
Financial Interests of Authors in Scientific Journals: A Pilot Study of 14 Publications

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ABSTRACT: *Disclosure of financial interests in scientific research is the centerpiece of the new conflict of interest regulations issued by the U.S. Public Health Service and the National Science Foundation that became effective October 1, 1995. Several scientific journals have also established financial disclosure requirements for contributors.*

This paper measures the frequency of selected financial interests held among authors of certain types of scientific publications and assesses disclosure practices of authors. We examined 1105 university authors (first and last cited) from Massachusetts institutions whose 789 articles, published in 1992, appeared in 14 scientific and medical journals.

Authors are said to "possess a financial interest" if they are listed as inventors in a patent or patent application closely related to their published work; serve on a scientific advisory board of a biotechnology company; or are officers, directors, or major shareholders (beneficial owner of 10% or more of stock issued) in a firm that has commercial interests related to their research. Applying the criteria to the reference population of journals and Massachusetts academic authors, we measured the following frequencies for lead authors: .20 for serving on a scientific advisory board; .07 for being an officer, director, or major shareholder in a biotechnology firm; and .22 for being listed as an inventor in a related patent or patent application. The joint frequency of articles in the journals reviewed with a lead author that meets one of the three conditions is .34. Implications of these results for the new conflict of interest guidelines and disclosure policies are discussed.

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INTRODUCTION

There was a time some decades ago when it would have been problematic for an academic scientist in most fields to acknowledge publicly a relationship with private industry. So it would have surprised—if not shocked—most attendees at the 1951 annual meeting of the American Association for the Advancement of Science if they had wandered into its Section on Industrial Science and heard a vice-president of Georgia Tech predict:¹

We may envision the time when industry and education are so closely related and so interwoven that it may be difficult to tell whether an individual is a worker in industry, or a faculty member in college, or whether he is a teacher or a student, and as a matter of sober fact, he may be all four over a year's time.

Considerable evidence exists that attitudes among academic scientists toward private industry have changed, particularly for those in the biological and biomedical sciences. Two 1986 reports^{2,3} found that in the United States, university-industry research relations had become increasingly important to both parties. Almost half of the biotechnology firms surveyed had such relationships,³ and their financial support "may account for 16 to 24% of all external support for university research in biotechnology".² Other studies also suggested that a sizable number of faculty members working in the life sciences at leading universities are involved in the commercialization of biotechnology.⁴

The Human Genome Project has generated an unusually large number of collaborations between academic scientists at universities or publicly funded research institutes and newly created biotechnology companies. Many leading scientists searching for genes linked to human diseases have been identified publicly as being associated with biotechnology and biopharmaceutical companies seeking to commercialize such technology.⁵

Since the U.S. Congress in 1980 passed the Bayh-Dole Act (Public Law 96-517) that gives educational institutions ownership of inventions created with federal grant funds, an increasing number of universities and colleges have been actively engaged in patenting and licensing such inventions. In fiscal year 1993, royalty revenues for the top 10 universities or state college systems amounted to \$170 million, and faculty scientist-inventors shared a varying percentage of those royalties.⁶ As U.S. researchers compete for decreasing levels of Federal research support and as major universities themselves create start-up biotech companies or engage in joint ventures with existing companies, the incentives for further academic-industry relationships increase.

While there are many positive benefits (*e.g.*, financial, scientific, educational, and societal) in academic-industry relationships, particularly in biotechnology and biopharmacology, some observers have begun to see potential hazards that must also be considered.

Blumenthal⁷ suggests that to the extent that academic-industry relationships or

individual university investigators' financial relationships are perceived as influencing the conduct and publication of research, "observers will cease to see universities as sources of impartial, disinterested knowledge that deserve public support and the freedom to use that support as they see fit." Similar concerns have been expressed regarding European, especially British, universities.⁸ Djerassi⁹ says that this involvement is of "a magnitude that invites instant suspicion and criticism."

