Essays of an Information Scientist, Vol:3, p.103-108, 1977-78 Current Contents, #17, p.5-10, April 25, 1977

CURRENT COMMENTS

Citation Analysis and The Anti-Vivisection Controversy

Number 17, April 25, 1977

Recently I was involuntarily drawn into the anti-vivisection controversy which has been raging at the American Museum of Natural History in New York City--as well as in the pages of many newspapers, magazines, and journals. The reason for my involvement was the use of *Science Citation Index*® data by a reporter to determine the scientific value of an individual's body of research.

The individual is Dr. Lester R. Aronson, Chairman and Curator of the Museum's Department of Animal Behavior since 1956 and Adjunct Professor of Biology at the City University of New York and New York University. His research involves removing glands, nerves, and brain tissue from domestic cats in order to facilitate study of animal sexual behavior.

The intense public interest in this study probably has two causes. First, the study involves cats, one of the most familiar and popular domestic species. Even those who don't own a cat invariably know someone who does. The mere thought that these friendly, furry pets are being blinded, deafened, or killed is enough to incite the anger of many sincere people.

The other factor which arouses the public's interest is sex. If the study were aimed at curing cancer, or fighting some horrible children's disease, or even at finding a cure for the common cold, it would be difficult to arouse the indignation of so many. But apparently there are many people for whom the study of sex in humans--no less in cats--seems frivolous, unnecessary, and perhaps even a bit perverse.

The controversy began about a year ago, when a high school teacher of English named Henry Spira used the Freedom of Information Act to obtain copies of Aronson's grant application to the National Institutes of Health. The application contained much apparently routine detail which, in the hands of anti-vivisectionists, was sensationalized and widely publicized.

Picketers arrived in front of the American Museum of Natural History carrying placards with such messages as "Castrate the Scientists," "Curiosity Kills the Cats," and "Close the Torture Laboratories." Headlines in the

National Enquirer declared, "Cats Are Tortured in Vicious Experiments at Famous N.Y.C. Museum," and the New York publication *Our Town* headlined an article, "Congress Pays for Sex Sadism at Museum." In one article, Spira claims that the experiments are merely "a way of getting government grants in exchange for animals' agony and blood." Demonstrations ensued, and accounts of the furor were carried over the national media. The museum received hate mail and bomb threats, and the lives of the researchers themselves were threatened.

In fact, according to Aronson's grant application, the researchers did intend to blind the cats, deafen them, sever nerves in the penis, cut off their testicles, destroy their sense of smell, and remove parts of their brains. All of these operations were meant to help investigate the sites of action of gonadal hormones, the role of sensory stimuli, and the role of olfaction and limbic structures in the cat's sex behavior.[1]

Aronson points out that his work is valuable because of the similarity of the cat's skull shape and nervous system to that of humans. For example, he has found that making lesions in the cat's amygdala, a part of the brain which has been associated with hypersexuality in humans, does not cause hypersexuality in cats but instead causes them to become less selective in their sexual behavior. A cat so treated may try to mount a stuffed panda or a block of wood the same size as a cat.

In his article, *Science* staff writer Nicholas Wade discusses each of the three contentions of the animal rights groups: that the cats are inhumanely treated, that the experiments are cruel, and that the experiments are unlikely to lead to any significant new knowledge.[2] The first charge Wade finds groundless since it is obvious that the experimenters were using proper, humane laboratory procedures. As for the imputed cruelty, he points out that an experimental psychologist's idea of cruelty may differ greatly from that of a pet-owner. It is in his reply to the third charge--that Aronson's cat experiments can not be expected to contribute new scientific knowledge--that Wade uses evidence based on ISI® 's *Science Citation Index.*

Although Wade is an esteemed and thorough reporter who has done excellent work--such as his report on citation analysis in 1975[3]--in this case his analysis leaves much to be desired. It is unfortunate that Wade did not consult someone familiar with citation-analysis techniques. Would he trust his own judgement to take readings from a mass-spec or an EEG?

As presumable evidence for the lack of scientific merit of Aronson's work, Wade performed his own citation analysis of Aronson's publications. He found that, "Of the 21 articles that Aronson and his colleagues have published on the cat study since 1962, 14 have never been cited in the scientific literature between 1965, when the

Science Citation Index starts, and March 1976. Because of the short citation half-life of scientific papers, it is unlikely that they ever will be cited. The seven other papers have an average 5.6 citations each over the same 11-year period."[2] It is noteworthy that Mr. Wade's assumption that the *Science Citation Index* began in 1965 is incorrect. In fact, the *SCI*® was first published in 1961; however, the first *Science Citation Index Five-Year Cumulation* covers the years 1965-1969.

