What is Research?

Will G Hopkins
Sport and Recreation
AUT University
Auckland NZ

How to do Research: solve a problem, publish

Dissecting the Dimensions of Research:
topic, novelty, technology, scope, mode, methods, ideology, politics, utility

Reassembling the Dimensions: quantitative vs qualitative research

How to do Research

- Research is all about addressing an issue or asking and answering a question or solving a problem, so…
- Identify an issue, question, or problem.
  - Talk with people who want or need your study.
- Find out what's already known about it.
  - Talk with experts and/or read their reviews and the original research on the topic.
- Plan, cost, and do your study accordingly.
- Write it up and submit it for assessment.
  - Better still, do a good job on it and submit it for publication.
    - Undergrad projects are sometimes good enough to publish.
    - Your work will **benefit more people** if you publish it.
    - Rule No. 1 in academia is **publish or perish**.
- This slide show is about different types of research you can do.

Dissecting the Dimensions of Research

- My understanding of the various kinds of research advanced when I identified various dimensions (components) of research.
  - A former colleague regarded such analysis as a trivial pursuit.
    - If you find a better way to understand research, let me know.
  - Meanwhile consider these dimensions:
    - topic: physical–biological–psychological–sociological
    - novelty: create new vs review published data or info
    - technology: develop new vs use existing methods
    - scope: study a single case vs a sample
    - mode: observe vs intervene
    - methodology: qualitative vs quantitative (info vs numbers)
    - ideology: objective vs subjective (positivist vs interpretivist)
    - politics: neutral vs partisan
    - utility: pure vs applied
    - reassembling the dimensions

Click to link to each dimension.
Click here for Conclusions.

Topic: what are you researching?

biophysical — psychosocial
clinical behavioral psychological economic social

- Examples
  - Clinical: the effect of a herb on performance.
  - Psychological: factors affecting work-place satisfaction.
  - Behavioral: how can we reduce truancy at this school?
  - Economic: characterize the productivity of new immigrants.
  - Social: develop risk-management procedures at a gym.
- Finding a good question/problem to address can be hard.
  - It helps to have a good supervisor, good colleagues, and/or knowledge or practical experience of and affinity for a topic.
  - You must read journal articles to find out what's already known.
    - Authors also often point out topics for future research.

Novelty: creating new or reviewing published info?

create — review

- Most research projects are so-called original investigations.
  - You obtain new data or information about a phenomenon.
  - You reach a conclusion and try to publish it.
- Some research projects are reviews of the literature.
  - You use other researchers' published data or info about a phenomenon.
    - A quantitative statistical review is called a **meta-analysis**.
  - You should "earn your spurs" doing original research before taking on a stand-alone review.
  - But a write-up of an original investigation always has to include a short review of literature.

Technology: develop new or use existing method(s)?

develop new — use existing

- Sometimes a legitimate topic for study is methodological.
- For example, development or novel investigation of…
  - a measuring device
  - a psychometric instrument (questionnaire or inventory)
  - a protocol for a physical performance test
  - a diagnostic test
  - a method of analysis.
- You usually include or focus on a reliability and/or validity study of the measure provided by the method.
  - Validity = the relationship between observed and true values.
  - Reliability = reproducibility of observed values.

Scope: case or sample?

- Are you solving a single case of something, or is it a sample that will allow you to generalize to a population?
- In a case study…
  - You are interested in "what happened or will happen here".
  - Your finding applies only locally: to the case you studied.
  - The quest for an answer can be like that in a court case.
  - Qualitative methods are often required.
  - You reach an answer by applying logic (= common sense?) and skepticism to your knowledge and to the information you gather.
    - Be wary of conventional wisdom and your own prejudices.
  - It may be possible to estimate probabilities of benefit or truth of various answers.

- In a study of a sample…
  - You are interested in "what happens in general".
  - Rarely, "what" is simply descriptive: the frequency, mean value or other simple statistic of something in the sample.
  - Most often, the "what" is the value of an effect statistic: the relationship between the thing of interest (a dependent variable, such as health, performance…) and something else (a predictor variable, such as training, gender, diet…) in the sample.
    - Examples of effect statistics: difference or change in a mean value; ratio of frequencies (relative risk); correlation coefficient.
  - You control for other possible predictor variables either by holding them constant or measuring and including them in the analysis.
    - Example: the effect of physical activity on health, controlling for the effect of age on health.
    - In controlled trials (interventions), a control group accounts for any effect of time that would have happened anyway.

