

Authorship and Publication Practices

2007

MICR510
Scientific Integrity



equipment, and to Dr. G. E. R. Donnan and the captain and officers of R.R.S. *Discovery II* for their part in making the observations.

¹ Young, J. E., Gerard, H., and Jevons, W., *Phil. Mag.*, **42**, 149 (1929).

² Longuet-Higgins, M. S., *Mon. Not. Roy. Astron. Soc., Geophys. Supp.*, **5**, 285 (1949).

³ Van Aken, W. S., *Woods Hole Papers in Phys., Oceanogr., Meteor.*, **11** (3) (1950).

⁴ Ekman, V. W., *Arkiv. Mat. Astron. Fysik. (Stockholm)*, **2**(11) (1904).

MOLECULAR STRUCTURE OF NUCLEIC ACIDS

A Structure for Deoxyribose Nucleic Acid

WE wish to suggest a structure for the salt of deoxyribose nucleic acid (D.N.A.). This structure has novel features which are of considerable biological interest.

A structure for nucleic acid has already been proposed by Pauling and Corey¹. They kindly made their manuscript available to us in advance of publication. Their model consists of three intertwined chains, with the phosphates near the fibre axis, and the bases on the outside. In our opinion, this structure is unsatisfactory for two reasons: (1) We believe that the material which gives the X-ray diagrams is the salt, not the free acid. Without the acidic hydrogen atoms it is not clear what forces would hold the structure together, especially as the negatively charged phosphates near the axis will repel each other. (2) Some of the van der Waals distances appear to be too small.

Another three-chain structure has also been suggested by Fraser (in the press). In his model the phosphates are on the outside and the bases on the inside, linked together by hydrogen bonds. This structure as described is rather ill-defined, and for

this reason we shall not comment on it.

We wish to put forward a radically different structure for the salt of deoxyribose nucleic acid. This structure has two helical chains each coiled round the same axis (see diagram). We have made the usual chemical assumptions, namely, that each chain consists of phosphate diester groups joining β -D-deoxy-ribofuranose residues with 3',5' linkages. The two chains (but not their bases) are related by a dyad perpendicular to the fibre axis. Both chains follow right-handed helices, but owing to the dyad the sequences of the atoms in the two chains run in opposite directions. Each chain loosely resembles Furberg's² model No. 1; that is, the bases are on the inside of the helix and the phosphates on the outside. The configuration of the sugar and the atoms near it is close to Furberg's 'standard configuration', the sugar being roughly perpendicular to the attached base. There



This figure is purely diagrammatic. The two ribbons symbolize the two phosphate-sugar chains, and the horizontal rods the pairs of bases holding the chains together. The vertical line marks the fibre axis.

is a residue on each chain every 3.4 Å, in the z-direction. We have assumed an angle of 36° between adjacent residues in the same chain, so that the structure repeats after 10 residues on each chain, that is, after 34 Å. The distance of a phosphorus atom from the fibre axis is 10 Å. As the phosphates are on the outside, cations have easy access to them.

The structure is an open one, and its water content is rather high. At lower water contents we would expect the bases to tilt so that the structure could become more compact.

The novel feature of the structure is the manner in which the two chains are held together by the purine and pyrimidine bases. The planes of the base are perpendicular to the fibre axis. They are joined together in pairs, a single base from one chain being hydrogen-bonded to a single base from the other chain, so that the two lie side by side with identical z-co-ordinates. One of the pair must be a purine and the other a pyrimidine for bonding to occur. The hydrogen bonds are made as follows: purine position 1 to pyrimidine position 1; purine position 6 to pyrimidine position 6.

If it is assumed that the bases only occur in the structure in the most plausible tautomeric form (that is, with the keto rather than the enol configurations) it is found that only specific pairs of bases can bond together. These pairs are: adenine (purine) with thymine (pyrimidine), and guanine (purine) with cytosine (pyrimidine).

In other words, if an adenine forms one member of a pair, on either chain, then on these assumptions the other member must be thymine; similarly for guanine and cytosine. The sequence of bases on a single chain does not appear to be restricted in any way. However, if only specific pairs of bases can be formed, it follows that if the sequence of bases on one chain is given, then the sequence on the other chain is automatically determined.

It has been found experimentally^{3,4} that the ratio of the amounts of adenine to thymine, and the ratio of guanine to cytosine, are always very close to unity for deoxyribose nucleic acid.

It is probably impossible to build this structure with a ribose sugar in place of the deoxyribose, as the extra oxygen atom would make too close a van der Waals contact.

The previously published X-ray data^{5,6} on deoxyribose nucleic acid are insufficient for a rigorous test of our structure. So far as we can tell, it is roughly compatible with the experimental data, but it must be regarded as unproved until it has been checked against more exact results. Some of these are given in the following communications. We were not aware of the details of the results presented there when we devised our structure, which rests mainly though not entirely on published experimental data and stereochemical arguments.

It has not escaped our notice that the specific pairing we have postulated immediately suggests a possible copying mechanism for the genetic material.

Full details of the structure, including the conditions assumed in building it, together with a set of co-ordinates for the atoms, will be published elsewhere.

We are much indebted to Dr. Jerry Donohue for constant advice and criticism, especially on interatomic distances. We have also been stimulated by a knowledge of the general nature of the unpublished experimental results and ideas of Dr. M. H. F. Wilkins, Dr. R. E. Franklin and their co-workers at

King's College, London. One of us (J. D. W.) has been aided by a fellowship from the National Foundation for Infantile Paralysis.

J. D. WATSON
F. H. C. CRICK

Medical Research Council Unit for the
Study of the Molecular Structure of
Biological Systems,
Cavendish Laboratory, Cambridge.
April 2.

¹ Pauling, L., and Corey, R. B., *Nature*, **171**, 368 (1952); *Proc. U.S. Nat. Acad. Sci.*, **39**, 84 (1952).

² Furberg, S., *Acta Chem. Scand.*, **4**, 634 (1952).

³ Chargaff, E., for references see Karadeniz, S., Finerman, G., and Chargaff, E., *Biochim. et Biophys. Acta*, **6**, 402 (1952).

⁴ Wyatt, G. R., *J. Gen. Physiol.*, **26**, 281 (1952).

⁵ Astbury, W. T., *Symp. Soc. Exp. Biol.*, **1**, *Nucleic Acid*, 44 (Camb. Univ. Press, 1947).

⁶ Wilkins, M. H. F., and Randall, J. T., *Biochim. et Biophys. Acta*, **18**, 192 (1955).

