University of Thessaly

Department of Physical Education & Sport Science

Masters Program

Research Methods
Experimental Research

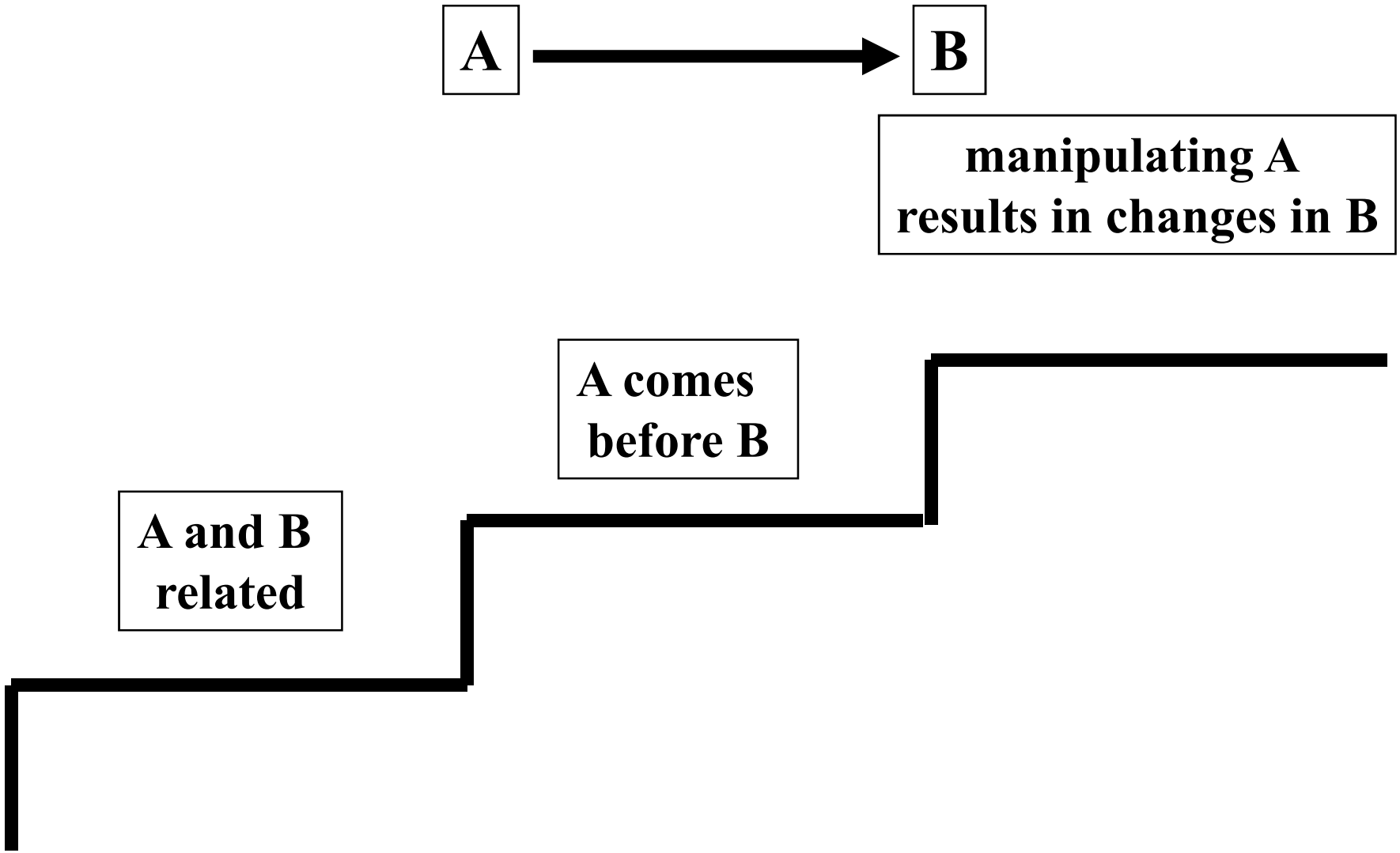
Research

What are the goals of Research?