- More about studying a sample…
  - You study a sample, because it is impractical and wasteful (and therefore unethical) to study a population.
  - "What happens in general" refers to the average person or situation in a population represented by your sample.
  - "Population" is a defined group, not the entire human race or all possible situations.
  - You make inferences about that population; that is, you generalize from the sample to a population.
    - You can make inferences to other populations only if you can argue that those populations are similar to your sample with respect to the effect you have studied.

- There are several ways to generalize from sample to population…
  - Old: develop a null hypothesis about a relationship, then test the hypothesis (that is, try to falsify it) using statistical significance based on something called the P value.
  - New: identify a relationship, measure its magnitude, state the uncertainty in the true value using confidence limits, then make a conclusion about its clinical or practical importance in the population.
- Sample size is a big issue.
  - The smaller the sample, the more the uncertainty.
  - A stronger relationship needs less certainty.
  - So a stronger relationship needs a smaller sample.
  - Unfortunately most relationships are weak or trivial, so you usually need large samples.

Mode of Enquiry: observational or interventionist?

- In an observational study…
  - The aim is to gather data or information about the world as it is.
  - So you hope the act of studying doesn't substantially modify the thing you are interested in.
- In an interventionist study…
  - You do something to the world and see what happens.
  - You gather data or information almost always before and after the intervention, then look for changes.

- The following comments refer to observational and interventionist studies with samples.
- The estimate of the magnitude of a relationship is less likely to be biased (that is, not the same as in a population) if…
  - the sample is selected randomly from the population, and…
  - you have a high compliance (low proportion of dropouts).
- An observational study of a sample…
  - usually establishes only an association between variables rather than a causal relationship;
  - needs hundreds or even thousands of subjects for accurate estimation of trivial or small effects.

- Types of observational study with a sample, weak to strong:
  - Case series, e.g. 20 gold medallists.
  - Cross-sectional (correlational), e.g. a sample of 1000 athletes.
  - Case-control (retrospective), e.g. 200 Olympians and 800 non-Olympians.
  - Cohort (prospective or longitudinal), e.g. measure characteristics of 1000 athletes then determine incidence of Olympic medals after 10 years.
- In an intervention with a sample…
  - You can establish causality: X really does affect Y.
  - You may need only scores of subjects for accurate generalization about trivial or small effects.
  - The outcome is the effect of a treatment on the average subject.
  - Researchers usually neglect the important question of individual responses to the treatment.

- Types of intervention with a sample, weak to strong:
  - No control group (time series), e.g. measure performance in 10 athletes before and after a training intervention.
  - Crossover, e.g. give 5 athletes a drug and another 5 athletes a placebo, measure performance; wait a while to wash out the treatments, then cross over the treatments and measure again.
    - Ethically good, because all subjects get all treatments.
    - But can't use if the effect of the treatment takes too long to wash out.
    - Each subject can receive more than two treatments.
  - Controlled trial, e.g. measure performance of 20 athletes before and after a drug and another 20 before and after a placebo.
    - You need up to 4x as many subjects as in a crossover.

- In interventions, bias is less likely if…
  - Subjects are randomly assigned to treatments.
  - Assignment is balanced in respect of any characteristics that might affect the outcome.
    - In other words, you want treatment groups to be **similar**.
  - Subjects and researchers are blind to the identity of the active and control (placebo) treatments.
    - **Single blind** = subjects don't know which is which.
    - **Double blind** = the researchers administering the treatments and doing the measurements and analysis don't know either.

Methods: quantitative or qualitative?

quantitative — qualitative

- With quantitative methods…
  - You gather data with an instrument, such as a stopwatch, a blood test, a video analysis package, or a structured questionnaire.
  - You derive measures or variables from the data, then investigate relationships among the variables.
    - Some people think you have to do it by **testing hypotheses**.
  - Error of measurement is an important issue.
    - Almost all measures have **noise** or other errors.
    - Errors affect the **relationship** between measures.
    - You attend to errors via **validity** and **reliability**.
    - A **pilot study** to investigate error can be valuable.

- With qualitative methods…
  - You gather information or themes from texts, conversations or loosely structured interviews, then tell a coherent story.
    - **Software** such as NVivo can help.
  - The open-ended nature of these methods allows for more flexibility and serendipity in identifying factors and practical strategies than the formal structured quantitative approach.
    - The direction of the research may change mid-stream.
  - Formal procedures enhance trustworthiness of the information.
    - **Triangulation**–aim for congruence of info from various sources.
    - **Member checking** or **respondent validation**–the subjects check the researcher's analysis.
    - **Peer debriefing**–colleagues or experts check the analysis.
- Hybrid or mixed method: analyze a sample of cases qualitatively, then code information into values of variables to make inferences about a population quantitatively.

