ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT
GLOBAL SCIENCE FORUM

Best Practices for Ensuring Scientific Integrity and Preventing Misconduct

Contents

1. Rationale 1
2. Background 2
3. The Varieties of Misconduct, and its Consequences 2
4. Options for Dealing with Misconduct Allegations 5
5. Responding to Misconduct Allegations 8
6. Investigating Misconduct 9
7. International Considerations 11
8. Causes, Contributing Factors, and Prevention 11

1. Rationale

Misconduct in research (for example, fabrication, falsification, and plagiarism) damages the scientific enterprise, is a misuse of public funds, and undermines the trust of citizens in science and in government. Misconduct is a special concern for governmental administrators, who are the primary constituency of the OECD Global Science Forum. On behalf of the public, and to achieve societal benefits, they fund, oversee and evaluate research, much of which is conducted directly in public institutions or is otherwise sponsored by governments. At a time when scientific advances are considered to be critical in areas such as economic competitiveness, health, national security, and environmental protection, public officials are strongly motivated – indeed obligated – to ensure the highest levels of integrity in research.

Widespread attention has recently focussed on a few cases of misconduct in research. Their significance, the damage done, and potential preventive measures are debated by scientists, government officials, the press, and concerned members of the public. Recognising that the issue affects all of these stakeholder communities and that, like science itself, the problem has a major international dimension, the OECD Global Science Forum sponsored an international consultation of government-designated officials and experts, based on an initiative from the Delegations of Japan and Canada. On February 22-23, 2007, in Tokyo, the Global Science Forum and the Ministry of Education, Culture, Sports, Science and Technology of Japan (MEXT) held the *Workshop on Best Practices for Ensuring Scientific Integrity and Preventing Misconduct*.

The goal of the OECD Workshop was to deepen the understanding of the underlying phenomena, to identify the range of possible solutions and, based on experience, to enumerate the pros and cons of various practical measures, lessons learned and good practices. This report summarises the deliberations that took place in Tokyo. Its findings and conclusions pertain to all domains of basic and applied science: the physical and life sciences, social and behavioural sciences, and the humanities.

Ensuring integrity in science is a complex, multifaceted task, touching upon education, publication, the functions of scientific and academic institutions, and the responsibilities of funding agencies. The present report refers to all of these, but its main focus is on the practical and administrative dimensions of dealing with allegations of misconduct. A number of countries are currently creating, modifying, or reviewing their administrative mechanisms for dealing with such allegations. For these countries, the Global Science Forum workshop and report should be particularly timely, by providing an opportunity for international consultation, and for learning from the experiences of others. Workshop participants addressed the issue of integrity in international collaborations, and they deliberated about possible new steps that might be needed to deal with special problems created by the differences in the ways that collaborating countries deal with allegations of misconduct. This matter will be the subject of follow-on work by the Global Science Forum.

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2. Background

This report is based on the Tokyo workshop, and on information compiled during the preparations for the event. A preliminary version of the report was provided as input to the "World Conference on Research Integrity" that was held in Lisbon on September 16-19, 2007[1]. The document was subsequently modified, and reviewed by the Chair and Vice-Chairs of the Global Science Forum. They approved and accepted this final version of the report on behalf of the Forum, and authorised its release to the general public.

It is important to state explicitly that this report is of an informative and advisory nature, without any attempt to instruct governments regarding what they should do in the matter of misconduct in research. The Global Science Forum, and the participants of the Tokyo workshop, have neither the authority nor the inclination to impose any prescriptive measures on sovereign governments. In addition, it is recognised that there is not an all-embracing, one-size-fits-all global solution, due to the considerable diversity among countries in such variables as the overall structure of the science system, the roles of public and private institutions, the status of researchers (e.g., whether they are public servants), the legal system, and historical traditions and customs. Even so, and within the constraints imposed by these legitimate differences, benefits could be derived from harmonising definitions, rules and procedures, sharing information internationally, and encouraging cooperation among officials and administrators who are responsible for promoting and enforcing integrity in research.

The Tokyo workshop was attended by over 50 government-appointed representatives of 23 countries, 2 invited experts, and the OECD secretariat. It was chaired by Professor Makoto Asashima of Japan and Dr. Nigel Lloyd of Canada. To supervise the workshop preparations, fourteen GSF delegations nominated members to the International Steering Committee (ISC). Delegations also designated national experts who were interviewed by the GSF secretariat. A detailed annotated agenda was prepared based on these interviews.

