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1

Qualitative Research Methods

Place, Purpose & Uses

CHICKENS PREFER BEAUTIFUL HUMANS

Stefano Ghirlanda, Liselotte Jansson, and Magnus Enquist
Stockholm University

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Learning outcomes

- By the end of this lecture students should be able to
 - Describe the quantitative research process
 - Develop a research question
 - Develop one or more hypotheses
 - Understand the principles of data analysis using statistical tools
 - Interpret the results of data analysis and draw appropriate conclusions

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Introduction to Quantitative Research

(in Kinesiology & Health Sciences)

- Quantity is the unit of analysis
 - Amounts
 - Frequencies
 - Degrees
 - Values
 - Intensity
- Uses statistics for greater precision and objectivity
- Based on the deductive model
- Careful, systematic and structured process for problem solving



Deductive v Inductive Reasoning

- Deductive reasoning
 - Testing a general assumption to arrive at a specific answer/solution
- E.g.
 - Premise 1: All students are clever
 - Premise 2: Kate is a student
 - Conclusion: Kate is clever
- This assumption can be tested



- Inductive reasoning
 - Logical argument in which specific premises lead to a general conclusion
- E.g.
 - Premise: My dog wears a jumper
 - Conclusion: All dogs wear jumpers
- All we know is that there is at least one dog in Wales and that he wears a jumper



The Scientific Method

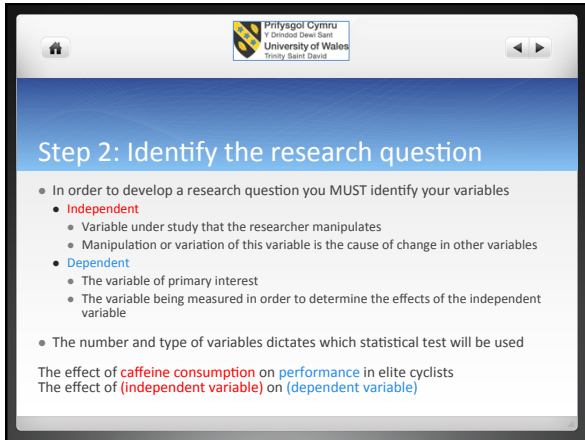
- Highly structured, sequential series of steps for conducting a scientific research study

- Understand the problem area
- Identify the research question
- Formulate one or more hypotheses
- Plan the research methodology
- Collect the data
- Analyse the data with statistical tools
- Interpret the results & discuss
- Derive conclusions from the results



Step 1: Understand the problem area

- Literature search
- Even if the topic is handed to you by a supervisor
- Consider the *quality* of your literature
 - Be critical
 - Peer reviewed?
 - Robust methodology?
 - How would I know?



Step 2: Identify the research question

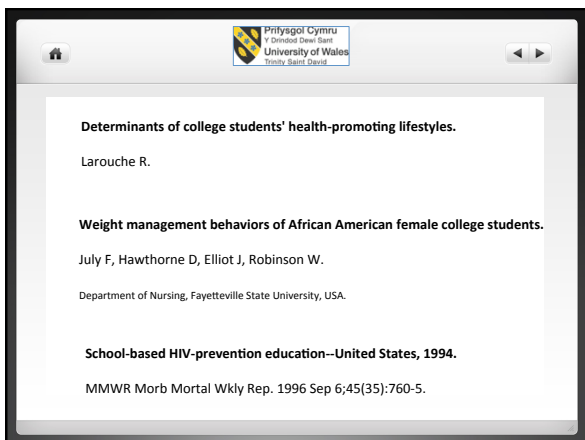
- In order to develop a research question you **MUST** identify your variables
 - Independent**
 - Variable under study that the researcher manipulates
 - Manipulation or variation of this variable is the cause of change in other variables
 - Dependent**
 - The variable of primary interest
 - The variable being measured in order to determine the effects of the independent variable
- The number and type of variables dictates which statistical test will be used

The effect of **caffeine consumption** on **performance** in elite cyclists
 The effect of (**independent variable**) on (**dependent variable**)



