CANADIAN COLLEGE OF OSTEOPATHY
TORONTO CAMPUS

STATS HELP

INTRODUCTION TO RESEARCH
FOR OSTEOPATHS

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LADY TASTING TEA

THE DESIGN OF EXPERIMENTS

Ronald Fisher

***The Design of Experiments* (1935)**

One of the first chapters of this textbook written by Fisher is the essay, "Mathematics of a Lady Tasting Tea."

Mathematics of a Lady Tasting Tea

By SIR RONALD A. FISHER

STATEMENT OF EXPERIMENT

A LADY declares that by tasting a cup of tea made with milk she can discriminate whether the milk or the tea infusion was first added to the cup. We will consider the problem of designing an experiment by means of which this assertion can be tested. For this purpose let us first lay down a simple form of experiment with a view to studying its limitations and its characteristics, both those which appear to be essential to the experimental method, when well developed, and those which are not essential but auxiliary.

AGENDA

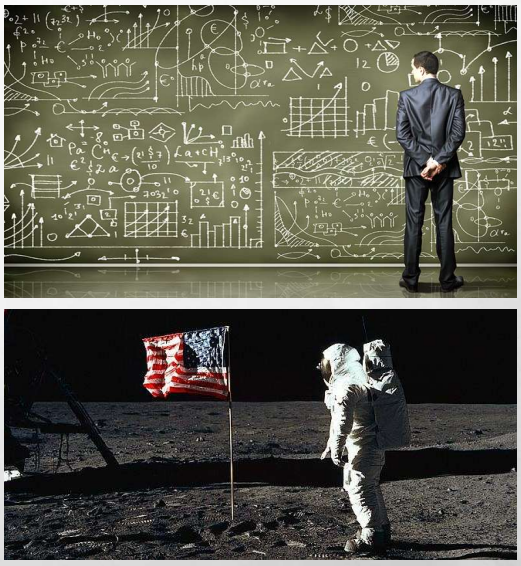
- WHAT IS RESEARCH?
- WHY DO RESEARCH?
- RESEARCH QUESTION
- TYPES OF RESEARCH DESIGNS
- COMMUNICATING THE KNOWLEDGE
- ELEMENTS OF GOOD RESEARCH
- AREAS OF STATISTICS
- UNDERSTANDING RESEARCH ARTICLES
- STATISTICAL VS PRACTICAL SIGNIFICANCE
- SUMMARY OF RESEARCH PROCESS STEPS
- STUDENTS' RESEARCH
  - SAMPLE SIZE
  - RECRUITMENT OF STUDY PARTICIPANTS
  - IDEAS FOR TOPICS IN OSTEOPATHIC RESEARCH
- HOW DO I LEARN MORE?

WHAT IS RESEARCH?

1. ASKING A QUESTION
2. FINDING THE ANSWER
3. COMMUNICATING THE KNOWLEDGE

WHY DO RESEARCH?

- BUILDING KNOWLEDGE
- PROVIDING UNDERSTANDING
- HUMAN CURIOSITY
- BEING FIRST
- HELPING SOCIETY



STEP 1: RESEARCH QUESTION

1. WHY DO PATIENTS SEEK OSTEOPATHIC TREATMENT?
2. DOES OSTEOPATHIC INTERVENTION X EFFECTIVELY REDUCE PATIENTS' PAIN AFTER 5 SESSIONS?
3. IS THERE AN ASSOCIATION BETWEEN THE AGE OF PARTICIPANTS AND THE NUMBER OF OSTEOPATHIC SESSIONS ATTENDED?
4. IS THERE A DIFFERENCE BETWEEN OSTEOPATIC INTERVENTION X AND INTERVENTION Y IN INCREASING THE PARTICIPANTS' QUALITY OF LIFE?
5. HOW RELIABLE IS A PARTICULAR TECHNIQUE IN DIFFERENTIATING EMPTY VS FILLED BLADDER?
6. IS THERE A CONSENSUS IN PUBLISHED STUDIES REGARDING THE EFFECTIVENESS OF INTERVENTION X?