The Global Science Forum of the Organisation for Economic Co-operation and Development is a venue for consultations among senior science policy officials of the OECD member and observer countries on matters relating to fundamental scientific research. The Forum's activities produce findings and recommendations for actions by governments, international organisations, and the scientific community. The Global Science Forum's mandate was adopted by OECD science ministers in 1999, and an extension until 2009 was endorsed by ministers in February 2004. The Forum serves its member delegations by exploring opportunities for new or enhanced international co-operation in selected scientific areas; by defining international frameworks for national or regional science policy decisions; and by addressing the scientific dimensions of issues of social concern.

The Global Science Forum meets twice each year at OECD headquarters in Paris. At these meetings, selected subsidiary activities are reviewed and approved, based on proposals from national governments. The activities may take the form of studies, working groups, task forces, and workshops. The normal duration of an activity is one or two years, and a public policy-level report is always issued. The Forum's reports are available at www.oecd.org/sti/gsf.

3. The Varieties of Misconduct, and its Consequences

A wide range of (mis)behaviours by scientists can be labelled "misconduct". Clarity and consistency in defining misconduct are prerequisites to establishing or evaluating an administrative system for processing misconduct allegations, and for understanding the underlying causes and effective remedies. A variety of administrative mechanisms and modalities (including prevention and investigation/enforcement) may be needed to deal correctly with the diversity of inappropriate behaviours. In particular, it is important to identify instances of misconduct that can be remediated via education, or that merit a full investigation, including procedures for establishing innocence or guilt.

[1] The report of the conference rapporteur, Dr. Peter Tindemans, can be found at www.esf.org/conferences/researchintegrity

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During the course of preparing the OECD workshop, interviews with experts revealed a broad spectrum of types of misconduct by scientists, as shown in the following table[2]:

Core "Research Misconduct" **F**abrication of data **F**alsification of data **P**lagiarism FFP normally includes: Selectively excluding data from analysis Misinterpreting data to obtain desired results (including inappropriate use of statistical methods) Doctoring images in publications Producing false data or results under pressure from a sponsor	Research practice misconduct Using inappropriate (e.g., harmful or dangerous) research methods Poor research design Experimental, analytical, computational errors Violation of human subject protocols Abuse of laboratory animals
Data-related misconduct Not preserving primary data Bad data management, storage Withholding data from the scientific community NB: The above applies to physical research materials as well	Publication-related misconduct Claiming undeserved authorship Denying authorship to contributors Artificially proliferating publications ("salami-slicing") Failure to correct the publication record
Personal misconduct Inappropriate personal behaviour, harassment Inadequate leadership, mentoring, counselling of students Insensitivity to social or cultural norms	Financial, and other misconduct Peer review abuse e.g., non-disclosure of conflict of interest, unfairly holding up a rival's publication Misrepresenting credentials or publication record Misuse of research funds for unauthorised purchases or for personal gain Making an unsubstantiated or malicious misconduct allegation

At the core of the spectrum of inappropriate behaviours is "Research Misconduct", consisting of Fabrication, Falsification and Plagiarism (FFP). Various definitions of these terms are possible. For example, the United States government defines research misconduct in a way that has been adopted in some other countries[3]:

> Research misconduct is defined as fabrication, falsification, or plagiarism in proposing, performing, or reviewing research, or in reporting research results.
>
> Fabrication is making up results and recording or reporting them.

[2] The chosen classification scheme is not intended to be exhaustive, or to constitute a universally valid intellectual framework for theoretical studies of research misconduct. In this report, it is presented merely as a way to summarise the information distilled from the expert interviews.

[3] The definition given above is not unique. It can, for example, be broadened to include "… significant departure from accepted practices of the scientific community". Alternative broad formulations can be used, such as "Behaviour by a researcher, intentional or not, that falls short of good ethical and scientific standards". The latter text has been adopted by the Committee on Publication Ethics.

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Falsification is manipulating research, materials, equipment, or processes, or changing or omitting data or results such that the research is not accurately represented in the research record.

Plagiarism is the appropriation of another person's ideas, processes, results, or words without giving appropriate credit, including those obtained through confidential review of others' research proposals and manuscripts.

Research misconduct does not include honest error or honest differences of opinions.

