Evaluation of the Research Norms of Scientists and Administrators Responsible for Academic Research Integrity

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Context.—The professional integrity of scientists is important to society as a whole and particularly to disciplines such as medicine that depend heavily on scientific advances for their progress.

Objective.—To characterize the professional norms of active scientists and compare them with those of individuals with institutional responsibility for the conduct of research.

Design.—A mailed survey consisting of 12 scenarios in 4 domains of research ethics. Respondents were asked whether an act was unethical and, if so, the degree to which they considered it unethical and to select responses and punishments for the act.

Participants.—A total of 924 National Science Foundation research grantees in 1993 or 1994 in molecular or cellular biology and 140 representatives from the researchers' institutions to the US Department of Health and Human Services Office of Research Integrity.

Main Outcome Measures.—Percentage of respondents considering an act unethical and the mean malfeasance rating on a scale of 1 to 10.

Results.—A total of 606 research grantees and 91 institutional representatives responded to the survey (response rate of 69% of those who could be contacted). Respondents reported a hierarchy of unethical research behaviors. The mean malfeasance rating was unrelated to the characteristics of the investigator performing the hypothetical act or to its consequences. Fabrication, falsification, and plagiarism received malfeasance ratings higher than 8.6, and virtually all thought they were unethical. Deliberately misleading statements about a paper or failure to give proper attribution received ratings between 7 and 8. Sloppiness, oversights, conflicts of interest, and failure to share were less serious still, receiving malfeasance ratings between 5 and 6. Institutional representatives proposed more and different interventions and punishments than the scientists.

Conclusions.—Surveyed scientists and institutional representatives had strong and similar norms of professional behavior, but differed in their approaches to an unethical act.

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CONFIDENCE IN scientific progress provides the basis for the public support of research. In medicine we depend on research to understand human biology, develop diagnostic and therapeutic techniques, generate rational health care policies, and make intelligent personal health decisions.

The conduct of science depends on the intellectual integrity of individual scientists,[1] so public support of science can be eroded by the negative publicity surrounding allegations of misconduct. Of late the integrity of the scientific enterprise has been subjected to much scrutiny.[2-4] Stimulated in part by federal rules[5-7] responding to these concerns, institutions have established policies regarding the ethical conduct of research.[8-10] Usually, these guidelines have been designed by administrators, senior scientists, or both.[5-10] Yet, how well these rules capture shared understandings of proper scientific conduct is an empirical question. Indeed, the policies may reflect the needs of research institutions more accurately than those of the scientific community. Moreover, in many cases, the policies lack an explicit theoretical or empirical foundation in the professional norms of scientists.[11]

See also p 62.

For sociologists, norms have 2 critical elements.[12] First, norms articulate obligatory actions and are, therefore, not opinions or attitudes. Second, norms are shared by members of a particular group. These 2 elements applied to scientific research norms can be examined by allowing members of the relevant groups to evaluate descriptions of research practices within the framework of a randomized experiment. Such approaches are useful when the information desired derives from complex multidimensional judgments.[13] Examples include research on perceptions of what constitutes sexual assault[14] and of appropriate punishment for criminal behavior.[15] It is important to stress, however, that research of this kind can only consider whether certain actions are perceived to be obligatory. Then how widely the perceptions are shared becomes a statistical issue.

This study was designed to assess the ethical beliefs surrounding research practice of a selected group of scientists and their institutional representatives (IRs), how they feel they should respond to unethical behavior, and the types of punishments they would consider to be appropriate.

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Table 1.—Scientist (SCI) and Institutional Representative (IR) Determinations of Degree to Which Scenario Acts Were Unethical