Step 2: Identify the research question

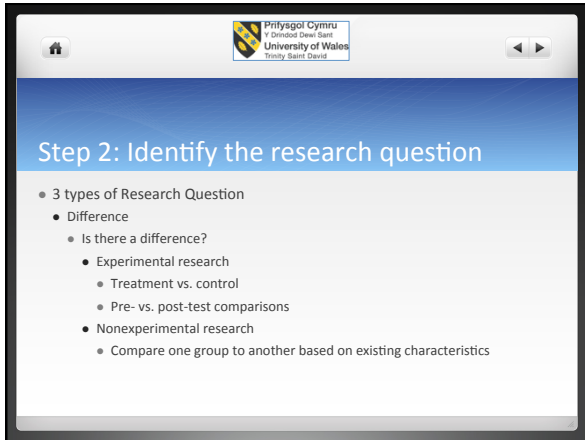
- 3 types of Research Question
 - Descriptive
 - To describe phenomena or characteristics of a particular group of subjects being studied
 - Survey research
 - Qualitative research



Determinants of college students' health-promoting lifestyles.
 Larouche R.

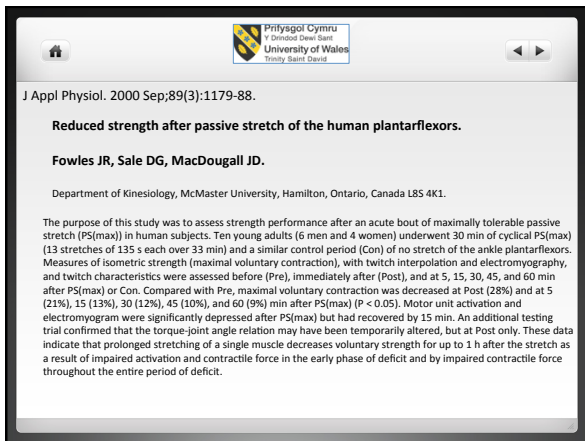
Weight management behaviors of African American female college students.
 July F, Hawthorne D, Elliot J, Robinson W.
 Department of Nursing, Fayetteville State University, USA.

School-based HIV-prevention education--United States, 1994.
 MMWR Morb Mortal Wkly Rep. 1996 Sep 6;45(35):760-5.



Step 2: Identify the research question

- 3 types of Research Question
 - Difference
 - Is there a difference?
 - Experimental research
 - Treatment vs. control
 - Pre- vs. post-test comparisons
 - Nonexperimental research
 - Compare one group to another based on existing characteristics



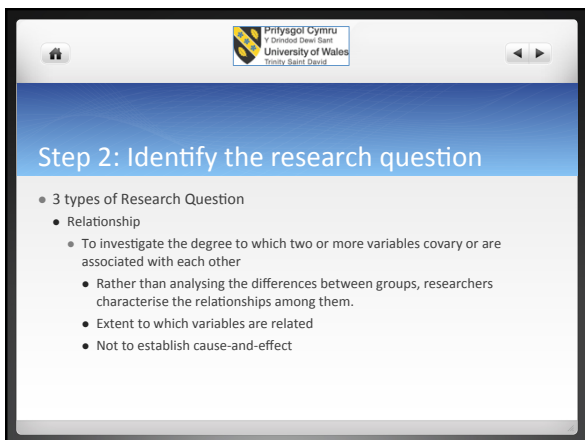
J Appl Physiol. 2000 Sep;89(3):1179-88.

Reduced strength after passive stretch of the human plantarflexors.

Fowles JR, Sale DG, MacDougall JD.

Department of Kinesiology, McMaster University, Hamilton, Ontario, Canada L8S 4K1.