- Description
- Interpretation
- Prediction
- Intervention & Change

Experimental Research

3 steps of causality



Key components

Groups. Experimental / Control

Experimental - treatment

Control - no treatment*

The groups are compared to assess ‘differences in means’ or ‘differences in change’

* Control groups ‘doing nothing’ is a threat to validity. Control groups should receive a ‘neutral treatment’ with similar characteristics (duration, frequency)

Key components

Sampling

• Probability sampling where possible – random assignment of individuals into groups

Random assignment of groups into experimental and control (to avoid differences between experimental and control groups)

• Matching

Individuals are matched on important characteristics

Individuals are matched on dependent variable to ensure no differences at baseline testing

• Problem of “volunteer” subjects

Key components

Variables. independent / dependent

impact of variable (A) on variable (B)

A: independent variable

B: dependent variable

Manipulation of independent variable
Control of *extraneous* variables
Measurement of dependent variable

Key components

Measures. pre / post testing

Post-testing

To assess differences in dependent variable after treatment

Pre-testing / Post-testing

To assess differences before and after treatment, but also change, and differences in change in dependent variable

Key components

Treatment

any sort of intervention, such as service, program, educational curriculum, or workshop whose goal is to produce certain outcomes

Piloting – Rehearsing
- duration, conditions, problems

Implementation protocol
- to the last detail

Training of providers
- identical treatment

Environment – circumstances
- place, time, environmental condition

Key components

Contamination of conditions

- Experimental group
  - awareness of treatment
  - awareness of goals
  - using own strategies
- Control group
  - leakage of treatment
  - using own strategies

Key components

Manipulation check

A validity test of an experimental manipulation to make sure that the manipulation does produce differences in the independent variable and the desired conditions were indeed created

Experimental group

necessary to claim that manipulation was successful

Control group

applicable in certain cases to check that control group was really control

Validity issues

Threats to experimental research

- Internal validity

did the treatment had an effect (was the effect due to the treatment)

- External validity

to what degree the results generalize in the real world (setting)?

Internal Validity issues

History

- events occurring during the experiment which are not part of the treatment

Experiment
Effect of physical activity program on moral development

Threat
Children participating in sport outside school

Internal Validity issues

Maturation

- changes that are due to the passing of time (growing, fatigue, boredom)

Experiment
effect of a year-long training program on elementary school throwing performance

Threat
children at that age will get stronger anyway during such a long period

Internal Validity issues

Testing - Learning

- changes are due to familiarization with the test or learning

Experiment
effect of imagery on golfing putt in high school students

Threat
students have no prior experience, so taking the test once will improve later performance

Internal Validity issues

Instrumentation

- reliability and validity of instruments due to use and familiarization

Experiment
the effect of the grip on rowing power

Threat
two different machines are used for the experiment to isolate experimental and control groups – one new / one old

Internal Validity issues

Hawthorn effect

- motivational influences on treatment groups (but not on control)

Experiment
the effect of a self-talk strategy on learning

Threat
the fact that participants have never taken part in an experiment and have never used self-talk motivates them to try harder

Internal Validity issues

Baseline measure

- particularly high or low scores at baseline measures, which are more likely change (increase or decrease) compared to moderate scores

Experiment
the effect of two different routines on free throwing performance in competition

Threat
group 1 from elite league – higher baseline %
group 2 from lower league – lower baseline %

Internal Validity issues

<u>experimental mortality</u>

- loss of participants

Experiment
effectiveness of a 3 months anti-smoking intervention

Threat
50% of participants quit the program after week 2, which eventually showed that 50% of those following the intervention quit smoking

Internal Validity issues

<u>contamination of treatment</u>

- knowledge of treatment can affect participants in both the experimental and control groups

Experiment
the effect of imagery on dart throwing performance

Threat
control group participants heard experimental participants talking of imagery and used it too

Internal Validity issues

<u>expectancy</u>

- researchers' expectancies on group performance

Experiment
the effect of two reinforcement strategies on persistence

Threat
the researcher knowing the hypothesis may (even unconsciously) implement more effectively the expected 'winner' strategy

Internal Validity issues

selection bias

- choosing groups in non-random ways

Experiment
A program for improving parents' attitudes towards the purpose of sport in young athletes

Threat
Parents selected from the field

External Validity issues

reactive effects of baseline testing

- baseline testing can make participants more aware to the treatment – as a result the treatment is not effective without the pre-test

Experiment
The effect of a training program on sit-up performance

Threat
initial testing may show very low performance levels and motivate participants to try harder during the program