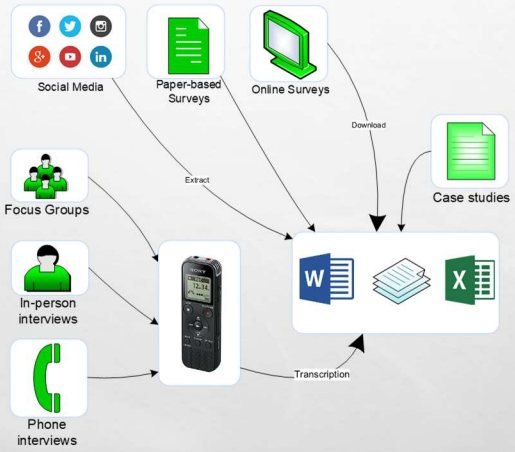
STEP 2: FINDING AN ANSWER

1. QUALITATIVE
2. QUANTITATIVE
3. CORRELATION / REGRESSION ANALYSIS
4. EXPERIMENTAL
5. RELIABILITY
6. META-ANALYSIS

QUALITATIVE

RESEARCH QUESTION:

WHY DO PATIENTS SEEK OSTEOPATHIC TREATMENT?



- Content Analysis to identify (common) themes
- Quotes from participants
- Summary of findings
- Expert opinion

QUANTITATIVE

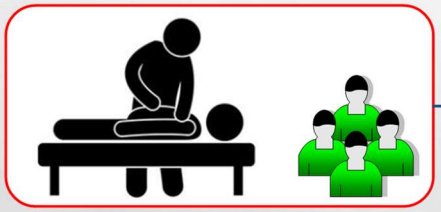
RESEARCH QUESTION:

DOES OSTEOPATHIC INTERVENTION X EFFECTIVELY REDUCE PATIENTS' PAIN AFTER 5 SESSIONS?

CORRELATION/REGRESSION ANALYSIS

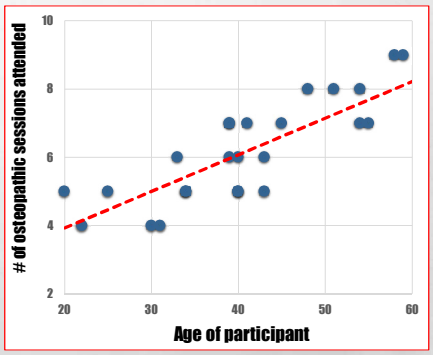
RESEARCH QUESTION:

IS THERE AN ASSOCIATION BETWEEN THE AGE OF PARTICIPANTS AND THE NUMBER OF OSTEOPATHIC SESSIONS ATTENDED?



Osteopathic Intervention

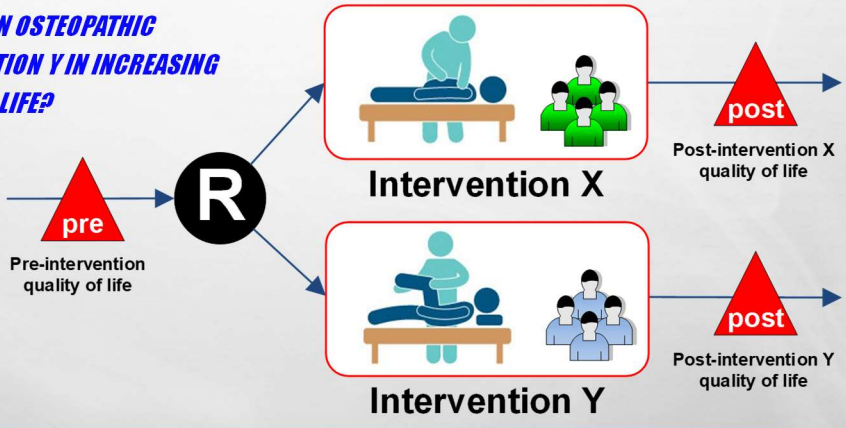
Age of participant
# of sessions attended



