Conflict of Interest in Industry-Sponsored Research The Impact on Undergraduates Perception of Cognitive Authority

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Undergraduates’ Perceptions of Conflict of Interest in Industry-Sponsored Research

Heather Brodie Perry

abstract: The prevalence of industry-sponsored research has led to significant concerns about financial conflicts of interest and the impact on research findings. This case study sought to examine how students considered conflict of interest when establishing the cognitive authority of a journal article. The case study used a mixed methods pretest and posttest to determine if instruction improved student ability to critically evaluate journal articles. A mixed methods approach investigated the terms undergraduates used to describe the attributes that contributed to the cognitive authority of research articles—that is, how reliable they found the source of the information. The case study showed that students attributed cognitive authority to authors affiliated with prestigious institutions and to articles from academic journals, with strong methodology and statistics. They expressed skepticism of articles that they felt had less methodological rigor and articles that deviated from their own view of the world.

Introduction

In 2016 and 2017, the phenomena of “fake news” challenged librarians to think about how information is presented and the ways users evaluate the information they read. While the term “fake news” is new, the underlying issue is a perennial concern: how do we assist users in becoming more critical consumers of information? This study took place before the advent of “fake news,” but it investigates a problem with a similar ability to undermine our functioning as a democracy, and it calls for greater development of strong critical skills among information consumers.

The prevalence of industry-sponsored research has led to significant concerns about financial conflicts of interest and the impact of such conflicts on research integrity. Recent reports of industry funding and researcher misconduct have brought this issue to the forefront. Partnerships between academia and industry permeate biomedical research,
and many scientific investigators benefit financially from these partnerships, leading to concerns about financial conflict of interest and its implications. Financial relationships between academic scientists and industry can contribute to the advancement of science and form productive research partnerships, but several incidents have undermined confidence in the integrity of the findings reported.

The scientific values of openness and objectivity can clash with the economic interests of industry, but ethical conduct is essential to scientific research. When describing conflict of interest in relation to responsible conduct of research, Adil Shamoo and David Resnick declare, “An individual has a conflict of interest when he or she has personal, financial, professional, or political interests that are likely to undermine his or her ability to meet or fulfill his or her primary professional, ethical or legal obligations.” While the ethical conduct of research can foster collaboration, cooperation, and the advancement of science, academic researchers have both conflict of interest and conflict of commitment to consider when accepting funding for their studies from private entities.

Scientific researchers could have several stakeholders to keep in mind when performing their studies. Conflicts of commitment occur for academic researchers when they have a relationship that conflicts with their responsibility to their home university. Conflict of commitment can include taking time away from students or from university projects to devote to industry research. As many industries look to form partnerships with academia, most institutions have policies to reduce these conflicts, but they vary widely.

Researchers also must consider their duty to the integrity of science. An exhaustive look at research ethics is beyond the scope of this article, but Resnick provides an excellent overview. While a myriad of issues can create the potential for conflict of interest, this study discusses only conflicts related to the funding source. Accepting industry funding does not automatically create a conflict of interest, but the funding source should at least raise a red flag for readers. Disclosure is not a panacea, but it does assist readers in decision-making. The question is, are undergraduates aware of disclosure statements and what they mean?

As people use scientific information for sound decision-making, selecting accurate information is essential. Librarians assist people with accessing and selecting information to satisfy their needs. Information seekers want to select the best resources for their needs. If they encounter flawed information due to corporate influence, they may make poor decisions. The choice of accurate information is particularly essential when selecting information about health care, but it can also be important when making other decisions.
Industry provides the funding for many clinical trials in the United States, giving opportunities for sponsors to influence research in ways that jeopardize objectivity. Because approximately 60 percent of scientific experimentation is funded by industry, the issue of industry sponsorship of research affects many fields of study, including tobacco, pharmaceuticals, energy policy, and nutrition. Conflict of interest disclosure policies aim to prevent and identify biases, but disclosure policies alone are not enough to prevent bias and ensure scientific integrity. This integrity is especially important when the reader is not an expert in the field, capable of making well-informed decisions about the quality of the research, but a student or layperson without the tools to assess research quality.