External Validity issues

<u>selection bias</u>

- if groups selected on certain characteristics, then treatment may be effective only on such groups

Experiment
the effect of a health education program on 5th grade students

Threat
the effectiveness of the program may be lower in later ages, if such programs are implemented as part of school education in later grades

External Validity issues

repeated treatment

- previous treatments may affect later treatments

Experiment
the effect of different grips on golf putting performance

Threat
a repeated measures design with participants trying several grips may means that performance was a result of trying different techniques

External Validity issues

<u>experimental conditions</u>

- treatment may be effective only in highly controlled settings

Ecological Validity - The limitation of experimental research

Validity issues

Methods to Increase Internal Validity

- Have a Control Group
- Random Assignment
- Apply effective manipulation checks
- Use Pre and Post testing

Exercise

Discuss and Critique the Self-Efficacy Experiment.

Make suggestions on how things could have been made.

Experimental research

Experimental designs

- pre-experimental designs
- true experimental designs
- quasi-experimental designs

R: randomized group formation

X: experimental treatment

O: observation (measure)

M_b: baseline measure

M_f: final measure

Experimental designs

Pre-experimental design (1)

- one group – one measure (X - O)

1. Experimental manipulation

2. Measure

we learn: the performance of the group that received the treatment

we don't learn: if the treatment had any effect

Experimental designs

Pre-experimental design (2)

- One group – Pre / Post measures (O_b - X - O_f)

1. Baseline measure
2. Experimental treatment
3. Final measure

we learn : if performance of the group changed

we don't learn : if the change is due to the treatment

Experimental designs

Pre-experimental design (3)

- two groups – no baseline measure (X - O)
  (O)

1. Treatment to experimental group
2. Measure

we learn: if performance of experimental group is different than that of the control group

we don't learn: (a) if performance of the experimental group changed due to the treatment (b) if the two groups differed before the experimental treatment

Experimental designs

True experimental design (1)

- two randomized groups – no baseline measure (R - X - O)
  (R - O)

1. Randomized group formation
2. Treatment to experimental group
3. Measure

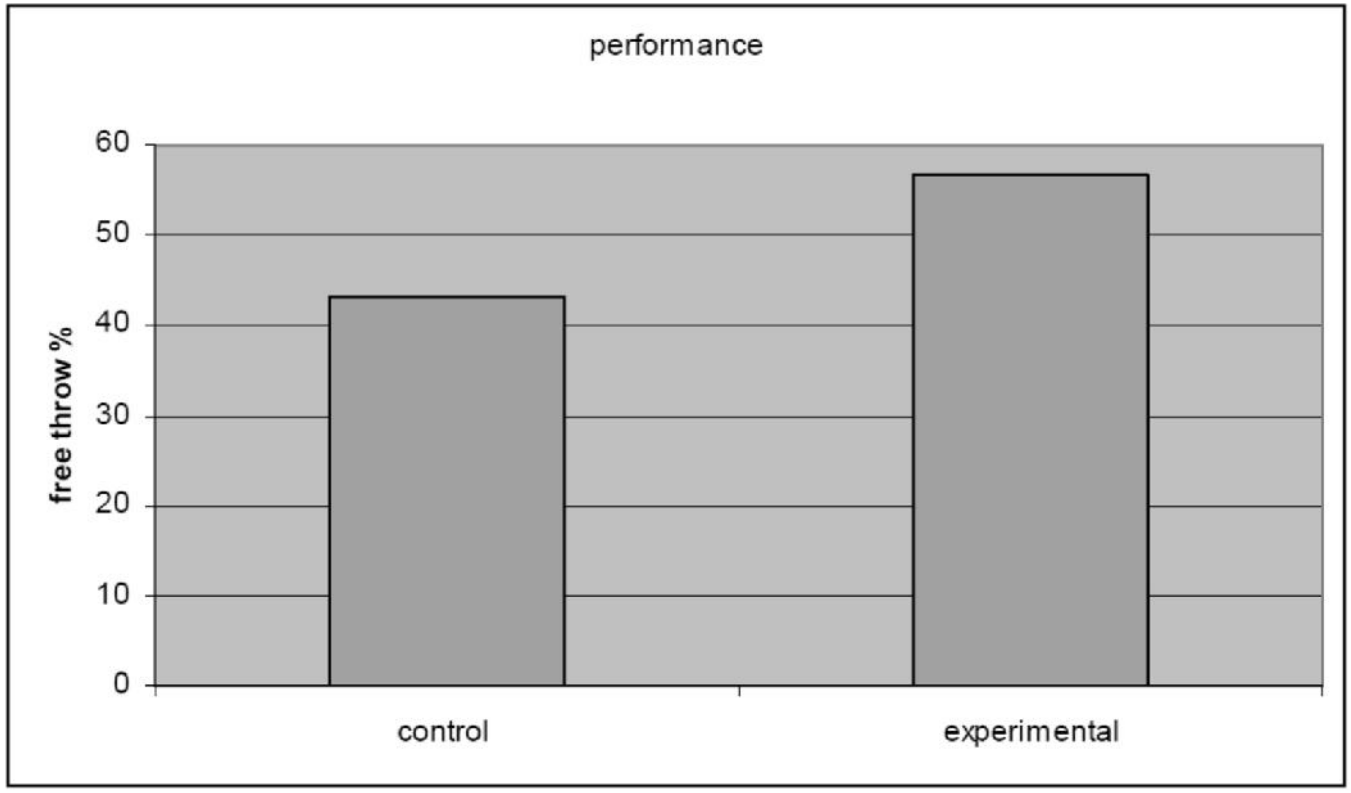
we learn: if performance of experimental group is different than that of the control group