The purpose of this study was to assess strength performance after an acute bout of maximally tolerable passive stretch (PS(max)) in human subjects. Ten young adults (6 men and 4 women) underwent 30 min of cyclical PS(max) (13 stretches of 135 s each over 33 min) and a similar control period (Con) of no stretch of the ankle plantarflexors. Measures of isometric strength (maximal voluntary contraction), with twitch interpolation and electromyography, and twitch characteristics were assessed before (Pre), immediately after (Post), and at 5, 15, 30, 45, and 60 min after PS(max) or Con. Compared with Pre, maximal voluntary contraction was decreased at Post (28%) and at 5 (21%), 15 (13%), 30 (12%), 45 (10%), and 60 (9%) min after PS(max) ($P < 0.05$). Motor unit activation and electromyogram were significantly depressed after PS(max) but had recovered by 15 min. An additional testing trial confirmed that the torque-joint angle relation may have been temporarily altered, but at Post only. These data indicate that prolonged stretching of a single muscle decreases voluntary strength for up to 1 h after the stretch as a result of impaired activation and contractile force in the early phase of deficit and by impaired contractile force throughout the entire period of deficit.



Step 2: Identify the research question

- 3 types of Research Question
 - Relationship
 - To investigate the degree to which two or more variables covary or are associated with each other
 - Rather than analysing the differences between groups, researchers characterise the relationships among them.
 - Extent to which variables are related
 - Not to establish cause-and-effect

Relation of cardiovascular fitness and physical activity to cardiovascular disease risk factors in children and adults.

Sallis JF, Patterson TL, Buono MJ, Nader PR.

Department of Pediatrics, University of California, San Diego, La Jolla.

The associations of physical activity and cardiovascular fitness with cardiovascular disease risk factors were studied in 88 male adults, 180 female adults, 148 male children, and 142 female children. Subjects were families recruited from elementary schools in San Diego, California. Fitness (VO₂ max) was measured by a submaximal cycle ergometer test. Physical activity was assessed by seven-day recall interview, yielding caloric expenditure, and by a simple self-rating of activity level. Risk factors included blood pressure, high density lipoprotein (HDL) cholesterol, the ratio of high density lipoproteins to low density lipoproteins (LDL), and body mass index. For all subgroups, fitness was strongly and significantly correlated with virtually all risk factors. After adjustment for body mass index, most fitness-risk factor associations were no longer significant. Seven-day caloric expenditure was significantly correlated with HDL/LDL only in female adults and children. The activity rating was significantly correlated with body mass index in all subgroups and with HDL/LDL in female adults and male adults. The simple activity rating tended to be correlated with fitness. The pattern of association was similar for adults and children.

Am J Epidemiol. 1988 May;127(5):933-41.

Step 2: Identify the research question

- Make sure it's worthwhile...

BMJ

BMJ 2011;342:d708 doi:10.1136/bmj.d708 (Published 15 December 2011)

Orthopaedic surgeons: as strong as an ox and almost twice as clever? Multicentre prospective comparative study

Conclusions Male orthopaedic surgeons have greater intelligence and grip strength than their male anaesthetic colleagues, who should find new ways to make fun of their orthopaedic friends.

Step 2: Identify the research question

- Make sure it's worthwhile...

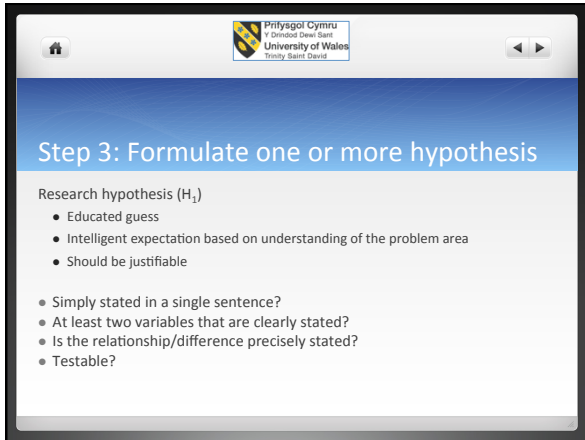
BMJ

BMJ 2011;342:d708 doi:10.1136/bmj.d708 (Published 15 December 2011)

Are Metabolically Healthy Overweight and Obesity Benign Conditions?: A Systematic Review and Meta-analysis

