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MIT Faculty Newsletter

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in this issue we offer commentary on teaching, beginning with our Editorial and "How Not to Teach Ethics," (below), and continuing with "On Critical Thinking and Nerd Epistemology" (page 7) and "A Collaboration in Learning" (page 8). There's also our continuing series "Across the Retirement Line," (page 15); "Climate and Accountability," (page 18); and "Introducing the MIT Academic Climate Survey" (page 22).

People's Republic of China

From The Faculty Chair
How Not to Teach Ethics

Susan S. Silbey

I WRITE THIS MONTH ABOUT stories and ethics, more specifically about the stories we tell about ethics. There is increasing talk lately, coming from unexpected and unaligned voices, about the importance of stories for understanding what we do, and what we should do. For example, Gary Saul Morson and Morton O. Schapiro write in their book, *Cents and Sensibility: What Economics Can Learn from the Humanities*, that "to understand people one must tell stories about them" and, while we can learn much from economics, culture and ethics cannot be reduced to economic equations.

In the popular press, *New York Times* columnist David Brooks recently recalled philosopher Alasdair MacIntyre's argument that you can't know what is the right thing to do unless you know what story you are a part of, that the story we

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MIT's Relationship to China

Richard Lester

Dear Colleagues,

I WRITE ON A SUBJECT of growing importance and complexity: MIT's relationship to China. In hopes of spurring dialogue, in this piece I outline how we are approaching this subject at the Institute level, offer some U.S. government context, and suggest some principles to guide us from here. Given China's growing strength in research and innovation, and the significant fraction of our community that hails from China, the practical and philosophical questions at play are relevant to all of us at MIT.

Building on A Global Strategy for MIT

Last year, my office published a foundational report developed with broad faculty input: *A Global Strategy for MIT*. Overall, it concluded that, as MIT's inter-

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Editorial
Education for Credit/Education for Progress

MANY OF OUR COLLEAGUES have labored over the updating and refinement of their course syllabi, over the development of new majors and new fusions of existing majors, and in broader reconsideration of the core curriculum. Our faculty has a long-standing tradition of debates over which subjects should be included in the General Institute Requirements (GIRs). The Science Council will be discussing possible development and implementation of new GIRs such as subjects in statistics/data science/computation. Making room for these additional subjects would mean shrinking the current set of GIRs.

Vice Chancellor Waitz describes, on page 8, a revision in first-year grading policy that grew out of the considerable effort put into a new course for the first-year curriculum. Keeping curricula

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current and relevant is certainly a continuing core role of our faculty. Financial support for such teaching initiatives is described in the announcement of the annual d'Arbeloff grants on page 21.

However, in the past all of these activities operated in a national environment and atmosphere in which progress in science and technology was highly valued, publicized, and recognized as a national priority. This background recognition that scientific and technological advances, thoughtfully and attentively shaped and directed, led to improvements in communication, in the health and welfare of the population, in growth of the economy, and in protection of the environment, made it easier for faculty to focus on student investment and performance in our courses, without necessarily any explicit discussion of values.

The nation has now entered a phase of public life in which the former values have been reversed. The current U.S. administration appoints – with rare exceptions – not only deeply unqualified leaders of government science, energy, and environment programs, but ones with deep conflicts of interest with respect to competing commercial and corporate interests, or even deep animus towards the very programs they have been chosen to lead. All this is clear from the daily news, from our professional journals, from the Marches for Science that brought out tens of thousands of young people.

Prof. Flowers' article (page 7) summarizes the need to actually focus on the powers of critical thinking, to refute continuing and perhaps increasing appeals to mysticism, fate, and other anti-science approaches to reality. He calls for bringing this directly into classroom pedagogy.

Prof. Silbey's article (page 1) calls for increased concern for ethical and societal aspects of our teaching. Others refer to this as increasing the values content of instruction, as opposed to focusing only on the quality of the pedagogy addressing technical content. Prof. Silbey points out:

"*. . . [that] we fail to provide students who will soon be professionals with the tools they will need to recognize the social structures through which individual action is channeled, skills they need to make their way in the world. Should students leave college and professional training believing that their individual will and personal resources are the major opportunities and limits determining success and failure, they will find themselves frustrated when they butt up against those very powerful, yet invisible social structures.*"

The current U.S. administration appoints – with rare exceptions – not only deeply unqualified leaders of government science, energy, and environment programs, but ones with deep conflicts of interest with respect to competing commercial and corporate interests, or even deep animus towards the very programs they have been chosen to lead.

We suspect many of our colleagues will hunker down to teach their courses, and hope to ride out the storm. But riding out a storm can take great skill and hard work, rather than waiting and watching. We need to consider the dangers of being too passive – of being bystanders – as the educational enterprise we are charged with advancing is buffeted by adverse winds.

This may be a period when classroom teachers need to be proactive, and state clearly to their students that the material they will be mastering is not just a path to acquiring the necessary academic credit, but potentially the path to social and economic progress. Though our style may have been to focus closely on the material, absent editorial comment, in this period we may need to explicitly and publicly protect and promote the social values of education in science and technology.

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Vote for FNL Editorial Board Members

MEMBERS OF THE *Faculty Newsletter* Editorial Board have diverse backgrounds, disciplines, and political outlooks, but we share the belief that the Faculty is a key stakeholder upholding the quality and character of education and research at the Institute. MIT is one of the very few major American universities in which there is neither a Faculty Senate nor a Faculty Union.

The one faculty body on the campus that reflects the views of the faculty independently of other influences, is the Editorial Board of the *Faculty Newsletter*. Nominations come only from the faculty, and only faculty vote. Please do vote when we send out ballots later this fall. We rarely have multiple candidates standing for the slots, but your vote is an affirmation that the faculty values having its own voice.

Editorial Subcommittee

How Not to Teach Ethics
Silbey, from page 1

tell about what we do can be more powerful than the specific details of programs and policies. Yet, in the intensifying calls for the teaching of ethics as part of both undergraduate and professional education, here at MIT and across the nation, the story being told about ethics is disturbingly banal and wrong-headed.

We might begin by noting that crises of corporate and professional responsibility have been endemic to American society, at least since the last quarter of the nineteenth century. With each chapter of professional misconduct – from the robber barons and the Teapot Dome scandals, through the progressive era up through Watergate, Iran Contra, the financial crisis of 2008, and to the recent epidemic of research scandals in political science and psychology – the response has been the same: calls for education in ethical responsibilities, and specifically training in ethics as part of professional education. For example, a 2017 article about bridge failures recommended that "engineering schools should do more to prepare students for the ethical challenges they'll face as individual workers – and as an industry." Another 2017 *Atlantic* article by Irina Raicu addressed the ethics of Silicon Valley directly, also recommending ethics education. "A growing chorus has argued that we need a code of ethics for technologists. That's a start, but we need more than that. If technology can mold us, and technologists are the ones who shape that technology, we should demand some level of ethics training for technologists. . . . Such training . . . would prepare them to make more thoughtful decisions when confronted, say, with ethical dilemmas that involve conflicts between competing goods. It would help them make choices that better reflect *their own values* (my emphasis)." Natasha Singer wrote in the *New York Times* in February 2018 about new efforts needed, and forthcoming, to incorporate ethics into computer science education. Most of these courses focus on getting students to reflect on their personal choices. Singer recounts how such courses are emerging at a moment when big tech companies have also been struggling to handle the side effects of Silicon Valley's build-it-first mindset. The message is clear: universities should embrace, not shun, teaching about values in the classroom.

Models for Teaching

This cycle of scandal and responsive calls for better training has been so often repeated that one can be surprised only by the paucity of models for providing that education. The standard model – required in law and medical schools now leaking into engineering and computer science programs with minor variations – teaches ethics as problems in individual decision-making, personal values, and choices. Training focuses on formalized rules of professional conduct, punctuated by appeals for social responsibility. It has not proved to be a successful regimen, if the repeated cycles of corporate and professional misconduct are any gauge.

Such standard models fail because the diagnosis and cure share a basic misconception: that corporate and professional misconduct are problems caused by rotten apples; some few weak, uninformed, or misguided individuals making independently poor choices. What is the source of this misconception?

Such standard models fail because the diagnosis and cure share a basic misconception: that corporate and professional misconduct are problems caused by rotten apples; some few weak, uninformed, or misguided individuals making independently poor choices. What is the source of this misconception? A great deal of education propagates this misunderstanding by focusing exclusively on two forms of causality familiar to engineers and scientists: physical forces or atomic structure and human will or intention. Although processes of aggregation and ecology for matter and mechanical systems are well understood, many seem unable to recognize patterns of aggregation when it comes to human action. Thus, when asked to interpret or explain social phenomena, including professional misconduct or inattention to competing interests, historical examples and possible precedents, the well-educated technologist as well as the popular pundit will more often than not offer accounts that rely on individual agency, choice, and personality. Unable to recognize or describe forms of social organization, many adopt a rationalist, often reductionist model of social action that in effect constitutes a powerful and unreflexive orthodoxy.

Consider an alternative account produced nearly 70 years ago when sociologist Edwin Sutherland published his now canonical work, *White Collar Crime*, in which he documented that American corporations constituted the most numerous population of criminal recidivists. This counter-intuitive observation flowed from Sutherland's earlier work outlining a theory of criminal behavior as normal behavior in situations publicly defined as undesirable, illegal, or unethical. Sutherland described *criminal behavior as normal learned behavior* in situations and transactions where there is an excess of circulating definitions favorable to violation of norms or law over definitions unfavorable to the violation of law. He called this the principle of "differential association."

Although Sutherland's work focused on criminal behavior, the insights merit our attention when considering what stories to tell about ethical and unethical professional behavior. Sutherland's principal account describes all behavior, deviant as well as normative, as habits learned in interaction with others, most often within intimate personal settings and organized groups. That learning includes the motivations, drives, and rationalizations for the action as well as

the techniques of committing the act, which can be complex, especially in white collar crime, financial, scientific, or computer-based fraud.