While the issue of conflict of interest is well understood in the medical and biomedical literature, it has not been studied from the library users’ point of view or in the library and information science (LIS) literature. Few data exist on whether disclosure statements affect readers’ confidence in research, but some studies indicate lower interest and believability for articles with financial disclosure statements. Because conflict of interest in research has far-reaching implications, such as impact on personal and public policy decision-making, further studies of this issue are warranted.

This study looks at whether financial disclosure statements affect an undergraduate student’s perception of research articles as rated on a Likert scale that allows individuals to express how much they agree or disagree with a statement, and as described in open-ended questions. This study also investigates if instruction changes student views of industry-sponsored investigations.

Readers use several strategies to establish the reliability of information. Cognitive authority theory describes how individuals attribute authority to secondhand information—that is, information outside their direct experience. This study explores undergraduate use of cognitive authority theory in determining the authority of scientific research articles.

As undergraduates begin to use scientific literature, they may not have acquired the skills necessary to recognize the potential for bias in scientific studies.

Literature Review
Decision makers of all types rely on scientific information to make sound choices. Physicians, patients, and medical policy makers rely on journal articles as trusted sources of information; however, the influence of corporate funding has undermined the credibility of such literature. Financial conflict of interest in research has become an ongoing concern in biomedical literature, but it is not limited to that field. There is widespread
concern that industry funding has an undue influence on research integrity. The impact on readers or students of financial conflict of interest has not been studied, leaving a significant gap in the literature.

It is important to determine if readers recognize industry-sponsored research, to examine the readers’ impression of sponsored literature, and to investigate if there are mechanisms to assist readers in critically evaluating sponsored experiments. Existing research has focused on biomedical professionals; this study, however, looks at undergraduate students.

**Recognition of Sponsored Literature**

Disclosure policies designed to assist readers in identifying potential for bias in articles may serve as little more than a red flag because many lay readers lack the tools and expertise to evaluate the quality of the research. Since many journals leave the reporting of conflict of interest to the authors and this reporting is done sporadically, disclosure statements are not consistent across the literature. As a result, the responsibility of judging the veracity of findings remains on the reader, who may not recognize a potential financial conflict of interest.

**Impressions of Sponsored Literature**

Most of the studies of reader perception focused on medical professionals. One study found that an industry-sponsored article was less interesting, important, relevant, valid, and believable to readers from the British Medical Association than one without competing interests. The authors described many limitations to their study; one question they wished to explore further was if different types of disclosure statements had different impacts on readers’ perceptions. To answer this question, researchers looked specifically at the readers’ impression of the credibility of research when faced with different types of conflict of interest statements. The second study examined two articles, each with three different variations of disclosure statements. The authors found that a financial disclosure statement reduced the perception of the article’s authority on several measures. They noted weaknesses and suggested that qualitative research might tell why the disclosure statement influenced reader impressions. A study by Aaron Kesselheim, Christopher Robertson, Jessica Myers, Susannah Rose, Victoria Gillet, Kathryn Ross, Robert Glynn, Steven Joffe, and Jerry Avorn analyzed how physicians interpreted conflict of interest statements and found that conflict of interest statements altered their perceptions of an article and made them less likely to believe the findings of a trial. Even when the study had high methodological rigor, Kesselheim and his team found that physicians were skeptical of industry-funded research. Studies by Samena Chaudhry, Sara Schrotter, Richard Smith, and Julie Morris in 2002; by Sara Schrotter, Julie Morris, Samena Chaudhry, Richard Smith, and Helen Barratt in 2004; and by Kesselheim and his team in 2012 looked the attitudes of doctors and other medical professionals.

There have been few published studies, however, of perceptions of conflict of interest among lay readers. One study had potential conflicts of interest itself. It surveyed users of the website SpineUniverse and found that 82 percent of respondents found research funded by medical companies valuable, but 66 percent felt that surgeons should not
research products in which they have a financial interest without regulatory guidelines.\textsuperscript{28} The authors admitted that the study had numerous limitations, most notably that several of the authors were consultants for various companies. They acknowledged that the study could be seen as self-serving in affirming the activity in which the authors engage.\textsuperscript{29} Despite the study’s limitations and possible bias, it was informative about public opinion regarding financial conflict of interest. A study by Charles Fisher, Christian DiPaola, Vanessa Noonan, Christopher Bailey, and Marcel Dvorak did not examine the level of understanding the respondents demonstrated regarding the impact of financial conflict of interest on research.