J. D. Watson
F. H. C. Crick



Neural Responses to Taxation and Voluntary Giving Reveal Motives for Charitable Donations

William T. Harbaugh,^{1,2*} Ulrich Mayr,^{3*} Daniel R. Burghart¹

Civil societies function because people pay taxes and make charitable contributions to provide public goods. One possible motive for charitable contributions, called "warm glow," is only fulfilled by an individual's own voluntary giving. However, consistent with the idea that we find that even mandatory, tax-like transfers elicit warm-glow processing. Moreover, neural responses to voluntary giving and to mandatory transfers are similar, suggesting that warm-glow processing is a common consequence of both types of giving.

Every social mechanism, for example, tax systems, are lower in the United States than in other countries, but philanthropists and economists, this change in money is a good, so why

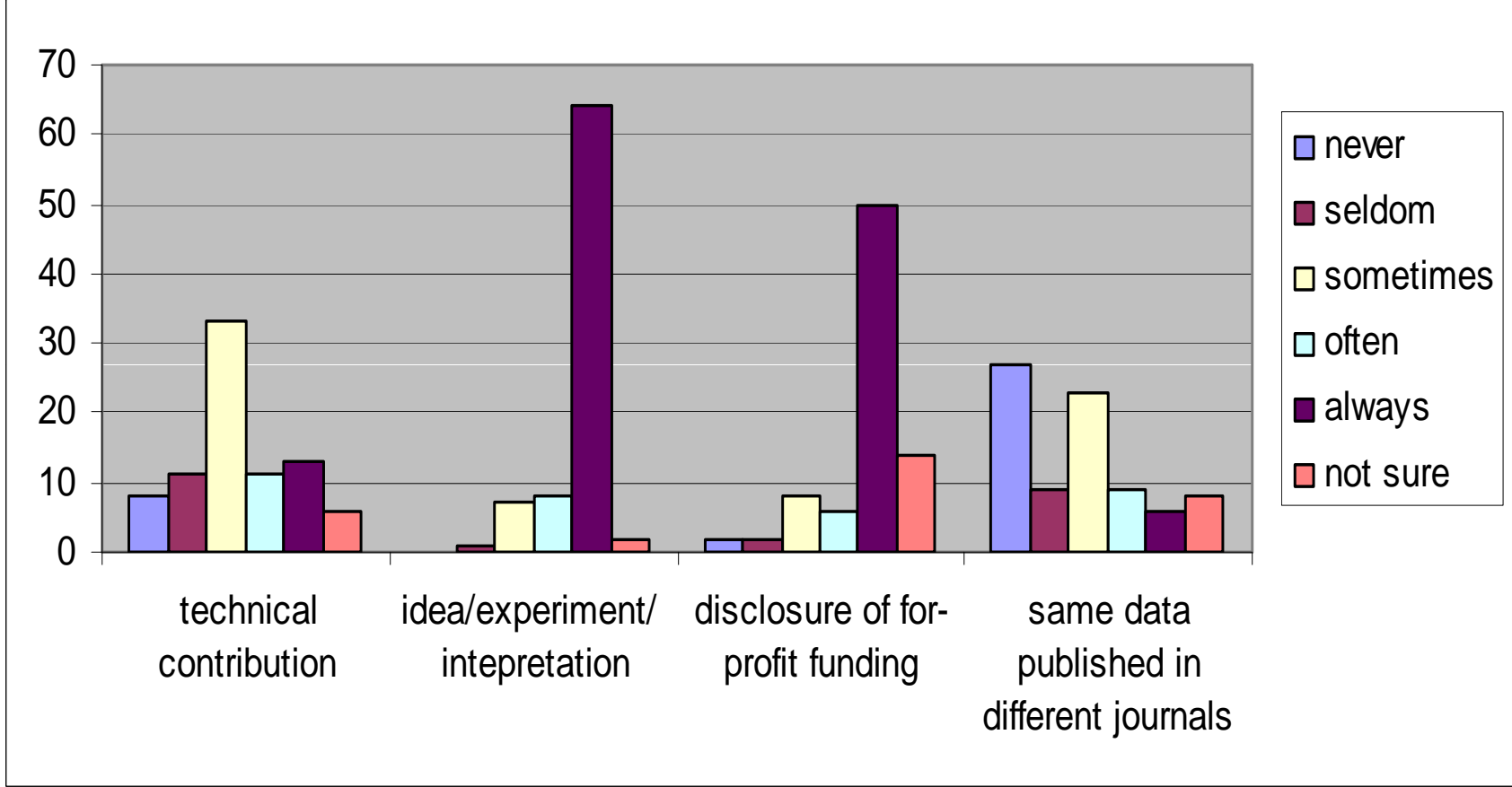
¹Department of Economics, University of Oregon, Eugene, OR 97403-1285, USA. ²National Bureau of Economic Research (NBER), Cambridge, MA 02138-5. ³Department of Psychology, University of Oregon, Eugene, OR 97403-1285, USA.