If we understand both ethical as well as criminal misconduct as consequences of normal learning, we might offer different kinds of ethics education, as well as different kinds of experiences, telling different stories than ones about individual, rational, and isolated decision-making. First, we would, of course, attend to the *content* of what is learned, which includes both motives and techniques. This would include in our local domain, scientific theories and engineering methods, but also various modes of collegiality, status hierarchies, gender performances, and appropriate degrees of ambition as well. Second, we would focus on pedagogy and the *process* of learning. Although Sutherland, following George Herbert Mead, focused on interpersonal and symbolic interaction, I might put as much emphasis in twenty-first century learning on mediated communication as on intimate personal transactions. Engineers learn to become engineers not only by doing problem sets and working in laboratories, but by mimicking what they observe as conventional, accepted and rewarded demeanors, conversational practices, and career expectations, whether observed face to face or through public media. The third, and most important lesson for ethics education is Sutherland's emphasis on *context and social organization* as an antidote to an exclusive focus on individual choice-making activity. In other words, while we might want to acknowledge human agency and decision-making at the heart of ethical action, which cannot be avoided for sure, nonetheless, we blind ourselves to the structure of those choices – incentives, content, and pattern – if we focus too closely on the individual and ignore the larger pattern of opportunities and motives that channel the actions we call ethics or occupation we call career.

Ethical Lapses

Perhaps the simplest way to think about how attention to context and social organization might challenge the individualist story of ethics is to consider the popular American narrative of ethical lapses. For example, the stories of Enron, drug trials for Actonel, the Schon affair at Bell Labs, and the Cambridge Analytica debacle at Facebook are usually narrated as the story of a few rotten apples giving the barrel a bad name. In other words, such bad apple narratives tell us that we need not worry about increasing evidence of financial misconduct, student cheating, scientific fraud, or the digitized threats to liberal democracy, because the grand narrative of well-functioning institutions (the market, meritocratic higher education, peer review, or digital connectivity through anonymous participation) remains in place, unsullied by the random bad apple.

Each of these examples is reported and interpreted as an anecdote. As separate accounts, anecdotes claim particularity, not typicality, and as such, anecdotes obscure the links connecting one event to another. The social organization that arranges the individual cases into a structure of action we might call professional or market failure, or digital warfare or social disintegration is suppressed and thus overwhelmed by the exclusive focus on personal motive, action, and fault.

How is this relevant for teaching ethics? Rather than thinking about ethics as a series of anecdotal instances of problematic choice-making, we might think about ethics as participation in a moral culture, and then ask how that culture supports or challenges ethical behavior. Or, in Sutherland's terms, what are the transactions among the cultural members, what are the communicated messages, how often and for how long, and thus how is that culture learned? How is the system of incentives and rewards organized, what is the structure of resources and rewards? More particularly, what do we describe as a good life?

Although studying culture is the adopted subject of many disciplines, sociology and anthropology specifically attempt to trace the links between the particular and the general to identify the mechanisms for aggregating individual actions or persons into collectivities and collective action, and as practices of a circulating culture. From this perspective, we might think of the task of ethics education as socio-cultural analysis, and preparation for a career as a scientist or engineer as requiring lessons in history, organization, cultural exploration, and management. Ethics education needs to be, following MacIntyre, historically contextualized, including analyses of what happens in particular situations to identify the logics operating in that historically located situation. Preparation for a career in science, for example, might include attention to the organization of laboratories (indud-ing perhaps how they have changed over time), the incentives and pitfalls of different forms of funding (including the differences between grants and contracts), as well as the role of gender in both local group and external professional activities. Preparation for a career in computer science, for example, might pay special attention to historical examples of technological catastrophes and the transformation of technologies into systems of social control. In some of our research, we refer to these kinds of accounts, which I am suggesting ought to be the subject of ethics education, as subversive stories: narratives that subvert or undermine claims of individualist causality by revealing how social structures link the general and the particular. Subversive stories reveal the patterns of aggregation through systems of opportunity and reward as well as structure and constraint.

For a moment, let's imagine repairing the conventional individualist narrative of ethical lapses by adopting the usual modifications: suppose we change the story of a few bad apples, to one about many bad apples, or one about all bad apples. This will not suffice, however. As long as we are describing the apples, we have preserved a system, a set of practices, idealizations, and cultural resources that support misconduct. We have helped to tell what we call a *hegemonic tale*, a story that buries

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the social organization of action and power, and thus absolves us all of a deeper responsibility. If we talk about ethics as individual decision-making without history, context, social structure and culture, we have not explained how the organization of apples in the barrel is part of why we see only an occasional bad apple and how those bad apples can infect the other apples. What are the mechanisms of infection and spread? This is the missing structural element that conventional accounts of ethics as bad apples usually miss, and an alternative approach to ethical education and responsibility might offer.

When a curriculum lacks a solid grounding in organizational and institutional analysis, it encourages the hyper-individualism characteristic of American culture, media, and politics generally. Rather than provide students with subversive stories and the tools for critical inquiry, the curriculum, inadvertently perhaps, becomes a vehicle reinforcing popular ideologies. As Karen Levy, Professor of Information Science at Cornell recently noted, ". . . if data science ethics training focuses entirely on the individual responsibility of the data scientist, it risks overlooking the role of the broader enterprise, ..." which is also making choices about its products and policies.

Influences on Social Structures

Too often, history, arts, corporate behavior, public affairs are understood as merely a series of individual actions, the product of human decision, utility, invention, malfeasance, avarice, or creativity: a series of particularly special and delicious apples with perhaps some attention to which trees grow better apples, but little attention to the organization of the orchard, especially the cultivation, resources, and weather that sustains the orchard. The culture writ large is understood, implicitly if at all, as an aggregation of individual preferences and attitudes. Too often, stories are framed primarily as tools for obtaining desired ends (normally power – i.e., tell a good story and you can convince others of what you want, successfully market yourself or your product). The mechanisms and processes of aggregation that provide intervening conditions that influence, channel, and organize human action are the subject of only a few elective, easily overlooked courses. It is common for students to complete degrees without any notice, no less concerted attention, to the processes and structures organizing human action, and accumulating power. And then, when crises of public confidence and professional irresponsibility erupt, we hear calls for training in (personal) ethics.

When a curriculum lacks a solid grounding in organizational and institutional analysis, it encourages the hyper-individualism characteristic of American culture, media, and politics generally. Rather than provide students with subversive stories and the tools for critical inquiry, the curriculum, inadvertently perhaps, becomes a vehicle reinforcing popular ideologies.

To the degree that this neglect of institutional analyses is a result of the way degree requirements are specified, as well as the way course offerings are organized, named, and announced, we fail to provide students who will soon be professionals with the tools they will need to recognize the social structures through which individual action is channeled, skills they need to make their way in the world. Should students leave college and professional training believing that their individual will and personal resources are the major opportunities and limits determining success and failure, they will find themselves frustrated when they butt up against those very powerful, yet invisible social structures. This naivite, or ignorance, is one crevice in which unethical behavior germinates. Should students, however, have an understanding of the constraints and resources of organizational structures and institutionalized cultures as well as worthy individual attributes, they will be more effective, perhaps more ethical professionals and citizens.

What story of ethics do we tell MIT students? Is it the familiar story of great men and a few women individually overcoming great obstacles and ignorance to push back the frontiers of knowledge? Is it the reductionist and one-dimensional story of initiative and creativity working to disrupt conventional modes of production? Let's stop telling this one hegemonic tale and ask instead what stories (plural) we should be using to help us interpret our world with greater precision and complexity. We might then, for example, demonstrate alternative modes of organizing technological and scientific production. For example, how might we organize to limit winner-take-all dynamics? What would happen if our intellectual property regime became more consistent with actual creative practices? Let's tell stories that interpret the world with greater nuance and empirical validity, and expose us to multiple voices that push us out of our habitual ways by seeing the world through the subjectivity – eyes and voices – of others. In *Sapiens: A Brief History of Humankind*, the Israeli historian Yuval Noah Harari makes a very similar claim as does the Nigerian novelist Chimanda Ngozi Adichie when she writes, "Stories matter. Many stories matter. Stories have been used to dispossess and to malign, but stories can also be used to empower and to humanize. Stories can break the dignity of a people, but stories can also repair that broken dignity."

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On Critical Thinking and Nerd Epistemology

Woodie Flowers

WE ADULTS HAVE CREATED MESSES. We need to help students learn to think critically about fixing our messes. Evolution has left us with brains capable of believing six impossible things before breakfast – without realizing it. Examples abound.

While boarding an airplane, I overheard two fellow passengers claiming that climate change was a hoax. I could not keep quiet. I cited the stack of reports from the national academies that argued otherwise. The fellow travelers' summary of my arguments was, "Well, all those scientists are atheists!" My retort was, "And they also designed this airplane."

We build thought-walls that keep one part of our brain separate from other brain parts that believe stupid stuff. Being even mildly consistent is hard. Critical thinking makes our brain hurt. Just fleeing the saber-toothed tiger or agreeing with others in our tribe is much easier. Evolution gave what Daniel Kahneman calls our "fast brain" a dominant and stealthy position in our lives. We are not as rational as we want to believe. Tribalism, human chauvinism, and fear interfere with critical thinking without our being aware.

We love mysticism, especially when it reinforces human chauvinism. On the evening news – "The vehicle was totally destroyed, but the driver survived. It was a miracle!" Maybe. More likely it was good engineering. Air bags. Crush zones. Knowledge of biomechanics.

We are launching students into a society that does not think critically.

An essential part of critical thinking is allegiance to objective truth – the kind of objective truth that underpins science and our understanding of the universe. This objective truth is being ignored by much of the population. Maxwell's equations are not published with an asterisk with a footnote saying "unless contravened by human thoughts and prayers."

Nerd epistemology adheres to beliefs based on objective truth rather than on volitional belief. For me, what I believe naturally results from what I think I understand.

Obviously, nerd epistemology does not cover all of human thought. Love, creativity, awe, devotion, leadership, empathy – many emotions and desires are not accessible to equations. For example, there are laws of thermodynamics, but no "laws of fairness" in the universe. There are no equations for ethics.

We have been divided into nerds and not-nerds. That is not good. The balanced human celebrates both types of thinking – without letting them become irrationally entangled. The students at MIT have passed a filter that selects for logical and rational thinking more than "other." I believe that should facilitate our guiding them to become rational and compassionate leaders. Maybe ubernerd epistemology is the answer.

Unless we talk about expanded nerd epistemology, students may not expand. If we help them develop critical thinking grounded in objective truth while honoring the messy stuff we never lecture about, we have some hope of redefining education for the twenty-first century.

At the beginning of class, maybe we should give a few minutes to a discussion of critical thinking. I believe that can be done without constraining students' beliefs. Maybe we can help them learn the difference between what they believe and what they assume they believe.

• Read an example of the day's horoscope and ask, "Is this good advice?"

