Mentor-Mentee Responsibilities and Relationships

6

Arthur L. Caplan and Barbara K. Redman

Research training has historically followed an apprentice model, informal, minimally structured, and idiosyncratic. Adequate mentoring has been defined by the mentor and frequently derived from how the mentor has traditionally behaved with prior students. Mentees have sometimes been seen as simply ready labor for mentor projects.

More recently, mentoring in research is being defined as a skill set that should support mentee learning. Most research on this relationship has focused on student persistence and productivity in a course of study, not on learning research integrity or behaving with integrity. Overall, few metrics exist to assess the effectiveness of mentoring though some US federally funded training grants require a mentoring plan. Most research regulations, such as those for misconduct, do not mention mentor roles or responsibilities.

Many mentor-mentee relationships are highly positive partnerships that add benefit to both parties. Mentees bring new ideas; mentors help them to think independently, include mentees in professional networks, and foster their careers. Because this relationship has largely been minimally structured, it is important to agree on issues such as authorship, credit, access to and ownership of data, commitments for space, funding and workload, and to put these agreements in writing in a formal mentoring plan. Should a mentor or mentee move or become dissatisfied, it is important to also agree on how such situations will be managed.

Mentors can be very powerful, especially in historically hierarchical cultures in science where students may be expected to provide unquestioning loyalty to the mentor. In highly competitive environments, the needs of mentors and mentees can conflict, thus the importance of the written agreement of conditions for working together. Conflicts should be resolved by institutional officers such as department chairs or directors of graduate study.

The mentor-mentee relationship is a prime source of instruction about research integrity, learned through everyday interactions in the practice of science and is an essential experiential part of the responsible conduct of research (RCR). Mentees should feel free to ask mentors about their experience with misconduct, fraud, authorship, and related issues.

Advice: Carefully check out a proposed mentor, especially by talking with prior mentees about the quality of their experience. Many funders require a mentoring plan; ask for one even if your funder doesn't require it. Know the director of graduate study in your department, who should be checking on the quality of your experience with your mentor. Set regular meetings with your mentor asking for your work to be evaluated and to resolve any emerging issues. Harassment or bullying should not be tolerated and should be reported either to your schools HR department, director of graduate or professional studies, or both.

A. L. Caplan · B. K. Redman (✉)
New York University Langone Medical Center,
New York, NY, USA
e-mail: Arthur.Caplan@nyumc.org

A. L. Caplan, B. K. Redman (eds.), *Getting to Good*, https://doi.org/10.1007/978-3-319-51358-4_6

6.1 Closing the Barn Door: Coping with Findings of Research Misconduct by Trainees in the Biomedical Sciences

Barbara K. Redman and Arthur L. Caplan

Redman, B, Caplan, A. Closing the barn door: Coping with findings of research misconduct by trainees in the biomedical sciences. *Research Ethics* 11(3), 124–132 (2015).

Article

RE

Research Ethics
2015, Vol. 11(3) 124–132

DOI: 10.1177/1747016115587157
rea.sagepub.com
SAGE

Closing the barn door: Coping with findings of research misconduct by trainees in the biomedical sciences

Barbara K Redman
New York University Langone Medical Center, USA

Arthur L Caplan
New York University Langone Medical Center, USA

Abstract
The proportion of research misconduct cases among trainees in the biomedical sciences has risen, raising the question of why, and what are the responsibilities of research administrators and the research community to address this problem. Although there is no definitive research about causes, for trainees the relationship with a research mentor should play a major role in preventing actions that constitute research misconduct (fabrication, falsification and plagiarism). Examination of the limited literature and of the number of cases closed by the US Office of Research Integrity (ORI) between 2009 and 2013 raises questions about the mentor-student relationship and what it should be accomplishing. But many gaps in policy and its implementation inhibit this role. There is no acknowledgement of mentorship in federal regulations and research on how to teach research integrity is woefully underdeveloped, especially for international trainees. And some institutional research integrity officers may have had little preparation for the role.

Keywords
ethical review, graduate students, research misconduct

Corresponding author:
Barbara K Redman, Associate, Division of Medical Ethics, New York University Langone Medical Center, 227 East 30th Street, #753, New York, NY 10016, USA.
Email: br68@nyu.edu

Introduction

Cases of research misconduct (RM) continue unabated around the world. In the US, ORI reports new allegations rising from 86 in 1993 to 154 in 2012 (Office of Research Integrity [ORI], 2012). Others recently reported include lack of acknowledgement in the peer reviewed literature of findings by the FDA of fabricated and/or falsified data (Seife, 2015). The ongoing parade of misconduct raises questions about why researchers, students and staff falsify, fabricate and plagiarize and how these actions might be prevented. This paper suggests that re-examination of information about graduate students committing research misconduct is necessary. It also suggests actions that can be taken to ameliorate the situation.

In the years 2009 to 2013, 26 of the 56 cases of research misconduct reported in the US Office of Research Integrity (ORI) newsletter involved graduate trainees including postdocs and medical residents. This figure is up from 30% for cases between 1990 and 2004 (Wright et al., 2008).

For having intentionally fabricated and/or falsified data or plagiarized in Public Health Service (PHS)-supported research, these individuals entered into agreements to be excluded from serving in any advisory capacity to PHS and frequently to be excluded from contracting or subcontracting with an agency of the US government for a period of two to five years. Sixteen of the 26 were also required to have an ORI-approved plan for supervision of any subsequent PHS research prior to any future application submission. For 10 of the 16, their employing institutions had to certify to ORI that data provided by these individuals were legitimate.

These statistics raise several questions. Why are trainees such a large proportion of cases? Are they reported more frequently than are scientists in the professorial ranks? Is their misconduct related to immaturity in learning scientific norms or to pressures to succeed or both? Are their mentors lax in reviewing source data and setting standards? Wright et al. (2008) found these mentoring problems in three-fourths and two-thirds respectively of trainee cases closed by ORI prior to 2005.

Although there is no definitive research about the problem, research misconduct may occur because of: 1) sociopathology, 2) increasing pressure on researchers, 3) ignorance of research standards and ethical norms or some combination of these causes (Wright et al., 2008). Some argue misconduct is behavior confined to a few bad apples. An implicit assumption in the bad apple explanation is that sociopathology, or just not being able to "cut it", are the sources of the problem.

The research mentor-trainee relationship should moderate pressure and assure that research standards and ethical norms are taught and learned. But in the US federal research misconduct regulations there is no definition of the responsibilities of the research mentor and no requirement regarding mentoring (Wright et al.,

2008), leaving little direction for what actions and outcomes are expected of mentors. (Mentors are faculty supervisors employed by the university that will award the research degree and are assigned to guide graduate students through the research process. Other terms for this role may be used in other countries.) In addition, scholarship regarding researcher moral development or the efficacy of research integrity teaching is woefully underdeveloped (Evans, 2011).

Since 1989, NIH has required trainee instruction in responsible conduct of research (RCR). RCR training is required only of those supported on NIH training mechanisms. Even among top-funded US institutions, only half require RCR training of all students (Resnik and Dinse, 2012).

Despite this investment, little is known about what works (Mazmanian et al., 2014; Kalichman, 2013). A summary of the few available studies suggests that current RCR instruction is largely ineffective and in some cases may be harmful, deriving from student avoidance of ethical problems or overconfidence in their ability to handle them (Antes et al., 2009).

As a strategy for economic competitiveness, many countries are heavily investing in PhD education in science and technology (Mulvany, 2013). Among the large number of international trainees in the US, many are first introduced to research practice in their home countries and are bewildered by US expectations for RCR. These authors have also found international trainees to be less likely to accept US norms than are their US-trained counterparts. The normalcy of plagiarism in many international environments, vague policies about what constitutes plagiarism, and difficulty writing in English (Heitman and Litewka, 2011) may put them and their mentors at risk of misconduct.

In addition to the usual sanctions in a finding of research misconduct, ORI's requirements for supervision and in some instances certification of trainees' subsequent work are likely meant to provide them with guidance and oversight to develop the research skills and integrity they need. Current regulations target the actions of FFP after they occur, without regard for the developmental situation of trainees or the institutional environment in which they are operating. But this is "shutting the barn door after the horse is gone." A whistleblower, sometimes the mentor, has already reported evidence of fabrication and/or falsification or plagiarism. Federal misconduct regulations or institutions themselves ought to require some prospective monitoring of or outreach to trainees.

Trainees surely should expect to receive guidance and mentorship in practicing research ethics. If they are found to have "intentionally, knowingly or recklessly" (42 CFR, Part 93.104) committed research misconduct, it is reasonable to ask what went wrong in their development. Research administrators follow institutional policy for handling allegations and investigations. But policy as 42CFR, Part 90, section 93.300 does not address responsibilities that educational institutions assume for the development of the ethics of students.

Doctoral students

While PhD education should be the primary locus of socialization into research ethics, there is almost no literature about how successfully that is accomplished. A survey from Norway of PhD students in all of that country's medical faculties found that "10% did not find it inappropriate to report experimental data without having conducted the experiment; 38% did not find it inappropriate to try a variety of different methods of analysis to find a statistically significant result; 13% agreed that it is acceptable to selectively omit contradictory results to expedite publication; and 10% found it acceptable to falsify or fabricate data to expedite publication", although no participants reported they had fabricated, falsified or plagiarized data or publications (Hofmann et al., 2013: 1).

A smaller Swedish study found that students reported that they had experienced exploitation by being asked by their mentors to do work not related to their doctoral studies, abuse through public humiliation, and had their ideas and/or data misappropriated (Lofstrom and Pyhalto, 2014).