Act		No.	Unethical Behavior, %	Malfeasance Rating, Mean (SD)	Deserves Punishment, %
1. Performance and Reporting of Research					
1-1 Fabricates data from scratch	SCI	235	99.1	9.8 (0.4)	100
	IR	47	100	9.8 (0.5)	100
1-2 Throws out negative results and reports positive results	SCI	274	98.9	8.6 (1.7)	92.9
	IR	46	100	9.3 (1.1)	100
1-3 Provides a misleading explanation of how the study was done to make it look sounder than it was	SCI	276	98.6	7.3 (2.6)	85.4
	IR	33	97	6.9 (2.4)	96.8
1-4 Reports the research incompletely, making it impossible to replicate in other laboratories	SCI	256	87.9	6 (2.6)	78.5
	IR	30	63.3	7 (2.0)	94.4
1-5 Picks the best results to report because he/she honestly believes them to be the correct ones	SCI	239	65.7	5.1 (2.8)	67.8
	IR	39	69.2	7.3 (2.0)	92.6
1-6 Does not carefully review work done by postdoctoral fellows that comes out as expected but is in fact erroneous	SCI	258	65.5	5 (2.6)	80.5
	IR	39	56.4	5.4 (2.3)	95.5
1-7 Makes an honest but serious mistake in reporting research results	SCI	231	31.6	4.7 (3.0)	80.8
	IR	38	34.2	4.8 (3.0)	92.3
2. Appropriation of Ideas					
2-1 Copies ideas and text from a published paper; investigator knowingly fails to give proper attribution	SCI	137	100	8.6 (1.7)	97
	IR	26	100	8.6 (1.7)	100
2-2 Uses, in a research project, an idea taken from a proposal that he/she reviewed; investigator knowingly fails to give proper attribution	SCI	158	100	8.2 (1.7)	94.3
	IR	23	100	8.5 (1.7)	100
2-3 Uses, in a research project, work from the investigator's graduate student; investigator knowingly fails to give proper attribution	SCI	147	97.3	7.5 (2.2)	92.1
	IR	20	100	7.8 (1.4)	95
2-4 Uses, in a research project, an idea taken from a proposal that he/she reviewed; through an oversight, investigator fails to give proper attribution	SCI	145	89	6.5 (2.6)	90.2
	IR	25	92	7 (2.5)	91.3
2-5 Authors a paper based on his/her own work; investigator knowingly fails to give proper attribution	SCI	147	91.2	5.9 (2.6)	78.2
	IR	18	88.9	6.4 (2.5)	86.7
2-6 Copies ideas and text from a published paper; through an oversight, investigator fails to give proper attribution	SCI	148	79.7	5.9 (2.7)	80
	IR	13	84.6	6.2 (2.9)	81.8
2-7 Uses, in a research project, work from the investigator's graduate student; through an oversight; investigator fails to give proper attribution	SCI	135	81.5	5.7 (2.9)	79.2
	IR	25	76	6.3 (2.5)	94.7
2-8 Bases his/her research on an idea obtained from a paper published at a professional meeting; investigator knowingly fails to give proper attribution	SCI	165	87.9	5.6 (2.8)	73.2
	IR	23	100	6.4 (2.5)	86.4
2-9 Bases his/her research on an idea obtained in casual conversation with a colleague; investigator knowingly fails to give proper attribution	SCI	152	84.2	5.3 (2.8)	67.2
	IR	13	76.9	5.4 (1.8)	90
2-10 Bases his/her research on an idea obtained in casual conversation with a colleague; through an oversight, investigator fails to give proper attribution	SCI	138	66.7	3.9 (2.5)	46.7
	IR	32	71.9	4.1 (2.4)	81.8
2-11 Bases his/her research on an idea obtained from a paper presented at a professional meeting through an oversight, investigator fails to give proper attribution	SCI	158	62.7	3.8 (2.6)	62.9
	IR	29	62.1	4.1 (2.8)	77.8
2-12 Authors a paper based on his/her own work; through an oversight, investigator fails to give proper attribution	SCI	143	52.4	3.8 (2.7)	70
	IR	20	50	5.7 (2.8)	88.9
3. Conflict of Interest					
3-1 Requires his/her graduate students to conduct research in his/her laboratory for a large firm	SCI	235	76.6	6.6 (2.5)	90.4
	IR	31	87.1	7 (2.0)	100
3-2 Spends (number of days) a week consulting during the academic year when he/she is drawing a full academic salary	SCI	227	66.5	6 (2.6)	91.8
	IR	46	58.7	6.6 (2.2)	96.3
3-3 Publishes papers based on work done with a commercial firm without revealing a substantial financial interest in the firm	SCI	264	70.8	5.9 (2.5)	86.1
	IR	33	87.9	7 (2.1)	96.6
3-4 Does research supported by a firm in which he/she has a substantial investment	SCI	214	54.7	5.7 (2.8)	82.3
	IR	39	69.2	6.4 (2.6)	100
3-5 Encourages his/her graduate students to conduct research in his/her laboratory for a large firm	SCI	235	55.3	5.6 (2.8)	80.8
	IR	42	64.3	6.4 (2.6)	77.8
3-6 Does research supported by a firm for which he/she does extensive consulting	SCI	242	34.3	4.6 (2.4)	77.5
	IR	35	45.7	4.9 (2.3)	80
3-7 Does research supported by a firm that makes large contributions to the university department in which he/she works	SCI	272	19.1	4.3 (2.6)	70.2
	IR	33	27.3	5.5 (2.1)	87.5

METHODS

Populations

Limited to National Science Foundation awardees, we defined the scientist population as those receiving funding from the Division of Molecular and Cellular Biology of the Biology Directorate of the National Science Foundation during the years 1993 or 1994, a total of 924 investigators.

