Research Seminar:

Introduction to Empirical Science

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Why Empirical Science?

- Empiricism makes it possible to rigorously develop and test theories and concepts and to gain insights on emerging management practices within industries.
- It follows the scientific method, in which salient constructs are first identified and clearly defined, hypotheses about interrelationships among the constructs are formed, and then these hypotheses are tested.
- Empirical research is the systematic process of deriving and analyzing data from direct or indirect observation.

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On Being a Scientist: Responsible Conduct in Research

The scientific enterprise is built on a foundation of trust. Society trusts that scientific research results are an honest and accurate reflection of a researcher's work. Researchers equally trust that their colleagues have gathered data carefully, have used appropriate analytic and statistical techniques, have reported their results accurately, and have treated the work of other researchers with respect. When this trust is misplaced and the professional standards of science are violated, researchers are not just personally affronted—they feel that the base of their profession has been undermined. This would impact the relationship between science and society.

POLYWATER AND THE ROLE OF SKEPTICISM

The case of polywater demonstrates how the desire to believe in a new phenomenon can sometimes overpower the demand for solid, well-controlled evidence. In 1966 the Soviet scientist Boris Valdimirovich Derjaguin lectured in England on a new form of water that he claimed had been discovered by another Soviet scientist, N. N. Fedyakin. Formed by heating water and letting it condense in quartz capillaries, this "anomalous water," as it was originally called, had a density higher than normal water, a viscosity 15 times that of normal water, a boiling point higher than 100 degrees Centigrade, and a freezing point lower than zero degrees.

Over the next several years, hundreds of papers appeared in the scientific literature describing the properties of what soon came to be known as polywater. Theorists developed models, supported by some experimental measurements, in which strong hydrogen bonds were causing water to polymerize. Some even warned that if polywater escaped from the laboratory, it could autocatalytically polymerize all of the world's water.

Then the case for polywater began to crumble. Because polywater could only be formed in minuscule capillaries, very little was available for analysis. When small samples were analyzed, polywater proved to be contaminated with a variety of other substances, from silicon to phospholipids. Electron microscopy revealed that polywater actually consisted of finely divided particulate matter suspended in ordinary water.

Gradually, the scientists who had described the properties of polywater admitted that it did not exist. They had been misled by poorly controlled experiments and problems with experimental procedures. As the problems were resolved and experiments gained better controls, evidence for the existence of polywater disappeared.

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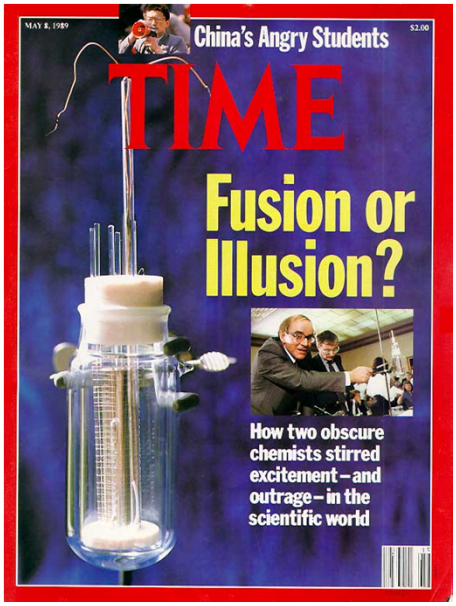

6 Reasons Why a Little Glass of Wine Each Day May Do You Good

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From *Health* magazine

The list of wine's benefits is long—and getting more surprising all the time. Already well-known as heart healthy, wine in moderation might help you lose weight, reduce forgetfulness, boost your immunity, and help prevent bone loss.

With America likely to edge out France and Italy in total wine consumption in the near future, according to one analyst, and with women buying more than 6 out of every 10 bottles sold in this country, we're happy to report that wine may do all of the following:

1. Feed your head
Wine could preserve your memory. When researchers gave memory quizzes to women in their 70s, those who drank one drink or more every day scored much better than those who drank less or not at all. Wine helps prevent clots and reduce blood vessel inflammation, both of which have been linked to cognitive decline and heart disease, explains Tedd Goldfinger, DO, of the University of Arizona School of Medicine. Alcohol also seems to raise HDL, the so-called good cholesterol, which helps unclog your arteries.

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University Suspects Fraud by a Researcher Who Studied Red Wine

By NICHOLAS WADE
Published: January 11, 2012

A charge of widespread scientific fraud, involving 26 articles published in 11 journals, was leveled by the University of Connecticut today against Dipak K. Das, one of its researchers, whose work reported health benefits in red wine.

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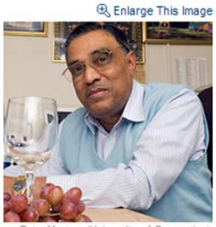

Peter Morenus/University of Connecticut, via Associated Press

Dipak K. Das in 2006. Fraud allegations against him, if verified, seem unlikely to affect the field of resveratrol research itself, because his work was peripheral to its central principles.