But perhaps the ultimate occurred with a group of doctoral students at the University of Wisconsin who reported their advisor for research misconduct, which she was found to have committed. One of those students describes the losses as including a mentor without a lab, many research projects never published, and students being advised to find a new laboratory home and start over on a new project. Those students now worry whether their roles as whistleblowers will affect their hireability (Allen and Dowell, 2013). Whistleblower protection policies assume threat to employment and do not address the educational impact on students when they act as whistleblowers. This must be explicitly addressed at institutions which host students. Also to be addressed is the university's responsibility in helping students in such a situation to finish a degree.

With one exception the PhD students in the current study, among those found to have committed research misconduct between 2009 and 2013, ceased publishing (as documented in Pub Med), although those found in later years of this period may yet regain the ability to publish. It's as if they simply vanished.

Postdocs

About half of biomedical postdoctoral fellows in the US are temporary residents, many of whom received PhD training outside the US (Ghaffarzadegan et al., 2014). Many are supported by research assistantships from NIH funds, which provide the institution with 50% indirects but on which they may not receive the documented formal and informal mentorship that is required of NIH-sponsored training grants, which yield 5% indirects. Such training grants require mentor plans and are judged by the quality of the mentor's training record and prior trainee outcomes (Rockey, 2014).

This constitutes a perverse incentive in US policy, largely benefiting senior researchers who depend on large numbers of graduate students and postdocs, well beyond the number who will find jobs (Stephan, 2012; Rockey, 2014). Indeed, a study of mentors affiliated with the Clinical and Translational Science Award (CTSA) program found 39% with four or more CTSA mentees, with most having additional non-CTSA mentees (Miyaoka et al., 2011), raising a question of mentor capacity.

Out of the 26 student cases settled by ORI between 2009 and 2013, 14 already held PhDs, and the misconduct was identified during the postdoctoral training (54% of student cases). One would expect such individuals to have been socialized to RCR during their PhD programs. Through publication records, four were verified as coming from a foreign country for a US postdoc and returning to their country of origin after the finding of misconduct (China, India, Japan), continuing to publish. Two others had been publishing from their country of origin prior to the US postdoc (China, Korea); recent publications show they are now working in US institutions. Japan also has suffered from multiple egregious cases of research misconduct, indicating a lack of research oversight and cultural reluctance to act on suspicions of peers (Agency for change, 2014; Normile, 2014). Many others could not be tracked because their publication records stopped or they could not be identified.

It is important to note that the major country supplying the US student or workforce in biology and other fields (17%) is China; the second is India (Franzon et al., 2012). Both countries have serious local problems with research misconduct. Conservative estimates indicate that a third of Chinese researchers have engaged in practices that include data fabrication and plagiarism (Cao, 2014). China has been very successful at recruiting overseas Chinese-born scientists back to their country of origin (Xie et al., 2014), raising the question of whether findings of RM in a US postdoc have any impact on a subsequent scientific career back in the homeland. India has no specific laws pertaining to scientific fraud. In a small study of medical colleges and hospitals, 56% of questionnaire respondents reported knowledge of alteration or fabrication of research data (Dhingra and Mishra, 2014). The rate reported largely in the US and UK summarized in a systematic review was 14% (Fanelli, 2009).

Role of the research administrator

Institutions receiving federal research funds must manage a number of regulatory requirements including protection of human and animal subjects, financial conflict of interest, biological risks. Among these regulations, in place since 1989, are those requiring assurance that policies and procedures are in place conforming to 42 CFR 93 to investigate allegations of research misconduct, defined as fabrication and/or

falsification and/or plagiarism. The institutional official, the Research Integrity Officer (RIO), administers these policies and procedures.

Although every institution with an assurance of compliance must name a RIO, the role is not delineated in the federal regulations. Two studies have found that in the aggregate, preparation for the role is rare, most have handled few cases, and many RIOs report inconsistent legal and logistical support (Wright and Schneider, 2010). When compared with responses of expert RIOs to usual research misconduct situations (sequestering evidence, threat of retaliation, and coordination of responsibilities with the institutional review board), many RIOs did not demonstrate a high level of skill (Bonito et al., 2012).

What are our responsibilities as a research community?

It is clear that system-wide reforms are necessary. Leshner (2012) notes there is far too much variability in training for the 50,000 postdocs in the US. Calls a decade ago to establish standards, norms and expectations for mentors, mentees and their institutions have still not been addressed (Leshner, 2012). Alberts, Kirschner, Tilghman and Varmus (2014) note that the severe imbalance between limited funds available for research and the still-growing numbers of researchers and personnel in the scientific community in the US have created a hypercompetitive atmosphere, which can heavily influence the integrity of graduate students and postdocs. Devereaux (2014) describes the growing gap between scientific ideals and the institutional reward system (e.g. science asks for collaboration and openness but rewards competition and "getting there first"). Yet, despite a more perilous environment, next to nothing is known about how to educate to reduce misconduct.

Even in the absence of reforms in the broader governance of science, institutions can adopt policies aimed at preventing research misconduct among graduate students and can evaluate them to see if they are effective. First, accountable mentoring must be assured, undergirded by mandatory and effective RCR education tailored specifically to graduate students. Particular attention must be paid to at-risk non-English speaking groups and those from countries with research ethics standards discrepant from those expected in the host country.

Mentors should receive training for their roles and be expected to review source data and set standards (Wright et al., 2008), and these expectations should be built into the institution's code of conduct for faculty employment. Investigations of misconduct allegations against a student should require an accounting of the mentor's activities in carrying out these duties. And NIH policy should require all students supported by NIH grants (whether research or training grants) to be assigned an accountable mentor.

Students in training programs have described mentor pressure to behave unethically. A survey of the MD Anderson Cancer Center found a third of student respondents feeling pressure to prove the mentor's hypothesis, even if the trainee's data did not support it. Twenty percent of students reporting in this survey said they had been pressured to publish findings about which they had doubts (Mobley et al., 2013). And an Australian survey found student criticism that university academic integrity policy was not enforced (Mahmud and Bretag, 2014). These kinds of experiences/perceptions can undo any RCR program.

RCR education should incorporate these and other concerns of doctoral and postdoctoral students. Their roles as beginners make them vulnerable to uncertainties about correct courses of action in situations they will encounter and dubious about the consequences of acting on their judgments, especially against authority figures. And as a condition of accepting graduate students, including postdocs from non-English-speaking countries, institutions must seek to improve their writing of English manuscripts, to a documented standard of acceptability, and provide help in teaching how to express their ideas without being tempted to, or even out of respect, plagiarize. In general, guidance on effective research ethics for international trainees and US trainees in international research settings has been vague and irregular (Heitman and Litewka, 2011).

As typically conducted, much RCR is not especially effective. It is important for institutions to adopt models shown to be more effective to obtain the best outcomes for the investment. The most successful programs are case-based and interactive, requiring practice in identifying ethical issues and strategies for working through problems (Antes et al., 2010). Nedeker (2014) recommends actively engaging students with role-play, debate and use of authentic examples and formative evaluation during instruction. Mumford, Steele and Watts (2015) suggest evaluation of RCR programs in four areas: behavior, cognition, reaction and institutional outcomes, and review measures available to do so.

The scientific community and individual institutions are not doing what is needed to discourage misconduct among young investigators. Education and mentoring clearly have important roles to play but how and with what accountability remain unclear. What is clear is that focusing on punishment is not the best route to discourage unethical conduct.

Conclusion

Ongoing issues with research misconduct among trainees in the biomedical sciences require action by research training institutions and by the scientific community. The absence of federal regulations addressing responsible mentoring and lack of a research base for education in the responsible conduct of research constitute gaps in our knowledge. But development of best practices that are evidence-based

can and should be undertaken by individual institutions and/or by consortia of research institutions. Accountable mentoring and effective RCR are basic. Graduate students operating in a hypercompetitive, hierarchical environment with a widening gap between scientific ideals and everyday practice are vulnerable. This is especially the case if they are not fluent in English and have been educated in a culture whose standards are not congruent with those in the host country.

The ultimate test of more rigorous standards will be a decrease in the percentage of research misconduct cases in students and their satisfaction that they have been supported in attaining scientific integrity.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

References

Agency for change [editorial] (2014) *Nature* 509(7498), 30 April. Available at: http://www.nature.com/news/agency-for-change-1.15120 (accessed 8 May 2015).

Alberts B, Kirschner MW, Tilghman S and Varmus H (2014) Rescuing US biomedical research from its systemic flaws. *Proceedings of the National Academy of Science* 111(16): 5773–5777.

Allen M and Dowell R (2013) Retrospective reflections of a whistleblower: Opinions on misconduct responses. *Accountability in Research* 20: 339–348.

Antes AL, Murphy ST, Waples EP, Mumford MS, Brown RP, Connelly S and Davenport LB (2009) A meta-analysis of ethics instruction effectiveness in the sciences. *Ethics and Behavior* 19(5): 379–402.

Antes AL, Wang X, Mumford MD, Brown RP, Connelly S and Davenport LD (2010) Evaluating the effects that existing instruction on responsible conduct of research has on ethical decision making. *Academic Medicine* 85: 519–526.

Bonito AJ, Titus SL and Wright DE (2012) Assessing the preparedness of research integrity officers (RIOs) to appropriately handle possible research misconduct cases. *Science & Engineering Ethics* 18: 605–619.

Cao C (2014) The universal values of science and China's Nobel Prize pursuit. *Minerva* 52: 141–160.

Devereaux ML (2014) Rethinking the meaning of ethics in RCR education. *Journal of Microbiology & Biology Education* 15(2): 165–168.

Dhingra D and Mishra D (2014) Publication misconduct among medical professionals in India. *Indian Journal of Medical Ethics* 11: 104–107.

Evans L (2011) What research administrators need to know about researcher development: Towards a new conceptual model. *Journal of Research Administration* 42: 15–37.

Fanelli D (2009) How many scientists fabricate and falsify research? A systematic review and meta-analysis of survey data. *PLoS One* 4(5): e5738.

