

NEW HOT PAPERS - 2009

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Kosuke Imai, Gary King, & Elizabeth Stuart talk with *ScienceWatch.com* and answers a few questions about this month's New Hot Paper in the field of Economics & Business.



Article Title: Misunderstandings between experimentalists and observationalists about causal inference

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* Princeton Univ, Dept Polit, Princeton, NJ 08544 USA.

* Princeton Univ, Dept Polit, Princeton, NJ 08544 USA.

* Harvard Univ, Cambridge, MA 02138 USA.

* Johns Hopkins Bloomberg Sch Publ Hlth, Baltimore, MD USA.

SW: Why do you think your paper is highly cited?

The results in our article have the potential to increase the effectiveness of causal inference in research across many fields of science. Most scholars make causal inferences, and all those making causal inferences use either experimental or observational studies. We found that the scholarly fields emphasizing experimental and observational studies have evolved in isolation to some degree, resulting in serious misunderstandings and fallacies about the advantages of each.

In fact, this isolation has paradoxically even led researchers to misunderstand and misuse their own research methods. We show how to avoid these problems for both groups and offer new conceptualizations and statistical methods that improve causal inference in many areas of scientific application.

SW: Does it describe a new discovery, methodology, or synthesis of knowledge?

The common misunderstandings and fallacies we address concern some of the most basic advantages and disadvantages of observational and experimental research designs. Problems include improper use of hypothesis tests for covariate balance between the treated and control groups, and the consequences of using random assignment, blocking before randomization, and matching after treatment assignment to achieve covariate balance. Applied researchers in a wide range of scientific disciplines seem to fall prey to one or more of these fallacies, and as a result make suboptimal design or analysis choices.

To help researchers avoid these problems, we derive a new four-part decomposition of the key estimation errors in making causal inferences. We then show how this decomposition can help scholars from different experimental and observational research traditions better understand each other's inferential problems and attempted solutions

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by thinking about the trade-offs of different study designs.

SW: Would you summarize the significance of your paper in layman's terms?

Our article shows how to make more accurate and reliable causal inferences, a subject fundamental to most scientific research and even to large parts of ordinary life. Whenever you ask "why" or "how," you are asking a question that involves causal inference. Whenever you wonder whether taking a medicine will improve your health, implementing a public policy will improve the life of the citizenry, driving this way or that will get you to work faster, or getting married or divorced will make you happier, you are asking causal questions, requiring causal inferences.

A large part of scientific research is designed to make these inferences with far less uncertainty and likelihood of bias than our qualitative judgments in daily life. Our article reveals inferential fallacies and other problems in the way scientists make causal inferences and offers ways to greatly improve them going forward.

SW: How did you become involved in this research, and were there any problems along the way?

We worked together on an article that developed matching methods for reducing model dependence and improving causal inference in observational data—which, coincidentally, was named a "**Fast-Breaking Paper**" last year by Thomson Reuters *ScienceWatch.com*.

In part of that article, we clarified misunderstandings that observationalists had about experimental work. But when we pushed farther, we were surprised to learn that experimentalists made these same errors in their own work. That insight opened a new vista for making progress on causal inference in both areas of science.

SW: Where do you see your research leading in the future?

We have already written and made publicly available open-source software that implements some of our methods for improving causal inferences ("**MatchIt**: Nonparametric Preprocessing for Parametric Causal Inference,") and applied our methods in a large evaluation of the Mexican universal health care system, as well as in evaluating school-based programs to prevent delinquent behavior. We hope to continue to develop methods and apply them in a variety of areas of social science and public health.

SW: Do you foresee any social or political implications for your research?

Whether denominated in the millions of federal (and other) research dollars that can be saved or the increase in knowledge that can be learned for the same research funding, the new methods and understandings offered in our article, for both experimentalists and observationalists, seem to have much potential across a wide variety of applications.

These methods and research designs, which we've discussed and improved upon, are routinely used in studying numerous social and political questions in public policy, political science, medicine, and public health. The implications of improving these methods in improving public policy and understanding democratic representation are likely to be widespread.

Kosuke Imai
Assistant Professor
Department of Politics
Princeton, NJ, USA

[Web](#)

Gary King
David Florence Professor of Government
and Director, Institute for Quantitative Social Science
Harvard University
Cambridge, MA, USA

[Web](#)

Elizabeth Stuart



Coauthor
Gary King



Coauthor
Elizabeth Stuart

Assistant Professor
Department of Mental Health
Department of Biostatistics
Johns Hopkins Bloomberg School of Public Health
Baltimore, MD, USA

[Web](#)

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