Caroline K. Kramer, MD, PhD; Bernard Zinman, CM, MD; and Ravi Retnakaran, MD

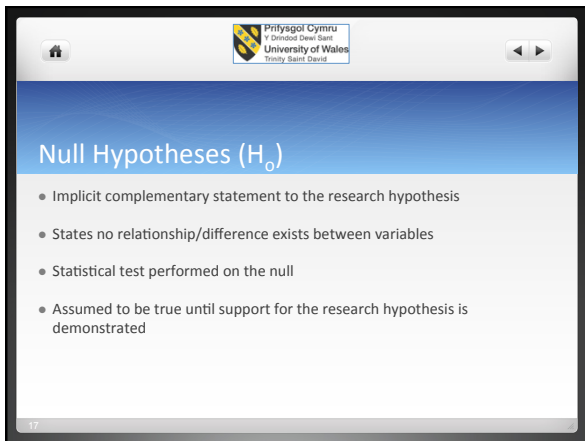
Conclusion: Compared with metabolically healthy normal-weight individuals, obese persons are at increased risk for adverse long-term outcomes even in the absence of metabolic abnormalities, suggesting that there is no healthy pattern of increased weight.



Step 3: Formulate one or more hypothesis

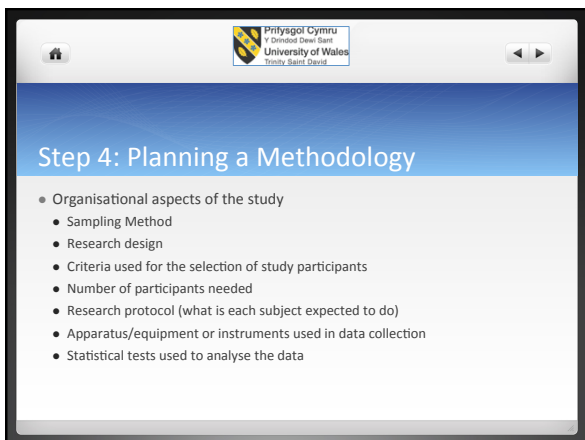
Research hypothesis (H_1)

- Educated guess
- Intelligent expectation based on understanding of the problem area
- Should be justifiable
- Simply stated in a single sentence?
- At least two variables that are clearly stated?
- Is the relationship/difference precisely stated?
- Testable?



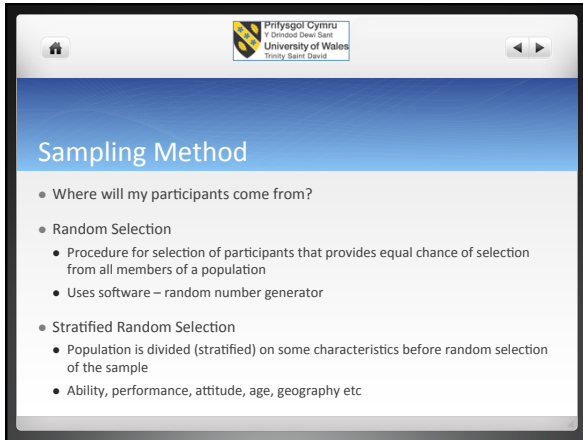
Null Hypotheses (H_0)

- Implicit complementary statement to the research hypothesis
- States no relationship/difference exists between variables
- Statistical test performed on the null
- Assumed to be true until support for the research hypothesis is demonstrated



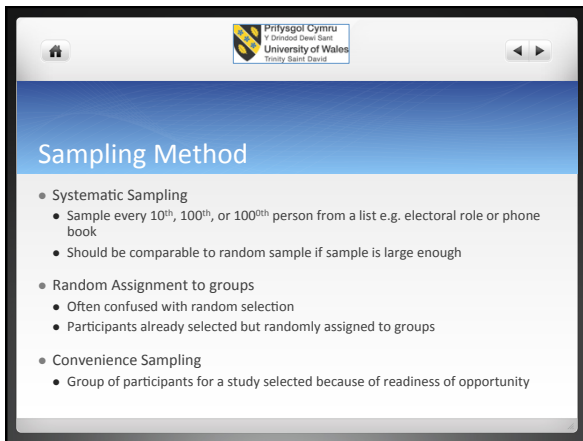
Step 4: Planning a Methodology

- Organisational aspects of the study
 - Sampling Method
 - Research design
 - Criteria used for the selection of study participants
 - Number of participants needed
 - Research protocol (what is each subject expected to do)
 - Apparatus/equipment or instruments used in data collection
 - Statistical tests used to analyse the data