Franzon C, Scellato G and Stephan P (2012) Foreign-born scientists: Mobility patterns for 16 countries. *Nature Biotechnology* 30: 1250–1253.

Ghaffarzadegan N, Hawley J and Desai A (2014) Research workforce diversity: The case of balancing national versus international postdocs in US biomedical research. *Systems Research & Behavioral Science* 31: 301–315.

Heitman E and Litewka S (2011) International perspectives on plagiarism and considerations for teaching international trainees. *Urologic Oncology* 29: 104–108.

Hofmann B, Myhr AI and Holm S (2013) Scientific dishonesty: A nationwide survey of doctoral students in Norway. *BMC Medical Ethics* 14(3).

Kalichman M (2013) A brief history of RCR education. *Accountability in Research* 20: 380–394.

Leshner AI (2012) Standards for postdoc training. *Science* 336: 276.

Lofstrom E and Pyhalto K (2014) Ethical issues in doctoral supervision: The perspectives of PhD students in the natural and behavioral sciences. *Ethics & Behavior* 24(3): 195–214.

Mahmud S and Bretag T (2014) Integrity in postgraduate research: The student voice. *Science & Engineering Ethics*. Available at: http://link.springer.com/article/10.1007%2Fs11948-014-9616-y (accessed 8 May 2015).

Mazmanian PE, Coe AB, Evans JA, Longo DR and Wright BA (2014) Are researcher development interventions, alone or in any combination, effective in improving researcher behavior? A systematic review. *Evaluation and the Health Professions* 37: 114–139.

Miyaoka A, Spiegelman M, Paue K and Frechtling J (2011) Findings from the CTSA National Evaluation Education and Training Study. Westatt Reports.Westat, Rockville, MD.

Mobley A, Linder SK, Braever R, Ellis LM and Zwelling L (2013) A survey on data reproducibility in cancer medicine provides insight into our limited ability to translate findings from the laboratory to the clinic. *PLoS One* 8(5): e63221.

Mulvany MJ (2013) Biomedical PhD education: An international perspective. *Basic & Clinical Pharmacology & Technology* 112: 289–295.

Mumford MD, Steele L and Watts LL (2015) Evaluating ethics education programs: A multilevel approach. *Ethics & Behavior* 25: 37–60.

Nedeker C (2014) Smart teaching matters! Applying the research on learning to teaching RCR. *Journal of Microbiology & Biology Education* 15(2): 88–92.

Normile D (2014) Faulty drug trials tarnish Japan's clinical research. *Science* 345(6192): 17.

Office of Research Integrity Newsletter (2012) https://ori.hhs.gov/newsletters.

Resnik DB and Dinse GGE (2012) Do US research institutions meet or exceed federal requirements for instruction in responsible conduct of research? A national survey. *Academic Medicine* 87: 1237–1242.

Rockey SJ (2014) Mentorship matters for the biomedical workforce. *Nature Medicine* 20: 575.

Seife C (2015) Research misconduct identified by the US Food and Drug Administration: Out of sight, out of mind, out of the peer-reviewed literature. *JAMA Internal Medicine*. Available at: http://archinte.jamanetwork.com/article.aspx?articleid=2109855 (accessed 8 May 2015).

Stephan P (2012) Research efficiency: Perverse incentives. *Nature* 484: 29–31.

Wright DE and Schneider PF (2010) Training the research integrity officers (RIOs): The federally funded "RIO Boot Camps" backward design to train for the future. *Journal of Research Administration* 41(3): 99–117.

Wright DE, Titus SL and Cornelison JB (2008) Mentoring and research misconduct: An analysis of research mentoring in closed ORI cases. *Science & Engineering Ethics* 14: 323–336.

Xie Y, Zhang C and Lai Q (2014) China's rise as a major contributor to science and technology. *Proceedings of the National Academy of Science* 111(26): 9437–9442.

6.2 Mentoring and Research Misconduct: Analysis of Research Mentoring in Closed ORI Cases

David E. Wright, Sandra L. Titus, and Jered B. Cornelison

Wright, D, Titus, S. Mentoring and research misconduct: analysis of research mentoring in closed ORI cases. *Science & Engineering Ethics* 14(3), 323–336 (2006).

Sci Eng Ethics (2008) 14:323–336
DOI 10.1007/s11948-008-9074-5

ORIGINAL PAPER

Mentoring and Research Misconduct: An Analysis of Research Mentoring in Closed ORI Cases

David E. Wright · Sandra L. Titus · Jered B. Cornelison

Received: 21 October 2007 / Accepted: 28 May 2008 / Published online: 10 July 2008

Abstract We are reporting on how involved the mentor was in promoting responsible research in cases of research misconduct. We reviewed the USPHS misconduct files of the Office of Research Integrity. These files are created by Institutions who prosecute a case of possible research misconduct; ORI has oversight review of these investigations. We explored the role of the mentor in the cases of trainee research misconduct on three specific behaviors that we believe mentors should perform with their trainee: (1) review source data, (2) teach specific research standards and (3) minimize stressful work situations. We found that almost three quarters of the mentors had not reviewed the source data and two thirds had not set standards. These two behaviors are positively correlated. We did not see convincing evidence in the records that mentors were causing stress, but it was apparent in the convicted trainees' confessions that over 50% experienced some kind of stress. Secondary data, while not created for this research purpose, allows us to look at concrete research behaviors that are otherwise not very researchable. We believe it is important for mentors and institutions to devote more attention to teaching

The views expressed herein represent those of the authors and do not necessarily represent the views of Michigan State University or the position of the Office of Research Integrity (ORI), the Department of Health and Human Services, or any component therein.

D. E. Wright
CARRS, Michigan State University, 135 Natural Resources Building, East Lansing, MI 48824, USA
e-mail: dewrite@msu.edu

S. L. Titus (✉)
Intramural Research, ORI, 1101 Wootton Parkway, Suite 750, Rockville, MD 20853, USA
e-mail: sandra.titus@hhs.gov

J. B. Cornelison
Department of Anthropology, Michigan State University, 204 Olds Hall, East Lansing, MI 48824, USA
e-mail: cornel24@msu.edu

mentors about the process of education and their responsibilities in educating the next generation of scientists. This becomes a critical issue for large research groups who need to determine who is in charge educating, supervising and assuring data integrity.

Keywords Research misconduct · Research mentoring · Supervision · Opportunity theory · Mentor · Trainee

Professor Eugene Braunwald, the head of the Cardiac Research Laboratory at Brigham & Women's Hospital, a teaching and research affiliate of Harvard Medical School, considered Dr. John Roland Darsee the most remarkable of the 130 fellows who had worked at the lab; he offered Dr. Darsee a faculty position at Harvard [1–3]. Indeed Dr. Darsee was to all appearances a rapidly rising star who, by 1981, had already published over 100 papers and abstracts—at Harvard (1979–1981) and in his previous position at Emory University (1974–1979). But then, fellow researchers who had suspected him of misconduct for some time observed him labeling the same data from one experiment "24 s," "72 h," "1 week," and "2 weeks," and reported him.

Dr. Darsee admitted to this instance of fabricating data, but claimed it was a unique error caused by extreme time-pressure. His mentors and the University were subsequently criticized as slow to realize the extent of the problem and to mount an effective investigation. When finally completed, however, formal investigation revealed the startling magnitude of Darsee's misconduct. Institutional and government investigators determined that he had "fabricated research publications beginning when he was a biology student at Notre Dame, continuing through his medical residency and cardiology fellowship at Emory University, and ending in Braunwald's Cardiology Lab at Harvard. More than 10 primary journal articles and more than 45 abstracts were retracted as a result of the investigations" [4].

The Darsee case challenged the widely shared beliefs that scientific research is honest and self-correcting with embarrassing questions about the diligence of his mentors and his co-authors. "A total of 47 medical researchers—24 from Emory and 23 from Harvard—coauthored Darsee's publications between 1978 and 1981" [5]. The Darsee case occurred at the beginning of the 1980s, the decade in which celebrated cases of research misconduct, a number involving trainees, came to national attention. Scrutiny by Congress followed scrutiny by the press, leading by the end of the decade to the promulgation of federal research misconduct regulations by both the Public Health Service, including the National Institutes of Health (PHS: 42 CFR 50, 1989; 42 CFR 93, 2005) and the National Science Foundation (NSF: 45 CFR 689, 1987, 1991, 2002). Created by the PHS regulation, the Office of Research Integrity (ORI)—originally the Office of Scientific Integrity (OSI)—has investigated or conducted oversight review of some 800 formal cases of alleged misconduct in research in 18 years since its inception. The Darsee case is not unique. Scores of ORI cases involve trainees who, while working under the supervision of mentors, have fabricated data—sometimes for extensive periods of

time. Most troubling, the pattern persists [6]. The research community has recognized this problem and responded with an effort to train young investigators in what has come to be called the *Responsible Conduct of Research* (RCR) [7]. However, cases of alleged research misconduct by trainees continue to confront us. How can trainees fabricate or falsify data, often extensively, without being detected by their mentors? What should be the level of responsibility borne by senior collaborators who participate in the submission of fraudulent trainee data for publication or for research grants?

Research Design and Methods

We decided to pursue these questions by investigating the role the mentor played in trainee research where the trainee—i.e., a graduate student a medical student or a postdoctoral fellow—was found responsible for misconduct. That is, we sought to learn whether deficient "mentoring" was a contributing factor in the misconduct. In the PHS regulation misconduct means "fabrication, falsification, or plagiarism in proposing, performing, or reviewing research, or in reporting research results."