Many of the articles reported positive effects from resveratrol, an ingredient of red wine thought to promote longevity in laboratory animals.

The charges, if verified, seem unlikely to affect the field of resveratrol research itself, because Dr. Das's work was peripheral to its central principles, several of which are in contention. "Today I had to look up who he is. His papers are mostly in specialty journals," said David Sinclair, a leading resveratrol expert at the Harvard Medical School.

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The significance of the case seems more to reflect on the general system of apportioning research money. Researchers complain that federal grants are increasingly hard to get, even for high-quality research, yet money seemed to have flowed freely to Dr. Das, who was generating research of low visibility and apparently low quality. The University of Connecticut said Wednesday that it was returning two new grants to Dr. Das, worth a total of $890,000, to the federal government.

The agency that granted the funds was the National Heart, Lung and Blood Institute. Renate Myles, a spokeswoman, said in response that scientific misconduct "can go undetected for a length of time even under the most rigorous systems of research oversight and review."

The investigation of Dr. Das's work began in January 2009, two weeks after the university received an anonymous allegation about research irregularities in his laboratory. A special review board headed by Dr. Kent Morest of the University of Connecticut has now produced a 60,000-page report, which has been forwarded to the Office of Research Integrity, a federal agency that investigates fraud by researchers who receive government grants.

According to a 60-page summary of the report, Dr. Das's published research articles were found to contain 145 instances of fabrication and falsification of data. Many involved cutting and pasting photographic images from a type of research record known as a western blot. Because western blots have often been subject to manipulations in the past, many journals require that the images not be altered in any way without an explicit description of the procedure.

Responsible Conduct in Research

Research is based on the same ethical values that apply in everyday life, including honesty, fairness, objectivity, openness, trustworthiness, and respect for others.

A "scientific standard" refers to the application of these values in the context of research. Examples are openness in sharing research materials, fairness in reviewing grant proposals, respect for one's colleagues and students, and honesty in reporting research results.

THE TREATMENT OF DATA

In order to conduct research responsibly, graduate students need to understand how to treat data correctly. In 2002, the editors of the *Journal of Cell Biology* began to test the images in all accepted manuscripts to see if they had been altered in ways that violated the journal's guidelines. About a quarter of the papers had images that showed evidence of inappropriate manipulation. The editors requested the original data for these papers, compared the original data with the submitted images, and required that figures be remade to accord with the guidelines. In about 1 percent of the papers, the editors found evidence for what they termed "fraudulent manipulation" that affected conclusions drawn in the paper, resulting in the papers' rejection.

MISTAKES AND NEGLIGENCE

All scientific research is susceptible to error. At the frontiers of knowledge, experimental techniques often are pushed to the limit, the signal can be difficult to separate from the noise, and even the question to be answered may not be well defined. In such an uncertain and fluid situation, identifying reliable data in a mass of confusing and sometimes contradictory observations can be extremely difficult.

Furthermore, researchers sometimes have to take risks to explore an innovative idea or observation. They may have to rely on a theoretical or experimental technique that is not fully developed, or they may have to extend a conjecture into new realms. Such risk taking does not excuse sloppy research, but it should not be condemned as misguided.

RESEARCH MISCONDUCT

Some research behaviors are so at odds with the core principles of science that they are treated very harshly by the scientific community and by institutions that oversee research. Anyone who engages in these behaviors is putting his or her scientific career at risk and is threatening the overall reputation of science and the health and welfare of the intended beneficiaries of research.

Collectively these actions have come to be known as scientific misconduct. A statement developed by the U.S. Office of Science and Technology Policy, which has been adopted by most research-funding agencies, defines misconduct as "fabrication, falsification, or plagiarism in proposing, performing, or reviewing research, or in reporting research results." According to the statement, the three elements of misconduct are defined as follows:

HUMAN PARTICIPANTS AND ANIMAL SUBJECTS IN RESEARCH

Any scientist who conducts research with human participants needs to protect the interest of research subjects by complying with federal, state, and local regulations and with relevant codes established by professional groups. These provisions are designed to ensure that risks to human participants are minimized; that risks are reasonable given the expected benefits; that the participants or their authorized representatives provide informed consent; that the investigator has informed participants of key elements of the study protocol; and that the privacy of participants and the confidentiality of data are maintained.

AUTHORSHIP AND THE ALLOCATION OF CREDIT

When a paper is published, the list of authors indicates who has contributed to the work. Apportioning credit for work done as a team can be difficult, but the peer recognition generated by authorship is important in a scientific career and needs to be allocated appropriately.

Authorship conventions may differ greatly among disciplines and among research groups. In some disciplines the group leader's name is always last, while in others it is always first. In some scientific fields, research supervisors' names rarely appear on papers, while in others the head of a research group is an author on almost every paper associated with the group. Some research groups and journals simply list authors alphabetically.

THE RESEARCHER IN SOCIETY

The standards of science extend beyond responsibilities that are internal to the scientific community. Researchers also have a responsibility to reflect on how their work and the knowledge they are generating might be used in the broader society.