Concerns over the potential for conflict of interest (defined as "situations in which financial or personal considerations may compromise, or have the appearance of compromising, an investigator's professional judgment in conducting or reporting research") (p.491)¹⁰ in science were heightened in the 1980s in response to the rapid commercialization of molecular biology and the overall growth of academic entrepreneurship.¹¹⁻¹⁴ University scientists and their institutions took on expanded roles in commercializing discoveries.¹⁵⁻¹⁹ Many professional organizations and journals have given voice to these concerns.²⁰⁻²⁷ In the aftermath of a series of Congressional hearings, scientific journals, universities, and most recently federal agencies responsible for funding have issued guidelines for disclosure of possible conflicts of interest.²⁸⁻³¹

Three important areas where disclosure has been discussed are federal grant proposals, articles submitted to journals for publication, and peer review.^{13,23,32-36} The most far-reaching regulations for preventing and managing financial conflicts of interest in federally sponsored research were issued by the Public Health Service (PHS) in July 1995.³⁰ These regulations apply to all research funded by the PHS, including the National Institutes of Health. Under these new rules, universities are required to establish review procedures to evaluate whether the mandatory disclosure of financial interests by a candidate for a grant constitutes a conflict of interest, and if so what steps should be taken.

These regulations define a "significant financial interest" as "anything of monetary value, including but not limited to, salary or other payments for services (e.g., consulting fees or honoraria); equity interests (e.g., stocks, stock options or other ownership interests); and intellectual property rights (e.g., patents, copyrights and royalties from such rights)." Investigators need to disclose only those significant financial interests that "reasonably appear to be affected by the research proposed for funding by the [Public Health Service] including the investigator's financial interest in entities whose interest would be affected."³⁰ A series of exemptions are also provided, including equity or salary interests that do not exceed \$10,000 in value or a 5 percent ownership interest in any single entity.³⁰ The National Science Foundation has a similar policy^{31,37} whereas the Food and Drug Administration has proposed a different approach.³⁸

Several journals have developed disclosure policies for contributors in reaction to public concerns over the appearance of bias in their publications.³⁹ The International Committee of Medical Journal Editors (ICMJE) passed a resolution in 1988 that authors should acknowledge any financial relationships that "may pose a conflict of interest",⁴⁰ but the resolution is not obligatory for the twelve journals participating in the organization. A few medical journals, including the *Journal of the American*

Medical Association, The New England Journal of Medicine (NEJM), and The Lancet have established policies that request authors to disclose to the readers any commercial associations they or close family members have that might pose a conflict of interest in connection with a submitted article.^{11,33} Contributors to these journals are expected to disclose consultantships, stock ownership, honoraria and substantial gifts. In 1993, the ICMJE reinforced its previous resolution urging that authors who submit a manuscript, whether an article or a letter, acknowledge all financial support and other financial or personal connections to the work.⁴⁰

This article reports on the results of a pilot study that measures the frequency of one set of verifiable "financial interests" (as defined for this study) in the subject matter of the articles published in 14 scientific journals that are linked to the principal authors of those articles. The objectives of this study were: (i) to select a set of published articles and observe the degree to which a sample of authors hold a financial interest in areas related to their research that are reportable under current standards; and (ii) to examine the hypothesis that significant numbers of authors of articles in life science and biomedical journals have verifiable financial interests that might be important for journal editors and readers to know.

These objectives were applied to a pilot study of Massachusetts academic scientists who were cited as first or last author in at least one article published during 1992 in 14 leading journals of cell and molecular biology and medicine. Massachusetts was chosen for the pilot study because it has significant biomedical activity, it is the home of many new biotechnology start-up companies, and it has strong academic institutions with faculty that are likely to have involvement in the biotechnology industry.

METHODS

To achieve these objectives we first adopted an indicator of "possessing a financial interest," following recent federal policy guidelines, that applies to scientific authors. Second, we constructed a database of every article published in 1992 by 14 leading life science and biomedical journals that had a first or last author whose affiliated institution was located in Massachusetts. Third, we applied the indicator to determine the frequency with which authors and articles satisfied the condition of "possessing a financial interest." Fourth, we examined the articles for any disclosure of financial interest.