In the biological or biomedical sciences which comprise most of these cases, the mentor is most likely to be the lab director, who has overall responsibility for the quality and integrity of the research in his or her lab/group and therefore has a personal stake in seeing that trainees understand the responsible conduct of research. Trainees are by definition supervised—with greater or lesser rigor. There is no federal definition, nor even a working definition in the sciences, that clearly specifies the responsibilities of this senior person. Nor is there any requirement regarding mentoring in the federal misconduct regulations. "Mentoring" is clearly a complex activity, but we sought to focus narrowly on the mentor–trainee relationship in the conduct of trainee research. Hence, we use the term mentor to refer to the person the institution identified as the responsible person's advisor. The trainee might also have other mentors, in addition to the formal one that the institution identified, however records did not indicate when or if that was the case.

In deciding what to measure, we began by asking, what would constitute clearly inadequate and deficient research mentoring. Thinking back to the Darsee case and other instances of well-publicized trainee misconduct, we believed it was clear that his mentors had not played an active role in the collaboration; further his co-authors had not appeared to have reviewed any of the source data on which their publications were based. Two of the authors of this paper, who have direct experience investigating allegations of research misconduct, also noted that trainees often reported that the relationship with their mentor was stressful. We hypothesized that we would see deficiencies in examining data and in setting standards; we further expected to see that trainees and others interviewed would indicate that there was a stressful working relationship between the mentor and trainee.

We decided to focus our research on the ORI cases of trainee misconduct. We reviewed all of the closed cases from the ORI files from 1990 to 2004 in which the accused was a trainee. These case files include the institution's documented record of its investigation (as required by the regulation) and the ORI oversight evaluation and its own analysis and separate finding of misconduct, if any. During this period ORI made a finding of misconduct in a total of 158 cases, with 30% of them involving these specific trainees (n = 45).

We began by reviewing a few case files to get a sense of the data we would find and then created our code so that we recorded evidence on the following questions: (1) Did the mentor review the source (raw) data produced by trainees? (2) Did the mentor set standards for conducting research, such as how to record and store data and see that trainees followed those standards? (3) Did the mentor create a stressful work environment? We conducted detailed reviews of cases in which a trainee was found guilty of misconduct. The case files identified the senior person who was responsible for the trainee. We read the records and took verbatim quotes regarding the mentor's conduct in working with the trainee for the three variables described above. In other words, we coded yes and no when we had substantive narrative to support the code.

These case files were created to document the institution's investigation and ORI's oversight review. Thus, they were not created to review the mentor's role in trainee research. A limitation of using these secondary data, therefore, is that the information we sought might not be present in some case files. Conversely, a strength of these data are that they allow an unobtrusive measurement based on the existing record which was not developed for the research purpose; therefore, there is less chance that the record will reflect a "desirable" response [8].

We recognize that not having a similar cohort of trainee–mentors where misconduct had not occurred certainly limits the interpretation of our findings. There are other limitations as well, discussed later in this paper. However, this is an exploratory study to see what we can learn about cases of misconduct and trainee–mentor relationships. We believe that focusing on the closed ORI cases of trainee misconduct will be useful in providing a description of critical mentor behaviors.

Demographics of Study Population

The sample is composed of 33 post docs, 10 graduate students and two additional trainees. Fifty-six percent (n = 19/34) were trained in the US. The next largest cohort of 35% (12/34) was trained in Asian countries. English was the first language for 58% (20/35) of the trainees. We determined from transcripts of interviews or written statements in the case files that English was not the first language for at least 43% (15/35) of the trainees (15); 22% (10/45) of the respondents could not be coded on this criterion due to insufficient evidence.

In all but three instances, these cases involved either or both fabrication and falsification. The trainee misconduct was discovered in various ways. In 39% (15/39) of cases misconduct was discovered because others could not replicate the

trainee's data. In 36% (14/39) of cases witnesses to an act or event reported the alleged trainee misconduct. And in another 25% (10/39) of the cases reports of misconduct were triggered by researchers who wanted to examine the source data and it could not be located by the respondent. There was inadequate information in the files to code six cases on this criterion. The trainee's research at issue was joint research with the faculty 79% (31/39) of the time; graduate students' fabrication or falsification always involved their dissertation and sometimes involved their advisor's research as well. Full professors were most likely to make the formal allegation (21/37) but informally the misconduct was often discovered by others in the research group who witnessed the act or who were attempting to replicate the findings. Technicians, students, post docs, assistant professors and associate professors also made complaints, and in eight cases there were multiple complainants.

The respondent eventually admitted to misconduct in 77% (33/43) of the cases. Seventy-three percent (33/45) of the trainee respondents signed a Voluntary Exclusion Agreement with ORI which generally precludes them from receiving federal funds for research for varying lengths of time ranging from 3 to 5 years. The finding of misconduct required retractions of published articles in 63% (26/41) of cases. Forty-one percent (15/37) of students were fired or dismissed from the university, and another 43% (16/37) of the respondents resigned. (We were unable to determine from the files what happened to the rest.) Only a few graduate students were allowed the opportunity to continue in graduate school, most often after taking some research ethics training that the university prescribed.

Findings: Examining Raw/Primary Data

We evaluated the record for information on whether the mentor regularly reviewed the research that was being conducted. Specifically, we coded whether the mentor had reviewed the trainee's raw data. Table 1 shows that in 12 of the cases mentors examined raw data; however in 32 cases mentors had not examined the raw data. When we adjusted this proportion by eliminating the cases we could not code, 73% of the mentors/PIs (32/44) had not looked at the raw data generated by their trainees. (We only had one case that could not be coded on this criterion).

Institutional Research Integrity Officers, Investigative Committees, and trainees themselves commented on the lack of attention by the mentor to the trainee's data.

Table 1 Mentor's role

Behavior	No	%	Adj% No	Yes	%	Adj% Yes	Unable to code
Did the mentor review raw data?	32	71	73	12	27	27	1
Did the mentor set standards?	21	47	62	13	29	38	11

Deficient Review of Source Data

We have included illustrations from four different cases that focus on the deficient review of source data:

Trainee Statement

"The Mentor [M] indicated that he had not personally examined the lab notebooks, but that he had met with Trainee's [T] on a regular basis to discuss his work and had reviewed posters and manuscript drafts with him. He recalled that [T] had assured him that all the data included in the manuscript were verifiable. [M] noted that there was a close community of investigators in the […] Center, with frequent meetings and discussion, but that it was not standard procedure for laboratory notebooks to be reviewed."

Trainee's Attorney Regarding the Lax Review of Primary Data

"His fabrications were not the result of careful planning but a frantic effort to appear to be productive. In fact, he did not even keep a lab notebook for a year and one half. If anyone in the lab had attempted to review his primary data, they would easily have been able to see that [T] was not producing any data." (T's lawyer, commenting on Inquiry Report)

ORI Report

Regarding oversight within the laboratory, there appeared to have been a lack of oversight as evidenced from the selection of raw Tracings appropriated for publication. DIO [ORI Division of Investigative Oversight] noted that "the coauthors had the opportunity to review a total of six versions of the questioned manuscript; at no time did any one of them observe errors or mistakes in the raw tracings, even though some had far greater experience with the […] technique [than the T]."

Investigation Report

"[T] worked to a large extent in isolation, under quite distant supervision from [M] and without much collaborative interaction with other members of the lab. Indeed, our information is that [T] was routinely loath to give up his clones and reagents to other members of the lab for experiments he did not himself control. We consider this to be a relevant observation in the context of this report. We further consider it important that the supervision of [T] by his mentor seems to have been inadequate, at least in terms of the routine and regular examination of primary results, except at the very beginning of [the M's] tenure in [the] lab. Rather he simply accepted the processed data presented to him by his graduate student. Trust is, of course, absolutely intrinsic to and required for all scientific research, and no mentor, the committee members included, carefully inspects every primary experimental result from every graduate student and every postdoctoral fellow every day. We do, though, consider it highly unusual to essentially never see primary data, or even to ask for those data from time to time. Indeed we consider it astonishing

> and, at very least, extremely poor practice for a thesis advisor. Concerning the question [with the hard data missing how can the committee determine if fabrication occurred] raised at the end of the previous paragraph our considered opinion is that this lack of direct, critical experimental supervision over the course of approximately three year's work would indeed allow the large scale fabrication of results that we suspect did, in fact, take place."

Setting Standards

We examined whether the mentor–trainee had a supervisory relationship in which information about standards (such as keeping a laboratory notebook) was conveyed. We coded comments made by the institution's investigative committee (usually the mentor's peers) or by the trainee on whether the mentor had specific rules or standards for collecting and maintaining data or other laboratory procedures.

Only 13 cases (38%) had mentors who supervised the trainee by setting standards. We found that 62% (21) appeared to have little awareness about the conduct of the research they were presumably supervising. We noted that when the mentor did not review the source documents there was a tendency for the mentor to have lax supervisory standards for conducting research—particularly standards on recording and reporting data. Inversely, 11 of the 13 cases that had a mentor who had examined raw data also provided contact and supervision with the trainee and had set standards for appropriate research behaviors.

Failure to Set Standards

The following passages from six institutional and ORI files, illustrate the failure of mentors to set supervisory standards:

> *Trainee Statement*
>
> She admitted to the actions that led to a finding of misconduct, but denied any intent to defraud—indeed she said she had been taught those techniques by her previous mentor, recorded them in her current lab book, and no current supervisor had asked her to change practice. [Paraphrase of a longer passage]
>
> *Trainee Statement*
>
> "There was a pervasive lack of integrity and disregard for rules in the lab. There was also a significant amount of scientific misguidance, especially in data analysis. Most of the people with prior lab experience found this disturbing and left the lab. I was not experienced enough to realize that what I was learning was incorrect."
>
> *Observation of Investigation Committee*
>
> "…it is also of significance that M did not begin the examination of the original data until after his return from Professional meeting (at which the data

were presented in poster) in spite of the fact that he had been warned on at least two occasions about potential problems with the quality of T's data …M failed to establish proper practices for data management."

