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Supporting Online Material for

Responding to Fraud

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Letter and report from committee examining *Science*'s peer review process for Hwang *et al.* papers [*Science* **303**, 1669 (2004) and *Science* **308**, 1777 (2005)]

Science's response to the committee report



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September 15, 2006

Dr. Donald Kennedy, Editor
Science
American Association for the Advancement of Science
1200 New York Ave., NW
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Dear Don:

I submit a report of the committee (John Brauman, John Gearhart, Douglas Melton, Linda Miller, Linda Partridge, George Whitesides) assembled to examine the process involved in publishing the paper by Woo Suk Hwang that was subsequently retracted: Woo Suk Hwang, Sung Il Roh, Byeong Chun Lee, Sung Keun Kang, Dae Kee Kwon, Sue Kim, Sun Jong Kim, Sun Woo Park, Hee Sun Kwon, Chang Kyu Lee, Jung Bok Lee, Jin Mee Kim, Curie Ahn, Sun Ha Paek, Sang Sik Chang, Jung Jin Koo, Hyun Soo Yoon, Jung Hye Hwang, Youn Young Hwang, Ye Soo Park, Sun Kyung Oh, Hee Sun Kim, Jong Hyuk Park, Shin Yong Moon, Gerald Schatten, Patient-Specific Embryonic Stem Cells Derived from Human SCNT Blastocysts, *Science*, **308**, 1777 – 1783 (2005),.

The committee examined the original submissions of Hwang from 2004 and 2005, and the editorial material (reviews, revisions, comments, editor's notes, additional information). We discussed both by phone and email our impressions and analysis of the way in which the papers were handled at *Science* and possible changes in procedures that might be appropriate. We hope that the results of this study will be helpful to you and to *Science*.

Sincerely,

A handwritten signature in black ink that reads "John I. Brauman".

John I. Brauman (for the committee).

Committee Report

Hwang, et al., *Science*, **308**, 1777 – 1783 (2005)

1. Summary:

In the case of the Hwang papers, the editors followed the procedures in operation at *Science*, a process review similar to that at other top tier scientific journals. Despite this, a bad outcome occurred for the journal, and for science. The journal was intentionally deceived. This type of deception has occurred before, and, as a result of the visibility of the journal, could well be attempted again.

No realistic set of procedures can be completely immune to deliberate fraud. However, although infrequent, these cases have important consequences for the journal and for science broadly. *Science* should therefore modify and strengthen its procedures for review to provide additional scrutiny of the papers it publishes, especially the high-impact papers. Heightened scrutiny will also deter the submission of flawed or intentionally deceptive work that falls short of outright fraud.

Current procedures are based on an assumption of trust: *Science* assumes that the papers it receives are honestly conceived and written. In fact, it now receives a small number of papers that are either intentionally misleading (Hwang, Schoen) or substantially distorted by self-interest. *Science* must institutionalize a healthy level of concern in dealing with papers that it considers for publication, especially those likely to be very visible or influential.

The number of papers submitted to *Science* makes it essentially impossible in practice to examine each of the papers it receives with this heightened level of scrutiny. Fortunately, only a small fraction of the papers it selects for publication require such special attention – attention that will be time consuming and expensive, and may lead to conflict with authors.

New procedures would help *Science* improve its defenses against intentionally misleading work. We recommend that editors conduct audits of submissions at a level of detail that it does not currently use (for selected papers, and for occasional randomly chosen papers). *Science* should have substantially stricter requirements about reporting the primary data. Papers selected for possible publication should undergo a formal risk-assessment using a template that the editors should devise. *Science* should also rethink its requirements for co-authorship, its policies concerning treatment of digital images and biological samples, and its penalties for authors who knowingly submit distorted or faulty work.

2. Process

Choice of reviewers; interpretation and response to reviews

We conclude that the editors correctly followed the procedures in place at *Science*. No set of procedures, however rigorous, will be capable of detecting deliberate fraud. However, the existing procedures led to an unfortunate outcome, and have done so on several previous occasions. Some additional procedures would have detected this fraud. *Science* must therefore act on the basis that its current procedures are inadequate to deal with the problems of intentionally misleading work.

The choice of the reviewers was sound, but these reviewers, and the editors -- even working on a paper that they knew to have the potential for high visibility -- did not detect intentional deception.

The editors made a serious effort -- substantially greater than that for most papers published in *Science* -- to ensure that the science was sound. In general, the response to reviewers' comments followed established procedures.

In retrospect, even within the existing procedures, we suggest that the reviewers and editors should have given more attention to some of the incomplete answers, both experimental and administrative, provided by the authors. It is clear from the correspondence that the editors were aware of a major potential flaw in both the 2004 study and thus the 2005 work, namely the possible occurrence of parthenogenesis. This possibility should have been pursued and eliminated, since the central contention of the 2004 paper was that a human stem cell line had been generated by nuclear transplant. This central fact was not established. The reviewers acquiesced in the authors' textual explanations rather than sticking with their initial requirements for better data. It is also worth noting that the behavior and notes from "invited" authors probably should have raised more concerns about the motivations of the Korean authors. In addition, the additive quality of all of the surrounding issues with IRBs, consent forms, and authorship gave a general sense of unease to many editors, yet was not given sufficient weight in the context of whether to publish. Thus, given the obvious high visibility that the paper would receive and the level of concern about some of the details, there might have been more concern about the paper as a whole.

3. Results

Were the actions taken correct, given the information available?
Should more information have been obtained - from authors or others?