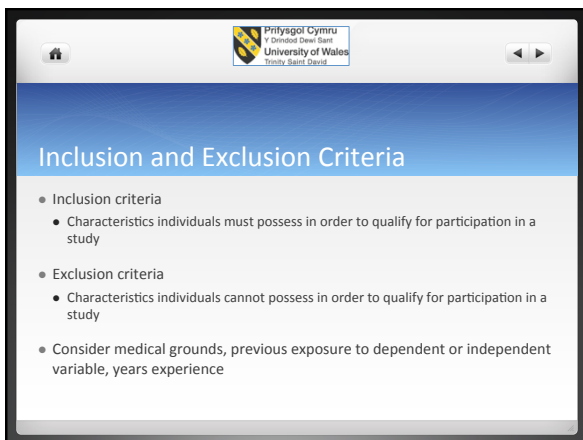
Sampling Method

- Where will my participants come from?
- Random Selection
 - Procedure for selection of participants that provides equal chance of selection from all members of a population
 - Uses software – random number generator
- Stratified Random Selection
 - Population is divided (stratified) on some characteristics before random selection of the sample
 - Ability, performance, attitude, age, geography etc



Sampling Method

- Systematic Sampling
 - Sample every 10th, 100th, or 1000th person from a list e.g. electoral role or phone book
 - Should be comparable to random sample if sample is large enough
- Random Assignment to groups
 - Often confused with random selection
 - Participants already selected but randomly assigned to groups
- Convenience Sampling
 - Group of participants for a study selected because of readiness of opportunity



Inclusion and Exclusion Criteria

- Inclusion criteria
 - Characteristics individuals must possess in order to qualify for participation in a study
- Exclusion criteria
 - Characteristics individuals cannot possess in order to qualify for participation in a study
- Consider medical grounds, previous exposure to dependent or independent variable, years experience

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Participant numbers required

- How many participants do I need?
- POWER of the study
 - Probability of correctly rejecting or accepting the null hypothesis
- Greater the power of the study, the greater the odds of arriving at statistically significant findings that accurately reflect the population
- Generally calculate the number of participants needed to arrive at a power level of 0.8
- Need the following information to calculate sample size
 - Acceptable level of significant (0.05)
 - Power of study (80%)
 - Expected effect size (0.15) ESTIMATED
 - Standard Deviation in population (0.5) FROM LITERATURE

Free online tool for calculating sample size G^*Power^2

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Research Design

- One-Shot Study Design
- One Group Pretest-Posttest Design

E.g. teacher collects data from end of term exam (D) and draws conclusions about the quality of instruction received (T)

E.g. Phys Ed teacher measures 'fitness' at the start of term (D_1) and end of school year (D_2) as a test of effectiveness of Phys Ed programme (T)

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Research Design

- Control Groups are important but not always possible....

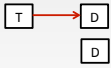
Parachute use to prevent death and major trauma related to gravitational challenge: systematic review of randomised controlled trials

Conclusions As with many interventions intended to prevent ill health, the effectiveness of parachutes has not been subjected to rigorous evaluation by using randomised controlled trials. Advocates of evidence based medicine have criticised the adoption of interventions evaluated by using only observational data. We think that everyone might benefit if the most radical protagonists of evidence based medicine organised and participated in a double blind, randomised, placebo controlled, crossover trial of the parachute.

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Research Design

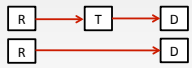
- Static Group Comparison Design



- Control Group
- No pretest

E.g. Comparison of performance on soccer test of students who received instruction and those who did not

- Posttest-Only Design

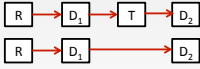


- Random assignment of groups

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Research Design

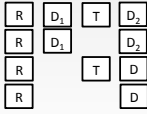
- Pretest-Posttest Design



- Demonstrate that the groups were equivalent at the beginning

Any change as a result of intervention ?