Indicator of Possessing a Financial Interest

For this study a scientific author is said to possess a financial interest in his/her published work if he/she meets one of the following conditions: (i) is a member of a scientific advisory board of a company that develops products related to the scientist's expertise; (ii) is listed as an inventor on a patent or patent application for a product or process closely related to the scientist's publication under review; (iii) serves as an officer, director, or major shareholder in a for-profit corporation involved in

commercial activities related to the scientist's field of expertise. This indicator is not meant to exhaust the meanings of "possessing a financial interest." Other possible criteria, which we were unable to check, include personal and familial investment holdings, consultantships, and honoraria.^{30,31} Note that many scientists have consulting relationships with biotechnology firms which are not in the form of membership on scientific advisory boards, but because we did not have data to independently verify these relationships, these financial interests were not included as indicators in this pilot study.

Scientists as Advisers to Companies

We used two data sets: 1) Massachusetts biotechnology firms, including their officers and scientific advisory boards (SABs), and 2) scientists listed as inventors on patents or patent applications registered with the World Intellectual Property Organization (WIPO). The methodology for developing an inventory of SABs for a population of companies was adapted from Krinsky et al.⁴¹

An inventory of Massachusetts biotechnology firms was developed in two stages. First, a comprehensive list of firms was derived from four sources: (i) unpublished data compiled for Krinsky et al.;⁴¹ (ii) the 1994 Massachusetts Biotechnology Council membership list; (iii) The Genetic Engineering News Guide to Biotechnology Companies, 1994;⁴² and (iv) an inventory of Massachusetts biotechnology companies prepared in June 1993 by Lyndon Lien for the Biotechnology Center of Excellence Corporation, Boston, Mass. We found a total of 149 biotechnology companies (*i.e.*, the comprehensive list) with a Massachusetts address derived from the four sources.

Second, a subset of the comprehensive list (*i.e.*, the dedicated list) was compiled by selecting from the comprehensive list those companies that use genetic or cellular techniques to manipulate genes or organisms, that work with genes or proteins, or that use cells to clone genes or reagents. Excluded from the dedicated list were those firms that are primarily instrument manufacturers or that engage in large scale fermentation from source materials provided by another company. The list of dedicated Massachusetts biotechnology companies (DMBC) consists of 84 entries. Scientific advisory boards and company officers were obtained from DMBCs through sources that included corporate annual reports and federally mandated financial disclosure statements of public companies. Corporations that are not required to file periodic reports with the U.S. Securities and Exchange Commission were surveyed by letter and phone. Using this method we compiled a list of 370 different scientists on SABs of Massachusetts firms.

Author Database

To select our study population of journal authors against which to apply our indicator "possessing a financial interest", we chose a base year of 1992 and 14 leading journals in cellular and molecular biology, and medicine. We chose 1992 because it was the most recent year for which complete patent information could be

obtained from the WIPO (the information becomes public 18 months after filing), it coincided with available information on SABs and it was a year that saw considerable commercial activity in biotechnology and a heightened discussion about conflict of interest.

The 14 English-language scientific journals represented a sample of the leading biologically-oriented science and biomedical journals based on the 1992 journal impact factors calculated by the Institute for Scientific Information (ISI).^{*} We sought journals that were publishing articles of potential commercial interest to biotechnology and biopharmaceutical firms, both in the clinical and basic sciences (see Table 1, page 409).

The journals [and their ISI impact factors] represented the **general sciences** (*Nature* [22.139], *Science* [20.967], and *Proceedings of the National Academy of Sciences of the U.S.A.* (PNAS) [10.480]); **biochemistry and molecular biology** (*Cell* [33.617], *EMBO Journal* [12.634], *Journal of Cell Biology* [11.118], *Molecular and Cellular Biology* [8.291], *Journal of Biological Chemistry* [6.733], and *Plant Cell* [6.342]); **genetics and heredity** (*Genes & Development* [14.270] and *American Journal of Human Genetics* [9.076]); and **general and internal medicine** (*New England Journal of Medicine* [24.455] and *Lancet* [15.940]). A new genetics journal, which only began publishing in 1992 and produced only 9 issues that year, *Nature Genetics*, was not rated by ISI but was included on the basis of its subsequent reputation.