The population of IRs was derived from the 1994 US Department of Health and Human Services Office of Research Integrity list of representatives from en-

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Table 1.—Scientist (SCI) and Institutional Representative (IR) Determinations of Degree to Which Scenario Acts Were Unethical (cont)

Act		No.	Unethical Behavior, %	Malfeasance Rating, Mean (SD)	Deserves Punishment, %
4. Collegiality and Sharing					
4-1 Shares no material products of his/her research outside investigator's own laboratory	SCI	235	73.2	5.3 (2.5)	71.3
	IR	36	41.7	4.3 (2.7)	71.4
4-2 Shares with colleagues only material products of his/her research that do not have commercial value long after publishing the initial papers describing the results	SCI	238	76.1	5.2 (2.5)	65.3
	IR	37	56.8	4.2 (2.5)	55
4-3 Shares material products of his/her research with colleagues only in return for authorship long after publishing the initial papers describing the results	SCI	267	83.5	5.1 (2.6)	67.1
	IR	32	75	5.3 (1.9)	87.5
4-4 Shares material products on his/her research with colleagues only in return for authorship	SCI	247	70.4	4.8 (2.5)	59.3
	IR	52	59.6	5.7 (2.1)	79.3
4-5 Shares with colleagues only material products of his/her research that do not have potential commercial value	SCI	245	59.6	4.7 (2.7)	66.9
	IR	36	38.9	4.4 (2.7)	50
4-6 Shares with colleagues only material products of his/her research that are in plentiful supply long after publishing the initial papers describing the results	SCI	257	69.6	4.5 (2.6)	56.7
	IR	44	52.3	4.2 (2.1)	57.1
4-7 Shares with colleagues only material products of his/her research that are in plentiful supply	SCI	267	38.2	3.8 (2.3)	58.9
	IR	31	38.7	3.8 (1.9)	66.7

tities conducting federally supported research. That list of 517 names was pared down to the 140 officials from the scientists' institutions. A survey of both complete populations was conducted.

Instrument

The content of the survey instrument was based on our experiences in teaching research ethics, the literature, and the findings of 3 focus groups devoted to identifying the norms of scientists and IRs.[16] The focus groups consisted of 2 groups of scientists and 1 group of IRs, similar to but not included in the study populations. The focus groups discussed professional norms, ethical violations and their harms, factors contributing to violations, and ways to improve scientific conduct. Perceptions of appropriate punishments were also explored. Based on the focus group findings, the range of unethical behaviors, responses to the behaviors, and possible punishments were identified.

Each respondent received a questionnaire containing 12 scenario cases describing research practices. The practices reflected 4 domains of professional behavior: (1) performance and reporting of research, (2) appropriation of ideas of others, (3) conflicts of interest or commitment, and (4) collegiality and sharing. Each scenario was constructed within a fractional factorial design[13] in which the scenario consisted of sentences derived from randomly assigned phrases, each consisting of 1 level from a dimension. The dimensions represented factors that theoretically might affect a respondent's reaction to a scenario, while a level was a particular manifestation of a dimension. Thus, if the dimension was the status of the investigator, laboratory chief and assistant professor might be levels. Behavior of the scientist was the core dimension, and acts were selected for each of the 4 domains to encompass the range of values (ethical to maximally unethical) (Table 1). The other dimensions contained in each scenario were sex; status of the scientist (tenured, prestigious head of laboratory, tenured senior researcher, untenured junior researcher); the immediate harm that resulted from the behavior; the larger consequences of the act; and whether this was a first offense (first time, prior offense, no mention). Since there were several dimensions and levels within each domain, there were a total of 8364 possible scenarios of which each respondent received a random sample of 12. The result was a design of sufficient power for estimation of main effects and 2-way interactions, with guarantees that, on the average, all main effects are independent. This report focuses on the main effects.

For each scenario, respondents were asked whether they considered the act unethical. If so, they estimated the severity of the unethical behavior on a scale from 1 to 10. They then selected which, if any, actions they would take in response to the behavior. Finally, if they considered the act unethical, they were asked to indicate whether they thought punishment was warranted and, if so, to select any of the options provided. A sample scenario is given in Figure 1.

Respondents were also asked about their demographic characteristics, academic position, and research experience. The instrument was pretested with a group of 40 scientists and trainees at 1 institution. Responses were kept completely confidential. An institutional review board approval waiver was obtained for the study.

