Independent Variables

Some typical Independent Variables:

Relating to technology: Different types of technology or devices, such as typing versus speech-based dictation, mouse versus joystick, touch pad, and other pointing devices; different types of design, such as pull-down menu versus pop-up menu, font sizes, contrast, background colours, and website architecture.

Relating to users: Age, gender, computer experience, professional domain, education, culture, motivation, mood, and disabilities.

Related to the context of use of technologies: Physical factors, such as environmental noise, lighting, temperature, vibration, users' status (e.g., seated, walking or jogging), and social factors, such as the number of people surrounding the user and their relation to the user.

Dependent Variables

Dependent variables can often be categorized into five groups:

Efficiency
Accuracy
Subjective satisfaction
Ease of learning and retention rate
Physical or cognitive demand

Misleading Influences: Other Variables

Extraneous Variable: A variable that can affect experimental results, but is not a variable we wish to study (could be related to researcher, participants, environment, or measurement task).

- Can change systematically or unsystematically

Confounding Variable: When an extraneous variable systematically changes along with a variable(s) of interest.

Aim: Identify and reduce effect of/eliminate potential confounding variables when designing the study

Conditions

Condition (level/treatment): Specific category of the independent variable.

Control Group: Group of participants measured on the dependent variable but does not receive any amount (or some reduced amount) of the independent variable (doesn't receive any treatment). This could also be a neutral condition - Baseline.

Experimental Group: Group of participants measured on the dependent variable but does receive the independent variable (do receive the treatment).

Conditions

Example: Experiment with participants. Independent variable of number of hours spent studying. Dependent variable of number of errors made on the assessment.

Condition 1: 1 hour	Condition 2: 2 hours	Condition 3: 3 hours	Condition 4: 4 hours
13	9	7	5
12	8	6	3
11	7	5	2

Randomisation

Totally randomized experiment: No one, including the investigators is able to predict the condition to which a participant is going to be assigned.

Well-designed experiments, often randomize assignment of experiment conditions, participants to conditions, plus other factors as well.

Randomization: Randomization software resources

Participant Allocations in Experiments

Within-subject Design: involves each participant performing under all sets of conditions.

Between-Subject Design: involves each participant only performing under one condition.

Mixed Factorial Design: One independent variable is within subjects and another between subjects. I.e., there are two independent variables (also called factors in this case) and one factor is within and one factor is between.

Participant Allocations in Experiments

Organisation of participants to tasks, reduce order effects.

Example Latin Square with four different tasks

Group	1st Task	2nd Task	3rd Task	4th Task
i	Task A	Task B	Task C	Task D
ii	Task **B**	Task C	Task D	Task A
iii	Task C	Task D	Task A	Task B
iv	Task D	Task A	Task B	Task C

Table 1.2 *Organising tests for comparing two interfaces with two different tasks*

Group	First task	Second task
i	Interface 1 Task A	Interface 2 Task B
ii	Interface 1 Task B	Interface 2 Task A
iii	Interface 2 Task A	Interface 1 Task B
iv	Interface 2 Task B	Interface 1 Task A

Reliable and Valid Empirical Studies

Reliability: Degree to which the same finding will be observed in a replication of the study.

Validity: Degree to which study accurately addresses the topic it claims to measure.

Validity

Content Validity: Degree to which measurements actually reflect the variable of interest (whether we actually and only measure an intended variable).

Construct validity: Extent to which a measurement reflects the hypothetical construct of interest (whether a variable actually and only reflects the intended hypothetical construct).

Internal validity: Degree to which the mathematical relationship we observe between subjects' scores actually and only reflects the relationship between the variables of interest (degree to which we can draw the correct inferences about the relationship occurring within a study).

External validity: Degree to which the results accurately generalise to other individuals and other situations (degree to which we can draw the correct inferences when generalising beyond a study.

Ecological validity: Extent to which research can be generalised to common behaviours and natural situations (extent to which the situation and behaviours in a study are those found in the natural environment.

指实验设置、条件和过程在多大程度上模拟真实世界的情境，**从而能够被广泛推广到日常生活中**

The Population and the Sample

Population: The entire group of people about whom we want to make a statement.

Sample: The subgroup of persons who actually take part in the research.

Study a sample of people in order to make claims about the population.