From these journals all original articles (10,148) about cellular and molecular biology and genetics were selected. From these we selected a subset on the criteria that either the first or last author was affiliated with a Massachusetts nonprofit academic or research institution (812 articles or 8.0 percent of the original set).

We chose first and last authors to set boundaries on the size of the author database while insuring that it included the significant contributors to the research publications. We assumed that one or both of these two authors would likely have had primary authorship responsibility, as is common practice in the biological sciences for multiple-authored papers. The number of unique Massachusetts-based authors derived from the screening criteria was 1150. The total number of authors on all articles screened is likely 5-6 times larger than that figure of 1150. As expected, many of these authors were listed on multiple papers. In our analysis we deleted from the reference group 45 authors who listed a Massachusetts biotechnology company as their address since that constitutes a disclosure of financial affiliation. This left 1105 authors who gave as their affiliation a nonprofit academic or research institution.

Patent Applications and Patents Issued

One of the objectives of the study was to determine the percentage of authors who were listed as inventors on patent applications, or were issued patents on products or

^{*} The journal impact factor has been defined as "a measure of the frequency with which the 'average article' has been cited in a particular year".⁴³

processes that closely resemble the content of their scientific papers. In this respect, the inventorship status on a patent/patent application meets one of the criteria for having a financial interest. Patent applications filed in the U.S. Patent and Trademark Office in Washington remain confidential until the date they are issued as patents, a process that can take 2-3 years or longer. Thus, at the time of the study, the patent application system in the United States was essentially a secret one, and there were no industry or academic databases containing information on filed U.S. patent applications. Therefore, we chose to review the patent applications of U.S. origin filed under the Patent Cooperation Treaty (PCT), which was signed in 1970 and came into effect in June 1978 under the supervision of the WIPO in Geneva. Under the terms of the treaty, WIPO is required to publish the patent applications it receives exactly 18 months after the date of their submission to the Patent Office. Using the PCT filings, we were able to identify the patent applications of U.S. origin on which authors were listed as inventors, which are otherwise required by U.S. law to be treated as confidential information by the Patent Office.⁴⁴

We matched the list of authors selected from the 14 journals with WIPO-listed patents and patent applications for 1992. The WIPO information was available on PCT Patent Search, a CD-ROM available from MicroPatent in East Haven, Connecticut and Cambridge, England.

We checked every author in the author database against the names of inventors on patent applications and patents listed on PCT Patent Search. Then we screened for those patent applications that listed the relevant author's name as an inventor and whose subject matter was closely related to the author's journal article. All four members of the study team reviewed the match between the subject matter of the patent and the subject matter of the journal article.

One of these reviewers (G.K.), a scientist with extensive experience with university intellectual property and technology transfer, served as the final arbiter of whether the patent application was indeed based on the research article in question. This process relied on the frequent similarity in tables and graphs used in both articles and patent applications, as well as a non-mechanistic visual search for similarity of language in the examples used to describe processes and findings. We reviewed the abstracts of patent applications for a match, and, in certain circumstances, obtained the full text of the applications in order to resolve uncertainties.

Corporate Officers, Directors or Major Shareholders

To identify authors who are officers, directors, or major shareholders of biotechnology companies, we used a database of information on public corporations created by analyzing filings with the U.S. Securities and Exchange Commission (SEC). The database titled Compact D/SEC (1995) is owned by Disclosure, Inc., Bethesda, Maryland, and is updated quarterly from July 1990. About 50 percent of the biotechnology firms in Massachusetts, and the overwhelming majority of biotechnology firms in the United States, are privately held, and therefore are not required to report information to the SEC. For other sources of information on private

companies we used surveys, news reports, and published materials from companies, but this information was very spotty and not very helpful.

RESULTS

From the 1105 journal authors we found that 112 or 10.1 percent were listed as inventors on patents or patent applications on file with the WIPO that correlated with published articles in our study sample. There were 69 authors who were SAB members in Massachusetts biotechnology companies (6.2 percent). There were 15 authors who serve as company officers, directors, or major shareholders (1.4 percent). The frequency with which an author who does not give a firm affiliation is associated with one or more of the three categories of financial interest under study is calculated by the union of the three sets, which have overlapping members. This condition is satisfied by 169 authors, which indicates that 15.3 percent of the author population had at least one financial interest in their published articles (see Table 2, page 410).