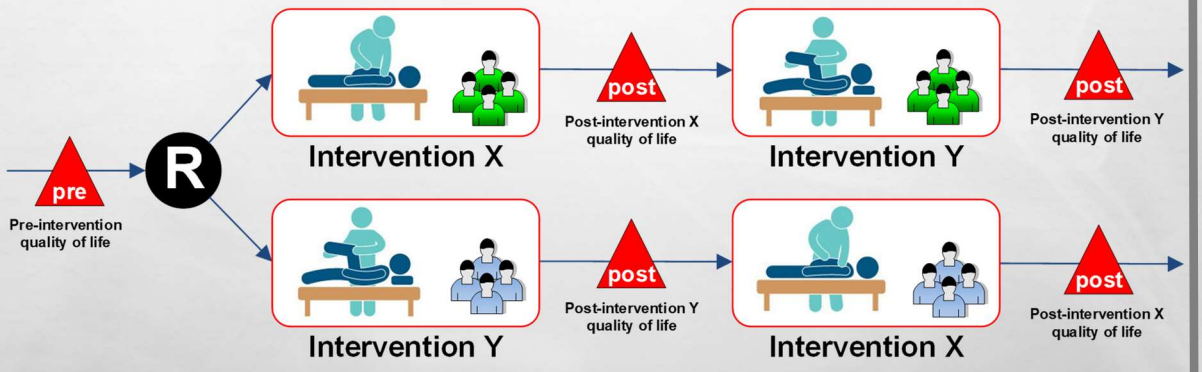
EXPERIMENTAL (PARALLEL ARMS RCT)

RESEARCH QUESTION:

IS THERE A DIFFERENCE BETWEEN OSTEOPATHIC INTERVENTION X AND INTERVENTION Y IN INCREASING THE PARTICIPANTS' QUALITY OF LIFE?



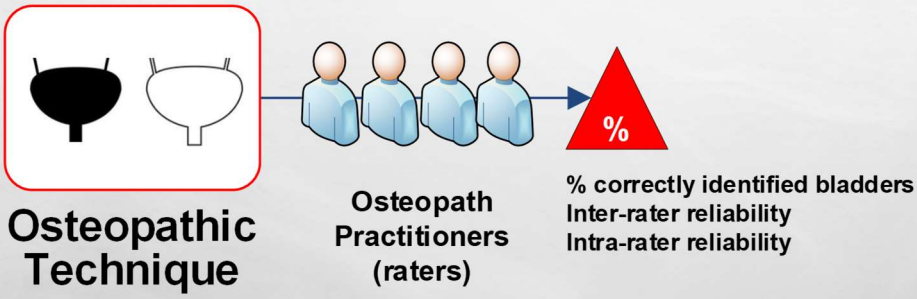
EXPERIMENTAL (CROSSOVER)



RELIABILITY STUDY

RESEARCH QUESTION:

HOW RELIABLE IS A PARTICULAR TECHNIQUE IN DIFFERENTIATING EMPTY VS FILLED BLADDER?



Osteopathic Technique

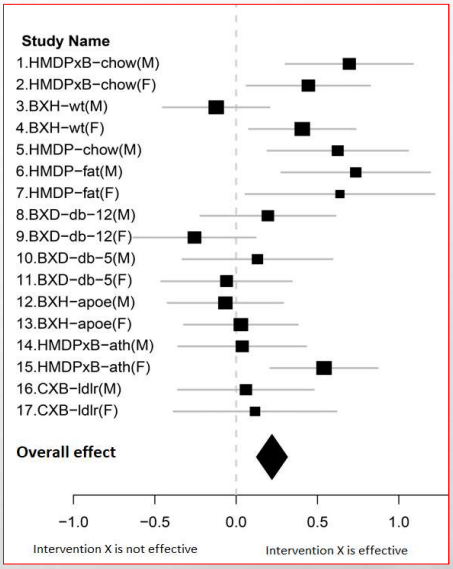
Osteopath Practitioners (raters)