limitation: we accept the principle of randomization that the two groups did not differ at baseline (before the treatment)

Experimental designs

True experimental design (1)

- two randomized groups – no baseline measure



Fictitious data

Experimental designs

True experimental design (2)

- two groups – baseline measure (R - O_b - X - O_f)
  (R - O_b - O_f)

1. Randomized group formation
2. Baseline measure
3. Treatment to experimental group
4. Final measure

We learn: (a) if performance of the experimental group changed, (b) if performance of the control group changed, (c) if there was a difference between the two groups at baseline, (d) if there is a difference between the two groups at final measure, (e) if the change (from baseline to final) for the two groups is different

Experimental designs

True experimental design (2)

- two groups – baseline measure

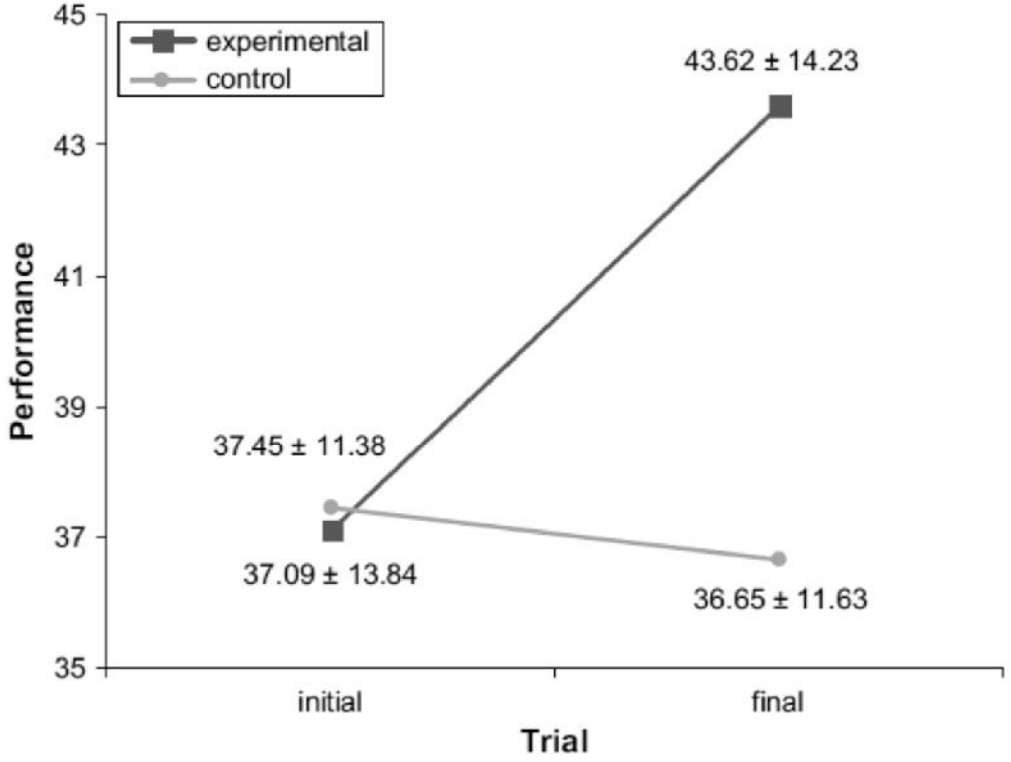


Fig. 1. Performance scores in the initial and final trials for the experimental and control groups.