- Solomon Four-Group Design



- Often used in studies where there is concern the pretest will influence posttest measures (e.g. tests of skill)

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Research Design

- Time Series Designs



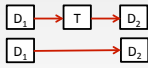
Interrupted by treatment

Ensure a stable baseline

Examines lasting effect of treatment

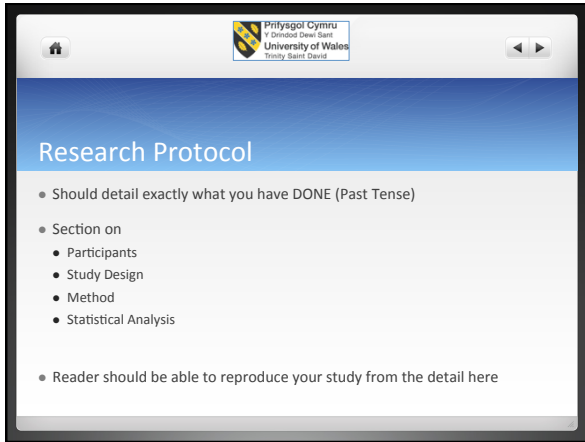
Can use more than one T phase

- Non-equivalent Control Group Design



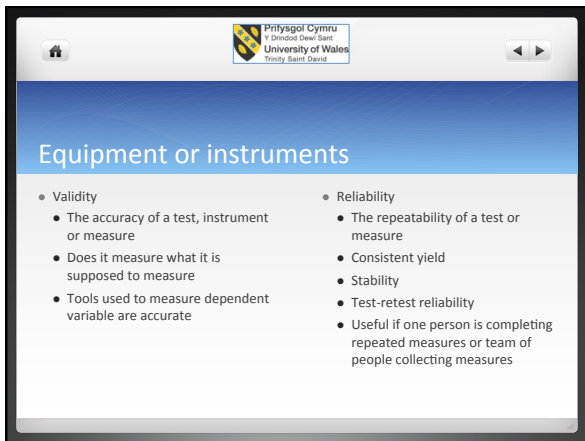
No random assignment

Often use voluntary participation rather than random assignment



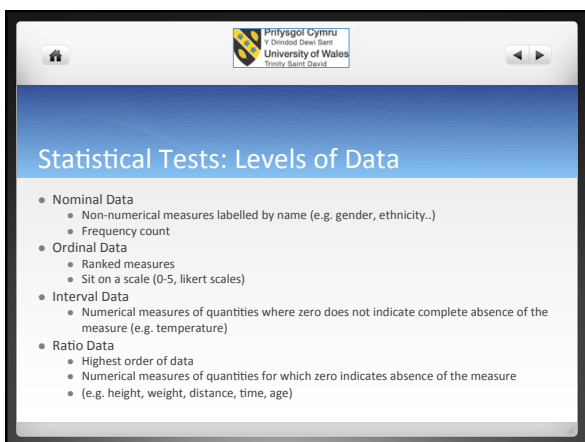
Research Protocol

- Should detail exactly what you have DONE (Past Tense)
- Section on
 - Participants
 - Study Design
 - Method
 - Statistical Analysis
- Reader should be able to reproduce your study from the detail here



Equipment or instruments

- Validity
 - The accuracy of a test, instrument or measure
 - Does it measure what it is supposed to measure
 - Tools used to measure dependent variable are accurate
- Reliability
 - The repeatability of a test or measure
 - Consistent yield
 - Stability
 - Test-retest reliability
 - Useful if one person is completing repeated measures or team of people collecting measures



Statistical Tests: Levels of Data

- Nominal Data
 - Non-numerical measures labelled by name (e.g. gender, ethnicity..)
 - Frequency count
- Ordinal Data
 - Ranked measures
 - Sit on a scale (0-5, likert scales)
- Interval Data
 - Numerical measures of quantities where zero does not indicate complete absence of the measure (e.g. temperature)
- Ratio Data
 - Highest order of data
 - Numerical measures of quantities for which zero indicates absence of the measure
 - (e.g. height, weight, distance, time, age)

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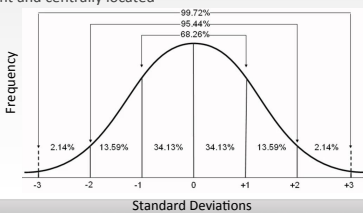
Statistical Tests: Parametric & Non-Parametric Statistics