% correctly identified bladders
Inter-rater reliability
Intra-rater reliability

META-ANALYSIS

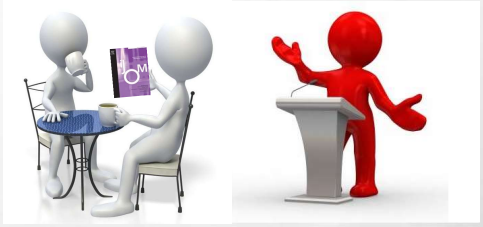
RESEARCH QUESTION:

IS THERE A CONSENSUS IN PUBLISHED STUDIES REGARDING THE EFFECTIVENESS OF INTERVENTION X?



STEP 3: COMMUNICATING THE KNOWLEDGE

1. JOURNAL ARTICLE
2. CONFERENCE OR SYMPOSIUM
3. NEWSLETTER
4. DISCUSS WITH COLLEAGUES
5. PHD PROGRAM



PUBLISHING A RESEARCH ARTICLE

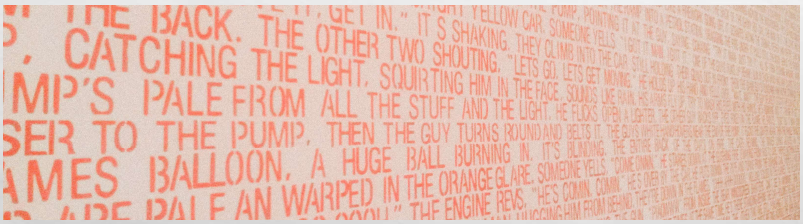
- THE OSTEOPATHIST - CANADIAN JOURNAL OF OSTEOPATHY
  HTTPS://WWW.OSTEOPATHYST.COM/
- THE JOURNAL OF THE AMERICAN OSTEOPATHIC ASSOCIATION
  HTTP://JAOA.ORG/
- INTERNATIONAL JOURNAL OF OSTEOPATHIC MEDICINE
  HTTP://WWW.JOURNALOFOSTEOPATHICMEDICINE.COM/

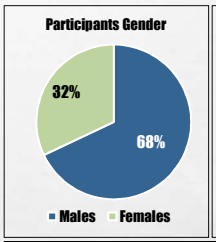
ELEMENTS OF GOOD RESEARCH

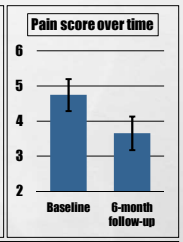
1. SAMPLE
2. RANDOM ASSIGNMENT
3. MEASURING OUTCOMES
4. DESIGN AND METHODOLOGY
5. STATISTICAL ANALYSIS