• Replay a set of absurd claims for a popular commercial and ask, "Should a venture capitalist invest in this business?"

• Ask "Would you buy an expensive house on the beach?"

• Ask "Is 'my lucky number' a logical concept?"

• Ask "Supreme Court Justices should be clear about what?"

• Ask "What data would inform better decisions about electric scooters in Cambridge?"

• Ask "How should EarthNow be regulated?"

As the students pursue a meaningful life, I believe a blend of understanding the universe and of understanding self and society will be essential. As machines prove more and more effective, humans who straddle will be needed. "Both" is becoming more important. MIT alumni in leadership positions will understand a lot about the universe. The ones who also make uniquely human contributions will be even more influential.

Woodie Flowers is the Pappalardo Professor Emeritus of Mechanical Engineering *(flowers@mit.edu).*

A Collaboration in Learning

"Designing the First Year at MIT" class catalyzes experimentation in the first year

Ian A. Waitz

ON AUGUST 2, THE COMMITTEE on the Undergraduate Program (CUP) approved an experimental grading policy for the incoming class (2022), namely:

• First-year students *entering during the fall of 2018* will be eligible to designate up to three core Science, Mathematics, and Engineering General Institute Requirements (i.e., 3.091, 5.111, or 5.112; 7.01n; 8.01n; 8.02n; 18.01n; or 18.02n) to be graded on a Pass or No Record basis (P/NR) after their first term.

• The first semester will still be graded P/NR, and the second semester ABC/NR.

• This added flexibility should encourage students to move some of their core SME GIRs out of the first year, providing more opportunities for students to take classes that enable them to explore majors and minors early in their time at MIT.

This experimental policy change is just one part of a larger effort spurred by the Office of the Vice Chancellor (OVC). Departments are creating more exploratory options for first-year students, promoting their existing options, and working with us to update the roadmaps for their majors (since creating greater flexibility for student exploration requires that we are clearer about downstream requirements). In addition, throughout relevant web pages, orientation activities, and advisor training we have changed our messaging to strongly encourage academic exploration as part of the first-year experience.

Both the experiment and these related efforts were made possible thanks to a marvelous collaboration with our students, the CUP (especially Chair Duane Boning), and the thoughtful consideration and input of deans, department heads, and faculty during the last academic year and this past summer.

Members of the class drew upon years of student data, focus groups, and broad community engagement, as well as their own personal experiences, to highlight the importance of exploration and how it is currently lacking, especially during the first year at MIT.

Why and why now?

We have arrived at this fortuitous moment in time thanks to a clearly defined set of needs for strengthening the first-year undergraduate experience, articulated in large part by the students in the spring 2018 "Designing the First Year at MIT" (DFY@MIT) class. Further, there has also been a growing sense of urgency at MIT that broader change is necessary. Many comments from those who provided input on the experiment echoed a recommendation from the 2014 Task Force on the Future of MIT Education: "MIT must engage in bold experiments that will help us learn about both the positive and negative aspects of pedagogical and curricular innovations."

What is particularly exciting is that we now have a path and the necessary foundations to achieve this change. With the benefit of a well-studied control group (the Class of 2021 was the focus of a CUP study group on undergraduate major selection led by Professor Jeffrey Grossman), the new experimental grading policy will help us learn more about strategies to improve the first-year experience. It's possible that more flexibility to explore majors will lead to increased confidence in and satisfaction with majors, as well as reduced stress and more interdisciplinary student work.

This experiment is also taking place against the backdrop of a broader reconsideration of the GIRs – a community discussion that Faculty Chair Susan Silbey and other faculty officers kicked off this past summer. Such conversation is rooted in some of the ideas generated by the students in the DFY@MIT class.

Members of the class drew upon years of student data, focus groups, and broad community engagement, as well as their own personal experiences, to highlight the importance of exploration and how it is currently lacking, especially during the first year at MIT.

Specifically, MIT's curricular structure and messaging, namely that students are encouraged to complete all of their core SME GIRs in the first year so that they can be prepared to select any major, leaves

many of them without an opportunity to investigate different majors to inform their choice (or minors, HASS concentrations, and other important dimensions of their education).

Remarkably, some of the student recommendations from the DFY@MIT class echo concerns articulated by the Lewis Report of 1949:

One of the most damaging criticisms of our undergraduate program is that the students feel so harassed by rigid routine and so overburdened by the quantity of work required in the individual subjects that they do not have time for reflective thinking or for the social experience that should be an important part of a college education. We recognize this unrelieved tension as a serious evil and we think that steps should be taken to remedy it. We think it particularly serious in the freshman year. (Committee on the Educational Survey, Lewis et al., 1949.)

Beyond the findings of the DFY@MIT class, the need for more exploration in the first year was also underscored in the 2018 Perceptions of Majors Survey released in June 2018:

- 27% of students surveyed did not feel prepared to select a major; and only 33% strongly agreed that they were well prepared.

- 38% of those who changed majors (who represent 30% of all respondents) indicated that an unsatisfactory experience with introductory subjects contributed to their decision to change majors. (Traditionally, around 80% of the first-year class takes three or four core SME GIRs in their first semester at MIT while on P/NR grading, leaving no room in their schedules to take these introductory subjects.)

The problem is particularly acute for students with fewer advanced credits for core SME GIRs (through advanced standing exams or AP credit). The 2017 Student Quality of Life Survey found that students with fewer core SME GIR credits at the start of their first year are statistically more likely to say they are dissatisfied with "[their] ability to balance academic and other aspects of [their] life," and are less likely to rate their academic experience as 'very good' or 'excellent.'

We note that 77% of the respondents to the 2018 CUP Study on Undergraduate Majors Selection said that making the core SME GIRs P/NR whenever they are taken would have improved the major selection process for them, more than any other option they were asked to consider (with the highest ratings being from those with advanced standing credit for fewer than three core SME GIRs).

Although the experiment will not help us understand how to address all the challenges first-year students report, we are optimistic that it will serve as a valuable learning opportunity for some of the most important challenges.

What's next

Although the experiment will not help us understand how to address all the challenges first-year students report, we are optimistic that it will serve as a valuable learning opportunity for some of the most important challenges.

We also carefully considered the difficulties of running this experiment, from changes in course enrollments and associated levels of TA support, to potential confusion of faculty, advisors, and students, to the need for more exploratory courses.

We have been taking steps to address these through information-sharing and support for expanding the current inventory of exploratory classes mentioned above. We are already monitoring the experiment in real time and will be reporting back to the MIT community at different points throughout the year and beyond.

I share the sentiment of Undergraduate Association President Alexa Martin and Vice President Kathryn Jiang who described the experiment as "a real opportunity to be innovators in the field of education, to be leaders amongst our peers, and to send a message to our students that we are listening and responding to their needs."

Based upon what we learn, we look forward to working with the MIT community in the coming year to determine what experimental policies we should consider for next year's incoming class.

Our thanks

The process of approving an experiment of this scope over the summer was extraordinary – and it is not something we want to do on a regular basis. But it was a unique opportunity and we are pleased that faculty governance and the Institute community came together to consider, improve, and ultimately approve this experiment.

The final proposal benefitted greatly from two rounds of feedback from deans, department heads, leaders of the First-Year Learning Communities, individual faculty, students and staff, and members of the CUP. Additional feedback came in after we submitted the proposal and that was considered as well.

Finally, thanks are owed to the core team who developed the "Designing the First-Year at MIT" class, the students in the class, faculty governance, and the many faculty, students, and administrators from across the campus who provided thoughtful input.

Ultimately, we owe it to our students to keep improving, and I believe that we've taken a big step in the right direction. Already, the effort is fostering greater discussion among students and faculty about how to make an MIT education the best it can be. With this experiment and future ones like it, I am confident that we are poised to usher in a new era of curricular innovation at the Institute.

Ian A. Waitz is Vice Chancellor and Professor of Aeronautics and Astronautics *(iaw@mit.edu).*

MIT's Relationship to China
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national activities continue to grow, we must become more purposive and proactive in how we select, organize, and manage our major international engagements. In terms of research and education, it recommended that MIT develop a more robust platform for supporting individual faculty members in their international initiatives, and that we should continue to build out MIT's distinctive "global classroom," in which our students learn about the world through hands-on, practical problem-solving projects *in situ*, augmented by country-specific cultural and historical education and language training.

While calling broadly for increased international engagement, the report highlighted China (as well as Africa and Latin America) as warranting special attention in view of the high potential for impactful engagement by MIT.

Over the past year my office has led a series of efforts to strengthen our ability to evaluate and develop MIT's China-related activities. We began with inside voices: interviews with more than 50 faculty colleagues who assessed China's likely future progress in their fields. For an outside perspective, we invited some of America's leading China experts to MIT to speak with an *ad hoc* working group of faculty and administrators about economic and political developments in China, and we consulted with policymakers and their advisors in Washington. On the ground, we have also been exploring several potential research and educational collaborations with Chinese partners, on their own merits and also as a way to clarify what we might and might not want to do in and with China. And this November, following a recommendation of the Global Strategy report, we will convene MIT's first Global Summit in Beijing. The first of its two days will feature activities and events around the city hosted by several MIT programs, including DUSP's China Future City Lab, Sloan's International Faculty Fellows program, the student-run MIT China Innovation and Entrepreneurship Forum (MIT CHIEF), the Alumni Association, and others. The second day is a plenary conference; designed to demonstrate MIT's interest in working with and learning from China and to communicate the values and principles most important to us in research and education, it will feature 15 MIT faculty as well as leaders from China's scientific and business sectors. Two key Summit themes will be: what we can learn from each other, and what we might do together to address major global challenges such as climate change, pollution reduction, and urbanization that are important to both countries and to the rest of the world. In concert with the Summit, the Executive Committee of the MIT Corporation will travel to Beijing and Shenzhen as part of a year-long effort to educate itself about the risks and opportunities of engagement with China.

The context: escalating U.S.-China tensions

Meanwhile, the bilateral relationship between the U.S. and China has entered a difficult period. The two countries are in the early stages of what seems likely to become a fully-fledged trade war, and the U.S.-China relationship is now framed by U.S. policymakers principally in terms of strategic rivalry with an adversary. The expectation is of growing economic, military, and ideological competition. In Washington this narrative has quickly become widely accepted, on Capitol Hill as well as in the Executive branch. Indeed, it is one of the relatively few issues on which there is currently fairly broad bipartisan agreement.