There is general agreement that credible allegations of research misconduct (FFP) should be investigated, and that corrective actions should be undertaken if the investigation makes a positive finding. The same applies to financial misconduct, and harassment, which are in the province of accounting and administrative departments in research institutions and appropriate government agencies. At the other end of the spectrum are such phenomena as inadequate mentoring of students, or incompetence in performing research. For these, the internal mechanisms of the scientific community can, in most cases, provide effective remedies, without the need for formal investigative actions. But there are also intermediate categories of misconduct where science administrations may need to be involved. The establishment of an optimal mapping between the offence and the method/venue for dealing with it is difficult. It is complicated by the importance of determining whether an inappropriate action was deliberate, i.e., of establishing intent. This is notoriously difficult to do in any investigation. For example, if the validity of published results is questioned, the subsequent inability of the researcher to provide primary data may be the result of a genuine mistake or accident, but it could also be considered as *prima facie* proof of serious misconduct if it can be established that it was done deliberately to conceal an act of FFP.

Misconduct in research damages science, but its consequences also extend into the broader societal sphere. The following general areas where negative impact occurs were identified in the run-up to, and during, the OECD workshop:

- Harm to individuals and to society, if fraudulent research results in the release of an unsafe product or process (e.g., a drug or a therapy). Society may be harmed if false results become widely known and believed. The formal responsibility for protecting the public lies mostly outside the research administration system, and is assured by a well-developed structure of national laws, regulations, and institutions (e.g., the drug approval process). Even so, research administrations must assume responsibility for not burdening the regulatory process.

- Direct damage to science itself, by creating false leads for other scientists to follow, and/or forcing others to waste time, effort and money to reproduce fraudulent results. Fortunately, the research record is inherently self-correcting, since repeatability, verifiability and consistency are hallmarks of the scientific method. However, incorrect results can persist and mislead for extended periods of time.

- The degradation of relations among scientists, between senior researchers and students, and between researchers and agency programme managers.

- Damage to science through the undermining of the public's trust in science, and of the government's ability to foster and promote research in a competent and responsible manner. A possible consequence is a decline in the credibility of scientific analysis and advice on issues that have important implications for society. These issues (in such areas as health, environment, energy, national security) often have a major scientific component, and science-based laws and regulations may be needed to address them.

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Conclusion A:

Instances of misconduct in research are regrettable, but real, occurrences within the scientific enterprise. Scientists, like all professionals, are subject to pressures and temptations, and they are no more nor less likely than others to behave badly. The prevalence of misconduct is difficult to measure but, when it occurs, the damage to science, and to the way it is perceived and utilised, can be severe.

Misconduct by scientists can take many forms, each affecting differently the stakeholders, such as researchers, institutions, government agencies, publishers, and the public. A well-designed strategy for promoting integrity should take this diversity into account by identifying the most appropriate methods and venues for dealing with each category of misconduct. As in other instances where society confronts individual wrongdoing, an optimal response contains elements of both prevention and enforcement. However, it is always better to prevent bad behaviour than to be forced to deal with its consequences. Accordingly, an optimal strategy consists of actively promoting integrity and deterring misconduct within all of the components of the scientific enterprise: universities and other research institutions, funding agencies, professional organizations (unions, academies, etc.), the publishing establishment, and in fora where scientists and the public interact.

4. Options for Dealing with Research Misconduct Allegations

Sections 4-7 of this report concern the practical, administrative aspects of dealing with misconduct allegations. The focus is on underlying principles and actionable procedures. It is worth repeating that no attempt is being made to devise a universal prescription for a system that all governments should put in place. Rather, the enumeration and analysis of the selected topics are meant to constitute a kind of "checklist" of issues that should be given consideration when creating or fine-tuning a system of national or local principles, rules, and procedures.

Given the inter-governmental status of the OECD Global Science Forum, this material is presented primarily for consideration by responsible public officials. Their role is a special one, and it is sometimes underappreciated. There is a body of opinion claiming that all matters pertaining to integrity should be handled exclusively within the scientific community, and in the context of the corresponding institutional frameworks (for example, academic departments at universities). However, government officials have certain responsibilities that they cannot delegate:

- They are formally accountable for the proper spending of public funds. In particular, they manage the granting process (including reviews of applications and monitoring of progress) which cannot function properly if it becomes compromised by dishonesty. As described further in Section 8, the granting procedures that agencies establish may have an effect on the prevalence of certain forms of misconduct (i.e., they can have a corrupting effect on susceptible individuals).
- They are responsible for public safety, which can be compromised by the consequences of misconduct in research.
- They fund (and are otherwise involved with) the education and training of researchers - activities that are vital for promoting integrity and preventing misconduct.
- On a practical level, they are sometimes the only agents who have the means to conduct especially complex or difficult investigations, or ones that transcend national borders.