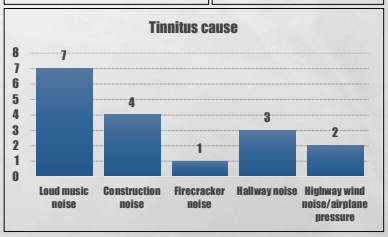
TYPES OF DATA IN RESEARCH

1. CATEGORICAL
2. NUMERICAL
3. SEMI-STRUCTURED AND UNSTRUCTURED



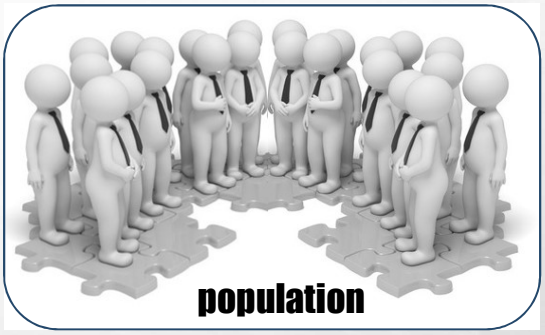






AREAS OF STATISTICS

1. DESCRIPTIVE
2. INFERENTIAL



EXAMPLE OF DESCRIPTIVE STATS

Table 1 Characteristics of both patient groups at the beginning of the study

	Osteopathy	Standard care
Male/female	6/14	10/9
Evaluated	19	17
Lost to follow-up	1	2
Mean age (years)	46.5	41
Smoker	6	6
Use of alcohol	9	9
Mean quality of life score	111	109
Mean symptom score	9.1	8.7
Mean FBDSI score	174	171

FBDSI, Functional Bowel Disorder Severity Index.

Source: Henry Hundscheild et al. Treatment of irritable bowel syndrome with osteopathy: Results of a randomized controlled pilot study
Journal of Gastroenterology and Hepatology 22 (2007) 1394-1398
http://www.academia.edu/download/28386472/hundscheid_treatmentofirritablebowelsyndromewithosteopathy.pdf

EXAMPLE OF DESCRIPTIVE STATS

TABLE 1. BASE-LINE CHARACTERISTICS OF THE STUDY PARTICIPANTS.*

CHARACTERISTIC	OSTEOPATHIC-TREATMENT GROUP (N=83)	STANDARD-CARE GROUP (N=72)
Age — yr†	28.5±10.6	37.0±11.0
Sex — no. (%)		
Male	34 (41)	32 (44)
Female	49 (59)	40 (56)
Leg pain — no.		
Above knee	30	23
Below knee	9	10
Visual-analogue pain score — mm‡	49.0±23.6	45.0±20.6
Median Roland–Morris questionnaire score§	7	7
Oswestry questionnaire score¶	25.0±12.2	23.1±11.8
Flexion — degree	31.9±22.5	33.0±17.1
Extension — degree	7.2±7.8	6.9±7.8
Straight-leg raising — degree	75.5±9.8	75.4±9.3
Onset of pain — no. (%)		
Gradual	44 (53)	34 (47)
Sudden	37 (45)	36 (50)
Unknown	2 (2)	2 (3)

*There were no statistically significant differences between the groups. For all scales and questionnaires, the score increases with the severity of the pain or disease. Plus–minus values are means ±SD.

†The P value for age was 0.091.

‡The visual-analogue pain scale was scored from 0 to 100.

§The Roland–Morris questionnaire was scored from 0 to 24.

¶The Oswestry questionnaire was scored from 0 to 50.

Source: Gunnar Andersson et al. A Comparison of Osteopathic Spinal Manipulation with Standard Care for Patients with Low Back Pain
The New England Journal of Medicine 1999; 341:1426-1431
http://www.nejm.org/doi/full/10.1056/NEJM199911043411903

CONFIDENCE INTERVALS

- Estimating proportion of patients that find Osteopathic Treatment helpful
- Estimating mean Quality of life score for patients in control and experimental groups
- Estimating average number of Osteopathic Treatment sessions attended
- Estimating mean decrease in VAS Pain score for patients after the series of osteopathic intervention sessions

EXAMPLE OF CONFIDENCE INTERVALS

TABLE 2. CHANGE IN PRIMARY OUTCOME MEASURES FROM THE FIRST TO THE FINAL VISIT AND PRIMARY OUTCOME MEASURES IN THE TWO GROUPS AT THE FINAL VISIT.*

MEASURE	OSTEOPATHIC-TREATMENT GROUP (N=83)	STANDARD-CARE GROUP (N=72)	P VALUE	95% CI OF THE DIFFERENCE†
Change from first to final visit				
Visual-analogue pain score (mm)‡	32.0±23.0	26.3±24.1	0.19	−1.8 to 13.2
Median Roland–Morris questionnaire score§	5	5	0.16	
Oswestry questionnaire score¶	13.6±13.4	12.9±13.4	0.97	−3.5 to 5.0
Flexion (degree)	1.9±22.0	4.2±21.3	0.64	−9.1 to 4.7
Extension (degree)	0.8±11.9	1.7±11.1	0.65	−4.6 to 2.8
Straight-leg raising (degree)				
Supine	2.8±9.7	1.3±9.1	0.40	−1.5 to 4.5
Sitting	6.6±12.7	5.2±10.4	0.94	−2.4 to 5.1

*All changes are improvements. All values are means ±SD, except those for the Roland–Morris questionnaire score, which are median values. For all scales and questionnaires, the score increases with the severity of the pain or disease.