Science and technology as geopolitical concerns

Science and technology are at the heart of this new strategic competition, as President Xi Jinping focuses on achieving world-leading science and technology in his drive to promote economic growth, strengthen China's military capabilities, and consolidate political control. At home, U.S. policymakers in both parties are focusing on China's theft of intellectual property and industrial espionage, and the forced transfer of technology to their Chinese rivals by U.S. companies seeking access to the Chinese domestic market. Texas Senator John Cornyn, the majority whip, reflected a widespread view in Congress in arguing last month that "[w]e simply can't let China erode our national security advantage by circumventing our laws and exploiting investment opportunities for nefarious purposes . . . . The backdoor transfer of technology, know-how, and industrial capabilities has gone unchecked for too long." Many in the U.S. government now see the Chinese as bent on Asian and eventually world domination, at America's expense, and see little reason to cooperate with the Chinese, especially in science and technology; as they see it, the goal should rather be to isolate China's scientific establishment, to cut it off from ours.

What does the worsening of U.S.-China relations portend for MIT?

In the short run, some legislators and federal officials are seeking to control the access of Chinese students and visitors to American university labs and technologies through visa restrictions and other means. At a congressional hearing earlier this year, FBI Director Christopher Wray described "non-traditional collectors of information, especially in the academic setting, whether it's professors, scientists or students . . . . exploiting the very open research and development environment that we have, which we all revere." Director Wray warned of the need to "view the China threat as not just a whole-of-government threat, but a whole-of-society threat on their end, and I think it's going to take a whole-of-society response by us."

Concerns for MIT on campus

There are legitimate concerns here that must be addressed promptly and effectively, but also real risks that the remedy will be worse than the disease. We must firmly resist threats to free and open

exchange and collaboration on campus, along with any proposals designed to discriminate against MIT students, researchers, and faculty from China (or any other country). We must also zealously protect our ability to invite the world's most outstanding students and faculty to join the MIT community. Over the past decade the numbers of Chinese graduate students and postdocs at MIT have both more than doubled: today, 10% of our graduate students and 20% of our postdocs hail from China. In the same period, the rate at which MIT researchers co-authored publications with colleagues from leading Chinese universities rose tenfold. These trends reflect assessments of the advancing quality of Chinese scientific research by many members of our faculty.

Concerns for MIT in China

In the longer run, a central question for MIT is how we will connect to China's rapidly developing scientific and technological infrastructure. A major focus of current U.S. government policy is to try to prevent or at least slow China's advance. A particular target is China's ambitious *Made in China 2025* strategy, which seeks to achieve global leadership in key fields of science and technology including AI, clean energy, advanced manufacturing, aerospace, quantum science and engineering, and genetic engineering. White House officials and congressional leaders are considering measures aimed not only at preventing unfair trade practices, but also at building firebreaks against China's industrial rise. But as President Reif trenchantly observed in a recent *New York Times* editorial, "If all we do in response to China's ambition is to try to double-lock all our doors, I believe we will lock ourselves into mediocrity."[1] He urged the government to focus on developing a domestic strategy of investment in sustaining American leadership in science and innovation. And he suggested that U.S. views of China as an adversary should be tempered by the recognition that China will increasingly have strengths in technology that we can learn from.

[1]https://www.nytimes.com/2018/08/08/opinion/china-technology-trade-united-states.html

On balance, however, the inclination of our faculty interviewees was to engage with China, and the most compelling justification to do so was also the simplest: it will make us a better institution. We become stronger when we succeed in attracting the world's most talented people to come and work with us, and many of these people come from China. We become stronger when our faculty and students are able to study and conduct research at the world's most advanced research facilities, and increasingly these will be located in China. We become stronger when we work with and learn from the world's most innovative firms, and more and more of these are Chinese.

Faculty perspectives

On these latter points, our faculty clearly agree. Many of the faculty we interviewed had no doubt that Chinese researchers in their fields would be matching the best of American capabilities in a decade or less, and some stated that this had already occurred. Some of the faculty saw immediate opportunities for productive scientific collaborations with capable and well-funded Chinese colleagues (in some cases their own former students), while others were attracted by the possibility of engaging with the downstream elements of China's rapidly developing innovation ecosystems, including sophisticated and adventurous industrial users of advanced technologies; abundant venture capital; troves of data; vast and fast-moving consumer markets; flexible and responsive supply chains; and unmatched abilities to scale up to high-volume production of innovative manufactured products. Some faculty emphasized the educational value of introducing our students to China, and that American graduates of MIT who are knowledgeable about China's history, culture, language, politics, and economic development and who also have a practical, hands-on knowledge of Chinese business practices and innovation capabilities will surely bring broader benefits to the U.S. Other faculty saw opportunities in China to use their knowledge and skills to tackle some of the world's most challenging problems – problems such as environmental pollution, food safety, and urbanization on an almost unimaginably large scale.

The views of our faculty interviewees were far from monolithic. Some expressed serious concerns over increasing censorship, human rights violations, and the reassertion of Party political control over Chinese university campuses. Some raised ethical concerns about the possibility that scientific collaborations with China might help the Chinese government – even if only indirectly and marginally – to use advanced technologies against its own people, or against the U.S. in future military confrontations. And some judged that Chinese capabilities in their research fields were not strong enough to justify collaboration.

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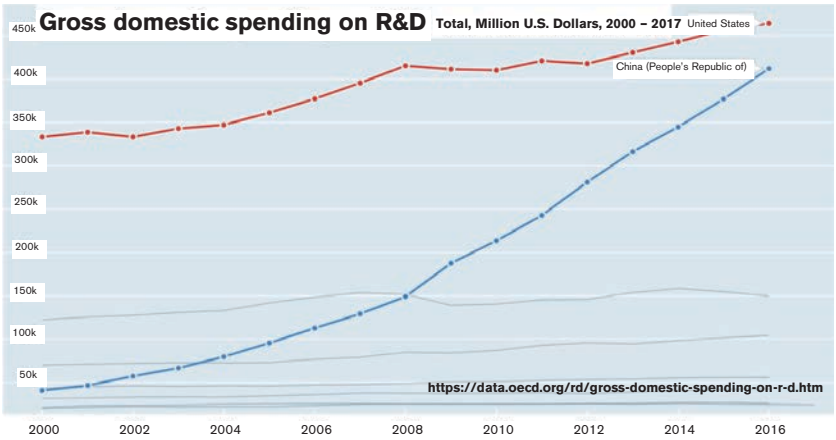


China will likely overcome the U.S. to become the world's largest funder of R&D by next year.

What are MIT's responsibilities?

This view of the merits of engaging with China is obviously quite far removed from the primarily adversarial and defensive posture of the U.S. government today toward China, and it raises an important question: when this kind of gap opens up, what are MIT's responsibilities as an American institution of education and research? Of course, our faculty are and must remain free to follow their intellectual agendas and moral predispositions. That is the Institute's most fundamental operating principle. But sometimes we must also act at the institutional level, and in such cases, as MIT considers its engagements with China, what is our responsibility to concern ourselves with the policies of the U.S. government?

Needless to say, one obligation is to ensure that MIT itself as well as individual members of the MIT community are in full compliance with all relevant federal (and state) laws and regulations. Additionally, as an American institution we must be cognizant of national policy and give due consideration to the national interest in our internal decision-making. However, with one important exception, national policy ought not to dictate our actions. Our job is to act in the best interests of MIT itself, even while recognizing that this may not always lead to outcomes that are consistent with the government policies of the day. When our plans and programs are not aligned with those policies, we have a responsibility to be fully transparent, to inform relevant agencies so that there are no surprises, and to engage with government officials in discussion of these differences.

The exception to the principle that national policy does not dictate MIT actions would arise if we were to encounter situations in which the interests of the United States and China were in direct conflict. (For an institution like MIT, with its strong practical and worldly orientation, this is not an implausible scenario.) In such cases, there should be full confidence, both at home and abroad, that MIT, as an American institution, will never put any other country's interests ahead of those of the United States.

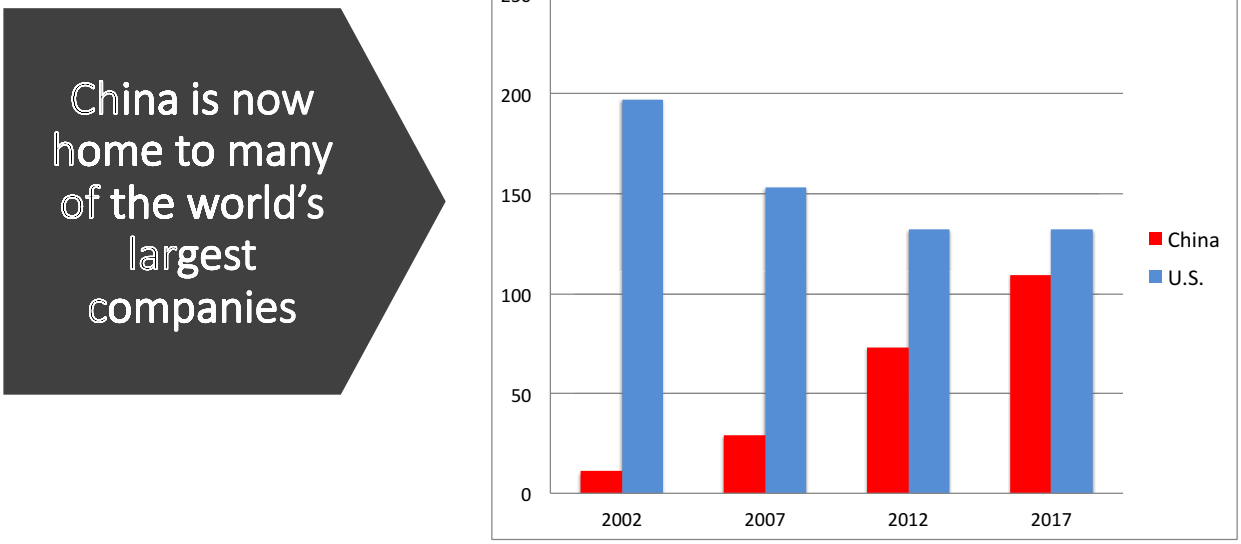
As a practical matter, there will generally be good alignment between what makes sense for MIT and what is good for the United States, not least because a hypothetical action taken by MIT that was harmful to U.S. interests would be likely to end up harming MIT too, in one way or another. That said, we cannot assume *a priori* that activities which we believe to be in MIT's long-term interest will always be aligned with whatever the government policies of the day happen to be. Preparing for such possibilities must be an important part of our China strategy.