Ideology: objective or subjective?

objective — subjective

positivist — post-structuralist — interpretivist

- Others refer to this dimension as paradigmatic or philosophical.
  - A paradigm sometimes has religious status for its adherents: thou shalt not question it!
- Positivist or objective
  - We make and share observations, identify problems and solve them without disagreement about the nature of meaning or reality.
  - This so-called dominant paradigm is responsible for our current understanding of life, the Universe, and almost everything.

- Post-structuralist
  - The researcher views people as subjects of discourses (interrelated systems of unstable social meanings).
  - Although the subjectivity of research is emphasized, the researchers attempt to achieve objectivity. Do they succeed?
  - Many people find post-structuralist papers hard to understand.
    - Alan Sokal, a physicist, wrote a nonsensical paper–*Transgressing the Boundaries: Toward a Transformative Hermeneutics of Quantum Gravity*–and got it accepted by the journal Social Text.
- Interpretivist
  - Part of the truth of a situation can be found in the researcher's interpretation of the self-understandings of participants.
  - Truth is discovered partly by thought as well as by observation.
  - Grounded theory of social science is interpretivist: truth emerges from your observations; you do not test a hypothesis.

Politics: neutral or partisan?

neutral — partisan

- Most researchers aim to be politically neutral or impartial by presenting all sides of an argument.
- Sometimes the researcher is overtly partisan or adversarial.
  - In social science such research is known as critical or radical.
    - The researcher attempts to raise understanding about **oppression** and to facilitate **collective action** against it.
    - Some commentators regard critical research as a specific paradigm in social science, but…
  - In my experience even biomedical researchers sometimes adopt an overtly partisan or adversarial stance on an issue.
    - Or there are often **hidden agendas** and **biased reporting**.
    - Maybe that's OK, because their stance **stimulates debate**.

Utility: pure or applied?

pure — applied

- In pure, basic, theoretical or academic projects, the aim is to understand the cause or mechanism of a phenomenon.
- Applied or practical projects impact directly on health, wealth, or culture (art, recreation…), or on development of a method.
- Even so, try to include mechanisms in an applied project.
  - It will help you publish in a high-impact journal, because their editors and reviewers can be snooty about pure research.
  - Understanding something may give you ideas for more projects.
  - A mechanism variable in an unblinded intervention can help exclude the possibility of a placebo effect.
- Pure is sometimes lab-based, lacking naturalness.
- Applied is sometimes field-based, lacking control.

Reassembling the Dimensions

- A given research project is a point in multidimensional space.
- Some regions of this space are popular:

biophysical	topic	psychosocial
sample	scope	case
quantitative	method	qualitative
interventionist	mode	observational
objective	ideology	subjective
neutral	politics	partisan

These often go together as quantitative research.

These often go together as qualitative research.

- This pigeonholing doesn't apply to the novelty, technology and utility dimensions.

- Some regions are less popular, but worth visiting. For example:
  - Action research is a subjective intervention with a case or sample.
    - Dealing with the **problems of everyday life** is an informal kind of action research.
  - Some researchers identify the extreme subjects in a quantitative survey, then interview them subjectively/qualitatively as cases.
  - Others do a qualitative pilot study of a few cases to identify a problem and the appropriate measures for a larger quantitative study of a sample.
- A project based in an unusual region may give new insights…
  - But you may struggle to publish in journals devoted to more popular regions.
- Researchers who mix qualitative methods (such as intensive interviews) with studying a sample (for generalizing to a population) can run into a sample-size problem, as follows...

- Qualitative methods applied to a sample often result in a small sample size because…
  - subjects are **hard to get**, or…
  - the interviews are **too time consuming**, or…
  - the researchers **dislike** the idea of **large samples**.
- But a study with a small sample can adequately characterize only strong associations (large effects) in a population.
- So these small-scale qualitative studies are not definitive for a small or trivial effect.
- Furthermore, open-ended inquiry is equivalent to assaying many variables, so there is a high risk of finding a spurious association.
- If the sample is small, the spurious association will be strong.
- Therefore small-scale qualitative studies are not definitive even for a moderate or large effect.
- Bottom line: when using qualitative methods to generalize to a population, you need a large sample to characterize small effects.

In Conclusion…

- A given research project can be characterized by topic, novelty, technology, scope, mode, methods, ideology, politics and utility.
- This dimensional view may help you sort out a good approach to a specific project, but…
  - I may have missed or mangled some dimensions.
  - There may be better ways to understand research.
- Your work needs to be credible to some people and preferably also published if it's to have any impact.

This presentation is updated from a paper at:

SPORTSCIENCE sportsci.org

A Peer-Reviewed Site for Sport Research

Hopkins WG (2002). Dimensions of research. Sportscience 6, sportsci.org/2002