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Based on the information gathered during the preparations for the Tokyo workshop, and at the workshop itself, it appears that dealing with misconduct in research is a shared responsibility of public officials, scientists and institutional administrators. The division of roles differs from country to country but, in general, three generic ways of handling misconduct cases can be identified:

a) Ad-hoc committees established to deal with specific cases. Such committees are often composed of prestigious individuals, possibly under the aegis of existing university-based ethics committees. The advantage of this approach is that ethics committees already exist at many institutions, although they are often associated chiefly with the life/medical sciences, and handle matters relating to human experimental subjects and patients. While the work of these bodies is vital, it cannot be assumed that they can handle all cases of misconduct in research. Ethical issues (i.e., questions of right and wrong and fairness) underlie the very concept of misconduct, but the practical adjudication of concrete cases revolves more around the determination of facts and the careful analysis of events, documents and other data records. This, in turn, can be difficult to do without specialised expertise, as well as special-purpose rules, regulations and precedents. All ad-hoc processes suffer, to some extent, from a deficit of consistency, since the functioning of each individual committee depends critically on its makeup, i.e., on the preferences, opinions and experiences of its members. For misconduct investigations, fairness and consistency are critical attributes, which can be difficult to ensure in an ad-hoc process. Extending the mandate of ethics committees to handling cases of misconduct in research should be accompanied by careful analysis and, if needed, modifications of existing rules and procedures.

b) Standing committees in research institutions. Some countries rely on standing entities (offices, officers, committees) and corresponding procedures, at the level of the institution (e.g., university, large laboratory) where the misconduct occurs. These can be responsible for receiving allegations, processing them (including conducting investigations), and recommending outcomes. Typically, these entities are not entirely autonomous: there is a measure of interaction with a government-mandated central national authority, for example, a funding agency. A system of this kind generally benefits from good acceptance by scientists, who prefer to put their trust in local arrangements that operate under terms and conditions that they can observe and understand. Acceptance by the community is a vital attribute of any misconduct-processing system. Scientists are understandably protective of their reputations and careers, which can be seriously damaged by allegations, or even mere rumours, of misconduct.

   A purely local arrangement ensures consistency of procedures throughout a given organisation (for instance, a large university) but does not necessarily do so at the national level – a source of potential problems when allegations of misconduct involve more than one institution. The cost, workload and administrative overheads of maintaining standing bodies must also be considered. Furthermore, there may be an inherent conflict of interest that could lead to the unjustified suppression of cases, based on a desire to avoid unfavourable publicity for the local institution.

c) One or more dedicated committee(s) at the national level. This variant may be preferred by countries whose scientific communities are small, and where it may be difficult to establish committees of impartial scientists, free of personal conflicts of interest. Members of permanent national committees can be selected so as to represent a wide spectrum of relevant expertise (for example, detailed legal experience), drawing on extensive human resources. A national committee can establish a consistent track record of cases, and there are benefits from having a stable support staff, consistent long-term relations with funding agencies, and independence from the vagaries of changing national governments. A committee of this kind can play a major role in reviewing and fine-tuning its own procedures, in advising the government on misconduct-related policies, in maintaining a permanent record of misconduct-related information, and in coordinating with similar committees in other countries.

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Countries that put in place formal procedures for dealing with misconduct allegations usually establish an Inquiry process, in which the allegations are received and evaluated, as well as an Investigation process which becomes activated if the Inquiry determines that this is appropriate. The two processes are dealt with in more detail in Sections 5 and 6 respectively.

Based on informal evidence presented at the OECD workshop, it may be the case that countries relying on ad-hoc committees generally report few cases of misconduct, and that the countries that have made a transition to more structured arrangements find that the number of cases increases. Such a transition can thus be difficult, since the public may incorrectly perceive an increase in dishonesty among scientists.

Regardless of the details of the system that is adopted in any country, the following *desiderata* were identified at the OECD workshop:

- To the extent possible, a uniform system should be adopted in each country. The question of international harmonisation of definitions, standards, and procedures deserves further study, given the growth in international collaborative research, and the increasing mobility of scientists.
- The pertinent principles, rules, and procedures should be clearly defined and well publicised. They should include the definitions of misconduct, and the steps for receiving and processing allegations. This promotes fairness (in both perception and reality) and ensures that the process will not be seen as arbitrary or deliberately targeted against any individual.
- Any system must be (and be seen as) scrupulously fair. A good way to ensure this is to distribute responsibility for the phases of the overall process (initial inquiry, investigation, adjudication, appeal) among the components of the system. Thus, for example, the entity (person or group of persons) that is responsible for the initial evaluation of an allegation (such as an ombudsman's office) would not be the same as the entity that decides on corrective measures or that considers an appeal. The feasibility of such an arrangement of "checks and balances" depends on local/national circumstances. Where it is implemented, it appears to work best when the entities are administratively independent of one another.
- The adopted system should only be as extensive as necessary to ensure the integrity of the research process. Understandably, some scientists worry that authorities may, inadvertently, set up oversight and reporting systems that are bureaucratic, unnecessarily burdensome, intrusive, or unfair. Others worry that the traditional openness and freedom of the research process could be jeopardised by excessive scrutiny and regulation. These legitimate concerns must be taken into account, and a special effort made to demonstrate the advantages of dealing with misconduct allegations in a confidential, fair and efficient manner. Monitoring and periodic evaluation are useful for ensuring that the system does not become too cumbersome or oppressive.
- The relationship to the national legal system must be defined and understood, considering that most of the misconduct-related procedures will take place at the administrative level. But there may be conditions under which reporting to legal authorities (i.e., regulatory, civil or criminal) may be necessary, provided that this is carried out in a systematic, consistent way. In such cases, care must be taken to ensure that the two processes interact constructively, with due recognition for national laws, administrative structures, traditions, and other circumstances.
- Even if the "local" system is adopted ("b" above), some overarching national governmental structure can be considered. At a minimum, its roles could be to provide a venue for consultations, evaluation, appeal, settling inter-organisational disputes, interfacing with authorities in other countries, or even taking over an investigation if the home institution is too small or otherwise can't do it. In addition, the local body can play an active role in preventing misconduct, e.g., setting standards for education and training of students and staff.
- There ought to be agreed-upon standards of performance, and periodic evaluation, as well as a mechanism for modifying the system based on the assessment results.

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Conclusion B:

There is no universal optimal system for dealing with misconduct in research. Administrations are free to design and implement the system that meets their needs and is consistent with the way research is managed in a given country or institution, and is compatible with local laws and traditions. Nonetheless, interested administrations are encouraged to implement such a system and to publicise it in the relevant communities. Wide-ranging consultations with principal stakeholders are desirable: with researchers, funding agencies, scientific publishers, representatives of the public. Sections 4-7 of this report can serve as an unofficial "checklist" of issues to be considered and questions to be answered.

5. Responding to Misconduct Allegations

Misconduct allegations most often arise in a spontaneous, unsolicited way; for example, when a graduate student (or other collaborator of the accused scientist) suspects that data have been fabricated. A researcher in the same domain may become suspicious when unable to reproduce a measurement, or evidence may emerge from a computerised search for plagiarised text, or evidence may be discovered by potential employers during verification of claims made in a CV. All too often, the potential accuser has no idea where to turn with the suspicions, and such uncertainty can be a powerful disincentive to taking action. Those seeking to create, review, or modify a system for dealing with misconduct would benefit from seeking answers to the following questions regarding the all-important "first link in the investigative chain":

- Who is the first person/organisation to turn to with an allegation or suspicion? Is there a special office/officer located near the same venue as the person who suspects misconduct? If so, does the person receiving the allegation have special expertise or training?
- Is the receiving office/officer someone whose elevated standing (e.g., dean of an academic faculty, high-level official of a science ministry) could discourage a student or other person who is in the lower ranks of the hierarchy? Does the allegation have to be presented to a person who has authority over the accuser (for example, a departmental chairperson vis-à-vis a graduate student)?
- Is adequate information available to the potential accuser? Is there generally accessible information on a web site, for instance, or via an anonymous hotline? Is there someone to consult when merely a suspicion exists, without certainty or definitive evidence?
- Are there requirements/restrictions on who can be accused (and be an accuser)? Can anyone come forward with an allegation? Are there restrictions on substance (for example, work outside one's academic field, work not published in a peer-reviewed journal, "opinion"-type work)? Does suspect work need to be published, versus presented in a conference, or mentioned in a conversation?
- Are anonymous allegations accepted?
- Is there the equivalent of a "statute of limitations" for misconduct allegations?
- How does the system deal with frivolous or malicious accusations? Does bringing forward a false accusation itself constitute actionable misconduct?
- What is the receiving person's exact role and authority? Does he/she play a mediator role, or just decide the merits of the allegation?