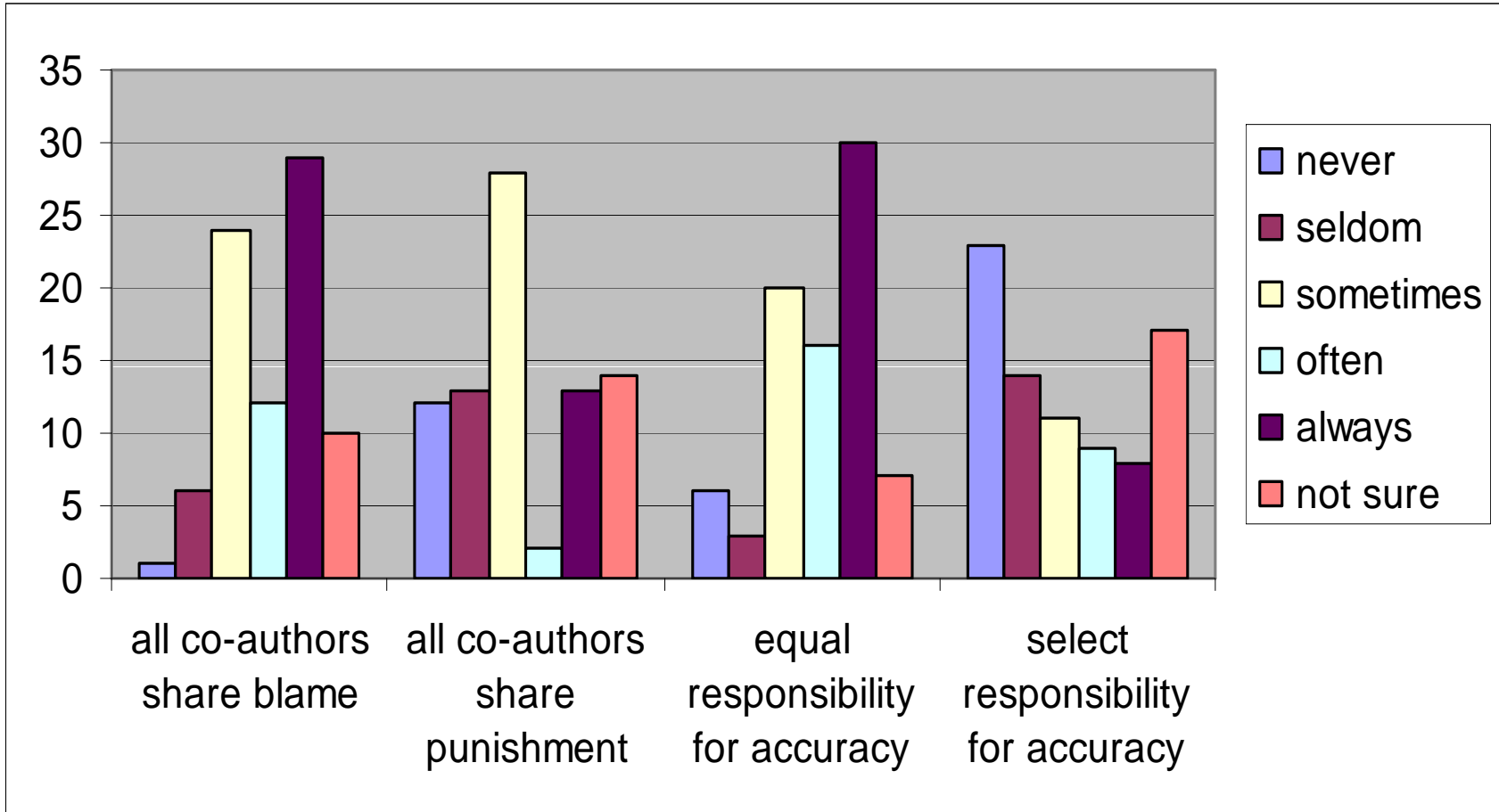
*To whom correspondence should be addressed. E-mail: mayr@uoregon.edu (U.M.) or harbaugh@uoregon.edu (W.T.H.)

Author contributions: Lead authorship was determined by a coin flip between the first two authors. Supported by the National Institute of Aging AG1979601A1 and NSF SES-0112157. We would like to thank J. Anderson, R. Boyck, T. Cameron, J. Chalmon, C. Hode, M. Taylor, and S. Fries, as well as the staff at the Lewis Center for Neuroimaging at the University of Oregon.

some satisfaction even when public goods are supplied through mandatory taxation, because, by this account, people care only about how much of the public good is provided and not about the process by which the transfer occurs. A second possible motive for giving is the sense of satisfaction that has been termed "warm glow." Warm-glow giving is the sense of satisfaction that is derived exclusively by the act of voluntary giving. Warm-glow has been termed "warm glow" because it is given exclusively by the act of giving and would derive satisfaction from the act of giving rather than from the public good itself. On the other hand, pure altruism produces a warm-glow effect that does not

and warm-glow. For several reasons, the effect of pure altruism, which is the only pure altruism, is to reduce private giving, potentially by a dollar, as people cut their voluntary contributions in response to these higher taxes (5). There should be no similar effect with warm-glow givers, as their benefit derives from the amount of their gift. Second, a warm-glow motive for altruism provides an argument in favor of policies that encourage voluntary giving, because the warm-glow benefit provides a reward to the giver that exceeds the benefit from paying an equivalent amount in taxes (6). Neural evidence may help clarify the relative importance of pure altruism and warm-glow motives for charitable giving. Although there is





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Instructions to Authors

1. *Archives of Oral Biology*
2. *Cell*
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4. *Journal of Bacteriology*
5. *Journal of Biological Chemistry*
6. *Journal of Dental Research*
7. *Journal of Experimental Medicine*
8. *Journal of Molecular Biology*
9. *Nature*
10. *New England Journal of Medicine*
11. *Proceedings of the National Academy (USA)*
12. *Science*

Good Practices

Authorship definition: significant intellectual contribution, not just technical one

No submission of previously published material

No simultaneous submission of same work to different journals

No public disclosure prior to publication or in keeping with embargos

Subjects protection compliance met

Data sharing a condition of publication

Deposit of archival data for public access a condition of publication

Disclosure and management of conflicts

Transfer of copyright to publisher

Use of contributorship model

PNAS | July 20, 2004 | vol. 101 | no. 29 | 10495

Responsible authorship of papers in PNAS
Nicholas R. Cozzarelli, Editor-in-Chief

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- Designed research
- Performed research
- Contributed new reagents or analytic tools
- Analyzed data
- Wrote the paper

<http://www.pnas.org/cgi/content/full/101/29/10495>

Authorship (Journal of Bacteriology [American Society for Microbiology])

An author is one who made a substantial contribution to the overall design and execution of the experiments; therefore, **ASM considers all authors responsible for the entire paper**. Individuals who provided assistance, e.g., supplied strains or reagents or critiqued the paper, need not be listed as authors but may be recognized in the Acknowledgments section.

All authors must agree to the order in which their names are listed in the byline. Statements regarding equal contributions by two or more authors (e.g., X.J. and Y.S. contributed equally to ...) are permitted as footnotes to bylines and must be agreed to by all of the authors. Other statements of attribution may be included in the Acknowledgments section.

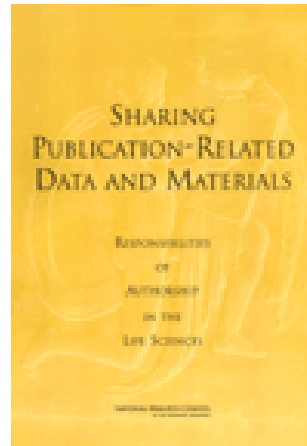
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Disputes about authorship may delay or prevent review and/or publication of the manuscript. Should the individuals involved be unable to reach an accord, review and/or publication of the manuscript can proceed only after the matter is investigated and resolved by the authors' institution(s) and an official report of such and signed statements of agreement are provided to ASM.

**Sharing Publication-Related Data and Materials:
Responsibilities of Authorship in the Life Sciences**
(2003) National Academies Press, Washington, DC.
2003. On line at:

<http://www.nap.edu/catalog/10613.html>

Principles and Recommendations



Principles

- Include **all** that is necessary to **support claims** and **reproduce work**
- **Central information** justifiably not included in paper **must be accessible** and or made available in usable form
- Where agreed upon by community of researchers, data must appear in a **publicly available database by the time of publication**
- State in paper **how to obtain likely requested materials**, information on material transfer agreement
- **Patented material** should be made available under a **license** for research use



Grants Policy

Policy & Guidance

Compliance & Oversight

Research Involving Human
Subjects

Animal Research (OLAW)

Peer Review Policies &
Practices

Intellectual Property Policy

Invention Reporting
(iEdison)

Global OER Resources

Glossary & Acronyms

Frequently Used Links

Frequent Questions

NIH Data Sharing Policy

Data sharing is essential for expedited translation of research results into knowledge, products and procedures to improve human health.