Process

The scenario instrument was sent by priority mail with a postage-paid reply envelope to the cohorts of scientists and IRs. A cover letter stressed the importance of the research and the confidentiality of the responses. Follow-up contacts were made by telephone and mail. Among the 924 scientists, 49 were not available. This left 875 as the target population. Of the 140 IRs, 8 could not be contacted, leaving 132 as the target population. If an IR had been replaced, the replacement was targeted for the survey. Sixty-nine percent of both the scientists (606) and the IRs (91) completed the survey. Nonresponders were recontacted, and 63% of them provided their age, academic rank, and sex.

The responses were collected and analyzed statistically as previously described.[17-19] Each factor was broken out from the scenarios and related to each act to estimate the specific role of each factor in the degree to which an act was considered unethical. Given the design, simple means and proportions could be used to obtain unbiased estimates of the impact of the various scenario dimensions and levels on respondents' judgments about malfeasance, allowing us to compare, for example, the mean malfeasance rating from fabrication vs an honest mistake or the role of sex in determining the malfeasance rating. The fact that each respondent evaluated multiple scenarios did not reduce the statistical power by a meaningful amount.[20]

RESULTS

Respondent Characteristics

The scientists had a mean age of 40.5 years, and 436 (72%) were male. One hundred nine (18%) were assistant professors, 152 (25%) associate professors, 230 (38%) professors, and 115 (19%) other (chair, administrator, dean). Ninety-nine percent of the group had PhD degrees. The IRs had a mean age of 52.0 years; 69 (76%) were male, and 75 (82%) held PhD de-

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Scenario

An untenured junior researcher throws out negative results and reports positive results in a fashion he knows to be misleading. After a time, the findings become the basis for a federally funded research proposal. Disclosure of the investigator's behavior causes embarrassment for the investigator's institution. The investigator never did anything like this before.

1. Is the investigator's behavior unethical? — 1 Yes–Continue With Question 2; 2 No–Go to Next Page [Not Shown] →

2. On a scale from 1 to 10, where 1 is "barely unethical" and 10 is "extremely unethical," how would you rate the investigator's behavior? (Please circle 1 number.)

Barely Unethical 1 2 3 4 5 6 7 8 9 10 Extremely Unethical

3. If you knew about behavior like this, would you *(Please circle all that apply)...*

a. Keep it to yourself
b. Speak directly to the researcher about your concerns
c. Indicate your misgivings about the behavior to your scientific colleagues
d. Inform the editor of relevant journals
e. Inform the researcher's immediate supervisor
f. Inform an administrator or dean in the researcher's institution
g. Inform the researcher's professional society
h. Inform the researcher's funding agencies
i. Contact a reporter for *Science*, *Nature*, or another professional journal
j. Contact the lay media
l. Other *(Please specify):*______

4. Is some form of punishment appropriate? — 1 Yes–Please Answer Question 5; 2 No–Go to Next Page [Not Shown] →

5. Which of the following punishments would you choose? (Please check all that apply and indicate the duration of the punishment in years.)

	Years
a. Require a course on research ethics	
b. A warning from his/her superior	
c. Suspension of membership in all professional societies for...	______
d. Deny permission to present research results at all professional meetings for...	______
e. Intensive monitoring of all grants by the investigator's institution	
f. Publication of a retraction in a professional journal	
g. Prohibition from publishing in any scientific journals for...	______
h. Notice of the behavior published in a professional journal	
i. A public announcement of the behavior	
j. Suspension of the right to submit grant proposals for...	______
k. Have a notation put in the investigator's dossier describing the behavior	
l. Dismissal from current position	
m. Other *(Please specify):*______ *(for)*	______

Figure 1.—Sample scenario from a questionnaire booklet. The scenario was computer-generated and differed for each of the 12 cases given to each respondent. The remainder of the sheet was identical for each scenario.

Table 2.—Relation Between Days Consulting and Malfeasance Rating*

	Scientist		Institutional Representative	
Days	% Unethical	Malfeasance Rating	% Unethical	Malfeasance Rating
Unspecified	51.2	5.8	63.4	6.4
1	46.4	5.1	21.4	5.7
2	72.5	5.7	60	5.7
3	78.2	6.8	88.2	7.6

*The dimension of days consulting, in "Conflicts of Interest" had 4 levels; no number or 1, 2, or 3 days per week. For both scientists and institutional representatives, 1 day a week was significantly different from 2 and 3 days in malfeasance rating ($P<.05$).

grees. One hundred ninety-four (32%) of the scientists and 86 (94%) of the IRs had institutional responsibility for the performance of science, such as animal protection or radiation safety committee service, and 97 scientists (16%) and 80 IRs (88%) had specific responsibility for the ethical conduct of research, such as misconduct investigations or policy development. Three hundred fifteen scientists (52%) described their principal research activities as cellular or molecular biology, 212 (35%) structural biology/biochemistry, 12 (2%) chemistry, and 67 (11%) microbiology/immunology. One hundred seventy scientists (28%) and 12 IRs (13%) held patents or were responsible for patents held by their institutions, and 84 (12%) of the entire group received personal income from commercial sources.

