The Agony and Ecstasy of Research

9 March 2009

Research Methods for Empirical Computer Science
CMPSCI 691DD
The Agony and the Ecstasy—
The History and Meaning of the Journal Impact Factor

Presented by

Eugene Garfield
Chairman Emeritus, Thomson ISI
3501 Market Street, Philadelphia PA 19104
Fax: 215-387-1266 - Tel. 215-243-2205
garfield@codex.cis.upenn.edu
www.eugenegarfield.org

at

International Congress on Peer Review And Biomedical Publication
Chicago, September 16, 2005

I had considered as an alternative title for my talk “Citation Sanity and Insanity -- the Obsession and Paranoia of Citations and Impact Factors.” Others might have preferred “Uses and Abuses of Impact Factors.”

Origins of the Impact Factor

I first mentioned the idea of an impact factor in Science magazine in 1955.¹ That paper is considered the primordial reference for the concept of the Science Citation Index. Five years later, we began the experimental Genetics Citation Index project which led to the publication of the 1961 Science Citation Index. In 1955, it did not occur to me that “impact” would one day become so controversial. Like nuclear energy, the impact factor is a mixed blessing. I expected it to be used constructively while recognizing that in the wrong hands it might be abused. Since Current Contents, no less SCI, did not exist, it would have been precocious indeed to contemplate the influence of the nascent impact factor.

In the early 1960s, Irving H. Sher and I created the journal impact factor to help select journals and to correct the imbalance between the primary and review journals.
The bad news

It’s relatively easy
to do research
that isn’t very interesting
“...from 1900-2005, about one half of one percent of cited papers were cited over 200 times. Out of about 38 million source items about half were not cited at all.”

– E. Garfield (2005)
“This is, frankly, science at its worst: more than 70 dense pages of detail-obsessed, overanalyzed measurement for its own sake, and with no hypothesis. It is the kind of thing with which the journals are stuffed, and which nobody ever reads.”
“Our successors will be amazed by the amount of scientific rubbish discussed today — that is, if they have the patience to trawl through the electronic archives of obsolete journals.”

- Sydney Brenner
There is an optimistic reply...

“[S]cience is rarely advanced by what is known in current jargon as a ‘breakthrough,’ rather does our increasing knowledge depend on the activity of thousands of our colleagues throughout the world who add small points to what will eventually become a splendid picture much in the same way the Pointillistes built up their extremely beautiful canvasses.”

— Howard Florey

Source: Apprentice to Genius, p. 229
However...

“Today, however, most observers of science do not accept this view, holding instead that a few scientists contribute out of all proportion to their numbers; that science amounts to two different worlds—one practiced by a large rank-and-file, the other by a tiny elite. A few top scientists...discover vastly more, and publish vastly more, than most other scientists. Half of all scientific papers...are the work of just ten or fifteen percent of all scientists.... Their papers make a bigger splash, being cited much more frequently—twenty, thirty, or forty times more frequently—than average.”

– Robert Kanigel

Source: Apprentice to Genius, p. 230
The good news

The quality of your work isn’t predestined. You can learn to do high-quality research.

But it isn’t easy...

and it is your responsibility
What is hard about learning to do research well?

- Research itself is an intrinsically difficult task
- Many component skills to learn
  Understanding the literature, forming hypotheses, proving theorems, designing experiments, writing papers...
- Very long time-scale on rewards
- Very little training
  - Prior to graduate school
  - In graduate school
- Ultimately, and at many levels...
  *You are responsible for directing your own education*
“It’s complicated explaining how genius or expertise is created and why it’s so rare. But it isn't magic, and it isn't born. It happens because some critical things line up so that a person of good intelligence can put in the sustained, focused effort it takes to achieve extraordinary mastery. These people don’t necessarily have an especially high IQ, but they almost always have very supportive environments, and they almost always have important mentors.

And the one thing they always have is this incredible investment of effort.”

- K. Anders Ericsson

“Our research shows that even the most gifted performers need a minimum of ten years (or 10,000 hours) of intense training before they win international competitions.”

10,000 hours

- Five years of 40-hour weeks of *doing research exclusively*
- Not...
  - Learning the technical literature
  - Building a professional network
  - Email, Web surfing, etc.
- ...and getting
  - High rate of feedback and coaching
  - Practice at those things you’re not good at
- Thoughtful practice is the thing that makes the difference
How to gain experience quickly

• Do it yourself
• Get it reviewed
• Learn from reviews
• See it done well
Do it yourself

• Research is no different than many types of expertise, you get better with practice.
• You particularly need to practice those things you are not good at already.
• Linus Pauling — The way to get good ideas, is to have lots of ideas and throw the bad ones away.
• Bonus — Doing lots of your own research provides new opportunities for interaction (“having your own color”).
Get it reviewed

• It’s the only way to quickly get the feedback necessary to learn

• Not all reviews are equally valuable
  • Depth of comments
  • Expertise of reviewer
  • Level of candor

• You have to seek out reviews

• Bonus — Getting your work reviewed is helps create new interactions
Learn from reviews

• *Listen*, don’t defend

• Read comments with an effort to understand their source, not with an eye to disproving them.

• Treat the comment process as *research*
  • View comments as: “Evidence about what is true”
  • Not as: “A threat to my favored hypothesis”

• Take comments seriously
  • Reviewers are always right...
  • ...but not necessarily in the way that they (or even you) might think they are

• Be a “reflective practitioner” (Schon), not a “reflexive practitioner”
See it done well

• Associate yourself with good researchers
  • Several, if possible, because there are many ways to do good research
  • Only a few, because it is difficult to learn without sustained interaction

• Read papers (though recall Medawar’s view)
  • Read scientific biographies
    • Sometimes “cleaned up” and mythologized
    • …but not always
    • …and in different ways
Scientific biographies