We also calculated the frequency that an article selected from the reference population (n=789) has one of its lead authors identified with one or more of the three categories of financial interest. Twenty percent of articles have a lead author on a Massachusetts SAB of a biotechnology company (n=160); seven percent have a lead author who served as an officer or major shareholder in a biotechnology company (n=57); twenty-two percent have a lead author who is listed as an inventor in a patent or patent application closely correlated with a publication in our study sample (n=175). Thirty-four percent of the articles in the study sample (n=789) meet one of the three criteria satisfying the condition of having at least one lead author with a financial interest (n=267).

After reviewing the 267 articles identified as having a lead author (first or last) with at least one financial interest closely related to their publication, we could find no statements of disclosure for any of the three indicators of financial interest linked to a lead author who gave an academic affiliation. There was a disclosure of stock ownership in one article in the *NEJM* but the authors cited were identified as employees of the corporation in which they held stock and were deleted from our analysis.

Patent applications are often filed as an afterthought by universities and nonprofit research centers that own the patent rights and require researchers to disclose their inventions in order that these institutions might benefit from successful technology transfer. The federal and state governments, to the extent that they have research laboratories, are doing exactly the same thing, and the U.S. Congress and state legislatures encourage such activities, public and private, to spur economic development.

DISCUSSION AND LIMITATIONS OF DATA

Scientific advisory board membership and corporate officers/significant shareholders

Our database included active SABs only, but occasionally members do cycle off. Membership information on SABs obtained from company reports and federally mandated documents does not stipulate the dates a person begins or terminates service on the board. Because our SAB data were collected in 1994 for companies founded up until 1992 and because SABs do not change very frequently, we felt it was reasonable to assume that the scientific advisers we identified in 1994 were active in companies that existed in 1992. However, our assumption may not be correct.

Our inventory of SABs was based on Massachusetts companies because we had access to the most complete information on SAB membership in that state. It seems likely that the profile of academic industry ties found in Massachusetts is similar to that of other biotechnology rich states that contain high concentrations of academic researchers such as California, New York, Maryland, New Jersey and perhaps Texas. However, without a national study of financial interests in publications or other state profiles, it is premature to extrapolate these results to other parts of the country. Because many Massachusetts scientists are on the SABs of out-of-state U.S. companies or international biotechnology companies, our data significantly undercount the corporate SAB affiliations of journal authors. Also, three private companies in Massachusetts declined to report their SAB composition.

A national data set of company officers, directors and major shareholders (beneficial owner of 10% or more of stock issued) was used to identify journal authors who have a university affiliation and fall into one of those categories. However, this database only applies to public corporations, which comprise about 50 percent of our Massachusetts firms but a much smaller percentage of all biotechnology companies in the United States. Thus, our sources underestimate the number of academic faculty who are corporate officers, directors or major shareholders. Because the number of such corporate affiliations among academic faculty in our sample is small (n=15) compared to patent/patent application inventors and SAB members, undercounting in this category is unlikely to affect the outcome significantly.

In general, our data underestimate financial interest because we only considered three factors in measuring it. Other circumstances such as personal or family stock holdings and consulting relationships would drive the numbers of authors with financial interests up. In addition we were not able to assess financial interest in privately-held biotechnology companies which are not required to report their data to public agencies. Nor did we have access to data that would identify academic consultants to biotechnology companies who are likely to have more technical interactions with client companies than are scientific advisory board members. Furthermore, we were unable to document scientist-authors who received unexercised stock options from biotechnology companies or who purchased company stock in the open markets. Finally, we had no way of determining whether the companies on whose

SABs any authors in this study were serving intended to exploit commercially the content of the authors' papers. Thus SAB membership, by itself, may not be a useful indicator of financial interest when examining published manuscripts.

Author Selection

It is possible that some authors listed between the first and last are scientists who hold financial interests of the type we were seeking to document. By limiting our analysis to first- and last-named authors, we could have underestimated the presence of such interests for any article's set of authors.