Comparing the age, sex, and academic rank of responders and nonresponders, there were no significant differences in the IRs. Nonresponder scientists did not differ in rank or sex from the responders, but they were somewhat older ($P=.009$). But, as we will see later, since age and rank of the respondent are unrelated to the outcomes measured, we are hopeful that this difference had no material effect.

Malfeasance Ratings of Behaviors

Table 1 summarizes the main results. The malfeasance rating was defined as the response to question 2 in Figure 1. The results are reported by domain of behavior in descending order of scientists' malfeasance ratings. We describe below the major results in each domain of scientific behavior. The hyphenated numbers in parentheses indicate the specific scenario acts.

Performance and Reporting.—Fabrication (1-1) and falsification (1-2) were condemned almost universally and gave malfeasance ratings near 10 with low SDs. Somewhat fewer respondents considered misleading behaviors (1-3, 1-4) to be unethical and gave them malfeasance ratings of 6 to 7. Selectivity (1-5) and sloppiness (1-6) were considered somewhat unethical by two thirds of the respondents, and their malfeasance ratings were about 5. An honest mistake (1-7), which we thought would be considered ethical, was considered unethical by one third of respondents who gave mean malfeasance ratings of 4.7 by scientists and 4.8 by the IRs. Respondent comments to this question revealed that some thought that the investigator might have known that the results were in error when reporting them and gave them a very high malfeasance rating because then the investigator was believed to be lying.

Appropriation of Ideas.—Most respondents found behaviors that failed to give proper attribution to the work or ideas of others unethical. Deliberate plagiarism was universally condemned, whether it was derived from text (2-1) or a research proposal (2-2), with mean malfeasance ratings of 8.2 or higher. Respondents were critical of the use of material from a research proposal (2-4) no matter what the cause of the failure of attribution, but in general, deliberate appropriation of the ideas of others without attribution was found to be much more unethical than an accidental failure to cite. One half of the respondents thought that failure to cite one's own work was unethical.

Conflicts of Interest.—Conflicts of interest were condemned most strongly when there was failure to disclose a financial interest (3-3) or mandatory involvement of a trainee (3-1). We probed attitudes toward conflicts of commitment

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Table 3.—Effect of Prior Similar Behavior on the Malfeasance Index*

	Mean Malfeasance Index	P
Scientists		
Never done before	3.82	. . .
No statement	4.21	.002
Has done before	4.86	<.001
Institutional representatives		
Never done before	4.28	. . .
No statement	4.49	.52
Has done before	4.94	.04

*For all 33 scenario acts the influence of prior similar behavior was assessed by a 3-level dimension indicating either nothing or that the individual had never done anything like this before or that the individual had done something like this before. A *t* test was used to assess significance (compared with never).