taken from Hatzigeorgiadis et al. 2009

Experimental designs

True experimental designs

Advantages of pretest design

Equivalency of groups

Can measure extent of change

Disadvantages of pretest design

Time-consuming

Sensitization to pre-test

Experimental designs

Quasi-experimental design (1)

• single subject – multiple baseline (O_{b1}, O_{b2}, … - X - O_{f1}, O_{f2}, …)

1. Identification of true baseline performance through multiple measures

2. Experimental treatment

3. Identification of true final performance through multiple measures

we learn: if performance levels changed

limitation: we accept that the assessment of performance at baseline and final stage was valid and that changes are due to the treatment

Single subject - Multiple Baseline design

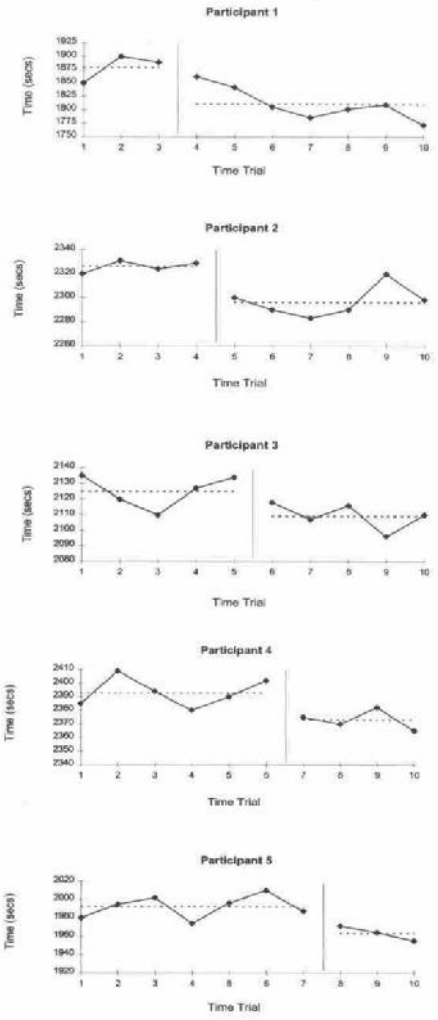


Figure 1 — Time taken for each participant to complete the gymnasium triathlon during the baseline and intervention phase.

taken from Thellwell & Greenlees, 2001

Experimental designs

Solomon Four Group Design

- four groups – experimental/control - with/without baseline

Experimental Group 1:	R –	O_b –	X	– O_f
Control Group 1:	R –	O_b		– O_f
Experimental Group 2:	R –		X	– O_f
Control Group 2:	R –			– O_f

strength: controls for the possibility that in taking a test more than once, earlier tests (baseline) have an effect on later tests

Experimental research issues

Multiple treatments

- independent measures design
  different groups receive different treatment
- repeated measures design
  same group receives all treatments

	advantages	disadvantages
Independent	no order effect	larger sample less sensitive to differences
Repeated	smaller sample sensitive to differences	order effect (practice, fatigue)

Experimental research issues

Lab	vs	Field
artificial environment		real environment
less extraneous variables		more extraneous variables
high control		low control
high internal validity		low internal validity
low external validity		high external validity
high replication possibilities		low replication possibilities

Exercise

Evaluate and Compare the various experimental research designs in relation to the validity threats

Exercise

Make a brief description of an experiment aiming to test the effectiveness of an imagery intervention on dart throwing performance

(a) Identify variables
(b) Write a research hypothesis
(c) Describe the sample
(d) Describe the measures (what and how)
(e) Describe the procedure (in details)
(f) Explain what type of statistical analysis is required

Textbooks

Thomas, J. R. & Nelson, J. K. (2003). *Research methods in physical activity*. Champaign, Ill: Human Kinetics.

Dyer, C. (2006). *Research in Psychology*. MA: Blackwell.