Need to ensure the sample is representative of the population.

Sampling

Note: Aspect of external validity is how well our conclusions generalise to the greater population. So important to have a representative sample

Recruitment of participants for a study:

Probability Sampling Techniques:

Simple random sampling: All members of the population have an equal chance of being selected.

Systematic random sampling: Select every *n*th person from a list of the population.

Stratified random sampling: randomly select from key subgroups so their representation in the sample is proportional to their representation in the population.

Cluster sampling: Certain groups/clusters are randomly selected and then all members of each group are observed.

Nonprobability Sampling Techniques:

Convenience sampling: Involves selecting participants from wherever is convenient for the researcher.

Statistics

Descriptive statistics: Measures of central tendency, variability.

Inferential statistics: Techniques to allow us to generalise the results from our study sample to the population.

We shall be covering these topics in Lect 10 Part 03.

Ethics

The **Declaration of Helsinki** (1964): Set of ethical principles regarding human experimentation developed for the medical community.

Essential components:

- Informed decisions and informed consent
- Carefully considered methods
- Assessment of benefits and risks
- Participant welfare
- Vulnerable populations
- Study termination
- Right to withdraw

Ethics

Require completion of data protection form and submit an ethics application to a local/overarching ethics committee. Only start research after receiving approval from the committee.

In completing an **ethics application** the following key details need to be provided:

Describe the rationale for the study, and detail the experimental methods.

Participant details: Numbers to be recruited and how, age, vulnerable groups, ability to provide consent.

Clearly detail the physical/psychological benefits and risks.

Sufficiently detailed Information about the experiment(s) to be provided to participants.

Sufficiently detailed Consent Form (consent for each component of the experiment/data collection).

Include details about data transfer and handling: Anonymization, storage and retention.

The types of data to be collected.

Right to withdraw from experiment and to withdraw data.

Confidentiality.

Below is a sample of the Materials and Methods section taken from a published article: Cassarino, M., Maisto, M., Esposito, Y., Guerrero, D., Chan, J.S. and Setti, A., 2019. Testing attention restoration in a virtual reality driving simulator. *Frontiers in psychology*, *10*, p.250.

Compare understanding pre-and post lecture:

Participants:

"In line with Berto (2005), a total of 38 participants (Mean age = 22.1, SD = 3.43; 44% female) were recruited through convenience sampling among undergraduate and graduate students at University College Cork, Ireland. Participants were randomly assigned to an urban or rural environmental exposure (n = 19 in each group). Half of the participants (n = 19) were fully licensed drivers with an average of 5.5 years of driving experience (SD = 3.24), whereas the other half (n = 19) included individuals with no full license and mean driving experience of 2.3 years (SD = 3.81). All participants read and signed a consent form prior to data collection in accordance with the Declaration of Helsinki. Ethical approval for the study was received by the School of Applied Psychology Ethics Committee, University College Cork. All participants read an information sheet briefing on the aims of the study and all were asked to read and sign a written consent form prior to participation in the study. No vulnerable populations were included in the study."

Below is a sample of the Materials and Methods section taken from a published article: Cassarino, M., Maisto, M., Esposito, Y., Guerrero, D., Chan, J.S. and Setti, A., 2019. Testing attention restoration in a virtual reality driving simulator. *Frontiers in psychology*, *10*, p.250.

Compare understanding pre-and post lecture:

Design:

"A 2 × 2 mixed between-within design was employed, with the participants' performance at SART, (assessed pre- vs. post- exposure to virtual reality environments in a full vehicle driving simulator) as the within-subjects factor; and Environment type (urban vs. rural) as the between-subjects factor."

Overall Summary

Types of research
Hypotheses
Components of an experiment
Measurement scales
Variables
Conditions of an experiment and participant allocations
Randomisation
Reliability and validity
Sampling
Ethics

Resources

Essential:

Research Methods and Statistics by Bernard C. Beins and Maureen A. McCarthy, Part I and Part II.

Research Methods in Human-Computer Interaction by Jonathan Lazar, Jinjuan Heidi Feng, Harry Hochheiser, 2017 2nd Edition. Elsevier. Chapters 1, 2, and 3.

Supplementary:

Research Methods for Human-Computer Interaction by Paul Cairns and Anna L. Cox, 2016. Chapter 1.