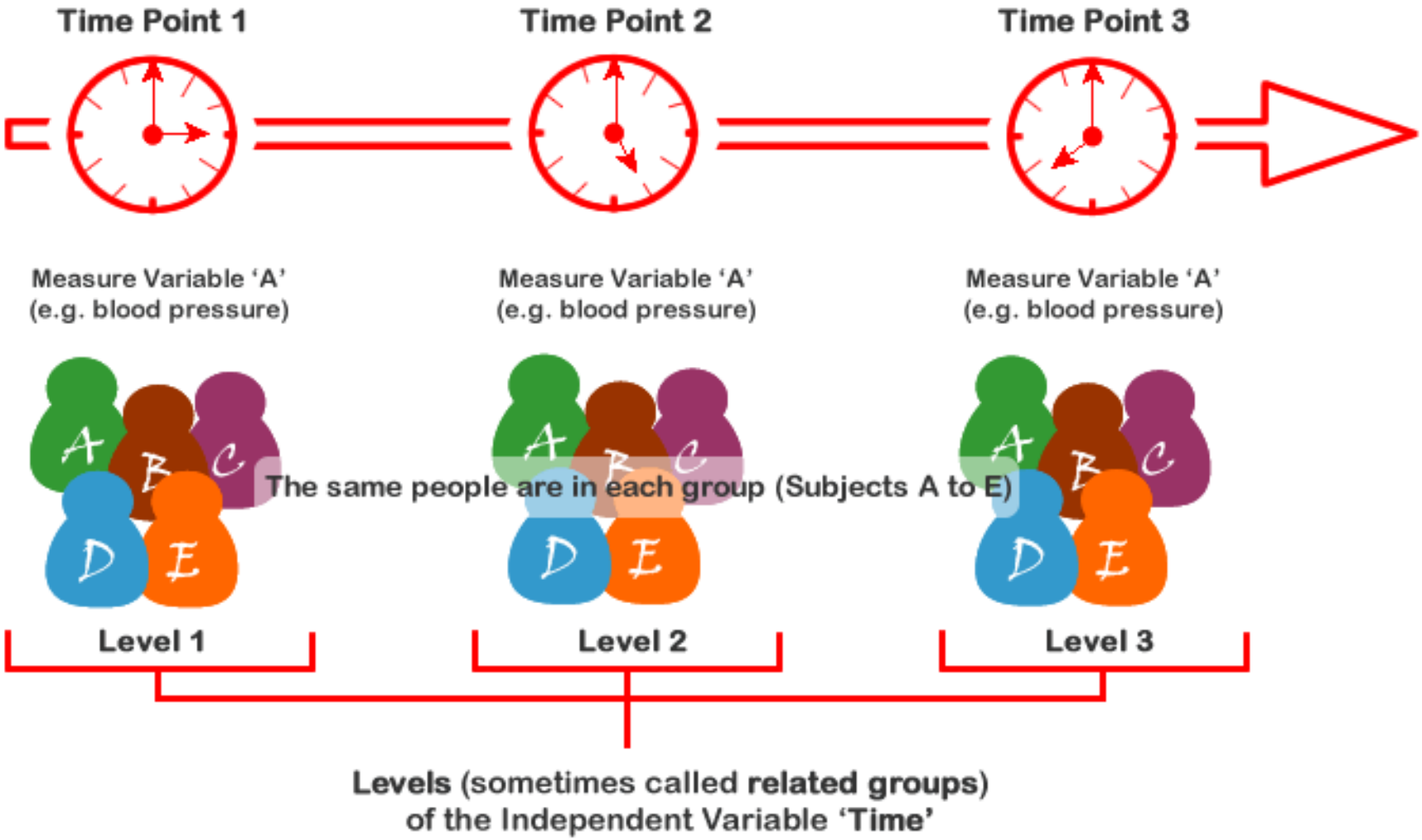
Factorial design

- disadvantage
- 1. A factorial design may require extra time, compliance, and management of applying two treatments at the same time.
- 2. Data analysis and randomization may be a little more complex because participants must be allocated to four arms either in one (A, B, C, and D) or two stages (first intervention and comparator, and then second intervention and its comparator

Factorial design

- disadvantage
- 3. Appropriateness and acceptability/tolerance of the combined intervention on biologic and scientific grounds must be explored and determined
- 4. If interaction is expected, but there is no intention to detect the interaction, the factorial has no sample size advantages compared with two separate two-arm parallel trials.

Repeated measurement design



Have a nice Day!