At the outset of this article I mentioned that we had embarked on a year-long process of learning how best to manage our relationship with China. The year isn't over yet, and the events in Beijing this coming November will certainly add to our stock of insights. But already some important lessons can be discerned. Here are a few:

• Any major MIT engagement with China is more likely than not to receive attention from both the U.S. and Chinese governments, because of our reputation and because of our involvement with strategic technologies. We must be prepared to explain in Washington what we're doing, why we're doing it, how we decided to do it, and that we understand that there are real risks of engaging with China and are taking concrete steps to deal with them. We must be prepared for negative reactions.

• To reach sensible decisions about our China-related activities, we must have well-designed internal processes capable of weighing risks and benefits carefully, making distinctions among different kinds of activities while ensuring that our core values and principles and general policies are brought to bear, and drawing on outside expertise when needed. An important part of these processes is the faculty International Advisory Committee (IAC). Following the recommendation of last year's Global Strategy report, the IAC was reconstituted a year ago as a Standing Committee of the Institute to provide an independent faculty voice in advising the senior administration on MIT's significant international engagements. Under its chair, Prof. Rohan Abeyaratne, the IAC has been considering our China-related

activities over the past year and will continue to play an important role in this domain. If you are considering new engagements with China, I urge you to contact the IAC about your plans.



• There is much about this situation that is new, and it would be a mistake for anyone – either inside or outside academia – to assume that they know the right approach to engagement with China. In both Washington and Beijing it is now common to hear about the onset of a new Cold War. But, of course, the twenty-first century competition with China is very different from the twentieth century strategic nuclear and ideological competition with the Soviet Union. Despite imbalances and vulnerabilities, the Chinese economy is far more robust than the Soviet economy ever was, and it will likely soon become the world's largest. This is a new situation for the United States – dealing with a military and ideological rival that is also a worthy economic competitor, with which our own economy is far more deeply intertwined than was ever the case with the Soviet Union.

For MIT and other leading American research universities, too, the situation is new: the emergence of world-class scientific, technological, and industrial capabilities with much potential benefit for us and the world in a country with which the U.S. has major political and ideological differences. Especially in this dynamic environment, when government policies in both countries are rapidly changing, it isn't obvious when to cooperate and when not to cooperate, and – when it is appropriate to cooperate – how to do so. How can we engage in China without checking our principles at the door? How can we collaborate with Chinese companies without losing control of our intellectual property? How can we work with Chinese collaborators at the technological frontier if we are anxious about how the Chinese government might use the results? At a time of growing confrontation, we must somehow create space for ourselves to experiment, and to recalibrate and refine what we are doing as we discover what does and doesn't work.

• Finally, when it comes to China collaborations, we should not be misty-eyed about China's importance to us. We need instead to be realistic in our expectations and clear about our interests and objectives, and the more specific and "granular" the goals for these collaborations, the better. For example, we might expect that such collaborations should help our faculty and students to make contributions and have impacts that they could not reasonably hope to achieve without collaborating. More generally, we must remember that our most fundamental interests are to make new contributions to research, to education, and to solving the great problems of the world and the puzzles of nature "that will best serve the nation and the world in the twenty-first century." And we should remember, too, that we stand for something even more fundamental – the core ideology of reason, rational and evidence-based debate, and the intellectual freedom to create and collaborate on which our entire academic enterprise rests.

I welcome your comments and suggestions. The expertise, good sense, and wisdom of the faculty will be of central importance as MIT seeks to manage its way through this complicated and challenging terrain.

Richard Lester is Associate Provost and Professor of Nuclear Science and Engineering *(rklester@mit.edu).*

MIT Open Access Task Force Shares White Paper on OA Landscape

Hal Abelson
Chris Bourg

IN JULY 2017, Provost Martin Schmidt, in consultation with the Vice President for Research, the Chair of the Faculty, and the Director of Libraries, appointed an ad hoc task force on open access to MIT's research. Convening the task force was one of the 10 recommendations presented in the 2016 preliminary report of the Future of Libraries Task Force. In addition, the 2013 *Report to the President on MIT and the Prosecution of Aaron Swartz* raised the question as to whether MIT should strengthen its activities in support of open access to the research and educational contributions of the MIT community. As a result of subsequent discussions held with the faculty and relevant committees, this task force has been charged to take up this question.

The open access task force is co-chaired by Class of 1922 Professor of Electrical Engineering and Computer Science Hal Abelson and Director of Libraries Chris Bourg, and is composed of a diverse and multi-disciplinary group of faculty, staff, postdocs, and graduate and undergraduate students. Throughout the 2017-18 academic year, task force members consulted widely with domain experts across campus and beyond to develop an understanding of current local, national, and global practices, policies, and possibilities. The task force is pleased to share a white paper, "Open Access at MIT and Beyond: A White Paper of the MIT Ad Hoc Task Force on Open Access to MIT's Research," with the community (read online at ***https://open-access.mit.edu***).

Impact of the MIT Faculty Open Access Policy

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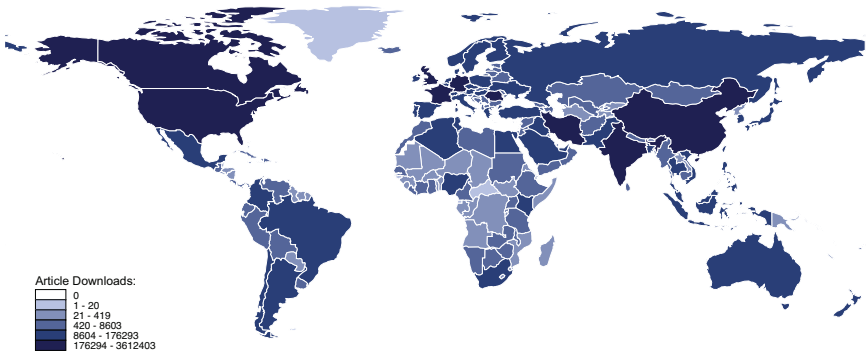
"Thank you, MIT Library, for providing open access to researchers in developing countries. It really makes life much easier for us. Please continue helping us produce knowledge and evidence for a better society."
-Researcher in Indonesia



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The task force is in the process of developing a set of draft recommendations across a wide array of scholarly outputs, including journal articles, scholarly monographs, data, computer code, and educational materials, and will be gathering community feedback on those recommendations throughout the coming academic year. We invite MIT community members to offer their ideas of new, updated, or revised policies or practices that might further the Institute's mission of disseminating the fruits of its research and scholarship as widely as possible. Ideas can be submitted via the task force idea bank (***https://open-access.mit.edu/idea-bank***), via email to the task force (*openaccesstaskforce@mit.edu*), or at upcoming community forums (details forthcoming).

Hal Abelson is the Class of 1922 Professor of Electrical Engineering and Computer Science *(hal@mit.edu);*
Chris Bourg is Director of Libraries *(cbourg@mit.edu).*

Across the Retirement Line

The Transition to Retirement

Dr. Emeritus Beaver

A COLLEAGUE ONCE TOLD ME he felt strongly that MIT faculty should retire fully from the Institute at age 70 (there are other options, to be explored in a subsequent column) in order to free up a position for hiring a young faculty member in his department. To the extent that this sentiment may no longer be as pervasive at MIT and other institutions as it once was, it may be a consequence of uncertainty about what life after retirement might entail: concerns about having sufficient finances to support the lifestyle to which one has become accustomed, affordable health care (see my previous column), or other issues. This month I explore the other side of the coin, delineating the positive features of a timely retirement and how it can significantly enrich the remaining years of life for all of us.

The life of a professor may be analyzed as having four components: the privilege of working with young people, the joy of discovery, the opportunity to serve, and the importance of family. The life of a retired professor can similarly be dissected into categories.

Liberation from classroom teaching affords time for other activities, while simultaneously relieving what for some has become a burden. Teaching is a service that with age may become physically and mentally more challenging as new generations of students bring habits, technologies, and personal likes and dislikes that resonate in a less and less familiar manner with the aging faculty member. Relief from the physical challenges of appearing for an hour or longer in front of a classroom, even in a small seminar-type setting, can promote the health and stamina of retired faculty, as they may diminish with the passage of time. Retirement makes it easier to fit important activities into one's daily schedule, activities that prolong a healthy life, such as personal training with strengthening and balance exercises.

Renewing and/or strengthening family ties is an important opportunity for the retired professor. The ease of travel combined with job and living opportunities in locales remote from MIT may have taken family members – parents, children, siblings, and sometimes even spouses or partners – to other cities or states where continued close interactions were less convenient and thus less frequent.

Renewing and/or strengthening family ties is an important opportunity for the retired professor. The ease of travel combined with job and living opportunities in locales remote from MIT may have taken family members – parents, children, siblings, and sometimes even spouses or partners – to other cities or states where continued close interactions were less convenient and thus less frequent. For some, the pursuit of an academic career limited the amount of time spent at home to share the responsibilities of parenthood. Depending on circumstances, these situations can be addressed in retirement by a move to another locale or by time made available in one's current environment. Grandchildren, if one is fortunate enough to have them, can bring great happiness, while benefitting from the rewards of wisdom and experience we can bring them. Have you ever heard a grandparent comment that if s(he) had known about the joys of grandparenthood they may have skipped parenthood altogether? Strengthening ties with siblings or having time to help care for aging or ill parents are also more feasible in retirement.

The continual pressure to remain creative, to raise (summer) salary, and to secure funds to support research in order to reap the rewards of discovery in a university environment vanishes on Day 1 of retirement. Ever younger undergraduates, graduate students, and postdocs make professional students out of all professors with their questions and ideas, but keeping up with them may become more difficult as aging dulls our senses. Writing new and competing grant proposals can be wearing for senior faculty nearing retirement, who have had to do so for many years. It takes financial resources to pursue one's research. Retirement can remove these pressures, and MIT's pension plan provides a degree of financial security not met by most other colleges and universities (more on this topic in a later column).

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The Transition to Retirement
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And then there are the new adventures – retirement can be as much of a beginning of exploration as an ending. There are many opportunities for retired faculty to remain at MIT and sustain an active research program, ranging from part time to nearly full time. It is also possible to do so from another city, owing to the facility of electronic communication and long-distance transportation infrastructure in our country. Or perhaps you always wanted to start that company, write a children's book, pursue a musical instrument or sing in a choir, learn to cook, master a new language, or travel to other countries! Do you love to read but find that, as an active faculty member, you simply do not make time to devour books the way you did when you were an undergraduate on summer break? Retirement brings you the freedom to pursue these passions.