**Mechanisms to Assist Readers**

Given serious concerns about scientific misconduct and misbehavior, scholars have suggested ethical instruction for scientific researchers to protect the integrity of science.\textsuperscript{30} Whether these programs are effective at increasing ethical behavior is unknown.\textsuperscript{31} A meta-analysis explored 26 of these programs and endeavored to provide a comprehensive evaluation of the effectiveness of ethics instruction programs; overall, the analysis found that the effect was moderate.\textsuperscript{32}

A study by Alison Antes, Stephen Murphy, Ethan Waples, Michael Mumford, Ryan Brown, Shane Connelly, and Lynn Devenport included some undergraduate nursing students, but no widespread study of ethics instruction focusing on conflict of interest has been performed on undergraduates. Following the study by Antes and her coauthors, Kate Greenwood, Carl Coleman, and Kathleen Boozang investigated evidence-based training about conflicts of interest for physician investigators, recognizing that many physicians feel little or no concern about financial relationships with industry.\textsuperscript{33} The Greenwood team sought models to inform the development of successful training. Furthermore, they proposed training that would go beyond compliance to creating a social norm.\textsuperscript{34}

The popular press has discussed this issue in a limited way. Many articles will mention that a company funded a study, but few discuss the broader issues. In 2007, *Discover* magazine published an article titled “Science under Siege” exploring corporate influence on science.\textsuperscript{35} A 2012 article goes into greater depth on the impact of conflict of interest on pharmaceuticals and the importance of ethical guidelines to maintain scientific integrity.\textsuperscript{36} The question of how widely the general population understands the issue of conflict of interest remains important.

**Theoretical Framework**

Cognitive authority theory looks at how individuals attribute cognitive authority to secondhand information—that is, information outside the range of their direct experience.\textsuperscript{37} Patrick Wilson found that college-educated people recognize the cognitive authority of science as an institution. Because some types of information receive cognitive authority automatically, this study questioned if journals would automatically receive cognitive authority and students would therefore overlook statements disclosing financial conflict of interest. The study also examined other factors contributing to the attribution of cognitive authority. It investigated what factors participants take into consideration
when they evaluate articles. After instruction about the potential for bias, would students consider financial conflict of interest statements and try to judge the potential ramifications of financial conflicts? Student perception of the cognitive authority of an article was measured by both the numeric value the students gave to the article and the words they used to describe the article’s authority. This study aimed to see which factors of cognitive authority participants considered and if the concept of conflict of interest influenced the attributes of cognitive authority.

While conflict of interest has long concerned scientists and scholars, the impact on the credibility of scientific research needs to be better understood. There is a significant gap in the literature regarding the understanding of conflict of interest among the public; it is uncertain if lay readers regard conflict of interest as a problem. There is also a gap regarding the reader’s reaction to information once the potential for bias is noticed. Further study of this topic is warranted because numerous questions have yet to be answered fully.

Method

To determine if lay readers understand that conflict of interest disclosure statements should alert a reader to the potential for conflict of interest, the author of this article conducted a small pilot study at a liberal arts college outside Boston. No one knows if students understand the function of disclosure statements or even if they read them. Twenty-one undergraduate students from different majors participated in this study as members of an information technology course. The participants were in their sophomore year in college and were 19 to 21 years of age; further demographic information was not collected to preserve anonymity in the small sample.

The mixed methods study required all participating students to complete a pretest and posttest. The study instrument provided both qualitative and quantitative data. The data enabled the author to triangulate the question to gain further understanding of the impact of disclosure statements on reader perception of research articles.