†The confidence interval (CI) is for the difference between groups (the mean in the osteopathic-treatment group minus the mean in the standard-care group).

‡The visual-analogue pain scale was scored from 0 to 100.

§The Roland–Morris questionnaire was scored from 0 to 24.

¶The Oswestry questionnaire was scored from 0 to 50.

Source: Gunnar Andersson et al. A Comparison of Osteopathic Spinal Manipulation with Standard Care for Patients with Low Back Pain The New England Journal of Medicine 1999; 341:1426-1431
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STATISTICAL TESTS – OVERVIEW

		Dependent variable	
		Categorical	**Numerical**
Independent variable	**Categorical**	Chi-square test Fisher's Exact test McNeimar test Binomial test	One sample t-test Paired samples t-test / Wilcoxon Independent samples t-test / Mann-Whitney One-way ANOVA / Kruskal-Wallis
	Numerical	Binary or multinomial logistic regression	Correlation Regression analysis (simple or multiple)

UNDERSTANDING RESEARCH ARTICLES

Table 2 Comparison of the VAS, MOV and ROM values between OMT and CCT groups ($n = 25$) at T0, T1 and T2.

		OMT		CCT		t		P
T0	VAS[a]	6.9	±0.88	6.40	±1.42		NS	
	MOV[b]	35.1	±4.36	34.9	±34.5		NS	
	ROM[c]	62.4	±10.67	64.5	±9.55		NS	
T1	VAS[a]	1.5	±0.85	2.6	±0.7	−4.995		0.000
	MOV[b]	46.0	±4.78	41.3	±4.52	3.572		0.000
	ROM[c]	81.9	±10.31	71.9	±9.05	3.654		0.000
T2	VAS[a]	3.8	±1.26	4.4	±1.75		NS	
	MOV[b]	42.9	±2.69	40.4	±2.41	3.461		0.001
	ROM[c]	80.5	±5.44	72.4	±2.95	6.545		0.000

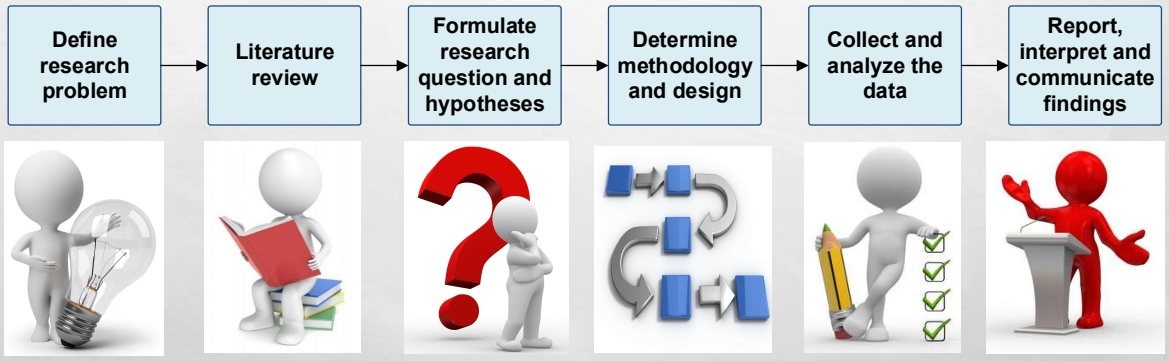
[a] The visual analogue pain scale was scored from 0 to 10.
[b] Measure in millimeters.
[c] Measure in degrees.