Observation of Investigation Committee

"Early in the course of the inquiry, it became known that [T] and others working under [M.s] supervision did not keep traditional laboratory notebooks."

Observation of Investigation Committee

The Investigation Committee, in response to what they found was a lack of appropriate oversight by the mentor, recommended that all graduate faculty members and graduate students be sent a copy of the NAS booklet, "Advisor, Teacher, Role Model, Friend" with a letter advising the faculty and students that scientific misconduct does occur, that improper mentoring can be a major contributing factor, and that lax oversight and/or supervision of experimental data recording also contributes to an environment that can lead to misconduct. [Paraphrasing Committee Report] The committee also noted that for misconduct to be committed over a long period of time, lax oversight mentoring was clearly implicated as well as poor communication between the trainee and mentor.

Observation of Investigation Committee and ORI

"There also were concerns about how data on research records were handled in the laboratory; each investigator used his own individual approach to record keeping. ORI noted that the direct oversight and supervision was the responsibility of the laboratory chief."

Attention to Stress

Stressful Work Environment

We examined the records for evidence that there were known stresses or conflicts between the trainee and the mentor and/or within the research group. While we found some comments about stress in the lab, we did not have enough data to code whether the mentor might be involved as a source of the stress or aware of its existence.

Ex Post Facto Analyses

We then reviewed the comments we had collected on stress and decided that we could examine, ex post facto, one pattern that emerged as we reviewed the files for comments on stress or stressors.

Twenty-four cases (53%) of trainee/respondents described their stress levels as a factor that caused or contributed to their misconduct. (We could not code this

for 21 cases.) Fifteen of the 24 cases (62%) focused on statements that they fabricated or falsified data because they felt internal pressure to perform well. Nine respondents (38%) attributed their stress to specific time-related issues such as submitting a grant, publication or publication deadline, or to complete their dissertation requirements to begin a new job. While claiming stress as the cause of misconduct can be interpreted as the trainee's rationalization for his/her act, these responses are nevertheless worth attending to because many respondents clearly believed they were overwhelmed by stress. Further, if trainees were using stress as an "excuse" for their misconduct, one might expect that the majority would blame others—notably the mentor—for creating stressful working conditions. But this was not the case. There were only four instances where respondents cited unreasonable pressure from the mentor to get desired results or quick results, although some of these appear to be egregious as seen in the following example: "In 1993 [M] requested that members of the lab not take a summer vacation because it was important that we all work hard for his tenure." But the great majority of respondents did not complain about their relations with their mentor or others in their research group. We saw evidence in only four case files that there was a good deal of conflict between members of the group with their mentor. Instead, in testimony before investigative committees, in comments on investigative reports, and in admissions of misconduct, trainees most often reported self-generated stress, e.g. perfectionism, as the force that drove them to cheat. (We note, however, that in many cases the trainees seem to have been internalizing the expectations for productivity in the lab or in their institutions. In other words, external expectations seemed to lead to internal stress.) Whatever the etiology may be, stress does appear to be a significant factor that contributes to the likelihood that a trainee will commit misconduct.

Stress. The following examples illustrate trainee perspectives on stress:

From an Investigation Committee Report

> The [T] stated that he was a perfectionist to a fault and when he failed to obtain results that he expected, he altered the data to correspond with what he expected the results to be. … He felt pressure to achieve perfection in the lab environment. He commented that the pressure was primarily internal, although he felt some external pressure to perform because [M] lab was so well respected by other researchers.

Trainee Testimony

> "Even though I had already secured a position at [major university] and even though I had 18 publications, an NIH fellowship and several awards for my prior work, I have believed myself to be a complete failure as a scientist… Thus, I think that was going through my mind, has led me to believe that, if I could just show one piece of 'promising' data on a group meeting, my supervisor would let me continue working on the problem and produce real data that could be presented, published etc. … I am deeply ashamed …"

Trainee Letter of Admission

"There was much excitement over this [surprising and promising preliminary result] and I began to feel a self-imposed pressure to keep the positive data coming in. It was at this time that I began to substitute buffer for the control XXX. At the time I realized I was making a grave error in judgment, but as the excitement over the results grew and grew I felt more pressure to manipulate the system. At no time were any of the co-authors of the paper aware of my actions, nor could they have anticipated my behavior. Over time I lost more and more control and felt like I could not stop falsifying experiments.
I became worried…not being able to reproduce my earlier work. I placed a tremendous amount of pressure on my self to get my current data to confirm my earlier work. When my latter results did not support my previous work, I falsely informed [M] that there was consistency among all the data."

Institutional Awareness of Mentoring and Misconduct

When we began to review our notes we realized that institutions were beginning to ask the same question we were asking: Did the mentor contribute to the misconduct? Eighteen Investigative Committees addressed the issue of whether and how the mentor contributed to the problem. In only one instance, where the issue of mentoring arose in a misconduct investigation, did the committee assert that the mentor HAD NOT contributed to the misconduct. Yet, even here, the institution addressed the possibility.

The following four excerpts highlight the judgments that Investigative Committees made about the culpability or contributing negligence of the mentor/PI and their feeling that the graduate student deserved a second chance:

Investigation Report—Concluding Statement

"Although outright fraud can circumvent virtually any review process, we believe that every laboratory head must take the responsibility to ensure that procedures are in place in the laboratory so that the possibility of fraud is minimized. These include that (a) every manuscript receive adequate review by senior members of the laboratory, that the PI is directly informed of the resulting criticisms, and that the PI reviews the final manuscript before submission for responsiveness to all criticisms, and (b) every effort should be made to provide opportunities for each investigator to present primary unedited data to an appropriate group or subgroup of the laboratory for criticism and feedback."

Investigation Report

"Mentor/PIs should provide a more formal process of initial training for their graduate students as they join a research project. This should include coverage of IRB regulations and the responsibility inherent in maintaining the integrity of research. The Board also recommends that [M/PI] should have more contact

with the graduate students throughout the research project … [T] should contact his academic advisor and with that advisor develop a mentoring plan."

Investigation Report

"The committee believes that it is a good practice for the mentor to examine the primary laboratory notebooks for a student conducting his/her Ph.D. thesis research in the mentor's laboratory. More than just checking the validity of results, it helps the mentor better understand some of the details and nuances of the work which will help with both the thesis and the publications. The committee recognizes that this practice currently varies widely from scientist to scientist. The committee recommends that the University consider establishing a set of recommendations which might be called "Good Laboratory Practice Guidelines" which would be applicable to the mentoring situation."

Investigation Report

"The committee concluded that [M] should have been more directly involved in the critical analysis of data and results in published works. Greater diligence in overseeing the work of [T], who alone appeared to have committed the fraudulent acts, was particularly called for because of [T's] lack of scientific training."

We believe the opinions and statements made by institutions thru their investigative committee provide further support to our observations on how deficient behaviors on the part of the mentor have been a major contributing factor.

Limitations of Data

These data provide information on instances of misconduct by trainees that is usually not available to scholars: institutional investigation reports (and related documents such as correspondence among administrators, and between administrators and the respondent and complainant), as well as ORI analyses of institutional investigation; testimony and letters from the respondent and other witnesses (including administrators) regarding why the misconduct may have occurred, about the quality of the mentoring relationship and collegial relationships in the research group. At the same time there are limitations to these data beyond those discussed in the introduction:

- The data are from instances where trainee misconduct were found and therefore can tell us nothing about the benchmark of normal or exemplary mentor–trainee relationships.
- Data from the potentially valuable subset of cases where trainee misconduct was alleged but not found are unavailable because many of these cases, when concluded at the assessment or inquiry stages, are not required by the regulation to be submitted to ORI and are kept confidential by institutions.
- Case files that are thorough in documenting and analyzing trainee misconduct may not address issues of mentoring and, indeed, they are not required to do so under the regulation.

- In some instances we have had to infer information about the mentor–trainee relationship by comments (e.g. by institutional administrators) in institutional case files.
- Admissions of misconduct and other explanations of conduct by respondents are post hoc and may be self-justifications or crafted to secure lenient treatment.
- As with all descriptive research, our findings do not clearly show a cause and effect structure. Hence other things could be causing the research misconduct and not be related to the mentor.
- The projects are all in biomedical or behavioral research funded by PHS, and therefore represent only a portion, albeit a very large one, of the research universe.
- The term mentor is an ambiguous term and there is no agreed upon definition. We have no way to assure that ALL those identified in the case files believed they were the mentor. What we do know is that the institution in all cases believed the person identified was the person who had some oversight responsibility for the trainee.

Conclusions and Recommendations

We suspect that many mentors avoid thinking about whether they have a role in preventing research misconduct. They are busy conducting research themselves and in many instances have had little formal education on educating trainees to conduct research. Indeed, in a large study of 2,000 laboratory directors, the investigators found that only 33% of the directors said that they had had a mentor who prepared them very well to be a good mentor to those that they supervise today. In this same study the directors indicated that they supervised on average 4.7 individuals in their group [9].

Further evidence on how mentors may have difficulty providing adequate mentoring comes from the research of Martinson et al. They have reported that 27% of their sample of NIH funded scientists indicated "inadequate record keeping related to research projects" [10]. If mentors aren't keeping good records of their own research, would we expect them to be engaging in adequate monitoring of their trainees' research? In another study by this team, we learn that 56% of 3,257 researchers admit to cutting corners; one component of this composite variable included "inadequate monitoring of research projects because of work overload" [11].