The instrument was comprised of two parts. The first part consisted of eight questions regarding student attitude toward issues of research funding (see Appendix A). The questions in this section were modeled on the study by Fisher and his team. The second section comprised an instrument for examining and evaluating four journal articles for believability, objectivity, and credibility (see Appendix B). This portion of the study was inspired by the studies done by Chaudhry and her coauthors and by Schroter and her team. Two of the articles were sponsored by industry with disclosure statements, and two were not. The articles were chosen because the two topics, sugar-sweetened beverages and climate change, were familiar to students. The Willie Soon and Sallie Baliunas article was selected because it had a clear disclosure statement (see Appendix C) and because, when searched on Google, the Wikipedia entry about the article topped the list of search results. The Wim Saris article was chosen because the disclosure statement

No one knows if students understand the function of disclosure statements or even if they read them.
was less straightforward. The Saris study was funded by the International Life Sciences Institute, an industry front group with a benign-sounding name that is financed by many companies with ties to sugar, such as the Coca-Cola Company. The study was published as a journal supplement, and students may not know that supplements often do not undergo the same rigorous peer review that other articles do. The disclosure statement was less straightforward than the statements on the Soon and Baliunas article (see Appendix C). The response sheet consisted of both Likert scale responses for each measure and open-ended questions for respondents to describe the attributes that students felt contributed to or detracted from the articles’ cognitive authority.

Testing was conducted in a lab where students had access to computers so they could do Internet research to establish the credibility of articles. Upon arrival, all students were informed that participation in the study was voluntary, and they could abandon the experiment at any time. Participants received instructions orally, as well as on the survey instrument. All students received the four articles and were given unlimited time to evaluate them.

After the pretest, the students were assigned the Jennifer Washburn article “Science under Siege” exploring corporate influence on science to prepare for class discussion during the next class meeting. Instruction took place during one 75-minute class period in an instruction lab. The instruction was comprised of a lecture, discussion, small group activity, and students reporting their findings. Participants watched a brief video featuring comedian John Oliver discussing scientific research. This video employs humor to bring a serious topic to students in an approachable way. The students discussed the concerns outlined in the Washburn article and brainstormed other fields that could be impacted by conflict of interest. Next, they were given several articles to examine. The students broke into small groups, and each group evaluated one article. Several of the articles were funded by industry. The students could search the Internet for information about the authors and funders of the article. After evaluating the article, the small groups presented their findings to the whole group and explained their process for assessing the article. They also explained their conclusions about the authority of the article. They displayed their article on screens so they could show their classmates the portions that they found important. As they presented their process in evaluating the article, the instructor pointed out additional ways to look for information to assist in judging the article, including searching for information about the author, affiliated institutions, journals, and funders. Students also learned about looking at citations and checking if an article had been cited. They learned about open access journals and that not all journals are of equal quality. They discussed the importance of finding multiple sources of information.

Two weeks after instruction, the students took the posttest, which was identical to the pretest. Students were given an interval between the pretest and the posttest to determine what they remembered from the instruction. Participants had unlimited time to complete the posttest, and access to computers enabled them to search for additional information if desired.
Results

The study had three components: (1) the multiple-choice test, (2) the Likert scale rating of the four articles, and (3) the open response questions. The students took significant time completing the pretests and posttests, from 25 minutes to over an hour, which seemed to indicate that they put thought into their answers.

The first portion of the results came from the multiple-choice survey modeled on the study by Fisher and his coauthors. Of the eight questions on the test, participant responses to several of the questions changed markedly (see Table 1). There was a significant effect for the question about scientists researching products in which they have a financial interest: $t(20) = 2.175, p < 0.05$.

The second portion of the results came from the Likert scale ratings of each article. A MANOVA (multivariate analysis of variance) was performed on the three attributes of each of the four articles, a statistical technique used in studies where more than one factor affects the outcome (see Table 1). The author hypothesized that the participants would rate the two industry-sponsored articles lower after instruction. The results of the MANOVA indicated that only one of the attributes had a statistically significant result. There was a significant effect of instruction on the believability of article 1 at the $p < 0.05$ level for the conditions $F(1,21) = 5.002, p = 0.031$. The results suggest that instruction may decrease the believability of articles sponsored by recognized industries. However, the believability of article 3 (also industry-funded) did not decrease in a statistically significant manner.

The final portion of the results, the open-ended questions, provided richer data. The answers to the questions were more enlightening than the numeric value assigned to the articles. Most students seemed to use only a small range of the numeric scale when assessing the value of the articles, but they were more descriptive in their narrative. The amount of detail they put into their open-ended answers varied greatly. The students also varied greatly in what they interpreted the three categories (believability, objectivity, and credibility) to indicate; perhaps the terms were too ambiguous, and operational definitions would have helped clarify the answers. Each of the three components received comments on the authors, sources, and footnotes.