Applications and Patents

Patents or patent applications of U.S. origin but not filed under the PCT would not show up in our data set, and thus patent inventorships among scientists in our study may be underreported.

The degree to which academic scientists are being listed as inventors on patents for biological materials and processes, and becoming eligible for royalties on successfully commercialized products or techniques, introduces an important new source of financial interest among life science and biomedical authors, but this reality must be placed in some context. Under university policies, faculty scientist-inventors themselves receive only a portion (often one-third) of royalty income from patents on their inventions. For most authors, the professional status they receive from publications is far more important than any financial interest they may realize from their research results.

Relevance of Financial Interests to Published Research

Financial interests of some kind may be inescapable to researchers and universities in the late 20th century, and the mere existence of a financial interest in no way establishes a "conflict of interest" or automatically makes questionable the data and conclusions presented. It is the appearance of a potential conflict that the various guidelines mentioned earlier seek to prevent, and the belief that disclosure of such interests to editors, reviewers or readers will eliminate all potential for such a conflict continues to be a hotly debated topic.

Our results understate the actual financial interests held among members of our study sample. No definitive data are available, but observers in the intellectual property field have speculated that in the early 1980s, more patent applications of U.S. origin were filed under the PCT. With greater financial cost now an issue to both universities and companies, these observers speculate that only the "best" and "most commercially promising" applications are now filed under the PCT.

Disclosure Policy

The notions of what constitutes a "financial interest" and what is considered a "disclosable financial interest" have been discussed at the federal and institutional levels. The broadest interpretation includes any activity that might give the appearance of impropriety or bias in the published or proposed research. The Public Health Service regulations³⁰ and those of the National Science Foundation³¹ distinguish between what investigators must *consider* and what they must *disclose*. "The investigator must consider all Significant Financial Interests, but need disclose only those that would reasonably appear to be affected by the research proposed for funding by the PHS...(p. 25812)³⁰. The PHS lists intellectual property rights under "Significant Financial Interest". It excludes income from service on public or non-profit advisory boards, but not for-profit advisory boards, although it is unclear whether the monetary threshold applies to SAB membership.

Interpreted narrowly, a "disclosable financial interest" might be limited to actual dollar payments above a threshold in areas related to the published or proposed research. Under this interpretation, holding a patent that has not generated income or serving on an SAB where the annual compensation is below \$10,000 would not be considered a disclosable interest. We have chosen the broader meaning of "financial interest" but leave it to others to determine whether such interests are disclosable under the prevailing standards.

Of the 14 journals in the study sample, four currently require disclosure of financial or other potential conflicts of interest: *Science*, *NEJM*, *The Lancet* and *PNAS*. However, *The Lancet* introduced its policy in January 1994, two years after our reference year. In 1992, *NEJM* and *Science* (*Science* instituted its policy July 31, 1992) required some form of disclosure.^{21, 45-47} *PNAS*, as of May 1996, requires that all authors "disclose any commercial association that might be a conflict of interest in connection with the manuscript".⁴⁸

Almost all the scientific journals surveyed did not in 1992 and still do not in 1996 require any disclosure to their editors and reviewers of the type of information we have characterized as constituting a financial interest. Since *Science* and *NEJM* carried a relatively small percentage of the articles in the database (6.78 percent), and since the requirement in *Science* only came into effect in mid-1992, the results of our study do not provide a baseline for mandatory disclosure of financial interest.

One article published in *Science* after the July 31, 1992 date that mandatory disclosure took effect had a patent application matching the manuscript without a disclosure statement; however, *Science* does not *require* disclosure of patent inventorship to the editors and we have no way of knowing whether it was disclosed.

It should be noted that we had no mechanism with which to examine whether any of the authors of the articles we examined submitted information regarding financial interests to editors of the journals involved, whether required to do so or not. The mere absence of such disclosure to readers of the printed articles does not indicate whether in fact specific disclosure occurred in any given case.

CONCLUSION

The degree of financial interest found among authors of published articles in this study is noteworthy. Of particular significance is the finding that one in every three articles in our sample has at least one Massachusetts-based author with a financial interest and that fifteen percent of authors in our sample have a financial interest in one of their publications. Moreover, the results provide a minimal estimation of the degree of financial interests held among authors in scientific publications.