Retirement frees time for personal training, yoga classes, swimming, and other fitness pursuits that contribute to a healthy senior life. Aging can bring increasing health issues that even excellent eating and exercise habits cannot guarantee to forestall. The medical professionals can be of great benefit but staying fit, eating healthy, and maintaining flexibility greatly increase your ability to fight off disease and to avoid accidents or at least recover more quickly from those that you will doubtless have.

There is another model that bears mention before closing, one not uncommon among academics, which is simply to remain in place and "see how it goes" after partial or full retirement. In many ways this is the easiest path for it requires little change in personal and professional infrastructure, from living space to lab space, but without the requirement to teach (unless you wish to do so – there are possibilities). I make no judgment in this regard and I marvel at my colleagues at MIT and elsewhere in their upper eighties and even nineties who retain an active research program to the end. Some have even worked in the lab – easier to do in retirement. But this choice must be balanced against those above; new adventures do not necessarily require a change in scenery.

* * * * * * * * * * *

This column is intended for MIT faculty who have already retired or are contemplating such a decision in the near future. The purpose is to provide some practical advice about health care at home and abroad, income sources, taxes, insurance decisions, and numerous other matters that may be helpful in preparing for the transition from active service (teaching, research, advising) to retirement. The goal is to help prepare for the new adventure that awaits you following the transition. The inspiration for writing such a column came from discussions that I had with colleagues during my own final months as an active MIT faculty member, many of whom were themselves contemplating retirement and wondered how best to prepare for the many decisions they had to make.

You are encouraged to send your comments and suggestions to the *Faculty Newsletter* (*fnl@mit.edu*). One colleague wrote the following after reading the previous Dr. Emeritus Beaver column about health insurance in retirement. We appreciate the clarification.

"The quoted rates seem about right, but fail to point out that the Medicare Parts B and D and the MIT cost to the MIT sponsored supplement for a retiree are for an individual only. If the retiree is married the quoted numbers will be doubled in most cases . . . something worth noting."

Stephen Hawking: The Eminent Physicist vs. The Media Myth

Eduardo Kausel

THE RECENT PASSING OF the notable British astrophysicist Stephen Hawking and the miscellaneous obituaries on his persona in magazines and newspapers motivate me to share with you some reservations I have had on the legend of Hawking in the mainstream media. Yes, he was indeed a world-class scientist, and surely one of his most notable and perdurable contributions will be the Hawking radiation from black holes. But supremely excellent as he was, the larger-than-life myth portrayed by the media has often bothered me, especially in the last decades of his life.

The rub is as follows: If you were to estimate the amount of technical information that Hawking produced in his life, say in terms of bits and bytes, you would find that that would amply (vastly?) exceed the time and means he had available to transfer his thoughts onto either paper or synthetic voice. This was especially true in the last few decades of his life when he was confined to a chair and communicated via his computer. So how did he get so much information out of his brain?

Now, I have seen numerous videos on Hawking, and especially those in which he sits immobile in his chair and answers questions posed by the audience via synthetic voice. But not once have I seen him actually creating his writings and working on his *in silico* responses. There is surely a good reason for that: Writing is a tedious, very slow process, and such videos would have been exceedingly boring.

My understanding is that he looked at a screen with a keyboard, and he selected letters by staring at individual characters; a scanner then picked up his gaze and detected which letter he was looking at. After two or three letters were selected, the software would offer him a choice of likely words – this was optimized by a statistical analysis of all of the words he had used in previous writings. But here is the bottleneck: This is an excruciatingly slow process, or as an information scientist would have expressed it, Hawking had minimal bandwidth. Indeed, try watching a video without a broadband cable connection. Yet the rate at which Hawking published papers with advanced ideas and very complex concepts and thoughts, not to mentions his books, surely greatly exceeded that bandwidth.

My own speculation is that he had an inner circle of scientists working with him, and that his output was the aggregate of the work of all of them, and not just of Hawking by himself. Now, there is nothing wrong with that – most science is the result of teamwork – but it should still be acknowledged openly. Most probably the special computer he owned must have already stored a good number of answers to myriad expected queries from the public and the media. Their choice and retrieval in response to an actual question could have been done automatically with the help of some artificial intelligence programs in the computer. Or perhaps the choice was made by one of his unseen assistants. Anyway, in none of the videos have I seen him moving a finger, blink one of his eyes, or twitch the edge of his mouth to search for and choose a proper response. So what gives?

Chances are that new concepts were created along the following interactive scenario: Say a researcher in his team asked him a question along the lines of: "Prof. Hawking, wouldn't you think that Artificial Intelligence is dangerous"? and then follow that with an elaboration on the problem. Hawking would then have simply listened, and in due time have agreed (or disagreed) with some subtle gesture of his. That assistant scientist would then have gone on to attribute to Hawking the authorship of that thought and perhaps even have written that opinion on his behalf. In other words, complex ideas and technical positions must have conveniently been elaborated by some back-and-forth interaction with his team, to which he eventually gave his final approval, even if not creating these *ab initio*.

All of that collaborative technical effort surely produced plenty of funds for the Lucasian Professorship at Cambridge that he held, for his affiliated lecturers and faculty as well as for his assistants and technical team, all of whom had a vested interest in keeping the money and celebrity machine well lubricated. Indeed, at his death, Hawking was a multimillionaire whose wealth vastly exceeded that of most other physicists in the world.

And society benefited too: They had a scientist who valiantly faced physical adversity, a living myth to celebrate and exhibit as a worthy example to others.

But why has nobody ever bothered to explain how Hawking-the-Media-Celebrity actually worked? Was the press so enthralled that they did not notice that large pieces of information were missing in this picture? Perhaps it is because exemplary heroes like Hawking are accepted at face value, for they are perceived to be beneficial to the world. We love to fool ourselves whenever it seems to serve a good purpose.

Now, last April the American CBS broadcast *60 Minutes* showed a segment on MIT's Media Lab and the development there of a device that can "read the mind," translating the thoughts into actionable ideas in the computer, say an Internet search. But I am quite certain that Hawking did not possess and use any such device, as they are still just in the very early design and development phase.

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One final word in closing: None of this is meant to detract from the superb technical merits and human qualities of Stephen Hawking-the-person and scientist. Instead, it is meant to combat Fake News. To the extent that mainstream media's exaggerated reports are clearly non-believable in some dimension, it seriously detracts from their credibility and damages their reputation, which they will then struggle to gain back. Put simply, it is the parable of the naked king all over again.

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Climate and Accountability

Edmund Bertschinger

MIT HAS DONE A LOT to improve the experience of women and others underrepresented in STEM (science, technology, engineering, and math) yet inequities of experience persist. Indications include:

- Only 23% of MIT faculty are women, up from 21% in 2013.
- Of the 914 female undergraduate respondents to the 2014 Community Attitudes on Sexual Assault survey, 284 reported experiencing sexual harassment, rape, sexual assault, and other unwanted sexual behaviors while at MIT.
- Responses to the 2016 and 2017 Quality of Life Surveys indicate that MIT women systematically report having to work harder than their peers or colleagues to be taken seriously compared with men. Half of female faculty respondents agreed with this assertion compared with only 17% of male faculty respondents. Similar results hold for both tenured and untenured women.

These quantitative results are put in more personal terms by many people who have shared their stories with me during my recently concluded service as the inaugural Institute Community and Equity Officer (ICEO). From the female undergraduate and graduate students who are excluded from full participation by male peers, to the staff members who are put down by supervisors, to the faculty members who are frustrated by others talking over them, there are real problems calling for recognition, understanding, and solution. The largest component of this is gender harassment, defined in the recent National Academies Consensus Study Report "Sexual Harassment of Women: Climate, Culture, and Consequences in Academic Sciences, Engineering, and Medicine," as verbal and non-verbal behaviors that convey hostility, objectification, exclusion, or second-class status about members of one gender.

Creating a Climate Dashboard

Conversations with many people suggest that one's social identity – especially gender, class or socioeconomic status, sexual orientation, gender identity, and disability status, affect one's experience of MIT. In order to assess this as fully as possible using existing Quality of Life Survey data, the ICEO and Institutional Research created a publicly accessible Climate Dashboard for MIT. Based on almost 13,000 responses during 2012-13 and 11,500 responses during 2016-17, with about a 50% response rate to these surveys, the dashboard summarizes the experience of groups defined by role (e.g., graduate student, postdoc, support staff on main campus, research staff at Lincoln Laboratory), gender, race, sexual orientation (self-identified in the survey), tenure status, and more.

Because racial tensions have drawn so much attention nationally during the last five years, I expected that MIT data would show that the largest differences of experience arise from differences in race or ethnicity. However, that was not the case. Gender, class (as indicated by role at MIT), and sexual orientation each account for more variation in the survey responses than does race. The effects are multiplicative: the most marginalized groups on campus are female, LGBTQ graduate students (and, presumably, students of color, although the numbers are too small to parse this finely). Existing MIT surveys do not adequately assess gender identity or disability status. Yet individual stories of queer students, staff of color, and people with disabilities show that they generally experience a different, and often less supportive, MIT than I do as a straight white male able-bodied senior faculty member.

How was the dashboard created? The choice of survey questions (items) to analyze for the dashboard was made iteratively. A preliminary qualitative study in 2013-2014 presented in the ICEO Report identified five major themes for concern: unconscious bias and micro-inequities, discrimination or harassment based on social identity, abrasive conduct, sexual harassment, and excessive stress. The sexual harassment topic was excluded from the dashboard because it was investigated separately for students in the 2014 CASA survey and we have no such data for postdocs and employees. Quality of Life Survey items were chosen to sample the other topics. In addition, a principal component analysis of a large bank of survey items was carried out to identify which groups of questions had the most explanatory power. When several survey items were strongly correlated, analysis of variance was used to select the single survey item with the most explanatory power. The list was refined further as different subsamples were investigated, combining information about social identities, role and work unit. For 2012-

13, a total of six survey items was used for employees and postdocs and five for students. New survey items were added for 2016-17, resulting in seven for employees and postdocs and eight for students (with the earlier items repeated allowing measurement of changes with time). Full details about the design and use of the dashboard appear elsewhere.