Article 1 was the Soon and Baliunas article on climate, an article so noteworthy that the Soon and Baliunas controversy has its own Wikipedia page. Because the students had access to computers, they could have found this information, but there was no indication that they did. This article received the most comments. Several students ($n = 4$) remarked on the funding source for article 1, funded by the American Petroleum Institute, a trade association that represents the oil and gas industry. Participants wrote "Supported by funds from the American Petroleum Institute (biased)" and "Do they have ulterior motives?" The students also commented that the authors were affiliated with Harvard University. Because the believability of article 1 was the only statistically significant result, it was not surprising that students mentioned threats to the cognitive authority of the article.

Article 2 received many positive comments; participants expressed confidence with the information contained in the article. One respondent said, "They are all progressive environmentalists so they’re biased,” but that was the only negative comment for article 2.
Table 1.
Summary of survey responses

<table>
<thead>
<tr>
<th>Question</th>
<th>Pretest</th>
<th>Posttest</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Does the source of scientific research funding affect the quality</td>
<td></td>
<td></td>
</tr>
<tr>
<td>of the research?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>83</td>
<td>81</td>
</tr>
<tr>
<td>No</td>
<td>17</td>
<td>19</td>
</tr>
<tr>
<td>2. Which research is more likely to be honest and objective?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government-funded</td>
<td>17</td>
<td>43</td>
</tr>
<tr>
<td>Corporation-funded</td>
<td>17</td>
<td>5</td>
</tr>
<tr>
<td>Both could be</td>
<td>65</td>
<td>52</td>
</tr>
<tr>
<td>3. Should corporations control whether or not the studies they</td>
<td></td>
<td></td>
</tr>
<tr>
<td>fund are published?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>70</td>
<td>38</td>
</tr>
<tr>
<td>No</td>
<td>30</td>
<td>62</td>
</tr>
<tr>
<td>4. Corporate funding is important to research important issues.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agree</td>
<td>86</td>
<td>67</td>
</tr>
<tr>
<td>Neutral</td>
<td>14</td>
<td>33</td>
</tr>
<tr>
<td>Disagree</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5. Should scientists be allowed to perform research on products in which</td>
<td></td>
<td></td>
</tr>
<tr>
<td>they have a financial interest?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>77</td>
<td>48</td>
</tr>
<tr>
<td>No</td>
<td>33</td>
<td>52</td>
</tr>
<tr>
<td>6. Is there sufficient regulation to regulate potential conflicts of</td>
<td></td>
<td></td>
</tr>
<tr>
<td>interest?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>45</td>
<td>33</td>
</tr>
<tr>
<td>No</td>
<td>55</td>
<td>67</td>
</tr>
<tr>
<td>7. Should there be regulations about the funding of research?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>95</td>
<td>90</td>
</tr>
<tr>
<td>No</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>8. Who should be involved in regulating industry-researcher</td>
<td></td>
<td></td>
</tr>
<tr>
<td>relationships?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government</td>
<td>5</td>
<td>14</td>
</tr>
<tr>
<td>Academia</td>
<td>9</td>
<td>29</td>
</tr>
<tr>
<td>Industry</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Not sure</td>
<td>23</td>
<td>14</td>
</tr>
<tr>
<td>Government and industry</td>
<td>59</td>
<td>38</td>
</tr>
</tbody>
</table>
Article 3 received the lowest rating on both pretest and posttest. The funding disclosure statement in this article was less clear; indeed, only one student mentioned the funding source, writing “Institution that supported this study.” A statement said the article was supported by ILSI, the International Life Sciences Institute, a nonprofit organization whose stated mission is to improve “human health and well-being.” The name obscures its funders, which include food industry companies. Students would have to look up what ILSI stood for and then look further into its funders. This in-depth investigation may be too much to expect from undergraduate students. Although only one student mentioned funding, some participants (n = 2) questioned the study, saying, “Can’t build a case on false info” and “Nothing in the article connects to each other.” Two students had the opposite reaction, saying, “The claim makes sense and seems reasonable” and “presents information that makes sense.”