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Conclusion C:

Well-intentioned persons who have a legitimate suspicion that misconduct may have occurred should have access to local information and assistance. Recognising that suspicions of misconduct place both accused and accuser in vulnerable positions, the first administrative response should be characterised by sensitivity, confidentiality, objectivity, and fairness. Persons receiving a suspicion or allegation should have the appropriate competence, training and mandate (including links to higher-level authorities, should they be needed). If possible, these persons should have the authority to resolve conflicts that do not merit a full investigative proceeding.

6. Investigating Misconduct

The rules and procedures for misconduct investigations should explicitly address the following issues and questions:

- For an ad-hoc local body, are there guidelines regarding such matters as:
  - The number of members and their affiliation (from inside/outside the institution where misconduct is alleged)
  - The areas of expertise that committee members need (including professional/judicial/procedural)
  - Avoidance of conflict of interest (and how conflict of interest is defined), including potential bias by local-level committees towards protecting the reputation of a home institution.

- How and under what authority does the investigatory body obtain the cooperation of the parties, especially those who are not themselves accused? Can they compel collaborators to provide data or testimony? What if they need cooperation from outside the institution? Does lack of cooperation with an investigation itself constitute misconduct?

- In cases involving collaboration among scientists from two or more institutions, questions of jurisdiction naturally arise, since parallel duplicative investigations are undesirable. One possible practical solution is to assign the task to the institution providing the greater share of the research funds.

- Can an investigation be enlarged as new evidence is discovered? Can it be extended to other institutions? If so, should additional committees be established? Is there a time limit on investigations? What happens if the accused resigns, stops the work, etc.? What happens if regulatory or criminal violations are uncovered? Does the misconduct investigation continue in parallel with other processes that may be triggered?

- Are there limits on the power/authority of the investigators? How much new work can they require (for example, repeating an entire series of experiments)?

- What is the source of funds for conducting an investigation? Do funding agencies provide any support?

- Questions of fairness are particularly important when dealing with misconduct, because the investigation process is a quasi-legal one; that is, it has many of the attributes of criminal or civil procedures, but is reduced in complexity and is meant to function more quickly. Moreover, the penalties can be severe, amounting to the destruction of a scientist's reputation and career. Precise definitions, policies and procedures for misconduct investigations are needed to prevent the perception (or, worse, the reality) of a "witch hunt", i.e., a process whose rules are contrived to persecute an individual, based on personal conflicts, or the unpopularity of a particular line of

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research. At the OECD workshop, attention was called to the undesirability of labelling as "misconduct" the pursuit of research that is merely outside of the mainstream scientific consensus – a hazard that could be linked to overly-broad definitions of misconduct. Accordingly, when constructing investigative procedures, answers can be sought to the following questions:

- What are the conditions and rules of confidentiality for accuser and accused? Can "whistleblowers" be given anonymity and protected from retaliation, without generating spurious/frivolous allegations?
- What is the standard of proof in a misconduct investigation (e.g., preponderance of evidence, proof beyond a reasonable doubt)? Is there a presumption of innocence? How can the validity of the proceedings be ensured, given that the investigators may be prominent scientists, but legal amateurs? What if the accused is doing "unpopular science" that draws the hostility of colleagues? In cases where intentional misconduct is hard to distinguish from unintentional carelessness in carrying out research, how do the investigators establish intent?
- How can the accused defend him/herself? Does he/she have access to documents, testimony? Can the accused confront accusers and witnesses? Can the accused be assisted by a lawyer during the proceedings? Does the accused have a right to question the composition of the investigating body? Can one set of allegations give rise to more than one investigation ("double jeopardy")? In general, how do the rights of the accused compare to those in a criminal or civil proceeding?
- What are the rights of appeal and review (by accuser or accused) at each step of the investigation?
- Who is notified of the progress of the investigation, and when? How much detail is provided (e.g., to the funding agency)? Can the agency provide feedback, suggestions, information? Can it play a more active role during the investigation?
- What are the conditions of access by journalists and the public to the outcomes and records of investigations? When are names named (those of the accuser and accused, and/or other persons involved in the investigation)? If no finding of misconduct is made, can the exonerated scientist require that a formal exoneration be published? How do requests for information relate to "sunshine" or freedom-of-information-type laws? Is it feasible to institute restrictions on speaking to journalists (a "gag order") during the investigation?