Adams and Pimple highlight another avenue on promoting integrity and preventing research misconduct [12]. They posit that responsible conduct of research (RCR) education must focus not only on the development of the researcher's [in this case the trainee's] ethical awareness—the ability to evaluate dilemmas, discuss value choices and develop the self control to resist unethical solutions to research problems—but also on issues of "opportunity." Norms and expectations are transmitted by mentors and by team members. Where there is the absence of capable supervision and the lack of informal social interaction the normative pressure to follow the group's standards can erode. This can allow the trainee to have opportunities to fabricate data to impress others, to get ahead, or to meet a deadline. If trainees work alone, they can easily hide their behavior. If they know how to use sophisticated equipment that few others use, then they can falsify their data. We believe that prevention of research misconduct is most likely to be

assured when there is involvement by the mentor to enforce research standards as well as pressure from the research group to conform to the group's rules.

If we are striving to build a culture of integrity, it becomes very important to examine how to address the fact that mentors feel less than well qualified to know how to mentor. With the growing trend to larger research groups, one can see that mentoring for the responsible conduct or research is likely to become an even more complex phenomena. Institutional leaders need to become involved in working with researchers in their institution to build programs that teach mentors how to mentor.

If the mentors had been more diligent in setting and monitoring appropriate research standards, in reviewing trainee raw data, in establishing a supportive work environment, and increasing their support and vigilance at times of high trainee stress, would the incidence of research misconduct in these cases have been reduced? This is an exceedingly difficult question to answer. No one knows what causes misconduct. Speculation in the literature and among those who handle allegations of misconduct include the following potential causes: (a) sociopathology; (b) increasing pressure on researchers—especially those trying to secure tenure or continuing employment—to publish and secure grants; (c) arrogance—already knowing the right answer without bothering to do the experiment; (d) ignorance of research standards and ethical norms in research, i.e. poor mentoring. These proposed causes are, of course, not mutually exclusive. We did not look for, nor do we have a definitive answer on what caused the actual misconduct for the cases we reviewed. We believe that the cases we examined illustrate all the potential causes listed above.

In summary, our findings suggest that there are straight-forward, concrete steps mentors could take that might reduce the incidence of trainee misconduct, or limit its seriousness or impact: (1) regular review of trainee raw data, (2) standard-setting, enforcement of standards, and (3) attention to trainee stress levels—all primary elements of supervision. Every mentor should, in our opinion, articulate and implement appropriate standards and rules for his or her research group for how to collect, record and maintain data; for when and how key experiments are to be replicated before data are submitted in manuscripts and grant applications; for who is responsible for assuring and documenting compliance with regulatory obligations (e.g. laboratory animal care, handling of hazardous materials); and for authorship practices. While we did not find evidence that the mentors caused stress, we did find trainees talking about their stresses in a manner that was believable. We think it would be prudent for mentors to realize that trainees are trying to produce research and learn new skills and that it would be an exceptional trainee who did not feel some stress at some time in the process.

Surprisingly, in doing our literature review we found that there appear to be no agreed upon standards or best practices in the research community recommending that mentors or lab directors review trainee raw data at regular intervals, whereas there should be.

Mentor review of raw data would certainly allow for its early detection when some misconduct did occur, but in addition it would create a powerful preventive strategy by reducing the opportunity for traniee misconduct. Regular mentor review of raw data presumes that the trainees record and manage their data in appropriate fashion in the first place. But in the cases we reviewed there was a troublingly high

incidence of missing data or of no lab books at all (even in the laboratories of renowned scientists).

The National Academy's call for responsible research occurred almost 20 years ago [13]. Have we heeded the call? Institutions, perhaps through peer review of mentoring practices, should assure that research standards are implemented and enforced. Some exemplary laboratories distribute their standards, rules and procedures in a booklet during orientation for each new member of the research group and ask each new member to sign a statement that they understand and will abide by those rules. Where agreed-upon standards and best practices do not exist we hope the research community, particularly those charged with research mentoring, will take up these issues and adopt standards.

Acknowledgements We would like to thank the following colleagues for reading and commenting on earlier versions of this paper: Prof. Douglas Adams, University of Arkansas; Dean Karen Klomparens, Michigan State University; Dr. Larry Rhoades, ORI.

References

1. Greenberg Daniel, S. (1983). How scientists get away with cheating. *Journal of Commerce and Commercial*, (357), 4A.
2. Judson, H. F. (2004). *The great betrayal* (pp. 112–122, 144–146). New York: Harcourt, Inc.
3. Wallis, C. (1983). Fraud in a Harvard Lab. *Time, 121*(Feb 28), 49.
4. Columbia University, (n.d.). RCR: Research misconduct. 3. John Darsee and Robert Slutsky. http://ccnmtl.Columbia.edu/projects/rcr/rcr_misconduct/foundation/index.html.#1_B_3. Accessed 15 Apr 2008.
5. Murray, M. (1987). A long-disputed paper goes to press. *Science News, 131*, 52. doi:10.2307/3971418.
6. *Federal Register* notices are posted when a case of misconduct occurs. The following cases are considered major by ORI: Rosner (NIH, 1992), Tracy (University of Southern California, 2002), Muenchen (University of Michigan, 2002), Simmons (University of Texas Southwest Medical Campus, 2000), Lin (Medical University of South Carolina, 2001), and Hajra (University of Michigan, 1997). These can be found at http://ori.dhhs.gov/. Accessed 8 June 2008.
7. National Academy of Sciences. (2002). *Scientific research: Creating an environment that promotes responsible conduct*. Washington: National Academy Press.
8. Webb, E. J., Campbell, D. T., Schwartz, R. D., & Sechrest, L. (2000). Unobtrusive measures; revised edition. Sage Publications Inc.
9. Rodbard, D. Survey of research integrity measures utilized in biomedical research laboratories, report prepared for ORI, 2003. http://ori.dhhs.gov/documents/research/intergity_measures_final_report_11_07_03.pdf. Accessed 8 June 2008.
10. Martinson, B. C., Anderson, M. S., & Devries, R. (2005). Scientists behaving badly. *Nature, 435*(7043), 737–738. doi:10.1038/435737a.
11. Anderson, M. S., Horn, A. S., Risbey, K. R., Ronning, E. A., De Vries, R., & Martinson, B. C. (2007). What do mentoring and training in the responsible conduct of research have to do with scientists' misbehavior? Findings from a national survey of NIH-funded scientists. *Academic Medicine, 82*(9), 853–860. doi:10.1097/ACM.0b013e31812f764c.
12. Adams, D., & Pimple, K. D. (2005). Research misconduct and crime lessons from criminal science on preventing misconduct and promoting integrity. *Accountability in Research, 12*, 225–240. doi:10.1080/08989620500217495.
13. National Academy of Sciences. (1989, 1995 2nd ed.). *Responsible conduct of research: On being a scientist*. Washington: National Academy Press.

6.3 Mentorship Matters for the Biomedical Workforce

Sally J. Rockey

Rockey, SJ. Mentorship matters for the biomedical workforce. *Nature Medicine* 20(6), 575 (2014).

OPINION

Mentorship matters for the biomedical workforce

Sally J Rockey

The mentorship of early-career scientists is necessary to their individual career success and the future of the biomedical research enterprise as a whole. Recently launched NIH programs and tools aim to facilitate this important type of training.

Sally J. Rockey

As scientists, we have the opportunity to make new discoveries that contribute to fundamental knowledge and improve people's health and quality of life through our research. But we also influence lives by fostering the careers of the less experienced investigators with whom we interact on a daily basis. We shape their professional development by mentoring them on how to be productive researchers who contribute to both science and the community.

Being a mentor goes beyond supervising lab projects and teaching sound experimental design. It includes training less experienced investigators how to conduct research ethically and with integrity. It includes advising on potential career paths, providing networking and collaboration opportunities and helping new researchers navigate the research funding process. Seasoned scientists can attest that breadth of knowledge is just as important as depth, and they can encourage mentees to develop a range of professional skill sets.

Biomedical research needs scientists who can effectively translate and communicate its intricacies and value to many stakeholders, such as journalists, advocates, members of industry, policy makers and the general public. Good mentors transfer these skills to their mentees. We can show young investigators how valuable they are to the future of science. They are the next generation of great ideas, further propelling us toward our goal of advancing the scientific enterprise and improving health.

In the last decade, more graduate students and postdoctoral fellows are supported by research grants, not just career- or training-focused awards. In 2011, 65% of full-time graduate students supported by the US National Institutes of Health (NIH) received funding from research assistantships, compared to 60% in 2001. This speaks to the evolving landscape of biomedical workforce support and the need to reaffirm the importance of both formal and informal mentorship, as students and postdocs on research grants may not receive the formal mentorship that is part of NIH-sponsored training programs.

The NIH's extramural and intramural programs have long recognized the importance of mentorship in research training. The agency offers mentored career ('K') awards for research career development under the guidance of an experienced mentor or mentoring team. For these and most pre- and post-doctoral fellowship ('F') awards, mentors provide a statement of support in the application that describes their mentoring plans and provide progress report updates throughout the duration of the award. Similarly, the NIH's institutional training ('T') review criteria ensure that reviewers will consider both the training records of the proposed mentors and historical trainee outcomes.

The NIH has a robust intramural research training program where trainees at all levels—from high school students through postdoctoral and clinical fellow—come to the NIH to pursue research and seek research mentors. The training resources, such as videos and panel discussion webcasts, are also available to those outside of the NIH. Among the diverse career-related topics they cover are mentorship and how to choose mentors.

In 2012, a working group of the NIH Advisory Council to the Director examined ways to support a sustainable and diverse biomedical workforce. The group discussed the need for strong mentorship and appreciation of the diversity of scientific career options that trainees may choose. In response to these recommendations, the NIH launched several new programs and policy changes to further enhance training of future scientists.

One of these is the Broadening Experiences in Scientific Training (BEST) award program started last year by the NIH to help institutions develop programs to expose trainees—both graduate students and postdocs—to the multitude of career paths utilizing PhD training. Programs such as this intend to create a culture change by enhancing appreciation for different scientific career options and diversifying the training experiences of graduate students and postdocs. Through the BEST program, trainees are connected to mentors in research-related fields and participate in much-needed opportunities for professional growth.