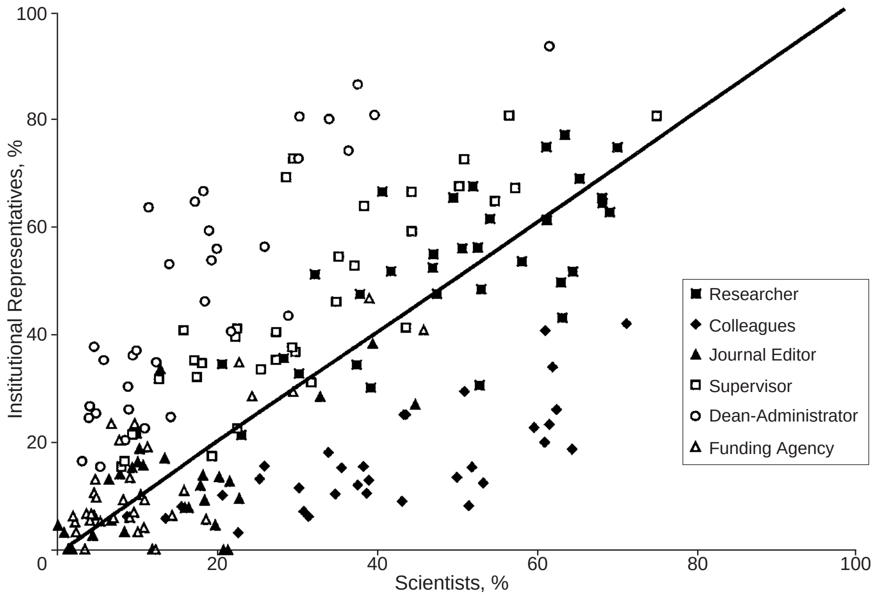

Figure 2.—Percentages of scientists and institutional representatives (IRs) proposing specific responses to scenario acts. Respondents were asked how they would respond to acts they rated as unethical. The 198 symbols represent the 6 most frequently chosen responses to the 33 scenario acts. They include informing the researcher, colleagues, researcher's supervisor, the researcher's dean or administrator, journal editor, or funding agency. Symbols above the line of identity were proposed more often by the IRs than by the scientists. If the scientists used the response to a greater degree than did the IRs, the symbol is below the line. The different symbols predominating above and below the line indicate that the 2 groups tended to propose different responses. The preponderance of responses above the line indicates that the IRs, on the average, proposed more responses than did the scientists.

by varying the number of days per week dedicated to consulting while drawing a full academic salary (3-2). If the number of days was unstated, more than half of the IRs and scientists considered the behavior unethical. Specifying the number of days of consulting demonstrated that 3 days a week of consulting was considered unacceptable academic behavior especially to the IRs (Table 2).

Collegiality and Sharing.—A significantly higher percentage of scientists than IRs considered the acts in this domain to be unethical ($P=.01$). Failure to share at all (4-1), sharing only long after publication (4-2), and sharing only in return for authorship (4-3) were similarly disapproved of. Sharing only materials that were in plentiful supply was considered unethical by a minority of respondents, and they gave low malfeasance ratings to the practice.

Investigator Factors Affecting Malfeasance Ratings

The scenarios contained dimensions, including the scientist's sex and academic seniority, to determine whether the malfeasance rating of an act was influenced by who performed it. It was not. There were also dimensions describing immediate and long-term harmful consequences of the behavior to determine whether the malfeasance rating was influenced by the consequences of the act. For example, if an act stimulated a grant proposal or adversely affected institutional reputation, the integrity of science itself, or collegiality among investigators, we postulated that it would be viewed more seriously than if there were a less consequential outcome. But adverse consequences had no effect on the malfeasance rating.

The only dimension that influenced the mean malfeasance rating was whether the investigator was a repeat offender (Table 3). A repeat offender received significantly higher malfeasance ratings by both scientists ($P=.001$) and IRs ($P=.04$) compared with first-time offenders.

Respondent Factors Affecting Ratings

Respondent sex, age, academic rank, and scientific field were not associated with a meaningful difference in malfeasance ratings. Other respondent factors failing to influence the malfeasance ratings included responsibility for research conduct, patents, commercial income, or whether the individual had been personally affected by scientific misconduct. As noted above, a smaller percentage of IRs than scientists thought acts in the sharing domain were unethical.

Responses to Unethical Behavior

Respondents considering an act unethical would by and large communicate that information, whether it be to the individuals themselves or to colleagues, superiors, deans, journal editors, or funding agencies, depending on the infraction. In general, the higher the malfeasance rating, the more such responses were given. Few scientists or IRs felt it would be right to keep the information to themselves, communicate with the scholarly or general media, or notify a professional society. Figure 2 compares the percentage of scientists vs IRs indicating each of the most common responses to the 33 behaviors (Table 1). If the same percentage of scientists and IRs favored a response, then the symbol would lie on the solid line, while if the IRs proposed responses more frequently, a greater proportion of the symbols would be above the line. As can be seen, the IRs proposed almost twice as many responses as the scientists. The scientists and IRs also preferred different responses. While both groups felt about equally strongly about communicating with the researcher, the scientists were much more likely to inform colleagues, while the IRs were much more likely to inform supervisors and deans. Neither group was eager to communicate with funding agencies or journal editors.

Punishments

Of those considering an act unethical, most proposed punishments. The IRs were more likely than scientists to propose punishments at each level of malfeasance rating. The distribution of punishments is shown in Figure 3, which compares the percentage of scientists and IRs proposing the 8 most commonly suggested sanctions for the 33 acts described in Table 1. The punishments preferred by the respondents were different. The IRs more often proposed a warning from a supervisor and a notation in the personal file than the scientists. Scientists proposed to punish with a forced retraction and a notice in a journal more frequently than IRs. Both groups commonly proposed requiring an ethics course.