- Concluding a misconduct investigation
  - Can disciplinary measures begin during the investigation (e.g., suspension of the research, withholding of a grant)?
  - Is there a fixed set of possible "verdicts"? Is it a simple guilty/not guilty system, or are shadings possible? Is there a reasonable and consistently applied relationship between the seriousness of the misconduct and the severity of the imposed punishment? Does the investigating body just make findings, or can it also recommend corrective actions (including the punishment of guilty individuals, retraction of tainted publications, and other measures to protect science and the public interest)? Can action be taken with regard to persons who should have exercised better supervision, even if they have not actively committed misconduct?
  - What specific steps can be taken to restore a damaged reputation, and to restore a project that may have been delayed or disrupted during an investigation?
  - Is there any provision for protecting "innocent bystanders", such as graduate students whose projects may be terminated even if their work had nothing to do with the misconduct committed by the principal investigator?

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Conclusion D:

Misconduct investigations must themselves satisfy the highest levels of integrity and accuracy, given that they are administrative procedures, and thus are not characterised by all of the standards and protections of the legal system. Fairness and credibility are critical, since the reputations of scientists are easily damaged and difficult to restore. Corrective actions should be commensurate with the seriousness of the misconduct, should be consistently applied, and should be aimed at undoing the consequences of misconduct. A good way to ensure these characteristics is via a well-defined and time-tested set of definitions, principles, and administrative arrangements. The issues and options enumerated in Section 6 of this report are a reference for designing the details of an investigative process.

7. International Considerations

National and local administrators actively promote integrity in research, but their work is particularly difficult when allegations of misconduct concern projects that involve collaborators from two or more countries. The principles, definitions, rules, and procedures may differ, or be absent, in those countries. Questions of authority and jurisdiction arise when more than one entity could investigate the same case. In addition, there may be purely practical difficulties linked to obtaining needed testimony and data. A finding of the OECD Tokyo workshop is that misconduct in international collaborations represents an important challenge. Among the recommendations of the workshop is strengthening contacts among the responsible national officials, and establishing an international venue that would allow them to: (a) share information about national definitions, rules, and procedures for dealing with allegations of misconduct; (b) cooperate on actual investigations, when there is a need to share data, physical records, or access to personnel; (c) develop generic models of misconduct-related documents for international research agreements (contracts, memoranda of understanding, founding documents for international research facilities, etc.); (d) harmonise national arrangements for dealing with misconduct, while recognising the legitimate intrinsic differences between national systems.

Conclusion E:

Responding to misconduct allegations in international collaborative projects is especially challenging due to possibly incompatible definitions, standards and procedures in participating countries. There are also purely practical problems associated with conducting inquiries across national boundaries, for example, linguistic barriers, and the lack of familiarity with institutional arrangements and personnel. Since the internationalisation of research is on the rise, it makes sense for competent national administrations to increase their level of cooperation, in order to understand one another's requirements and constraints. Harmonisation and convergence on definitions and procedures is also desirable. Interested countries are encouraged to undertake an international dialog among national practitioners. Initially, this dialog could take place under the aegis of the OECD Global Science Forum.

8. Causes, Contributing Factors, and Prevention

An act of misconduct in research is an instance of moral failure, where an individual makes an intentional choice to behave badly. The detailed examination and causal explication of any such act is inherently difficult. Given identical circumstances, one scientist would commit misconduct, whereas a hundred others would not. It has been argued that seeking causes and explanations is pointless: bad people will behave badly, and good people will behave well. This line of argument is overly simplistic. A more reasonable hypothesis is that some individuals have a propensity (or susceptibility) to misbehaviour, which can be aggravated (and lead to concrete acts of misconduct) by external factors, such as the ones listed below.

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Identification of contributing factors can be useful for devising remedies and preventative measures. It should be understood, however, that acknowledgement of external influences in no way implies that the behaviour should be tolerated or excused.

During the course of preparations, and at the OECD workshop itself, the following potential causes and contributing factors were cited[4].

Factors relating primarily to individual researchers and their careers:

- Pressure of severe competition for funds.
- Requirements to achieve significant positive results (and to publish extensively) in order to obtain and secure a staff position in a research institution, or to receive favourable consideration for future funding of research.
- Lack of knowledge/preparation about the realities and stresses of a scientific career.
- Pressure to achieve a desired result in the case of sponsored applied research.
- Assorted personal failings (e.g., a craving for fame, a desire to hurt colleagues, a general lack of moral rectitude).