Insofar as the 'standard' process was followed, the actions taken followed the guidelines of the journal. In spite of pressure from authors regarding rapid publication, and in spite of issues related to the timing of public presentations of

the work, the editors followed established procedures and extended them to include additional reviewing in an effort to ensure high standards. As we note below, given the number and location of authors it would have been prudent to ascertain in more detail the contributions of each of the various authors. Although there appear to be check-lists, it was not entirely clear who was responsible for making sure that appropriate documentation was complete and correct.

4. Given what we now know, does a re-examination of the published manuscript suggest that the process was flawed or inadequate? Are the standards applied by the editors consistent with current *Science* policy? Are the current standards used at *Science* reasonable or should they be changed in some way?

Science (and *Nature*) have reached a special status. Publication in *Science* has a significance that goes beyond that of 'normal' publication. Consequently, the value to some authors of publishing in *Science*, including enhanced reputation, visibility, position or cash rewards, is sufficiently high that some may not adhere to the usual scientific standards in order to achieve publication. Thus, the cachet of publishing in *Science* can be an incentive not to follow the rules. This problem has a significant impact on all of science, since trust in the system is essential, and since *Science* and *Nature* are seen to speak for the best in science. Furthermore, false information in the literature leads to an enormous waste of time and money in an effort to correct and clarify the science.

Science as a journal tries to select papers that will have high impact on both science and society. Some papers will be highly visible and attract considerable attention. Many of these papers purport to be major breakthroughs and claim to change fields in a significant way. However, because the content is so new or startling, it is often more difficult to evaluate the quality or veracity of the work than would be the case for a more conventional paper.

Papers in this class, particularly those that will receive public attention, can influence public policy or contribute to personal or institutional financial gain and thus warrant special scrutiny. In the immediate future, examples will likely come from the areas of climate change, human health, and particular issues in commercial biomedicine and nanotechnology. Progress in science depends on breakthroughs and in taking risks, both in research and in publishing. Nevertheless, it is essential to develop a process by which papers that have the likelihood of attracting attention are examined particularly closely for errors, misrepresentation, deception, or outright fraud. This examination should include especially high standards for providing primary data, a clear understanding of all of the authors' and coauthors' contributions to the paper and a careful examination of data presented in the papers.

5. Suggested changes

It appears that the current process, predicated on the assumption that there is no misrepresentation, is not adequate to deal with problems of this kind. We suggest that the editors consider some modifications that may be helpful in the future.

- a. There should be a formal, required 'risk assessment' for papers that have been selected for publication. This assessment would be a new procedure, and would explicitly ask questions about the probability that the work might be intentionally deceptive, or just wrong, and the consequences for the reputation of *Science* and science, and for other issues (public policy, intellectual property, academic credit). Papers that are likely to have high visibility, for example in climate, energy, human health, etc., should get special scrutiny.
- b. A method should be developed to clarify the contributions and responsibilities of authors and co-authors. Standards should be publicized and followed by all parties.
- c. More extensive information should be put in the published supporting material. Primary data are essential and should be available to reviewers and readers. The General Information for Authors should be modified to make it clear that, for example, requests for materials, methods, or data necessary to verify the conclusions may be required prior to acceptance.
- d. To the extent possible, *Science* should act in concert with *Nature* and perhaps a few other high-profile journals to establish common standards. It would be undesirable to have authors choose a journal for submission based on standards, or the lack of standards, of the type discussed here.

John Brauman, John Gearhart, Douglas Melton, Linda Miller, Linda Partridge,
George Whitesides

Science's Response to the Committee Report on
Hwang *et al.*, *Science* 2004 and 2005*

Science is grateful to Professor Brauman and his committee for a thoughtful and challenging Report. Its findings and recommendations were discussed at *Science's* Editorial Retreat late in September, with members of the Senior Editorial Board in attendance – including three of the six members of the Brauman committee. We are glad that the committee found that the editorial procedures we used to evaluate the papers by Hwang *et al.* were sound, often requiring extra levels of care and effort on the part of our editors. We find much to praise in the Report's account of actions taken by our editors in the process, with the following exception: A statement in the Report suggests that the authors did not supply additional data to address the possibility of parthenogenesis. Such data were provided at the request of reviewers and appear as Figure 4 of the 2004 paper, but as the Report correctly states and the authors reported, that possible objection could not be eliminated.

We are committed to accepting the major findings of the Report, and to making our new procedures clear to authors, reviewers, and readers as they are developed. In responding to the recommendations, we are now moving to develop criteria for the “risk assessment” template described in the Report which should allow us to apply especially stringent attention as needed. Authors may be asked to disclose information about their individual roles in the work and, on occasion, to supply original data, images, or materials when questions are raised. In our discussions, *Science* editors recognized that extreme care and vigilance are required in evaluating papers that meet certain criteria: for example, when the results include presently unexpected, counterintuitive, or path-breaking findings.

The issue of research misconduct has been raised with increasing frequency over the past few years, and the prominence of the incident involving the papers by Hwang and his colleagues has attracted considerable public attention – and perhaps some erosion of public confidence in science. For that reason, we are publishing the Report in full, along

with this response. *Science* agrees that the publication of these papers amounts to what the Report justly calls a “bad outcome.” By making the recommendations and our response public, we intend to emphasize our commitment to safeguard the review process from abuse by intentional misconduct. Readers of *Science* can expect to see revisions of our “Information for Contributors” that will offer guidance about preparation of images, defining authorial roles, and other matters. We will continue to consult broadly with the scientific community as we consider other changes in response to the Report.

Donald Kennedy

Editor-in-Chief, *Science*

24 October 2006

* *Science* **303**, 1669 (2004) and *Science* **308**, 1777 (2005) .