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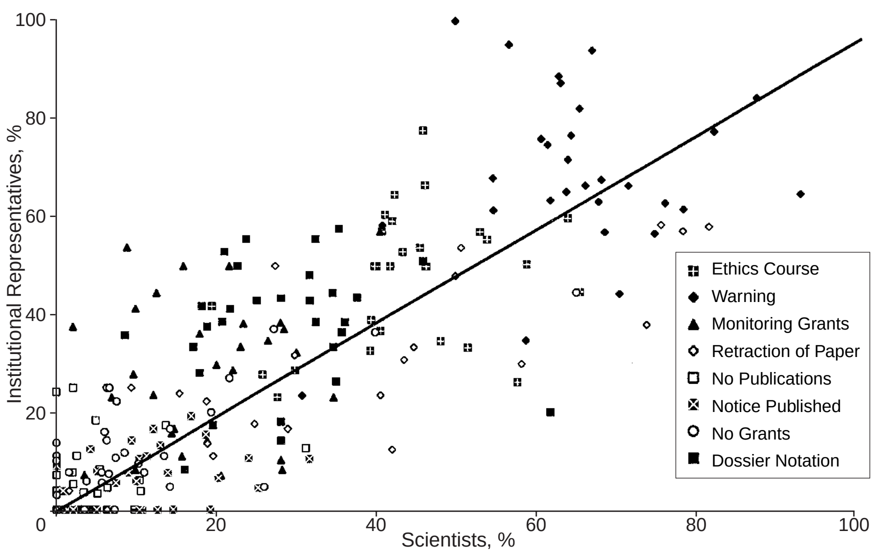

Figure 3.—Percentages of scientists and institutional representatives (IRs) proposing specific punishments to scenario acts. Respondents were asked how they would punish acts they rated as unethical. The 264 symbols represent the 8 most frequently chosen punishments for the 33 scenario acts. They include requiring an ethics course, a warning from a supervisor, monitoring grants, publishing a retraction, prohibiting publication, publishing a notice of the behavior, suspension of the right to submit grant proposals, and a dossier notation. Symbols above the line of identity were proposed more often by the IRs than by the scientists. If the scientists used the punishment to a greater degree than did the IRs, the symbol is below the line. The different symbols predominating above and below the line indicate that the 2 groups tended to propose different punishments. The preponderance of responses above the line indicates that the IRs, on the average, proposed more punishments than did the scientists.

COMMENT

There are more than 1 million active scientists in the United States whose activities contribute greatly to our prosperity and on whose integrity we rely. Yet, to our knowledge, there have been no previous attempts to formally delineate their norms of research behavior. Rather, studies have focused on reports of unethical behaviors. In 1992 the American Academy for the Advancement of Science reported the results of an opinion poll completed by 31% of 1500 randomly selected members.[3] They showed that the scientific community felt that it should be self-regulating, with laboratory directors and bench scientists playing the key roles in ethics education and in detecting and reporting misconduct. The study revealed that the overwhelming majority of instances of suspected misconduct did not result in an outcome reflecting an admission or demonstration of actual misconduct.

Twenty-seven percent (549/2010) of graduate and postdoctoral students at 1 institution responded to a survey of trainees' perceptions of research ethics.[21] One hundred twenty nine (23%) had received no training in research ethics, 195 (36%) had observed some kind of scientific misconduct, and 83 (15%) would be willing to "select, omit or fabricate data to win a grant or publish a paper." The authors concluded that it was essential to improve students' knowledge of and attitudes toward ethical research behavior. Both of these studies were hampered by low response rates.

A large study by Anderson and Louis[22] on the subscription of graduate students to a list of scientific norms and "counter norms" concluded that there are differences between fields of research, that pressures on the students affect their perceptions of right and wrong, and that international graduate students have less adherence to the classical norms of science than do US-trained graduate students.[22] They suggested that we need to teach classical scientific norms to our trainees or accept an alteration in expected behavior.

In contrast to the above, our study was designed to evaluate the professional norms of scientists and compare them with those of IRs. Scenarios of scientific practice were used to elicit views on professional malfeasance. Respondents were asked to respond in a framework in which personal implications of their responses were deliberately omitted. The study also attempted to examine the views of scientists and IRs about responses to an act and punishments for malfeasance. These views were taken to be indicators of scientific norms.

This approach revealed a hierarchy of unethical acts by displaying a range of percentages of respondents considering an act unethical superimposed on a range of malfeasance ratings. The IRs and scientists gave indistinguishable malfeasance ratings, suggesting that there are indeed professional norms of scientists and that standards are high. The fact that the 2 groups of respondents were selected by different criteria and that the IRs came from a broad range of disciplines strengthens the perception that these results relate to the underlying professional norms of scientists.

It was reassuring that the characteristics of the respondents, the characteristics of the investigators in the scenarios, and the adverse consequences of the behavior had no measurable influence on the malfeasance ratings. This lack of biases supports the expectation that professional norms refer to the science not to the scientists. On the other hand, if the investigator was known to be a repeat offender (Table 3), higher malfeasance ratings were given.