The final article, article 4, received no comments questioning its authority, and participants used fewer words evaluating this article compared to the others. Students (n = 4) commented that there was no bias. Several mentioned that the information presented in the article confirmed what they understood to be true. One student wrote, “Well America has a weight problem that we need to solve ASAP.” Another wrote, “Claim makes sense and seems legitimate.”

Discussion

Students seemed to focus on many of the features that librarians and professors mention when suggesting what to look for in research. Students liked authors who were affiliated with prestigious institutions, inclusion in journals, and long bibliographies. In this small population, students seemed to have a good deal of cohesion around the factors they considered valuable to cognitive authority. They also seemed reluctant to criticize research articles; even when finding fault, they did it obliquely, suggesting that an article might have bias. The instruction did increase understanding in one key aspect for the clearest type of disclosure statement. Future studies of this question will need to rethink the instruction to produce more robust results and increase understanding of more complex disclosure statements.

The study did not provide clear statistically significant results, but the qualitative statements were informative. The questions dealing with the identification of conflict of interest and its impact on the students’ impressions of research were not completely answered. The instruction was designed to make the students aware of the issue of conflict of interest, provide them with the skills to critically evaluate articles, and make them aware of the potential for bias. Financial conflict of interest is such an important issue that a single class period is too short for students to fully understand all the implications.

The question of how students perceive cognitive authority in research was answered more satisfactorily. The open-ended questions proved informative. The rich descriptions that participants provided for the cognitive authority of the articles were enlightening. The descriptions were uniform in their description of the components of cognitive au-
authority. Students mentioned author affiliation, inclusion in a peer-reviewed journal, and citations as indicators of cognitive authority. Participants were rarely skeptical about the authority of the articles. This is concerning because the authors of sponsored research are motivated to make readers believe their findings.

The final question in this study had limited success. The MANOVA indicated only one statistically significant finding in the results. This case study shows that clear instruction about the different types of financial conflict of interest statements will be necessary to determine if instruction has a robust impact on student learning.

**Strengths and Limitations**

The study used mixed methods to explore the issue of financial conflict of interest from multiple dimensions. Using a mixed methods approach had the potential to triangulate the issue and achieve a greater knowledge of the factors contributing to the perception of the cognitive authority of journal articles. One limitation was that the quantitative portion of the study failed to produce statistically significant results. The study design was modeled on a study of medical professionals. Perhaps it was too complex for students to ascertain the distinctions between the three attributes the study examined. The second disclosure statement was not as clear as the first; this may have been difficult for students who were new to the issue of financial conflict of interest. Students may have also suffered from study fatigue. The first articles received the most complete answers, and students used the most words to describe the authority of those articles. By the time some of the students got to the fourth article, they used very few words and even left some questions blank. The study may be improved with operational definitions or a simpler study design. The instruction was limited to 75 minutes, which may have been too brief for participants to learn the skills desired. Another limitation was the small study sample and the lack of a control group.

This study should be repeated with a true scientific design, with random assignment and a control group to better understand the attribution of cognitive authority to sponsored research articles. The design should also be reevaluated to fully reflect the desired learning outcomes and information literacy competencies expected of students in the discipline. This has important implications for how undergraduates are taught to judge research in achieving information literacy competence. The study did provide useful information for design of future studies on this topic.

**Conclusion**

Students understand the underlying concepts of conflict of interest but cannot apply their skepticism due to their lack of in-depth knowledge in the subject matter. Students hesitate to question the authority of the articles, couching any critical comments carefully. They rely on the other indicators of cognitive authority, such as inclusion in a journal, that they have been taught to use to determine the veracity and quality of research. Many students mentioned that an article fit with their knowledge of the topic, and therefore they found it authoritative. This method of determining cognitive authority is potentially troubling because it is often important to read research that challenges one to think in new and different ways.
Conflict of interest and its impact on the integrity of the body of scientific research are important areas of study. Since there are concerns about sponsorship of research and its impact on investigations, it is important that readers have the tools necessary to evaluate research. Because scientific research is often used for decision-making in the personal and public realm, understanding how readers assess and use research is essential.