Factors relating primarily to the evolving nature of science and of the research enterprise:

- The negative aspects of fragmentation, isolation and specialisation. In some scientific domains, researchers work for long periods without adequate contact or interaction with colleagues who would be in a position to scrutinise and review their results. This can result in the proliferation of "lone wolf" researchers who may lose their grip on proper standards of conduct. But it can occur in large collaborations as well, if the project brings together individuals from vastly different scientific domains, and if collaborators do not adequately monitor one another's work.
- The proliferation of highly specialised, custom-built scientific instruments that can only be meaningfully operated by one researcher, thus making it difficult to independently verify that measurements are untainted or, in the event of controversy, to reproduce questionable measurements.
- The ready availability of complex, opaque software for statistical analysis and other manipulations (notably, image processing) that make it easier to commit and conceal falsification and fabrication.
- Lack of awareness of the rules and standards of proper scientific conduct, of the investigative processes that are in place, and of the penalties that can be imposed on those found guilty of misconduct. In some cases, individuals (especially students) may be truly unaware that certain behaviours (notably plagiarism) constitute misconduct.
- Misapplication of the mission-oriented research paradigm (where concrete, usable results are expected in the relatively short term) to the traditional curiosity-driven research process.
- Expectations and pressure from supervisors, sponsors or publishers for positive, unambiguous and significant results. In general, the prevalence of misconduct can be aggravated by an unsupportive or indifferent environment where integrity is ignored or downplayed.

In connection with the OECD workshop, a number of potential remedies were identified for lessening the prevalence of misconduct in research. These are listed below. There is a possible analogy to remedies that society uses to deal with criminality in general, in that there are two basic approaches that can be followed concurrently: (1) prevention; and (2) deterrence/enforcement. The first approach focuses on the underlying systemic factors that can push susceptible individuals over the threshold of violating established scientific norms. The second aims to exclude guilty individuals from the scientific community, thereby also deterring others by demonstrating the dire consequences of committing misconduct. Among specific steps that can be taken are the following:

[4] As in Section 2 of this report (footnote 2), a *caveat* applies here, namely, that no attempt is made at presenting a complete and universally valid theoretical framework for understanding the causes of misconduct.

ED_006238_00001329-00012

- Designing and implementing a formal system for addressing allegations of misconduct in research. The system should be tailored to local conditions and requirements, taking into account the issues and questions enumerated in Sections 4-7 of this report.
- Making the results of each investigation known in the scientific community, as a deterrent to similar occurrences[5].
- Adopting definitions, standards, rules and codes of conduct. These can cover three areas: (1) good scientific practice (e.g., experimental design, laboratory safety, error analysis, data curation and access); (2) traditional ethics issues (e.g., rights of human subjects, handling of experimental animals, philosophical/moral aspects of research in human reproductive biology, defence-related research); and (3) misconduct as considered in this report.
- Promoting the internalisation of rules and standards via carefully designed and implemented educational measures. Curriculum design is a key issue, as is the question of when (at what stage of a scientific career) educational measures can be most effective.
- Incorporating instruction about responsible conduct of research in student curricula, and in the training of faculty, staff and technical personnel. Of particular value is instructing graduate students about the realities of scientific careers, including a realistic description of the pressures that can destabilise the lives of postdoctoral fellows and assistant professors.
- At the level of research institutions (e.g., university departments, large laboratories), actively fostering open and frank discussion of misconduct-related matters. Promoting collegiality and networking among colleagues to discourage isolation of the type that can harm susceptible individuals ("lone wolf" scientists) and to clarify collaborators' responsibilities within research collaborations. At the institutional level, rewarding those leaders who set an example by visibly adopting the standards of integrity in research.
- In hiring and promotion, rewarding quality of work rather than quantity of publications.
- To the extent possible, streamlining, rationalising, and simplifying the grant application and award system.
- In scientific publishing (and in grant applications) adopting clear, uniform standards for:
  - authorship criteria for papers, including obligations of co-authors
  - allowable types of image processing in published images
  - requirements for making primary and secondary data available to the general scientific community
  - conditions under which results will be published (i.e., with or without permission of the sponsor)
- Making use of computer-assisted tools (software) for detecting plagiarism in publications, proposals, reports, etc. Promoting the development of software for detecting fraud in images, data, figures, etc.

Conclusion F:

Understanding the causes is useful for devising effective measures for preventing scientific misconduct, and for dealing with it when it occurs. A number of hypothetical causative factors are enumerated in this report, and, for each one, corresponding remedies can be devised. Of particular value are: educating young researchers, based on the existence of standards of conduct; fostering frank debate about misconduct at the institutional level; devising a credible and transparent system for dealing with misconduct allegations; publicising the results of completed investigations; streamlining and rationalising the process of hiring, promotion and grant review.

[5] Privacy and confidentiality have to be respected when the results of investigations are publicly disclosed.

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