- All statistical tests fall in to two broad categories
- Parametric
 - Category of statistical test used for sets of Interval & Ratio data
- Non-Parametric
 - Category of statistical tests used for Nominal and Ordinal Data
 - *As well as Interval and Ratio data that does not meet the assumptions required*

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Statistical Tests: Normal Distribution

- Bell shaped frequency plot for which the mean, median and mode are coincident and centrally located



Frequency

Standard Deviations

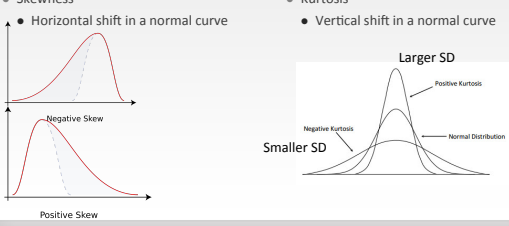
99.72%
95.44%
68.26%

2.14% 13.59% 34.13% 34.13% 13.59% 2.14%

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Statistical Tests: Normal Distribution

- Skewness
 - Horizontal shift in a normal curve
- Kurtosis
 - Vertical shift in a normal curve



Negative Skew

Positive Skew

Larger SD

Positive Kurtosis

Smaller SD

Negative Kurtosis

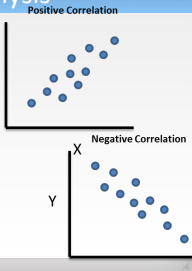
Normal Distribution

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Statistical Tests: Types of Analysis

Finding relationships among variables

- **Correlation**
 - A measure of the relationship among two or more variables
 - Do they change together in a predictable fashion
 - Strength of correlation
 - -1.0 to +1.0
 - The further away from 0.0 the stronger the correlation
 - Use Pearson's Product Moment Correlation Coefficient

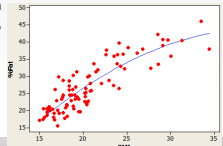


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Statistical Tests: Types of Analysis

Finding relationships among variables

- **Regression**
 - A statistical method for predicting one variable based on the value of another variable
 - Used when there is a significant, strong correlation
 - E.g. skinfold calliper scores predict your body fat %



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Statistical Tests: Types of Analysis

Finding Differences among Groups

- Testing a hypothesis
- Setting an appropriate alpha level
 - Level of significance
 - Usually <0.05 or 0.01 in human participants
 - P value

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Statistical Tests: Types of Analysis

Finding Differences among Groups

- T-Tests
 - Compares two groups on one dependent measure
 - Two groups and two sets of data
- Paired T Test (repeated measure)
 - Same subjects tested twice
- Independent T Test
 - Two groups of people and you want to compare their scores

```
graph LR; D1_1[D1] --> D2[D2]; D1_2[D1] --> D1_3[D1]
```

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Statistical Tests: Types of Analysis

Finding Differences among groups

- Between Groups One Way Analysis of Variance (ANOVA)
 - More than two groups
 - Test that allows evaluation of the null hypothesis between two or more group means
- Avoids repeated T-Tests

```
graph TD; D1_1[D1] --> D1_2[D1]; D1_2 --> D1_3[D1]
```

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Statistical Tests: Types of Analysis

Finding Differences among groups

- Repeated Measures One Way Analysis of Variance (ANOVA)
 - Same group testing on more than two occasions

```
graph LR; D1[D1] --> D2[D2]; D2 --> D3[D3]
```

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Statistical Tests: Types of Analysis

Finding Differences among groups

	Math	English
School A	D	D
School B	D	D
School C	D	D

- Multivariate Analysis of Variance (MANOVA)
 - Compares groups on a number of different but related dependent variables
 - ANOVA with several dependent variables
 - E.g. comparing the effect of an intervention on a number of outcome measures (such as anxiety, depression, sleep, mood)
 - E.g. teacher wanted to compare pupils from 3 primary schools results in Maths and English tests

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Statistical Tests: Types of Analysis