I have repeatedly stated that a high citation rate probably indicates the importance or at least the utility of a contribution. But I have also repeated that we simply don't know enough about the meaning of infrequent citation. As Aronson and his associate, Madeline L. Cooper, assert in a reply to Wade's article, the *SCI* "can only serve as a valid criterion if its limitations are recognized and it is used properly."[4] Indeed, even when it *is* used properly there are some who question its validity.

In this case, Wade has failed to consider several essential matters. For one thing, he did not consider the possibility that Aronson's work may be "premature." I have often mentioned the problem of identifying "premature science."[5] This phrase is used to describe scientific advances which are ahead of their time; the classic example being the case of Gregor Mendel.

But how can we determine whether one of our contemporaries--in this case Dr. Aronson--is engaged in "premature" research? Approximately 25% of the papers published in scientific journals are never cited at all! For some low-impact journals the percentage is even higher. And Aronson's work is certainly far from uncited. Which among these papers are premature?

I am confident that the number of truly "premature" papers is small--but certainly not zero. But from such circumstantial evidence it is impossible to determine whether in fact Aronson's research is or is not premature.

Moreover, some research is "dormant," having its greatest impact years after its initial publication. Sometimes this is due simply to the small number of people working in a field. Thus, in some branches of mathematics it takes much longer for important work to make its impact than in, say, biochemistry. The same is true in some areas of descriptive biology.

This does not mean that research in biochemistry cannot also be "dormant," although the reason for this often escapes people. While there will be many more citations *from* biochemistry papers than from mathematics papers this year, it is also true that the population of biochemistry papers that can be cited is much larger than that of mathematics papers. The most critical factor in citation impact is the average number of references cited per paper. Since math papers cite 8 papers on average, while biochemistry

papers cite about 20, it is to be expected that biochemistry papers generally have greater impacts than math papers.

Also, the term "field" can be deceiving. Each of us works in what we define as our own scientific "field." Some "fields" are more closely related than others. Maybe Aronson, like Mendel, happened to be working in a field where few others worked. We know that studies of animal behavior have long been artificially separated from studies of human behavior. The acceptance and recognition of ethology as a legitimate field with implications for human behavior is very recent; it is only a few years since Konrad Lorenz received the Nobel Prize. Like researchers in so many other fields, perhaps the animal behaviorists have been working in such tight compartments that they were not apt to cite one another. Maybe Aronson didn't do a good enough job of conveying his ideas to his peers in other "fields."

If Aronson's critics fail to provide convincing evidence, so do his defenders. Ms. Ann Breen, manager of the museum's Department of Development and Public Affairs, has asserted in Aronson's defense that, "The numerous and invariably favorable reports over the years is our best assurance that Dr. Aronson's research is not only important to the Museum's scientific program, but also makes an important contribution to our nation's scientific endeavor."[6] But Ms. Breen does not document the "favorable reports," nor does she explain why Aronson's work might be important to peers but not significant enough to be regularly cited.

In Wade's article, Aronson defends his record by claiming that his work on cats (which takes only about a third of his time, the rest of which is devoted to studies of fish and other animals) may have received relatively few citations because few researchers are doing this type of work. "Most of the research on reproduction is in rats and the rat people are very parochial in that they only read the rat literature and only cite rat studies, so very frequently our papers are not cited," Aronson told Wade.[2]

In his grant application, too, Aronson asserts that some problems in human sexual behavior "can only be investigated by experimentation in animals." However, he says, "The present emphasis and dependence on the physiology of sexual behavior in rodents surely presents a rather specialized and unrepresentative picture as the relatively few reports on cats, dogs, monkeys and other mammals have clearly shown." He further claims that "with the exception of our laboratory, all sex behavior research is conducted on rodents or primates with only occasional papers on other species from various laboratories."[1]

It is interesting that even before the Aronson controversy, Frank A. Beach of the University of California at Berkeley, a well-known experimental psycholo-

gist, was calling attention to the widespread use of rats among experimental psychologists. My colleague Robert K. Merton remarks in a footnote in his book *Sociological Ambivalence*, "As Frank Beach has reported...for a time more than half of American experimental psychologists had focused on one species, the rat, as their experimental organism."[7] This supports Aronson's claim that many experimenters work with only one species--the rat--and confine their interest largely to that species.