The dashboard summarizes a lot of information. Surveys do not provide a controlled experiment nor are they sufficiently precise to answer every question. With these caveats, here are some additional findings from the surveys, beyond the fact that gender effects are large:

1. Based on their sense of fair treatment, the most privileged groups are undergraduates, graduate students, and faculty, while the least privileged are service staff, administrative staff, and support staff. Although some people may be surprised to find students feeling treated most fairly, others will recognize that even at a technical institute, administration and faculty are most solicitous of students (especially undergraduates).

2. Students respond much more negatively than other groups to "Taken seriously" (i.e., they are much more likely than employees to agree that "I have to work harder than some of my peers to be taken seriously." (Students were asked this question only in 2017.) This might be ascribed to impostorism, i.e., the fear of being revealed to be incompetent despite high ability and achievement. However, the large gender differences in this item suggest that not being taken seriously may be due more to the environment than to the individual. As a female graduate student asked me, "Why do you call it impostorism when we are treated as though we really don't belong?" A similar point was made this summer in the *New York Times*.

3. The largest gender differences occur for Other Instructional staff (mostly lecturers and instructors), faculty, and research staff at Lincoln Lab. This result affirms reports I have heard from women in these roles.

4. Compounding effects of social identity (i.e., intersectionality) are obvious in the climate dashboard. Combining gender and sexual orientation produces the most positive (for heterosexual men) and negative (for LGBTQ women) climates. (Gay men who are faculty or are research staff at Lincoln Lab are also among the top-ranked groups for a positive climate, revealing the complications of intersectionality.)

5. Between 2012-2013 and 2016-2017, the range of mean responses grew for each category of social identity. In other words, mean differences grew when comparing men and women, whites and underrepresented minorities, heterosexual and Lesbian/Gay/Bisexual or Unsure/Other (this selection is mainly a proxy for queer, transgender, and other non-binary gender identities). In particular, the experience of women became worse on average for all groups except faculty, while the experience of men improved in most groups (with exceptions for administrative staff, postdocs, and research staff at Lincoln Lab). The growing disparity of experience should concern everyone.

6. In 2012-2013 service staff had the worst average climate rating of any group at MIT; in 2016-2017 they had the best, and were the most satisfied group. Why? One reason may be the SEIU contract negotiated in 2016, which resulted in a substantial pay raise for janitors. (Service staff also had the lowest survey response rate of any group, 30% in 2016.)

7. Postdocs declined from 4th to 9th place (of 11 groups) in the climate rankings over the four years between surveys. They experienced the most negative change. This may be related to increasing financial stresses combined with other challenges identified in the National Postdoc Survey.

What is next? The reader may ask why we didn't extend the analysis prior to 2012-2013, why we didn't include certain groups like people with disabilities, or how their own department ranks. For the first two, we lack good survey data; MIT has been changing its survey questions over time, and the only long-term baseline we have is overall satisfaction. By this measure, there has been substantial overall improvement during the last 20 years, but the analysis by demographic groups is available only in recent surveys. We haven't asked about respondents' disabilities in the Quality of Life Surveys to date. We do have information on respondents' work units (academic department or otherwise), but for most units the number of respondents is small and does not allow for dividing by demographic group given our requirement of 15 or more responses. The ICEO Report showed that department or work unit is, like role and social identity, a source of considerable variation in the climate for inclusion. This information is available to the senior administration and is being used to help improve department climates. I hope that, going forward, MIT will continue to ask the subset of questions used in this dashboard so that it can be kept current, and will seek additional demographic information about respondents. In particular, respondents should be given the option to specify both gender identity and sexual orientation using common designations as well as disability status.

Recognizing climate challenges is only a beginning. Concerns must be understood and addressed, progress assessed, and the cycle repeated. Having observed these issues play out over more than 30 years on the faculty, I believe that three ingredients are necessary for sustaining change: committed leadership, upward pressure from the community, and internal and external accountability measures. The third ingredient has not always been effectively utilized, but we can change that, now.

Accountability

Since 2010, various groups in the MIT community have created sets of recommendations for making MIT more equitable, inclusive, and diverse, ranging from the 2010 Report on the Initiative for

Climate and Accountability
Bertschinger, from preceding page

Faculty Race and Diversity to the 2016 Report on the Status of Undergraduate Women at MIT. The Academic Council Working Group was created in response to two 2015 reports (from the Black Students' Union and the Black Graduate Students Association) with 18 recommendations. Nine MIT reports about equity and inclusion presented during 2010-2016 made a total of 177 recommendations. Most of the reports have received little attention. In my view, we don't need many more recommendations, but we do need attention focused where community members have already invested so much effort (see "upward pressure from the community," above).

To this end, the ICEO hosts a Recommendations Scorecard summarizing progress on each of the 177 recommendations. The average completion rate per report ranges from 22% for the Recommendations of LBGTQ+ Students and Communities at MIT to 57% for the BSU recommendations. As of this summer, the overall completion rate is 39%, indicating that much work remains to be done. As more progress is made, the scorecard will be updated. I hope that this internal accountability measure will help guide committed leadership to continue improving the experience of all people at MIT.

In the end, internal accountability measures rarely suffice to sustain change. Leadership changes, students move on, employees retire, new initiatives shift our attention. However, issues of equity, diversity, and inclusion do not disappear. MIT prides itself on solving problems, but sometimes it needs help. All faculty who have participated in the Corporation Visiting Committee process recognize the value of an external evaluation and accountability measure. Indeed, the MIT Corporation is interested in the topics of this article. But the Visiting Committee process focuses on the research and teaching of academic departments, and it cannot be counted on to have the expertise to deal with complex issues of equity and inclusion.

Fortunately, another mechanism exists: the STEM Equity Achievement (SEA) Change initiative of the American Association for the Advancement of Science. SEA Change provides a LEED-like certification for institutional efforts to promote equity, diversity, and inclusion in colleges and universities, focusing on the STEM disciplines. Participation requires agreeing to a set of guiding principles, conducting an evidence-based self-assessment, and developing a plan to make progress. The institutional application is substantially smaller than a Visiting Committee binder but requires participation of a cross-functional team with access to and support of key stakeholders (e.g., MIT senior leadership and Deans). Once the university as a whole has an entry-level certification, individual STEM departments can apply for their own rating. I believe it is very important for MIT to show leadership among universities by participating in this initiative sooner rather than later or not at all. The data presented above show a compelling need to hold ourselves accountable. I urge faculty to call on their leaders to begin the SEA Change process in 2018.

Edmund Bertschinger is a Professor of Physics. He recently stepped down as Institute Community and Equity Officer *(edbert@mit.edu).*

Nominate a Colleague as a MacVicar Faculty Fellow

PROVOST MARTIN SCHMIDT is calling for nominations of faculty as 2019 MacVicar Faculty Fellows.

The MacVicar Faculty Fellows Program recognizes MIT faculty who have made exemplary and sustained contributions to the teaching and education of undergraduates at the Institute. Together, the Fellows form a small academy of scholars committed to exceptional instruction and innovation in education.

MacVicar Faculty Fellows are selected through a competitive nomination process, appointed for 10-year terms, and receive $10,000 per year of discretionary funds for educational activities, research, travel, and other scholarly expenses.

The MacVicar Program honors the life and contributions of the late Margaret MacVicar, Professor of Physical Science and Dean for Undergraduate Education.

Nominations should include:

- a primary nomination letter detailing the contributions of the nominee to undergraduate education,
- three to six supporting letters from faculty colleagues, including one from his or her department head if the primary letter is not from the department head,
- three to six supporting letters from present or former undergraduate students, with specific comments about the nominee's undergraduate teaching,
- the nominee's curriculum vitae,
- a list of undergraduate subjects, including the number of students taught, and
- a summary of available student evaluation results for the nominee.

For more information, visit ***registrar.mit.edu/macvicar*** or contact the Registrar's Office, Curriculum and Faculty Support at x3-9763 or *macvicarprogram@mit.edu*.

Nominations are due by Friday, November 16, 2018.

Request for Proposals for Innovative Curricular Projects

The Alex and Brit d'Arbeloff Fund for Excellence in Education

THE VICE CHANCELLOR IS currently soliciting proposals for the d'Arbeloff Fund for Excellence in Education for MIT faculty-led projects that strengthen undergraduate education and enrich the experiences of our undergraduates.

Proposals can be focused at any level of undergraduate education; priority will be given to projects that:

- Expand inspiring opportunities to help undergraduate students explore different fields of knowledge, academic departments, and possible future careers, particularly in the first year.
- Improve the first-year academic experience, including the General Institute Requirements (GIRs).
- Develop student motivation, self-awareness, confidence, and self-efficacy by providing opportunities to demonstrate educational accomplishments in authentic contexts.
- Enhance undergraduate advising – including professional and career development discussions – between faculty and students.
- Create subjects in the humanities, arts, and social sciences that explore a set of enduring questions, concepts, ideas, or values. These subjects should engage with fundamental issues of knowledge in the discipline, historical examination of the topic, and relevance of the topic in today's world. In addition to topics taught by an individual faculty member, we are also interested in collaborations across departments. These might be through having faculty members from multiple departments collaborate on a single subject, or through having more than one department offer subjects with the same, closely-related, or overlapping topics or concepts that can be taught with the materials from the distinct disciplines yet address common problems, for example, justice, equality, personhood (to encourage students in different subjects to find opportunities for connected conversations).

Proposals that make use of innovative, active, and/or inclusive pedagogies to improve student learning and the student experience are encouraged, as are projects that transcend specific departmental curricula, and/or make use of online technology.

The Selection Committee encourages all applicants to reflect upon the efficacy of their proposed educational innovations and to disseminate the findings and lessons learned. If you are interested in discussing how you might develop an educational research study for your innovation, please contact the Teaching + Learning Lab (T+LL). Resources to help you develop your own plan are available on T+LL's website.

In addition, a select subset of proposals may be particularly well-suited for rigorous, educational research studies. In these cases, the Selection Committee may ask that PIs work with Assessment and Evaluation experts in the Teaching + Learning Lab to develop and implement a robust educational research study.

A final report on the project at the end of the funding period is also required.

For guidelines and more information, visit: ***https://registrar.mit.edu/darbeloff***.

For questions about applying for a grant, please contact Assistant Dean Genevre Filiault (x3-5629) or *darbeloff-fund@mit.edu*.

Proposals are due by Friday, September 28, 2018.

Introducing the MIT Academic Climate Survey

Lydia Snover
Jonathan Schwarz

THIS FALL, THE INSTITUTIONAL Research (IR) group in the Provost's Office will invite all faculty, staff, and students in academic departments and research units to participate in the MIT Academic Climate Survey. Although similar to the Faculty and Staff Quality of Life Survey administered in 2016 and the Student Quality of Life Survey administered in 2017, this survey is much shorter and more focused on the climate in academic departments and research units.