Finding Differences among groups

- ANOVA & MANOVA
- Significant results indicate that differences exist, but do not show which groups differ from each other
- Post Hoc Tests are used as a follow up for an ANOVA/MANOVA to show where significant differences occur

More conservative ← → More liberal

Test	Conservativeness
Scheffe	High
Tukey HSD	Medium-High
Newman-Keuls	Medium-Low
Fisher's LSD	Low

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Statistical Tests: Types of Analysis

- Finding Differences among Groups
 - A difference exists
 - Perhaps I have completed a post-hoc to find the difference
 - Then what?
- Examine Effect Size
 - Simple way of quantifying the difference between two groups

EDITORIAL

Using Effect Size—or Why the P Value Is Not Enough

GAIL M. SULLIVAN, MD, MPH
RICHARD FEINN, PhD



Step 5: Collecting the data

- Easy part!



Step 6: Analysing your data with statistical tools

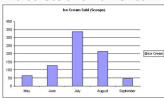
- You should never collect data without identifying HOW you will analyse it!

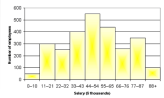


Step 7: Interpret & Discuss the Results

- Tables & Graphs (Figures)
- Bar Graphs
 - Data in categories on X-Axis
 - Categories presented in any order
 - Bars do not touch – data is discrete and numerical

- Histograms
 - Data in ranges on x-axis
 - Ranges placed in numerical order
 - Data is continuous
 - Bars can touch





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Step 7: Interpret & Discuss the Results

- Line Graph
 - Data on x-axis is numbered
 - X-axis data is specific – not ranges
 - Points are placed in numerical order
 - A line can be drawn through the points

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Step 7: Interpret & Discuss the Results

- Tables
 - Units of measurement should be clear
 - Horizontal lines ONLY no vertical
 - Table title should be above with capital letter only for first word.

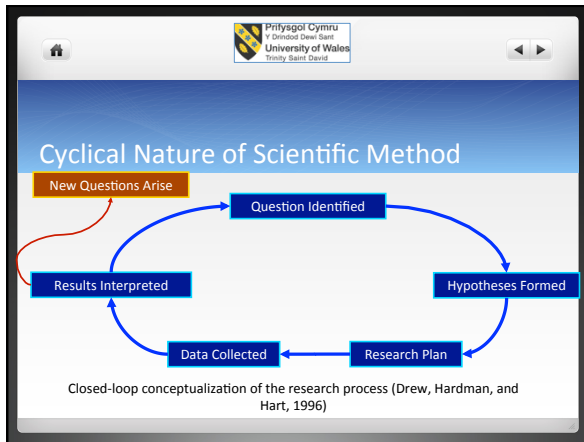
	Group 1 n = 21 (52.5 %)	Group 2 n = 19 (47.5 %)	p value
Age (years)			
Mean ± SD	26.0 ± 8.49	25.7 ± 8.12	n.s.
Gender % (n)			
Male	81.0 (17)	94.7 (18)	n.s.
Female	19.0 (4)	5.3 (1)	
Dominant extremity % (n)			
Right	81.0 (17)	89.5 (17)	n.s.
Left	19.0 (4)	10.5 (2)	
Injured knee % (n)			
Right	38.1 (8)	15.8 (3)	n.s.
Left	47.6 (10)	68.4 (13)	
Bilateral	14.3 (3)	15.8 (3)	
Baseline VISA-P			
Mean ± SD	32.5 ± 12	69.5 ± 10.05	<0.001

Values expressed as mean ± SD or frequencies and percentages

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Step 8: Derive Conclusions from Results

- Be careful not to over reach the results when making conclusions
- Can you accept or reject the H_0 and H_1 ?
- Do not
 - Over generalise the results
 - To a larger population
 - Overstate the impact of the research
- Acknowledge the limitations of the study
- Suggestions for future research



Summary

- Quantitative methods of enquiry have the ability to be objective
- Consider the use of quantitative methods as part of mixed-method approach to research
- "Beware of the man of one method"

Mixed Methods Research: A Research Paradigm Whose Time Has Come

R. Burke Johnson, Professor and

Mixed Methods Research in the Movement Sciences

Case studies in sport, physical education and dance