If the cat people and the rat people live in two separate worlds, then it would seem that they deserve their respective oblivion. Why would such an apparently illogical separatism exist in sexual studies?

Admittedly, determining the scientific worth of any individual's research by means of citation analysis is at best a tricky business. One must be cognizant not only of the data's implications, but also of its limitations.

First, there is the problem of defining the field in which the researcher works. The definition of fields is a fundamental problem for information scientists. But classification is our business. In order to define the field in which Aronson works I would first examine the papers that he cites. I would then examine the other papers that cited these papers as well as those that cited Aronson's work. From this I could develop clusters of papers that would define the field.

Once the field was defined, I could readily determine who in it had the greatest impact--and could test this tentative finding by asking workers in the field to name the most important workers. Judging from previous work of this kind, such informal peer review would confirm the results of the citation study.

In order to check Aronson's claim of species discrimination, I would construct similar citation clusters for other species, and then look for points of cross-over. If I found evidence of species discrimination, I would want to know if it is peculiar to Aronson or if it affects all those in this field. This mapping exercise would reveal whether he has truly been a lone wolf. Even if not, we would then have a sound basis for comparing the citation impacts within the field.

In a letter to *Science*,[8] B.D. Sachs of the University of Connecticut adds an ironic footnote to the controversy. "Ten years ago," he asserts, "*Science* rejected, without review, a report by Aronson and Cooper because the editor felt that the sex research on cats, as described in that report, would offend the sensibilities of some *Science* readers, including anti-vivisectionists. Ultimately, *Science* had the report reviewed and published a modified version (8 Apr. 1966, p. 226) with no adverse repercussions." *Science*'s publication of this letter without rebuttal by its editors suggests that the episode it describes actually occur-

red. If so, it is a sad commentary on the editorial practices of *Science*--at least in 1966. Surely it is ironic that a report rejected as "offensive" should a decade later become the subject of an investigative article in the journal which rejected the original report.

In their letter to *Science*,[4] Aronson and Cooper offer their own reply to Wade's citation study. "Of the 21 publications to which Wade refers," they write, "the seven full reports, each representing 3 to 5 years of continuous experimental observation, have all been cited except for one which was published in Moscow. In addition, two doctoral dissertations by former students have been cited as such, and later as journal publications. The remaining 14 publications were abstracts of reports given at scientific meetings while the work was in progress, and even a goodly number of these have been cited."

This whole unfortunate episode has caused me to reflect on some of the criticism levelled at the misuse of citation analysis, both by myself and others. I have written a general review of these criticisms which I hope will be accepted for publication in a journal of wide circulation, since it is addressed mainly to those who use citation analysis only occasionally. Perhaps that article will be reprinted in this space in the future. In addition, we plan to carry out and publish in this space the type of citation analysis of Aronson's studies outlined here.

It is increasingly clear to me that citation analysis, like any other scientific advance--whether nuclear physics, the laser, or recombinant DNA--has the potential for harm as well as for benefit. As always, the results depend upon the way the new tool is used.

1. **Aronson L R.** Behavioral effects of selected denervation. (Grant application to US Department of Health, Education and Welfare, Public Health Service) 2 January 1974.
2. **Wade N.** Animal rights: NIH cat sex study brings grief to New York museum. *Science* 194(4261):162-7, 8 October 1976.
3. **Wade N.** Citation analysis: a new tool for science administrators. *Science* 188(4187):429-32, 2 May 1975.
4. **Aronson L R & Cooper M L.** Animal welfare and scientific research. *Science* 194(4267):784-5, 19 November 1976.
5. **Lederberg J & Zuckerman H.** Discontinuities in science; the case of bacterial recombination. *Daedalus* 1977 (in press).
6. **Anonymous.** Animal rights groups demonstrate against cat research. *National Society for Medical Research Bulletin* 27:1-2, September 1976.
7. **Merton R K.** *Sociological ambivalence and other essays.* New York, The Free Press, 1976.
8. **Sachs B D.** Animal welfare and scientific research. *Science* 194(4267):786, 19 November 1976.