Another new program aims to enhance diversity within the biomedical workforce specifically through mentorship. The NIH-supported National Research Mentoring Network will engage individuals from many research disciplines to serve as mentors and link them to mentees who are at a wide array of career stages, ranging from undergrads to early-career faculty members. It will also provide training for mentors and networking and professional opportunities for mentees.

NIH-wide initiatives are complemented by programs developed by NIH institutes and centers. For example, the National Institute of General Medical Sciences recently announced Innovative Programs to Enhance Research Training (IPERT) to encourage creative new educational activities for students, postdocs and early-career faculty. IPERT focuses on courses for skills development such as problem solving and leadership, structured mentoring activities to promote career planning, and outreach programs such as evidence-based science education.

The NIH is facilitating mentorship by promoting individual development plans, or IDPs, which it encourages institutions to begin reporting in progress reports submitted this October and going forward. An IDP is a living document that maps out approaches for developing skills that help an individual identify and achieve short- and long-term career goals. The IDP process can facilitate communication between faculty mentors and trainees. We have encouraged grantee organizations to develop an institutional policy requiring an IDP for graduate students and postdocs supported by *any* NIH grant, not just training grants and fellowships. Many academic institutions already use IDPs, and the NIH is cognizant of administrative burdens on scientists and research administrators, so it allows flexibility for grantee institutions to choose the IDP format that is the best fit for their community. IDPs will be meaningful only if mentors and mentees make full use of their potential as career development tools. I hope our grantees join as full partners in this effort.

The training of the biomedical workforce has always been an integral part of the NIH mission, and through its infrastructure of funding opportunities and other initiatives, the agency hopes to champion a culture of mentorship in the research community. It takes just one good mentor to influence the career of a new investigator; it takes a robust culture of mentorship across the research community to strengthen, sustain and diversify the entire biomedical research enterprise.

Sally J. Rockey is deputy director for extramural research at the National Institutes of Health, Bethesda, Maryland, USA.

6.4 Professional Responsibility

C. K. Gunsalus

Gunsalus, CK. Professional responsibility. *Inside Higher Education,* May 14, 2013.

opinion (/views)

Professional Responsibility

Teaching ethics should be part of the job of all faculty members in all disciplines, writes C.K. Gunsalus.

By C.K. Gunsalus // May 14, 2013

5 COMMENTS (/VIEWS/2013/05/14/ESSAY-RESPONSIBILITY-TEACH-ETHICS#DISQUS_THREAD)

(https://www.insidehighered.com/sites/default/server_files/styles/large/public/media/iStock_000017356047XSmall.jpg?itok=m6fWWJy4)

People who hire and supervise others in the real world are desperate to hire people — our graduates — who have the "whole package": substantive knowledge plus "soft" skills (basic responsibility, working well with others, ethics, etc.) that contribute to success in the world of work. You might argue that teaching those skills isn't our problem because we're providing educational foundations for professional knowledge. Or that we can hardly be held responsible for failings of families and society, which ought to be the ones instilling work ethic and manners and common sense.

Still, didn't we open this can of worms ourselves when we started arguing that colleges and universities are engines of economic development and that government should keep (or go back to) investing in education because it creates a knowledgeable workforce? When employers complain about what they perceive as a lazy and entitled attitude among young workers, and we see an apparently never-ending stream of ethics scandals, maybe there's another way to think about this that is directly congruent with our mission and, furthermore, falls directly within our expertise: embedding ethics and concepts of professional responsibility throughout our curriculums and courses.

If you think about it, doing so is a positive and preventive approach to what many perceive as an epidemic of cheating. There is research suggesting (http://http://www.swarthmore.edu/Documents/academics/economics/Dee/w15672.pdf) that an educational approach can be an effective strategy, and if enough faculty members purposefully and thoughtfully incorporate ethical connections into classes, it will help those among our students who mean well and want to follow the rules. If we can help those students to find a voice and provide positive examples, we gain, too.

Over the years, I've heard countless arguments about why faculty cannot or do not include ethics in their courses, or add courses about professional responsibility to their disciplines. The curriculum is too full already, and besides, you cannot teach people not to lie and cheat if they didn't learn that in their families. The objections I hear go further, though, and betray a serious discomfort, fear even, about teaching "ethics": I don't want to have to talk about deontology (I don't like Kant or haven't read it and don't want to); it's too hard or too subjective; I'm not qualified; someone else can handle it (bosses, the research compliance people, someone across the street, whatever). Ethics is boring and dry. I don't know enough and don't have time to go learn another field while I'm working on getting promoted/getting the next grant/serving on too many committees. What if someone asks a question and I don't know the answer? What if I look stupid? I might come off as judgmental or not judgmental enough. A required event is going to get really bad student evaluations.

We Can All Teach This Stuff, and We Should

As higher education experiences disruptive transformation through the changing economics of what we do, price pressures and technological upending, homing in on what we uniquely do is likely to be part of our path to the future. What is more central to that than helping students explore questions about and learn to use responsibly the knowledge we are conveying? The responsibilities of professionals — researchers, scientists, scholars, teachers — are deeply personal ones, and too important to leave to others outside our disciplines to teach. Outsourcing shortchanges our students and ourselves.

If you think matters of professional responsibility in your discipline matter, if you care about accountability and transparency and fairness and rigor, you can and should teach ethics in your field, whether that's a course or workshop that meets the requirements for responsible conduct of research education or topics that you integrate into your substantive classes — or both.

There are good reasons to teach in courses that are not about ethics, and it needn't be daunting or hard. There are some straightforward ways to do it and as a practicing professional in your field (they pay you to do what you do at work, right?), you can and you should. Here's how.

1. Think and talk about your mistakes. Who hasn't made a mistake at work? A big one? An embarrassing one? One you still cringe thinking about? What did you learn from those mistakes? If you've thought about it over the years, can you talk about it, obviously not naming names if that would violate confidences or confidentiality requirements?

Have you ever looked back on something that seemed perfectly reasonable at the time, and with the value of hindsight, thought "How could I have been such an idiot?" Or, been sitting with someone who's making a huge mistake and thought "no, no, no!"

If you can find a way to talk about those moments and the lessons you took away from them, your students will learn. Talking calmly and clearly about mistakes you have made will shape them as professionals and as people — and not so coincidentally, the world you are going to live in when they take over. (Another plus: modeling how you deal with hard stuff, and showing that life and careers rarely go in a clean, clear forward path without setbacks will be memorable and they will like you all the more for it.)

2. Articulate one of the lessons that govern your professional life. Where and when did you learn about the value of boundaries and when to refer students to other resources rather than trying to help them yourself? That it's easier to start out relatively strictly in a course and relax the rules as you go than vice versa? That's a lesson that extrapolates to a lot of other contexts. How did you learn to set the ground rules for talking to reporters about your work or setting boundaries when acting as a consultant or expert witness? When have you made a hard choice about a professional topic that you found challenging? If the lesson is connected to a mistake, it will be even more gripping to your class.

If you ask the students make a connection to the topic you're teaching that day, you will likely be surprised and pleased with what emerges. And even if your examples are all from your life in academe, the examples will likely have relevant lessons for students looking at other careers.

3. Talk with students about ethical dilemmas or hard moments they've faced (or will face). For years, I've asked students to write a short (200 word) description of an ethical dilemma they have faced. (This is an assignment idea from Harris Sondak of the University of Utah, a friend of a friend who was kind enough to talk with me about his teaching techniques and syllabus when I first started teaching ethics in a business school.) Not only does this essay get students thinking about these issues in their own lives, properly managed it creates a wonderful set of discussion topics.

Even if you don't ask students to do exactly that, or if you adapt and ask them to write about ethical applications of your topic or questions they have, it will tell you a lot about where the students are. In the dilemmas I've gotten over the years, the same issues come up over and over again: bosses who put pressure on workers to cut corners to meet deadlines. Perverse incentives in reward systems. Peer pressure. Temptation and rationalization in the face of a desire to succeed. You know, all those human frailties that come up when you work with other people.

And not one of those is hard to connect to the kinds of problems our students will face in what they do after college or grad school. Believe me, they are all cued into power imbalances, fairness, and how to navigate difficult situations. Connect it to how you use what you're teaching, even if you only do that once in a while, even if it's only talking about your policy for awarding grades, and you'll be contributing to their development in a broader way.

Students who've never held a job have faced dilemmas in school, like a friend who asked for help with an assignment when it was against the rules to collaborate. That situation is relevant to most every class and a great place to use it is it when you're discussing the syllabus, especially if that's all you do on your first day (contrary to advice offered here (https://www.insidehighered.com/blogs/first-day-class-rituals)).

If you're nervous about flying blind, take a look at the range of ethics resources, including "two-minute challenge" (2MC) collection on Ethics CORE (http://www.NationalEthicsCenter.org) . What's a 2MC? It's a problem that you cannot necessarily resolve in two minutes, but comes up and you may need to respond to it in two minutes — or less. It's the kind of problem that comes up all the time in professional life and you need to be prepared to handle. Use the same simple framework for structuring discussion of your own or other ethical dilemmas.

Don't come prepared with the "answer," and do come prepared to point out that you already know what you would do in hard situations (mostly), and that you won't be going to work with them, so it's THEIR answers that matter the most. If you are going to opine or editorialize, do it only after they've all had their say. Prepare a few questions to keep the discussion going, using the framework as your basis for that.

If you do that, based on real problems people (in the room sometimes!) have faced, you'll be doing some of the most important things that emerging research on efficacy in ethics education suggest: using short examples that carry emotional punch because they happened to real people. Modeling a way to talk about them. Helping to analyze them by practicing. Over and over. (If any of them are musicians or athletes, ask them to talk about the value of practicing scales or free throws for a useful analogy.)