Although we found no formal study on the subject, it seems unlikely, however, that the vast majority of researchers realize any significant financial gain from any individual publication. Yet it also seems increasingly evident that the goal of "science for the sake of science", that is research objectively performed for the sake of pure knowledge (if that were ever the reality), is challenged by the perception that someone—the researcher, the institution for whom the researcher works, a biotechnology company with whom the researcher or the institution is affiliated—stands to benefit from the research in a way that could bias the manuscript or its findings. At a time of diminishing research funds and institutional budgets, this is a perceptual problem worthy of consideration.

We can conclude with confidence that for the year 1992 the rate of *published* voluntary disclosures of financial interest (as defined in our study) for 14 leading journals by Massachusetts-based academic scientists (i.e., those who do not give a company affiliation) is virtually zero. Similarly, most life science and biomedical journals do not require that any of these financial interests be disclosed to their editors and reviewers. Further research is needed to determine the effectiveness of mandatory disclosure requirements instituted by several journals, a policy development described by one critic as "the new McCarthyism in science".⁴⁹ The newly established Public Health Service and National Science Foundation guidelines on conflict of interest in research will broaden the scope of mandatory financial disclosure within the grant process, leaving open the issue of financial disclosure in published research. The need for a clearly defined and pragmatic set of guidelines governing the relationships between academic researchers and industry has been persuasively articulated.⁵⁰

It is conceivable that the day may come when financial interests of authors of scientific articles will be so ubiquitous that readers will assume automatically the existence of such interests unless there is a specific disclaimer to the contrary. That approach may represent a less burdensome and intrusive one to some scientists, but it may only heighten the anxiety that the reputed independence and disinterested nature of universities, and the accompanying public support, will suffer in the process.

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TABLES

Table 1. Fourteen Journals Surveyed on Financial Interest of Authors

Journal Title	Total No. of original articles on biology and genetics in 1992	No. of original articles with Massachusetts authors in 1992	Percentage of total	Percentage of database	Disclosure of interests required by journal in 1992
Am. J. Human Genetics	271	11	4.05	1.35	no
Cell	357	51	14.3	6.28	no
EMBO Journal	546	28	5.13	3.45	no
Genes & Development	217	27	12.4	3.32	no
J. Biol. Chemistry	3854	226	5.86	27.83	no
J. Cell Biology	516	42	8.13	5.17	no ^a
The Lancet	46	1	0.02	0.12	no
Molecular and Cell Biology	610	51	8.36	6.28	no
Nature	535	61	11.4	7.51	no
Nature Genetics	120	15	12.5	1.85	no
New England J. Medicine	23	5	21.7	0.62	yes ^b
Plant Cell	117	7	5.98	0.86	no
Proc. Nat'l Acad. Sciences	2454	236	9.62	29.06	no ^c
Science	482	50	10.4	6.16	yes ^d

- ^a *Lancet's* conflict of interest policy, introduced to authors on January 1, 1994, expects authors to list all relevant sources of financial support that could potentially embarrass an author if the grant, business interest, or consultancy became known after publication.
- ^b *The New England Journal of Medicine* first introduced its conflict of interest policy in July 1990. The journal expects that its authors will not have any financial interests in a company or competitor that makes a product discussed in the article.
- ^c *The Proceedings of the National Academy of Sciences*, as of May 1996, requires that all authors "disclose any commercial association that might be a conflict of interest in connection with the manuscript."
- ^d *Science* instituted a policy of requiring authors "to reveal to us any relationship that they believe could be construed as causing a conflict of interest, whether or not the individual believes that is actually so" as of July 31, 1992.

Table 2. Financial Interests and Publications

	A	B	C	A,B or C
REFERENCE CLASS	PATENTS	SABS	CORPORATE OFFICERS	COMBINED (excludes overlapping members)
AUTHORS n=1105	112	69	15	169
PERCENT	10.1	6.2	1.4	15.3
ARTICLES n=789	175	160	57	267
PERCENT	22.2	20.2	7.2	33.8