The [Final NIH Statement on Sharing Research Data](#) was published in the NIH Guide on February 26, 2003. This is an extension of NIH policy on sharing research resources, and reaffirms NIH support for the concept of data sharing. The new policy becomes effective with the October 1, 2003 receipt date for applications or proposals to NIH.

- [Data Sharing Regulations/Policy/Guidance Chart for NIH Awards](#) (09/30/2006) - (MS Word - 62 KB) - This chart is designed as a quick guide only for the purpose of identifying various data sharing regulation/policy/guidance documents applicable to NIH funding.
- [NIH Guide Notice](#) (02/26/2003) - Final NIH Statement on Sharing Research Data.
- [NIH Guide Notice](#) (03/01/2002) - NIH Announces a Draft Statement on Sharing Research Data.
- [NIH Data Sharing Policy and Implementation Guidance](#) (03/05/2003) - Guidance providing the NIH policy statement on data sharing and additional information on the implementation of this policy.
- [Frequently Asked Questions - Data Sharing](#) (02/16/2004) - Listing of Frequently Asked Questions that will be updated as new questions are received. Please check back periodically for new questions and answers.
- [Data Sharing Workbook](#) ([PDF](#) - 75 KB) or ([MS Word](#) - 74 KB) - (02/16/2004) - Workbook to show how investigators working in a variety of scientific areas have shared their data.
- [NIH Data Sharing Brochure](#) (PDF - 244 KB) - (05/20/2003) - Printable brochure that summarizes main elements of the NIH Data Sharing Policy.
- [Testimonials](#) (MS Word - 22 KB) - (03/05/2003) - First-hand accounts from researchers who have shared data.
- [Other Data Sharing Documents and Resources](#) (02/19/2004) - Additional resources relating to data sharing.

http://grants.nih.gov/grants/policy/data_sharing/index.htm

Club Rules of Authorship

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AUTHORSHIP GUIDELINES: ICMJE

<http://www.icmje.org/>

Vancouver Group, 1978

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Guidelines on many aspects of publication, including Authorship

AUTHORSHIP GUIDELINES: ICMJE

February 2006

1. All persons designated as authors should qualify for authorship
2. All those who qualify should be listed
3. Each author should have participated sufficiently in the work to take public responsibility for appropriate portions of the content
4. One or more authors should take responsibility for the integrity of the work as a whole, from inception to published article.

AUTHORSHIP GUIDELINES: ICMJE

Authorship credit based only on:

- substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data
- drafting the article or revising it critically for important intellectual content; and
- final approval of the version to be published

Authors should meet all three of these conditions

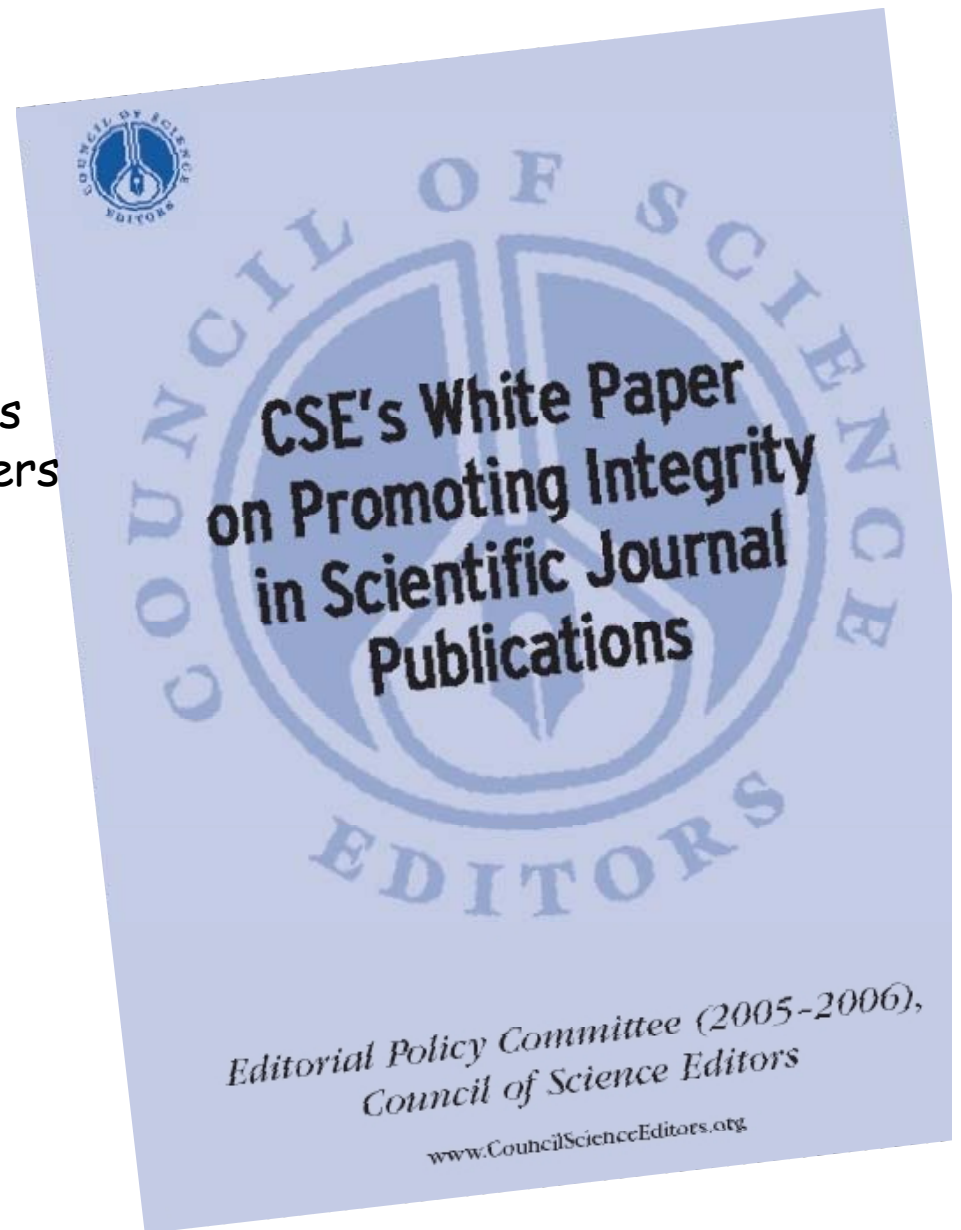
Insufficient grounds for authorship:

- Acquisition of funding
- collection of data
- general supervision of the research group

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- Editor Roles and Responsibilities
- Authorship
- Reviewer Roles and Responsibilities
- Sponsor Roles and Responsibilities
- Relations Between Editors and Publishers
Sponsoring Societies, or Journal Owners
- Responsibilities to the Media
- Description of Research Misconduct
- International Models for Responding
to Research Misconduct
- Reporting Suspect Manuscripts
- Digital Images and Misconduct
- Correcting the Literature
- Handling Third Party Inquiries About
Scientific Misconduct



http://www.councilscienceeditors.org/editorial_policies/white_paper.cfm

Committees, Associations, and Organizations

The Council of Science Editors. This group began in 1957 as the Council of Biology Editors. Its mission is *to serve members in the scientific, scientific publishing, and information science communities by fostering networking, education, discussion, and exchange and to be an authoritative resource on current and emerging issues in the communication of scientific information*

<http://www.councilscienceeditors.org/>

Uniform Requirements for Manuscripts International Committee of Medical Journal Editors.

In 1978, a group of editors proposed uniform guidelines for publication in medical journals, including specific criteria for authorship. These guidelines for publication are periodically updated; the most recent update was February 2006. These guidelines may be accessed at:

<http://www.icmje.org/index.html>

Committee on Publication Ethics

[Formed in 1997] COPE is a forum for editors of peer-reviewed journals to discuss issues related to the integrity of the scientific record; it supports and encourages editors to report, catalogue and instigate investigations into ethical problems in the publication process (from their mission statement)

<http://www.publicationethics.org.uk/>

The World Association of Medical Editors

Established in 1995 to facilitate worldwide cooperation and communication among editors of peer-reviewed journals; this groups compiles resources and develops policies of relevance to authorship and publication practices. <http://www.wame.org/>

The HHS Office of Research Integrity: Resources on Publication Practices; e.g., responsible authorship, peer review, literature searching and more.

http://www.ori.hhs.gov/education/products/rcr_authorship.shtml

THE ROLE OF SCIENTIFIC SOCIETIES

Society for Neuroscience 1998; Guidelines: Responsible Conduct Regarding Scientific Communication.

<http://www.sfn.org/index.cfm?pagename=responsibleConduct>.

American Chemical Society 2006; Ethical Guidelines to Publication of Chemical Research.

<http://pubs.acs.org/ethics/ethics.pdf>.

American Society for Microbiology 2007; Instructions to Authors for ASM Journals.

<http://www.journals.asm.org/misc/ifora.shtml>.

Authorship Culture and Club Rules: Professional Society Policies

	APA (Psych)	SFN (Neurosci)	ICMJE (Med. Eds.)	ASM (Micro)	ACS (Chem)	ASCE (Civ. Eng.)	AGU (Geophys. Union)
Tech. Contribution - Signif. Contribution	X	X	X	X	X	X	X
Copyright issues	X	(X)	X	X	X	X	X
COI	X	X	X	X	X	X	(X)
Duplicate Publication	X	X	X	X	X	X	X
Sharing Data	X	X		X			X

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US Medical Schools with Guidelines Discussing Authorship

Year	Authorship Guidelines Reported	Respondents
1990	13%	99 (n=125)
1997	21%	unknown
2000	36%	99 (n=125)

Recent Developments in Publication Practices

Biosecurity implications (4/12)

Clinical trials registration (all ICMJE)

Peer review and digital imaging (5/12)

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1. *Archives of Oral Biology*
2. *Cell*
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5. *Journal of Biological Chemistry*
6. *Journal of Dental Research*
7. *Journal of Experimental Medicine*
8. *Journal of Molecular Biology*
9. *Nature*
10. *New England Journal of Medicine*
11. *Proceedings of the National Academy (USA)*
12. *Science*

Experiments of Concern:

1. Demonstration of how to render a vaccine ineffective.
2. Conferring resistance to therapeutically useful antibiotics.
3. Enhancing the virulence of a pathogen or rendering a non-pathogen virulent
4. Increasing transmissibility of a pathogen
5. Altering the host range of a pathogen
6. Manipulations that would enable diagnostic evasion
7. Weaponization





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■ Caution About a Bioterror Attack on the U.S. Milk Supply

June 2005

STANFORD GRADUATE SCHOOL OF BUSINESS — A mere 4 grams of botulinum toxin dropped into a milk production facility could cause serious illness and even death for 400,000 people in the United States. Investments that would cost the public only 1 cent more per half-gallon of milk could prevent this nightmare scenario, according to Lawrence M. Wein of the Stanford Graduate School of Business.

Wein, the Paul E. Holden Professor of Management Science, has been conducting a series of studies on the effects of various potential terrorist activities in United States. Not only milk, but soft drinks, fruit and vegetable juices, processed tomato products, and even grains—anything that goes through large-scale storage and production and rapid distribution—could be at risk for such an attack, with catastrophic consequences for the American public, Wein says in his most recent study, conducted with Yifan Liu, a PhD candidate at the Institute for Computational and Mathematical Engineering at Stanford University.

Public Policy

Research by

Lawrence Wein
Paul E. Holden Professor of
Management Science
Stanford Graduate School of
Business

Yifan Liu
PhD Candidate
Institute for Computational and
Mathematical Engineering
Stanford University

http://www.gsb.stanford.edu/news/research/pubpolicy_wein_bioterror.shtml

1918 Flu and Responsible Science

The influenza pandemic of 1918 is estimated to have caused 50 million deaths worldwide; 675,000 in the United States. The reconstruction of the 1918 virus by the synthesis of all eight subunits and the generation of infectious virus are described on p. 77 of this issue,* and the sequences of the final three gene segments of the virus are described in a concurrent *Nature* paper.† Predictably, but alarmingly, this virus is more lethal to mice than are other influenza strains, suggesting that this property of the 1918 virus has been recovered in the published sequence. The good news is that we now have the sequence of this virus, perhaps permitting the development of new therapies and vaccines to protect against another such pandemic. The concern is that a terrorist group or a careless investigator could convert this new knowledge into another pandemic.