Source: A.M. Cuccia et al. Osteopathic manual therapy versus conventional conservative therapy in the treatment of temporomandibular disorders: A randomized controlled trial. Journal of Bodywork & Movement Therapies (2010) 14, 179-184
https://pdfs.semanticscholar.org/849d/3c122af15a27b3dc59de93a76dde196e52a4.pdf

STATISTICAL VS PRACTICAL SIGNIFICANCE

- Statistical significance: p-value <0.05
- Practical significance: Effect Size
- Statistical significance is a first step to Practical significance

SUMMARY OF RESEARCH PROCESS STEPS



STUDENTS' RESEARCH

- Proposal (PICO statement)
  - P = patient/problem (research question)
  - I = intervention (experiment design)
  - C = comparison (control)
  - O = outcome (validated instrument to measure)

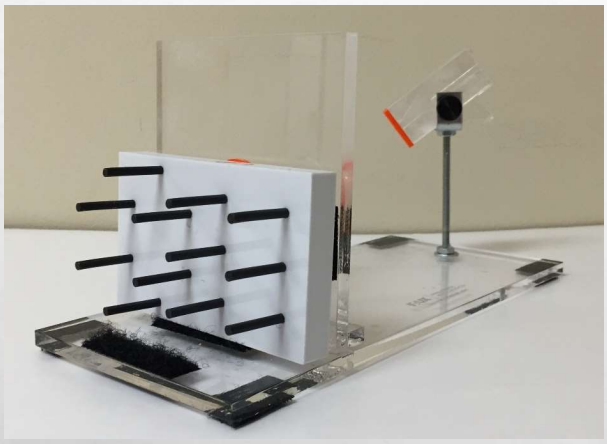
STUDENTS' RESEARCH (CONTINUE)

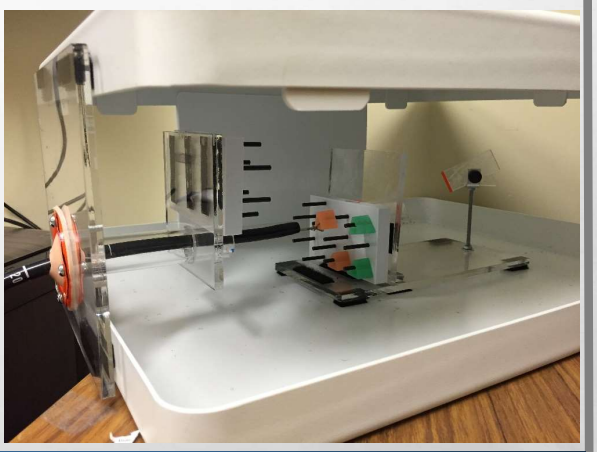
- What instrument to use?
- Sample size calculation
  - Effect size
  - Pilot study
  - Minimum important difference
    Clinically important outcome

STUDENTS' RESEARCH (CONTINUE)

- Recruitment of study participants
  - Specialized clinics
  - Osteopathic practices
  - Social media (Facebook, LinkedIn)
  - Kijiji and other online postings

TRAINING STATION FOR SURGEONS





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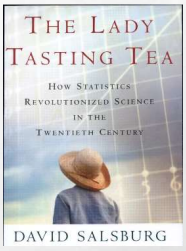
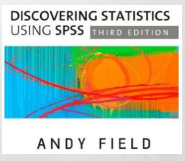
RELIABILITY STUDIES

- Practical aspects
  - Live patients or objects (models)
  - Repeated trials to make a diagnosis
- Benefits
  - Relative simplicity in design
  - Contribution to osteopathic profession
  - Improving manual skills

HOW DO I LEARN MORE?

- **BOOKS**
- **INTERNET**
- **COURSES/WORKSHOPS**
- **PROFESSIONAL CONSULTING & COACHING**





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QUESTIONS? COMMENTS? THOUGHTS?

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