We appreciate that surveys can be an intrusion into the lives of respondents. In Institutional Research, we vigilantly seek to minimize the length and number of surveys that are administered at MIT for two reasons. First, every response to every question on an IR survey is voluntary – respondents generously fill out our surveys to inform administrative policies and practices, and we want to be respectful of their time and effort. Second, we seek to minimize survey fatigue – there is a limit to how much you can survey a population; passing that threshold threatens the integrity and limits the utility of the data.

So Why Are We Doing This?

By focusing on a limited number of metrics for the entire population in the same time frame and in shorter intervals, we will be providing department, laboratory, and center leadership with more useful and timely data. With a biennial rather than a quadrennial administration, it will be easier to measure changes that might result from initiatives taken by the local administration. Like most survey data, there will be a number of uses for data we collect in this survey. We will post overall results on the IR website (***web.mit.edu/ir/surveys***). These data will also undergird the ongoing Department Support Program, a part of the MindHandHeart initiative, and provide important data for department and lab administrators.

Short and to the Point

We have designed this survey to be short, and focused with the goal of increasing response rates. About half of the survey may look familiar, because we have selected questions from previous surveys that have provided campus and department leaders with the most useful information. Higher response rates provide leadership with more reliable data.

Reporting and Confidentiality

It is essential that we receive candid and honest feedback through our surveys, especially for a topic as important as department climate. In order to improve the earnestness of responses, we want to be transparent about data security and confidentiality procedures so that respondents can have confidence that their responses are safe. We consider responses in climate surveys to be "highly sensitive" in nature and restrict access to these data to a small core of experienced Institutional Research analysts.

We take meticulous care to guard against inadvertent disclosure of individual responses. We only report quantitative survey data in aggregate form and do not report any survey responses for a sample of fewer than five respondents. If there are fewer than five responses for any subgroup, we will follow one of two paths: pooling or redaction. Where possible, we will combine (pool) your data with data from colleagues in a similar area until we reach at least five. While five is our minimum, in practice, we often avoid reporting data for any category for which there are fewer than 10 or 15 respondents.

If we are unable to pool data in a logical way to obtain a large enough sample size, we will redact results for that group. In this case, one's responses will be part of the aggregate data for a division, School, or the Institute, but will not be included at any level where there are fewer than five total responses.

Open responses play an increasingly important role in the data IR analyzes. The more nuanced information from these comments is incredibly valuable and we want to honor the effort that survey-takers invest in writing thoughtful answers to questions. At the same time, text boxes pose a particular challenge in reporting because they are subject to intentional or accidental disclosure of identifying information by the survey respondent. In most cases, we will analyze these qualitative data and provide summary findings. As is standard practice in qualitative research, occasionally we may use excerpts from open response items as illustrative examples. In doing so, we take precautions to guard against disclosing any identifying information.

We are also concerned about inadvertent disclosure of identifying characteristics. For instance, a colleague may have a distinctive writing style or favored turns of phrase that could make their open response identifiable. To minimize the likelihood of inadvertent disclosure, we will analyze and present open response data with an eye to protecting respondents as much as possible.

Thank you in advance for engaging with the Academic Climate Survey. Your feedback on areas such as workplace values, work-life balance, stressors, and what you like about your job will provide useful insight into

what is going well at MIT and illuminate ways to improve the academic and research experiences of faculty, staff, and students. Your participation is highly valued and greatly appreciated. If you have any questions about the Academic Climate Survey or data protection in Institutional Research, please do not hesitate to contact us.

Lydia Snover is Director of Institutional Research *(lsnover@mit.edu);*
Jonathan Schwarz is Assistant Director of Institutional Research *(jschwarz@mit.edu).*

Study Abroad IAP Opportunities Continue to Grow

Julia Mongo

MIT'S GLOBAL EDUCATION OFFICE, in collaboration with campus faculty, academic departments, and office partners, continues to expand program offerings for students interested in studying abroad during IAP. These 3-4 week January sessions have increasingly become an attractive study abroad option for students who desire an international academic experience but prefer to not spend too much time away from campus or internship opportunities.

Now in its eleventh year, IAP in Madrid has grown to include three options: Global Literature taught in English by Professor Margery Resnick, Spanish III taught this year by lecturer Mariana San Martin, and Advanced Spanish Conversation and Composition taught by senior lecturer Margarita Ribas Groeger.

All three courses provide MIT credit. Students gain cultural immersion and experiential learning through homestay accommodations and the opportunity to have Madrid as their global classroom. The Global Education Office staff guide students who need financial assistance for these programs through the scholarships application process.

IAP in Madrid has expanded over the years thanks to funding from the Victor and William Fung Foundation and the Institute. The Fung Foundation funding also enabled a new seed fund, the MIT Global Classroom Fund, which started last year. This seed fund is helping to create new international academic opportunities for MIT undergraduate students by allowing faculty to innovate teaching and learning engagement throughout the world. A collaboration between the Global Education Office and MISTI, the Global Classroom Fund offers awards for up to $15,000 per year for faculty and lead instructors to develop new courses and modules or take existing courses/course modules to international locations.

Literary London, launched in January, was a successful initiation of the Global Classroom Fund premise and charts the way for future faculty to engage in international classroom programming. This newest IAP course was developed and led by literature professor Diana Henderson. Through Literary London, Professor Henderson brought 15 students to England to explore the locations, histories, and artistic institutions that have made London a world cultural hub. Students experienced guided readings, theater performances, walking tours, museums, and visits to sites associated with major British authors and their works. Students who participated in Literary London received HASS-H credit and the course counted for the Literature major or minor.

For faculty, the IAP study abroad programs provide a vehicle to experiment with new pedagogical approaches. "Of the curricular innovations I have designed and brought to fruition, IAP courses in Madrid have been among the most rewarding – both to me as a professor whose field is Hispanic culture and to the now more than 500 undergraduates who have participated in this adventure," says Margery Resnick, associate professor in the Department of Literature. "Giving MIT undergraduates the opportunity to immerse themselves in Spanish life while acquiring linguistic, cultural, literary, and historical knowledge, is exhilarating. The joy of teaching this class to a group of MIT students who savor every moment in Spain is immeasurable."

"The IAP-Madrid program has been a valuable addition to the Spanish curriculum in Global Studies and Languages," notes Emma Teng, Head of Global Languages and Literature and Professor of Asian Civilizations. "Due to student demand, we expanded the program to include a second Spanish-language class, Spanish Conversation, which has proved to be enormously popular. Students and instructors alike report that the experience in Spain, especially the extracurricular activities and local tours, are extremely enriching. Students have an opportunity to practice their language skills *in situ* and to gain invaluable cultural immersion experiences. Additionally, they return with renewed enthusiasm for Spanish and are able to enroll in higher-level courses, participate in internships abroad, and even complete a Spanish minor."

The Global Education Office is pleased with the positive response from students and faculty and looks forward to future collaborations. "Feedback from students and faculty tells us that these programs create very powerful student learning through experience and significantly increase students' global fluency. That is hugely motivating for us in the Global Education Office," states Malgorzata Hedderick, Associate Dean of Global Education. "We have had great partners in faculty, academic departments, MISTI, and others for the development of these programs and we hope to be able to continue this positive growth momentum."

Julia Mongo is Staff Writer and Advisor, Career Services and Professional Development *(jmongo@mit.edu).*

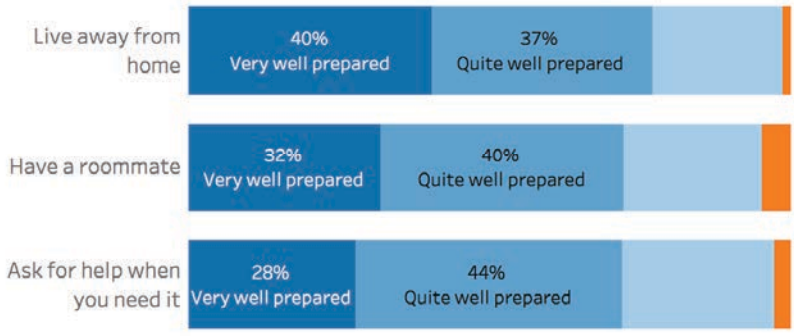
M.I.T. Numbers
from the 2018 MIT Survey of New Students

AT A GLANCE ...

Feel well-prepared to succeed academically at MIT
56%

Feel well-prepared to get along socially at MIT
72%

Two-thirds or more say they are well-prepared to...



To how many colleges did you apply? (average)
8.4

To how many colleges were you admitted? (average)
5.4

MIT was first choice
86%

As of right now, in which area are you most likely to major?

1 ENG – Civil and Environmental Engineering	2%
2 - Mechanical Engineering	4%
2 A – Mechanical Engineering	5%
3 - Materials Science and Engineering	1%
3 A - Materials Science and Engineering	0%
4 – Architecture	1%
5 7 – Chemistry and Biology	2%
5 - Chemistry	1%
6 1 - Electrical Science and Engineering	0%
6 2 - Electrical Engineering and Computer Science	10%
6 3 - Computer Science and Engineering	15%
6 7 - Computer Science and Molecular Biology	2%
6 14 - Computer Science, Economics, and Data Science	5%
7 - Biology	1%
7 A – Biology	0%
8 - Physics	5%
9 - Brain and Cognitive Sciences	2%
10 - Chemical Engineering	3%
10 B – Chemical – Biological Engineering	2%
10 C – Chemical Engineering	0%
10 ENG –Chemical Engineering	0%
11 - Urban Studies and Planning	0%
12 – Earth, Atmospheric, and Planetary Sciences	1%
14 1 - Economics	0%
14 2 – Mathematical Economics	1%
15 1 - Management	0%
15 2 – Business Analytics	1%
15 3 - Finance	1%
16 – Aerospace Engineering	5%
16 ENG – Engineering	0%
18 - Mathematics	5%
18 C - Mathematics with Computer Science	4%
20 - Biological Engineering	7%
21E - Humanities and Engineering	0%
21M -1 - Music	0%
21S – Humanities and Science	0%
22 - Nuclear Science and Engineering	1%
24 - Linguistics	0%
24 - Philosophy	0%
I'm not sure	8%
I'm planning to major in two or more areas.	1%

Source: Office of the Provost/Institutional Research