You'll be helping your students to anticipate consequences of various actions. Apply labels to what the problems are (deception, temptation, rationalization, slippery slope problems…).

Or pick articles out of the newspaper or journals in your field about someone who's crossed the line. If you cannot find something, go to Ethics CORE and look at the recent news feed. There won't be a shortage of examples. Look for the videos. Try out some of the role plays there. Read my most recent book and use some of those examples.

what's right and what's wrong. How you act on it. What you're willing to sacrifice for your principles. (Are they really principles if you're not willing to sacrifice for them?)

You are a practicing professional. Who better than you to teach your students about professional ethics in your field?

Bio

C.K. Gunsalus is the director of the National Center for Professional and Research Ethics, professor emerita of business, and research professor at the Coordinated Sciences Laboratory at the University of Illinois at Urbana-Champaign. She is the author of The Young Professional's Survival Guide (http://www.hup.harvard.edu/catalog.php?isbn=9780674049444) ***(Harvard University Press).***

Read more by C.K. Gunsalus

site&utm_content=sidebar-link&utm_campaign=jobs)

Hide comments

6.5 All You Need is Mentorship

Robert A. Weinberg, Maya Schuldiner, Hong Wu, Beth Stevens, Jens Nielsen, P. Robin Hiesinger, and Bassem A. Hassan

All you need is mentorship. *Cell* 10, 1092–1093 (2016).

Cell

Leading Edge
Voices

All You Need Is Mentorship

The Importance of Scientific Taste

Robert A. Weinberg
Whitehead Institute/MIT

I find it humbling to confess that most of the truly original ideas that have driven my research group's agenda over four decades of time have come, not from my own brain, but instead from the minds of my trainees, both graduate students and post-docs. This on its own might explain why I, rather selfishly, have given them long leashes, allowing them to strike out on their own and craft their own research trajectories.

But there has also been a slightly more altruistic agenda: recently arrived trainees often assume that mastery of a set of experimental strategies and a familiarity with the relevant scientific literature should represent the core of their training. I, in stark contrast, have always viewed my own job quite differently, hoping to train my mentees to think independently, to think critically about their own work and that of others and, most importantly, to develop a sense of which problems are important conceptually and which are, in one way or another, trivial and not worth their time. Developing this last element in the cognitive toolkit is ultimately the most challenging one for many, who would rather direct their experimental agenda toward problems that are sure to yield abundant data rather than those that actually matter. In a time when generating large datasets and mastering novel, elegant technologies has become progressively easier, the temptations increase inexorably to embrace what is new rather than what is truly important in remodeling our conceptual understanding. If I, as a mentor, can imbue my trainees with this last skill—a taste for important problems—I view their experience with me as a major success!

A Passion for Mentoring

Maya Schuldiner
Weizmann Institute of Science

The biology textbooks that I read as a student described scientists that made great discoveries and changed the world. I decided to become a scientist myself because I wanted to be just like them. However, through the years, I started seeing that although I liked making discoveries, there was, in fact, something that I loved much more. As I started mentoring my very own PhD students I realized that, for me, the best thing about doing science is not the process of discovery itself but rather the process of mentoring other people on the path to discovery.

I love my students. I care about their success and spend time thinking about their needs and about ways to help them grow and flourish. An important part of mentoring, for me, is being someone that they can relate to and not someone that they must look up to. I try to convey to my students that I am not so different than them—I am mostly more experienced.

One important aspect for me is mentoring women to succeed in combining family with a career. Having three children, I know that it is not easy but it is doable. Together with my friends Prof. Nirit Dudovich and Prof. Michal Sharon, we have created a workshop to help women who wish to combine the two to acquire these skills.

I think that much of my scientific success comes from my dedication to my students and to mentoring because I have an amazing team. I will probably never change the world but I am touching the lives of my students. And they might very well change the world. Or their students.

Pay It Forward

Hong Wu
Peking University

Both my graduate and postdoctoral advisers have been key in my growth as a scientist. With them, I learned to identify and focus on the big questions, while taking risks to explore uncharted frontiers. Importantly, they also taught me to stay critical to myself. As both labs were rather large in size, I had the privilege to interact with many scientists working on a myriad of scientific questions. This "environmental mentorship" has contributed tremendously to widen my knowledge and horizons. In my eyes, effective mentorship depends on the quality of both the direct mentors, as well as the scientific environment they offer.

I have used these lessons as a foundation for my mentorship style, while adding my own touch. I talk to every student and postdoctoral fellow who applies to my lab about my expectations and mentorship goals—they should become independent scientists, not my spare hands. Therefore, they must lead their own projects and follow their own interests. I also emphasize that willingness to accept criticism is instrumental for success and that professional criticism should not be taken personally.

After returning to China, I realized that, in contrast to labs in the United States, there is a general lack of senior scientists and postdoctoral fellows in Chinese labs. With inadequate "environmental mentorship," direct interactions between mentors and trainees become even more important. Unfortunately, graduate students in Chinese research labs are regarded as the primary force of productivity but are often overlooked as the future leaders in the field. A training program on effective mentorship is therefore desperately needed in China—by teaching the value of good mentorship to our current independent scientists, we will be able to positively impact all generations to come.

Cell

Mentorship Is a Two-Way Street

Beth Stevens
Boston Children's Hospital

Mentors shape who we are as scientists and as future mentors. At every critical step in my scientific journey, I can look back and see the more senior scientist who helped me, whether it was challenging me on my critical thinking, inspiring me to tackle big problems, or reminding me that I needed to ask questions when attending meetings to learn how to become a part of the conversation. The importance of mentors is undeniable.

What is perhaps less well appreciated is that mentorship is a two-way street. The mentee needs to take responsibility and action to capture the attention of potential mentors. Just as other aspects of science are intensely competitive, so too is the competition for the time and interest of more senior scientists. How does a trainee or a junior faculty stand out in a sea of talented and driven young scientists? The student who often captures my attention is not necessarily the one who has a *Cell* paper in press (though that sure helps!) but is the person who consistently asks great questions, engages in interesting discussions, shows they care about the field and where it is headed, and works very hard. As we move up in science, all of us have a responsibility to not just help young scientists become good scientists but to create opportunities for them to shine and show their true potential. So next time you spot an impressive trainee with a fire in their belly, seek them out and engage them. You won't regret it. That conversation could be hugely impactful for both of you.

A Journey of Equals

Jens Nielsen
Chalmers University of Technology

Throughout my career, my mentoring philosophy has always been based on trust and enthusiasm. Young talented people who want to work in science and engineering should be inspired through enthusiasm. They should be encouraged to embrace all opportunities and to tackle big problems, while pursuing their aspirations for carrying out research that may impact society. Basically, I tell them from the beginning that we should learn new things together and that my primary role as their mentor is not only to help when problems arise or they need to make complicated decisions but also to challenge them so they understand and identify the important questions we should be focusing on. This is a process that involves keeping my trainees up to date on the current status of the research field and aware of the relevance of their own work. Additionally, I include them in publications as early as possible and connect them to the industry and their international peers at conferences and meetings. I generally tend to give an overall direction for a project and let the young researchers (including the PhD students) influence the path of their project, including the choice of methodologies and scientific hypotheses. I see my role to advise, guide, and encourage them during that journey, but I insist the journey to be discussed equally between the mentor and the student in order to foster their independence and creative thinking. In practice, based on my initial ideas and introduction, I expect them to propose which directions they prefer to take, how and why, in a dialogue where we define the problem and the projects together. My knowledge and experience are crucial in this step since I have a better overview about the relevance or technical limitations that a young researcher may not be aware of. However, if they insist on certain paths that I believe may be problematic, but strongly believe in their hypothesis, I let them test their ideas and will support them fully in their endeavor, hoping that, in that case, I am wrong and they are right, and that way we may end up discovering something really exciting!

The Tightrope of Mentorship!

P. Robin Hiesinger[1] and Bassem A. Hassan[2]
[1]Free University Berlin; [2]VIB/KU LEUVEN/ICM

Both mentoring and being mentored can be hard. One, because it involves people! Two, because it requires compromises between two people with partially divergent interests in the context of a hierarchical relationship. A one-sided benefit is a failure; a two-sided benefit is the goal of successful mentorship. Whenever different personalities are involved, sharing and promoting positive experiences may be more helpful than general advice. Our experience is one of an unusually generous mentorship from our common postdoctoral mentor. Based on this experience, we learned to appreciate open, and sometimes uncompromising, two-way communication. Mentors should be clear about expectations and "mentees" clear about goals. Students and postdocs are not just employees. They work on their own projects and on their own future. Mentors need to recognize their intellectual independence, for instance by allowing them to independently publish or act as corresponding authors on work to which the mentor did not directly contribute intellectually.

Scientific research is not a classical business and the rules and jargon of business management should have little place in the laboratory. Mentors and their mentees are colleagues and partners in a creative enterprise that seeks to solve the mysteries of the universe. When it comes to the business side, when we needed it, we were given the opportunity not only to learn the skills of transforming experimental data into publishable papers and fundable grants but also the right to take projects with us without fear of competition. This is an experience worth sharing.

Scientists often are fiercely independent and ambitious people working in a competitive environment. This makes one size fits all solutions unlikely to be successful. But, if there is one key experience we would like to share, it is this: dare to be open with each other about your thoughts, doubts, and plans. You might not always get what you want, but more often than not, you'll get what you need!

Additional Suggested Reading

McGee R. Biomedical workforce diversity: the context for mentoring to develop talents and foster success within the 'pipeline'. AIDS Behav. 2016;20(Supplement):231–7. (*Describes necessity of mentoring diverse trainees in order to solve a particular clinical/research problem.)*