Since this study was conducted, there have been steps toward increasing transparency in research and providing readers with additional tools. PubMed has started providing Conflict of Interest disclosure statements on the results page, just after the abstracts. This feature benefits those who read only the abstracts and would not have gone to the full article to find the disclosure. Because PubMed added this feature only recently, there is no research on its effectiveness. Additionally, the disclosures are not always as informative as they could be. Appendix D has two examples of disclosure statements. The first says only, "Disclosure AG, IC, VF and SR are IBSA employees." Attempts to find what IBSA stands for are initially confusing: IBSA Institut Biochimique SA is a Swiss pharmaceutical manufacturer. The lay reader may not get much insight from a disclosure statement this terse. A statement explaining that several paper authors are employed by the company that manufactures the drug would be clearer. The second disclosure statement in Appendix D, Sample 2, is more informative. Access to disclosure information is a benefit for the lay reader who uses PubMed to search for information.

Many students mentioned that an article fit with their knowledge of the topic, and therefore they found it authoritative. This method of determining cognitive authority is potentially troubling because it is often important to read research that challenges one to think in new and different ways.

Next Steps

This study should be repeated with a control group to determine if instruction does change student understanding and recognition of scientific research with industry funding. With so many recent examples of scientific misconduct related to industry suppression and misrepresentation of data, it is essential that librarians gain greater understanding of the knowledge of their users. Now that PubMed provides disclosure statements on the first page, it would be useful to study how this change affects users’ selection of articles.

Librarians instructing students in the “Information has value” frame should explain to students the economic realities of scientific research and encourage them to think critically about the information they find.
information ecosystem. Although the Framework does not explicitly mention the issue of conflict of interest, it lays out some concepts that tie in with the issues arising from conflict of interest. Librarians instructing students about evaluating information should explain to students that not all journals are equal in quality. Students who receive instruction from their professors to select material from peer-reviewed journals should understand what peer review is and why it is important, and not simply check off the box during a database search. Librarians instructing students in the “Information has value” frame should explain to students the economic realities of scientific research and encourage them to think critically about the information they find.

When there is much information available for a student to access, the question becomes not is there any information, but is there any good information. As information becomes ever more abundant, skills at evaluating it will become more important. Understanding the potential for financial conflict of interest is one element in becoming an information literate consumer.

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Appendix A

Please select the answer that best represents your opinions.

1. Does the source of scientific research funding affect the quality of the research?
   a. Yes
   b. No
2. Which research is more likely to be honest and objective?
   a. Government-funded
   b. Medical company-funded
   c. Both could be equally honest and objective.
3. Should corporations be able to control whether or not the studies they fund are published?
   a. Yes
   b. No
4. Corporate funding is important to research important issues.
   a. Agree
   b. Disagree
   c. Neither agree nor disagree
5. Should scientists be allowed to perform research on products in which they have a financial interest?
   a. Yes
   b. No
6. Is there sufficient regulation to regulate potential conflicts of interest?
   a. Yes
   b. No
7. Should there be regulations about the funding of research?
   a. Yes
   b. No

8. Who should be involved in regulating industry-researcher relationships?
   a. Government
   b. Academia
   c. Industry
   d. Unsure
   e. Government and industry together

Appendix B

Article Evaluation

If you were going to select sources for a paper, please rate each article on the following characteristics:

Article 1

Considering article 1, how would you rate the following:

<table>
<thead>
<tr>
<th></th>
<th>Poor</th>
<th>Fair</th>
<th>Good</th>
<th>Very good</th>
<th>Excellent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Believability</td>
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<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Objectivity</td>
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<td>2</td>
<td>3</td>
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<td>5</td>
</tr>
<tr>
<td>Credibility</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Please describe any factors that influence your perception of the Believability of the article:

Please describe any factors that influence your perception of the Objectivity of the article:

Please describe any factors that influence your perception of the Credibility of the article:

Article 2

Considering article 2, how would you rate the following:

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<th>Fair</th>
<th>Good</th>
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<tr>
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<tr>
<td>Credibility</td>
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<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Please describe any factors that influence your perception of the Believability of the article:

Please describe any factors that influence your perception of the Objectivity of the article:
Please describe any factors that influence your perception of the Credibility of the article:

**Article 3**

Considering article 3, how would you rate the following:

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<th>Good</th>
<th>Very good</th>
<th>Excellent</th>
</tr>
</thead>
<tbody>
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<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Please describe any factors that influence your perception of the Believability of the article:

Please describe any factors that influence your perception of the Objectivity of the article:

Please describe any factors that influence your perception of the Credibility of the article:

**Article 4**

Considering article 4, how would you rate the following:

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<th>Fair</th>
<th>Good</th>
<th>Very good</th>
<th>Excellent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Believability</td>
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<td>2</td>
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</tr>
<tr>
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<tr>
<td>Credibility</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Please describe any factors that influence your perception of the Believability of the article:

Please describe any factors that influence your perception of the Objectivity of the article:

Please describe any factors that influence your perception of the Credibility of the article:

**Appendix C**

**Disclosure Statements**

Below are the disclosure statements that appeared on the two articles that had such statements. The formatting has been preserved.

Acknowledgments. This work was supported by funds from the American Petroleum Institute (01-0000-4579), the Air Force Office of Scientific Research (Grant AF49620-02-1-0194), and the National Aeronautics and Space Administration (Grant NAG5-7635). The views expressed herein are those of the authors and are independent of the sponsoring agencies. We have benefited greatly from the true and kind spirit of research communications (including a preview of their thoughts) with the late Jean Grove (who passed away on January 18, 2001), Dave Evans, Shaopen Huang, Jim Kennett, Yoshio Tagami, and Referee #3. We thank John Daly, Diane Douglas-Dalziel, Craig and Keith Idso for their unselfish contributions to the references. We also thank the Editor, Chris de Freitas, for very helpful editorial changes that improved the manuscript. We are very grateful to Maria McEachern, Melissa Hilbert, Barbara Palmer and Will Graves for invaluable library help, and both Philip Gonzalez and Lisa Linarte for crucial all-around help.


1. From the Nutrition and Toxicology Research Institute (NUTRIM), University of Maastricht, Maastricht, Netherlands.

2. Presented at the Sugars and Health Workshop, held in Washington, DC, September 18–20, 2002. Published proceedings edited by David R. Lineback (University of Maryland, College Park) and Julie Miller Jones (College of St. Catherine, St. Paul).

3. Manuscript preparation supported by ILSI NA.

4. Address reprint requests to WHM Saris, NUTRIM, Department of Human Biology, University of Maastricht, PO Box 616, 6200 MD Maastricht, Netherlands. E-mail: w.saris@hb.unimaas.nl.
Appendix D

PubMed Conflict of Interest Statements

Example 1

Figure 1. A screenshot of a PubMed results screen. The Conflict of Interest statement has been opened.
Figure 2. A screenshot of a PubMed results screen. The Conflict of Interest statement has been opened.
Notes


4. Ibid., 191.


6. Ibid.


11. Lo and Field, *Conflict of Interest in Medical Research, Education, and Practice*.


15. Lo and Field, *Conflict of Interest in Medical Research, Education, and Practice*.


19. Ibid.


22. Ibid.

23. Schroter, Morris, Chaudhry, Smith, and Barratt, “Does the Type of Competing Interest Statement Affect Readers’ Perceptions of the Credibility of Research?”

24. Ibid.


26. Ibid.
28. Ibid.
29. Ibid.
31. Ibid.
32. Ibid.
34. Ibid.
39. Chaudhry, “Does Declaration of Competing Interests Affect Readers’ Perceptions?”
40. Schoter, Morris, Chaudhry, Smith, and Barratt, “Does the Type of Competing Interest Statement Affect Readers’ Perceptions of the Credibility of Research?”
43. Washburn, “Science under Siege.”
45. Kesselheim, Robertson, Myers, Ross, Gillet, Ross, Glynn, Joffe, and Avorn, “A Randomized Study of How Physicians Interpret Research Funding Disclosures.”
46. Soon and Baliunas, “Proxy Climatic and Environmental Changes of the Past 1000 Years.”
49. Ibid.
53. ILSA NA stands for International Life Sciences Institute North America. The disclosure statement did not spell out the abbreviation.