Should the sequence of the 1918 virus have been published, given its potential use by terrorists? The dual-use nature of biological information has been debated widely since September 11, 2001. In 2003, a committee of the U.S. National Academies chaired by Gerald Fink considered this issue, weighing the benefits against the risks of restricting the publication of such biological information. They outlined the tradeoff between erring on the side of prudence, thus potentially hindering the progress of critical science, and erring on the side of disclosure, thus potentially aiding terrorists. The U.S. National Science Advisory Board for Biosecurity (NSABB) was established to advise governmental agencies and the scientific community on policies relative to public disclosure. This board has begun to deliberate, but the questions are complex, as typified by these papers on the 1918 virus. It is reassuring that the NSABB was asked to consider these papers before publication and concluded that the scientific benefit of the future use of this information far outweighs the potential risk of misuse. People may be reassured that the system is working, because agencies representing the public, the scientific community, and the publishing journals were involved in the decision.

I firmly believe that allowing the publication of this information was the correct decision in terms of both national security and public health. It is impossible to forecast how scientific observations might stimulate others to create new treatments or procedures to control future pandemics. For example, in the *Nature* article, sequence comparisons suggest that the 1918 virus was generated not by incremental changes in the polymerase genes, but by the movement of these genes, in total, from an avian source into a human influenza virus. The availability of these sequences will permit identification of their avian origin and should show why this particular set of genes was selected. Similarly, the results in the *Science* article suggest that the cleavage of a protein on the surface of the 1918 virus, a step critical for virulent infection, may occur by a previously unknown mechanism—a hint that could lead to new drugs for inhibiting this step and thus preventing future pandemic eruptions.

Influenza is highly infectious, and a new strain could spread around the world in a matter of months, if not weeks. The public needs confidence that the 1918 virus will not escape from research labs. All of the described experiments were done in a Biosafety Level 3 laboratory, a high-containment environment recommended by the U.S. Centers for Disease Control and Prevention and the National Institutes of Health on an interim basis, whose use should become a permanent requirement for such experiments. Current evidence suggests that some available drugs and possible future vaccines could suppress infections by the 1918 virus. Given the prospect of another natural influenza pandemic, the recent decision by the U.S. administration to stockpile antivirals for influenza treatment seems wise. Finally, although a sequence of the 1918 virus has been determined and is highly virulent in mice, this may not be the specific form of the virus that caused the pandemic of 1918. An article in the same issue of *Nature*‡ reports the existence of sequence variation in a natural population of influenza virus; yet we have only one sequence for the 1918 pandemic strain, and the reconstructed virus described in the *Science* article was built into the backbone of a laboratory strain. Because a pandemic infection is dependent on many unknown properties, there is no certainty that the reconstructed 1918 virus is capable of causing a pandemic.

Phillip A. Sharp

Phillip A. Sharp is Institute Professor at the Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA 02139, USA.
10.1126/science.1120820

*T. M. Tumpey et al., *Science* 310, 77 (2005). †J. Taubenberger et al., *Nature* 437, 889 (2005). ‡S. Salzberg, *Nature* 10.1038/nature04239 (2005).



Science
7 October 2005

Recent Developments in Publication Practices

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9. *Nature*
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III.J. Obligation to Register Clinical Trials

The ICMJE believes that it is important to foster a comprehensive, publicly available database of clinical trials. The ICMJE defines a clinical trial as any research project that prospectively assigns human subjects to intervention or concurrent comparison or control groups to study the cause-and-effect relationship between a medical intervention and a health outcome. Medical interventions include drugs, surgical procedures, devices, behavioral treatments, process-of-care changes, and the like.

The ICMJE member journals will require, as a condition of consideration for publication in their journals, registration in a public trials registry. The details of this policy are contained under [editorials](#). The ICMJE encourages editors of other biomedical journals to adopt similar policy.

<http://www.clinicaltrials.gov/>

Policies and
Guidelines

Policies

Guidelines

Oversight

Clinical Trials Protocol Registration

The International Committee of Medical Journal Editors (ICMJE) proposed publication policies in 1978 which the Committee has periodically updated since that time. Over 500 biomedical journals use the ICMJE policy as a publication requirement. A recent update announced that beginning July 1, 2005, all clinical trials must be registered on a publicly accessible internet site prior to patient enrollment as a condition for publication in any journal subscribing to the ICMJE publication policy. Beginning September 13, 2005, clinical trials that enrolled their first patients prior to July 1 must be registered before submission for publication. (for more information, go to http://www.icmje.org/clin_trialup.htm).

In large part, this policy will facilitate the peer review of submitted manuscripts to journals using the ICMJE publication policy. Referees will be able to view on-line a description of the clinical trial being reported, and reconcile the data presented with the plan of the study.

The VCU Office of Research endorses the requirement for clinical trial registration, and VCU intends to promote this standard for the following reasons:

- The broad reach of the ICMJE Policy will set a national standard and will eventually be adopted by most, if not all biomedical journals. The concept of clinical trial registration makes sense and is meritorious. Click here for a list of the current subscribing biomedical journals.
- Public access to clinical trial protocols will provide a novel and effective educational tool for human subject volunteers.
- Clinical trials registration ensures continuity in VCU's research enterprise. If a principal investigator directing a trial were to leave the institution, the trial could be continued under a new investigator without concerns about having precluded options for publication of the results.

Frequently Asked Questions

http://www.research.vcu.edu/p_and_g/clinicaltrials.htm

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6. *Journal of Dental Research*
7. *Journal of Experimental Medicine*
8. *Journal of Molecular Biology*
9. *Nature*
10. *New England Journal of Medicine*
11. *Proceedings of the National Academy (USA)*
12. *Science*

What's in a picture? The temptation of image manipulation

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It's all so easy with Photoshop¹. In the days before imaging software became so widely available, making adjustments to image data in the darkroom required considerable effort and/or expertise. It is now very simple, and thus tempting, to adjust or modify digital image files. Many such manipulations, however, constitute inappropriate changes to your original data, and making such changes can be classified as scientific misconduct. Skilled editorial staff can spot such manipulations using features in the imaging software, so manipulation is also a risky proposition.

Good science requires reliable data. Consequently, to protect the integrity of research, the scientific community takes strong action against perceived scientific misconduct. In the current definition provided by the U.S. government: "Research misconduct is defined as fabrication, falsification, or plagiarism in proposing, performing, or reviewing research, or in reporting research results." For example, showing a figure in which part of the image was either selectively altered or reconstructed to show something that did not exist originally (for example, add-

ing or modifying a band in a polyacrylamide gel image) can represent falsification or fabrication.

Being accused of misconduct initiates a painful process that can disrupt one's research and career. To avoid such a situation, it is important to understand where the ethical lines are drawn between acceptable and unacceptable image adjustment.