Researchers assume different roles in public discussions of the potential uses of new knowledge. They often provide expert opinion or advice to government agencies, educational institutions, private companies, or other organizations. They can contribute to broad-based assessments of the benefits or risks of new knowledge and new technologies. They frequently educate students, policymakers, or members of the public about scientific or policy issues. They can lobby their elected representatives or participate in political rallies or protests.

Next several slides are adapted from an earlier presentation by

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Guidelines for Conducting Empirical Research

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Join a scholarly conversation

- Which specific conversation do I wish to join?
- What is the current status of that conversation?
- Who are the principal members of that conversation?
- What are the assumptions underlying this conversation?
- How can I make a contribution (add ONE new element)?

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Join a scholarly conversation II

What "end" do you have in mind for your scholarship?

Try to get others interested in "my voice"
- I studied the relationship between X and Y
- No one has every put X, Y and Z together into one framework before
- I have collected the most complete data set on this subject

Join established conversations with scholars
- Change the minds of the experts on this subject
- Alter current conceptions / conclusions

Join established conversations with practitioners
- Understand their toughest problems
- Enhance their insights and competencies

Making a contribution

Step 1: Identify a conversation
- Study the history of the conversation ("Life cycle" of the arguments)
- Select 3-5 exemplary articles (Visualize the conversation)

Step 2: Analyze the conversation
- What are the key elements? (Explanations, assumptions, etc.)
- What's missing, wrong, incomplete, etc.? (Fix or enhance)
- Why does this warrant attention? (Consequences of inattention)

Step 3: Propose your contribution
- What is your proposal? (Focus on ONE important, specific modification)
- How is it different? (Before and after comparisons / arguments)
- If accepted, what difference would it make? (Altered research practice / questions)

The Basic Skills

- Content
  - Theory
  - Research design
  - Implications
- Presentation
  - Writing skills
  - Paper Structure

What makes a GREAT paper?

Manuscript Structure I

- Background
  - Overview of ideas/problem to be considered
- Literature review
  - Description of the relevant basic theories/ theoretical arguments
- Hypotheses/Propositions
  - Relationships to be tested
- Research Methods
  - Means of testing the proposed relationships

Manuscript Structure II

- Results
  - Presentation of the evidence produced by the methods
- Discussion
  - Arguments as to what the evidence means *plus* refutation of possible counterarguments *plus* plausible explanations for contrary evidence
- Conclusions
  - Reference back to the basic theory, implications, and a comment on the larger territory of which the article is a part

- ***Plus*** limitations and directions for future research
- ***Plus*** managerial implications

Introduction

- Is there a clear research question?
- Why is the research question interesting? Why is it important? Is there a solid motivation behind it?
- By the end of the introduction, is the reader 'hooked' into reading further? Has the 'hook' been clearly identified?

Theory

- Is there a well-developed and well-articulated theoretical framework?
- Are the core concepts clearly defined?
- How does the theory provide conceptual insight into the problem?
- How does it guide proposition/hypothesis formulation? Is the logic behind these persuasive? Do they logically flow from the theory?
- Does it cover the existing literature appropriately?

Hypotheses

- Do the hypotheses capture the richness of the theory
- Is the logic behind these persuasive? Do they logically flow from the theory?
- Are the hypotheses clearly differentiated from those which would be derived using other theories?
- Are the boundary conditions (i.e. limits) of the theory tested or are contingencies considered?

Research Methods

- Is the method chosen (qualitative/quantitative) and the analytical techniques appropriate for the theory and research question(s)?
- Is the data collection method consistent with the analytical technique(s) applied? Have they been clearly presented?
- Are the sample and the variables appropriate for the hypotheses?

Results

- Are the results reported in an understandable way?
- Are there alternative explanations for the results, and if so, are these adequately controlled for in the analyses?
- Is there a reasonable attempt to provide plausible explanations for counter-intuitive results?

Discussion

- What are the implications of the theory/results/overall study? In what way is it 'surprising? In what way does it build upon, add to and make a value-added contribution to existing work?
- How does it stimulate thought or debate?
- What are the implications for managers?

The Importance of Conclusion

- Have a strong concluding section
  - Discuss implications of the findings
    - How data/paper adds to/modifies original theory
  - Fully develop the theoretical contribution and point out the novelty/new understanding
    - How data/paper adds to the developing knowledge base within field
  - But be congruent with the rest of the manuscript

Summary

The what/how/why/when/where/who questions
- What---The constructs of interest
- How---The relationships between the constructs
- Why---Explanations of these relationships
- When/where/who---The boundary conditions

What's new?
- Does the paper make a significant, value-added contribution

So what?
- e.g., are solutions proposed for remedying alleged deficiencies in current theories?

Summary

- Why so?
  - Is the underlying logic and supporting evidence compelling?
- Well done?
  - Does the paper reflect ‘seasoned’ thinking?
- Done well?
  - Well-written? Flows well? Enjoyable read? Easily accessible?
- Why now?
- *Who* cares?

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