Deliberate deviations from honesty were awarded the highest malfeasance ratings. Of primary concern seemed to be acts that would undermine the binding norms of the scientific enterprise. This would seem to support the premise that when trust is compromised, so is science.

On the other hand, inadvertent errors, most conflicts of interest, and failure to share were lesser violations than deliberate dishonesty. Exploiting a graduate student and conflicts of commitment were the most serious conflicts of interest. Severely limited sharing was given malfeasance ratings in the 5 range, but a majority of the IRs did not think some of those scenario acts were unethical. "Communality," implying sharing, was one of the principles Merton[23] used to describe scientific norms, and some of the premier journals require sharing. However, a number of respondents commented that sharing in contemporary science can be extremely expensive, reduce a laboratory's competitiveness, and actually delay scientific progress. These results are consistent with the wide range of views regarding sharing expressed recently in *Science*[24] and raise the question as to whether sharing of resources remains a viable norm of science at this time.

Although they had essentially identical beliefs about ethical behaviors, IRs diverged substantially from the scientists in proposing more as well as different responses and punishments (Figures 2 and 3). The differences between the IRs and scientists may be attributable to the different kinds of worlds in which they compete. We believe from our focus group studies[16] and personal experience that university administrators view themselves as temporary guardians of

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their institutions regardless of their professional backgrounds, and their main role is to protect, preserve, and enhance the institution. Since research institutions compete in an arena where "ownership of science" is the paramount indicator of success and "reputation" is the primary medium of exchange, reputations are easily damaged by scientific misconduct. Thus, sanctions aimed at punishment and deterrence make sense to IRs. Damage to the social fabric of science may be a lesser consideration. Scientists, on the other hand, prefer social constraints and peer pressure to handle misbehavior, including communication with investigators and colleagues and mandated exposure of incorrect results. For scientists, integrity of the scientific community is essential, and that requires trust and cooperation. In this light, it should not be surprising that sometimes there are tensions between scientists and institutional administrators. And it should not be surprising if such tensions lead to complaints by scientists about the integrity of their institutions.[16]

This study may also illuminate the problems surrounding the new definition of scientific misconduct proposed by the Commission on Research Integrity.[25] Consistent with the views of IRs, broad definitions and the use of legalistic approaches to allegations of misconduct were proposed by the commission. They were met with suspicion by practicing scientists[26-28] who, as noted above, prefer a collegial approach, especially to lesser degrees of malfeasance. Perhaps this represents a form of dissonance based on the different arenas in which government, research institutions, and scientists find themselves, and the different constituencies they must satisfy. If further investigation demonstrates generalizability of the results of this study, perhaps models could be developed whereby the most serious types of misconduct would be subject to sanctions, and lesser offenses would be handled by the scientific community or their institutions, as suggested by Guenin[11] and to a degree in the commission's report.[25] But no matter what sorts of interventions one might suggest, it is critical not to lose sight of the fact that any intervention on behalf of scientific integrity must not undermine the social structure of science. Better still, these interventions should reinforce it.

What might be done to improve the ethics of scientific practice? The value of ethics education was underscored (Figure 3). Furthermore, reinforcing the standards of scientists by specific institutional actions to inhibit "survivalist" behavior (eg, in promotion policies) might contribute to maintenance of the high professional norms of scientists.

This study has several limitations. First, the study was limited to a relatively homogeneous, funded group of basic scientists. That implies that generalizations to other scientists and scientific fields would be risky. However, the close agreement between the malfeasance ratings of the scientists and IRs suggests that at least some of the shared understandings are generalizable, because the IRs are not likely to have been in the same fields as the scientists.

Second, some of the comparisons in which the absence of a relationship was found might be subject to a type 2 error in that the numbers were insufficient to identify small difference, but we had plenty of power to identify the large differences which were what interested us.

Third, a small percentage of the scenarios were ambiguous, as might be expected from computer-generated phrase combinations of this kind. For example, the honest but serious mistake (1-7) and unintended failure of attribution to one's own work (2-12) were designed to be the most ethical extremes of domains 1 and 2. We know that in 1-7 some investigators were concerned that the investigator was reporting the honest mistake as true even after knowing that it was a mistake. Others may consider 2-12 to have indicated self-plagiarism. However, ambiguity is as typical of real-life behaviors as well as scenarios. In fact, by limiting the scenarios to the essentials, we may have reduced the uncertainty surrounding the acts.

Fourth, since the nonresponders were similar to the responders in age, rank, and sex and we achieved response rates of 69%, we remain hopeful that nonresponse may not have contributed significant bias to the study.

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