Here we present some general guidelines for the proper handling of digital image data and provide some specific examples to illustrate pitfalls and inappropriate practices. There are different degrees of severity of a manipulation, depending on whether the alteration deliberately changes the interpretation of the data. That is, creating a result is worse than making weak data look better. Nevertheless, any manipulation that violates these guidelines is a misrepresentation of the original data and is a form of misconduct. All of the examples we will show here have been created by us using Photoshop; although they may appear bizarre, it is remarkable that they are actually based on real cases of digital manipulation discovered by a careful examination of digital images in a sample of papers submitted (or even accepted) for publication in a journal.

Why is it wrong to "touch up" images?

If you misrepresent your data, you are deceiving your colleagues, who expect

age usually carries information beyond the specific point being made. The quality of an image has implications about the care with which it was obtained, and a frequent assumption (though not necessarily true) is that in order to obtain a presentation-quality image, you had to carefully repeat an experiment multiple times.

Manipulating images to make figures more simple and more convincing may also deprive you and your colleagues of seeing other information that is often hidden in a picture or other primary data. Well-known examples include evidence of low quantities of other molecules, variations in the pattern of localization, and interactions or cooperativity.

Journal guidelines

It is surprising that many journals say little or nothing in their "Instructions to Authors" about which types of digital manipulations are acceptable and which are not. The following journals provide some guidelines, but they vary widely in comprehensiveness.

Molecular and Cellular Biology. "Since the contents of computer-generated images can be manipulated for better clarity, the Publications Board at its May 1992 meeting decreed that a description of the software/hardware used should be put in the figure legend(s)."

Journal of Cell Science. "Image enhancement with computer software is acceptable practice, but there is a dan-

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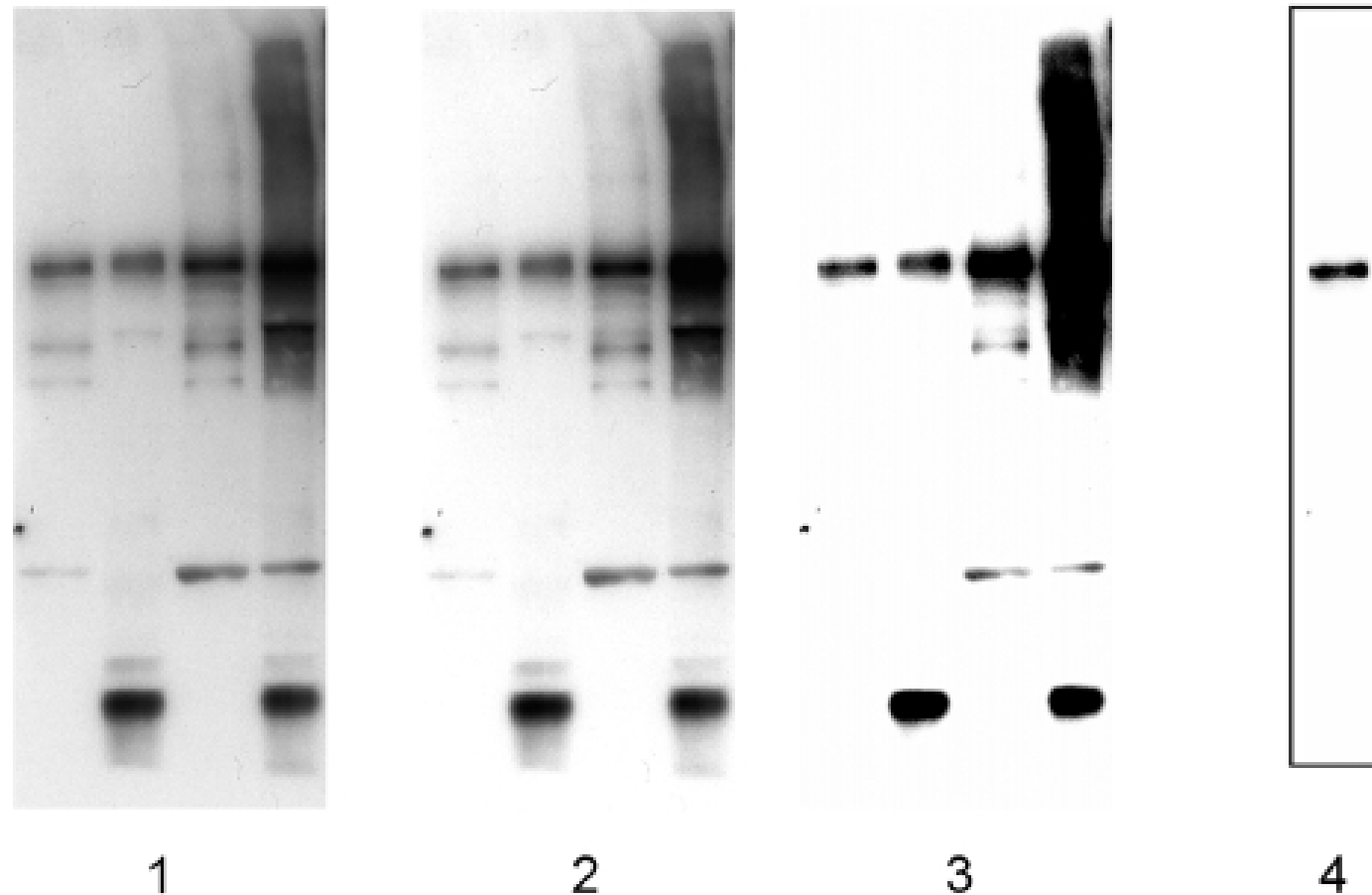


Figure 3. **Manipulation of blots: brightness and contrast adjustments.** (A) Adjusting the intensity of a single band (arrow). (B) Adjustments of contrast. Images 1, 2, and 3 show sequentially more severe adjustments of contrast. Although the adjustment from 1 to 2 is acceptable because it does not obscure any of the bands, the adjustment from 2 to 3 is unacceptable because several bands are eliminated. Cutting out a strip of a blot with the contrast adjusted provides the false impression of a very clean result (image 4 was derived from a heavily adjusted version of the left lane of image 1). For a more detailed discussion of "gel slicing and dicing," see *Nature Cell Biology* editorial (2).

J. Experimental Medicine (Rockefeller Press)

Image Acquisition and Manipulation. No specific feature within an image may be enhanced, obscured, moved, or removed. The grouping of images from different parts of the same gel or from different gels, fields, or exposures must be made explicit by the arrangement of the figure (i.e., using dividing lines) and in the text of the figure legend. If dividing lines are not included, they will be added by our production department, and may result in production delays. Adjustments of brightness, contrast, or color balance are acceptable if they are applied to the whole image and as long as they do not obscure or eliminate any information present in the original, including backgrounds. Without any background information, it is not possible to see exactly how much of the original gel is actually shown. Nonlinear adjustments (e.g., gamma settings) must be disclosed in the figure legend. All digital images in manuscripts accepted for publication will be scrutinized by our production department for any indication of improper manipulation. Questions raised by the production department will be referred to the Editors, who will request the original data from the authors for comparison to the prepared figures. Cases of deliberate misrepresentation of data will be reported to the corresponding author's home institution or funding agency.

Science (AAAS)

Modification of figures. *Science* does not allow certain electronic enhancements or manipulations of micrographs, gels, or other digital images. Figures assembled from multiple photographs or images must indicate the separate parts with lines between them. Linear adjustment of contrast, brightness, or color must be applied to an entire image or plate equally. Nonlinear adjustments must be specified in the figure legend. **Selective enhancement or alteration of one part of an image is not acceptable.** In addition, *Science* may ask authors of papers returned for revision to provide additional documentation of their primary data.

Guide for digital images

Images submitted with a manuscript for review should be minimally processed (for instance, to add arrows to a micrograph). Authors should retain their unprocessed data and metadata files, as editors may request them to aid in manuscript evaluation. If unprocessed data are unavailable, manuscript evaluation may be stalled until the issue is resolved. All digitized images submitted with the final revision of the manuscript must be of high quality and have resolutions of at least 300 dpi.

A certain degree of image processing is acceptable for publication (and for some experiments, fields and techniques is unavoidable), but the final image must correctly represent the original data and conform to community standards. The guidelines below will aid in accurate data presentation at the image processing level; authors must also take care to exercise prudence during data acquisition, where misrepresentation must equally be avoided. Manuscripts should include a single Supplementary Methods file (or a subsection of a larger Supplementary Methods file) labeled 'equipment and settings' that describes for each figure the pertinent instrument settings, acquisition conditions and processing changes, as described in this guide.

Authors should list all image acquisition tools and image processing software packages used.

Authors should document key image-gathering settings and processing manipulations in the Supplementary Methods.

Images gathered at different times or from different locations should not be combined into a single image, unless it is stated that the resultant image is a product of time-averaged data or a time-lapse sequence. If juxtaposing images is essential, the borders should be clearly demarcated in the figure and described in the legend.

The use of touch-up tools, such as cloning and healing tools in Photoshop, or any feature that deliberately obscures manipulations, is to be avoided.

Processing (such as changing brightness and contrast) is appropriate only when it is applied equally across the entire image and is applied equally to controls. Contrast should not be adjusted so that data disappear. Excessive manipulations, such as processing to emphasize one region in the image at the expense of others (for example, through the use of a biased choice of threshold settings), is inappropriate, as is emphasizing experimental data relative to the control.

When submitting revised final figures upon conditional acceptance, authors may be asked to submit original, unprocessed images.

Electrophoretic gels and blots

Positive and negative controls, as well as molecular size markers, should be included on each gel and blot - either in the main figure or an expanded data supplementary figure. For previously characterized antibodies, a citation must be provided. For antibodies less well characterized in the system under study, a detailed characterization that demonstrates not only the specificity of the antibody, but also the range of reactivity of the reagent in the assay, should be published as supplementary information.

The display of cropped gels and blots in the main paper is encouraged if it improves the clarity and conciseness of the presentation. In such cases, the cropping must be mentioned in the figure legend and the supplementary information should include full-length gels and blots wherever possible. These uncropped images should be labeled as in the main text and placed in a single supplementary figure. The manuscript's figure legends should state that "full-length blots/gels are presented in Supplemental Figure X."

Vertically sliced gels that juxtapose lanes that were not contiguous in the experiment must have a clear separation or a black line delineating the boundary between the gels.

Cropped gels in the paper must retain important bands.

Cropped blots in the body of the paper should retain at least six band widths above and below the band.

High-contrast gels and blots are discouraged, as overexposure may mask additional bands. Authors should strive for exposures with gray backgrounds. Multiple exposures should be presented in supplementary information if high contrast is unavoidable. Immunoblots should be surrounded by a black line to indicate the borders of the blot, if the background is faint.

For quantitative comparisons, appropriate reagents, controls and imaging methods with linear signal ranges should be used.

Microscopy

Authors should be prepared to supply the editors with original data upon request, at the resolution collected, from which their images were generated. Cells from multiple fields should not be juxtaposed in a single field; instead multiple supporting fields of cells should be shown as supplementary information.

Specific guidelines: Adjustments should be applied to the entire image. Threshold manipulation, expansion or contraction of signal ranges and the altering of high signals should be avoided. If 'Pseudo-coloring' and nonlinear adjustment (for example 'gamma changes') are used, this must be disclosed. Adjustments of individual color channels are sometimes necessary on 'merged' images, but this should be noted in the figure legend.

We encourage inclusion of the following with the final revised version of the manuscript for publication:

In the Methods, specify the type of equipment (microscopes/objective lenses, cameras, detectors, filter model and batch number) and acquisition software used. Although we appreciate that there is some variation between instruments, equipment settings for critical measurements should also be listed.

A single Supplementary Methods file (or subsection of a Supplementary Methods file) titled 'equipment and settings' should list for each image: acquisition information, including time and space resolution data (xyz and pixel dimensions); image bit depth; experimental conditions such as temperature and imaging medium; and fluorochromes (excitation and emission wavelengths or ranges, filters, dichroic beamsplitters, if any).

The display lookup table (LUT) and the quantitative map between the LUT and the bitmap should be provided, especially when rainbow pseudocolor is used. If the LUT is linear and covers the full range of the data, that should be stated.

Processing software should be named and manipulations indicated (such as type of deconvolution, 3D reconstructions, surface and volume rendering, 'gamma changes', filtering, thresholding and projection).

Authors should state the measured resolution at which an image was acquired and any downstream processing or averaging that enhances the resolution of the image.

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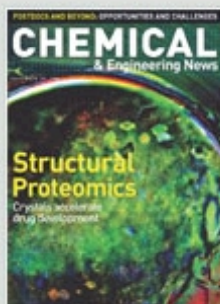
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SCIENTIFIC PUBLISHING

NIH UNVEILS DRAFT OPEN-ACCESS PLAN

Agency's policy closely resembles one proposed by Congress

[SUSAN MORRISSEY](#)

A draft policy for open access to NIH-funded research was released by the health agency on Sept. 3 and [posted for](#) its website. As released, the plan closely resembles one [previously](#) suggested by Congress ([C&EN, Sept. 6, page 14](#))

Under the proposed plan, once manuscripts describing research supported in whole or in part by NIH funds have been accepted for publication, they would have to be posted on [PubMed Central](#), the agency's free digital archive of research. The manuscripts would then be posted on PubMed six months after journal publication. Final edits by the publisher would not be reflected in the NIH Web posting.

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