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Leading for Research Excellence and Integrity: A Qualitative Investigation of the Relationship-Building Practices of Exemplary Principal Investigators

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Abstract

We conducted semi-structured, telephone interviews with 52 federally-funded researchers nominated as exemplars for their integrity and professional conduct, and their scientific achievements. The aim was to identify the practices they report utilizing to build respectful relationships in their teams. We found four practices, holding meetings, providing supervision and guidance, encouraging shared ownership, and expressing values, which were also important to performing high-quality, compliant research, were essential to fostering relationships. The most common practice described for building relationships was actively and deliberately cultivating a positive team environment. Additionally, exemplars described the need to lead by example, tailor their approach to the needs of individuals, address interpersonal conflict, and hire team members cautiously. We also identified practices the exemplars reported as important to managing the demands of their work and found that encouraging shared ownership and tailoring to individuals supported this goal. Additional strategies related to prioritization and planning, seeking advice, engaging in self-care, and managing emotional reactions. Finally, we identified priorities guiding the exemplars' practices. Key priorities included providing outstanding mentoring, building collaborations and relationships, and engaging in discovery and innovation. Investigators require exceptional leadership skills but receive limited systematic leadership training. Addressing this gap would advance research excellence and integrity.

Introduction

Discovery in contemporary science is a team endeavor (Adams 2014; Cooke and Hilton 2015). Accordingly, there is increasing awareness of the need for investigators to create healthy, collaborative environments in their research teams (Bennett, Gadlin, and Marchand 2018; Van Noorden 2018). Effective team processes require both task-related interactions focused on the scientific effort and interpersonal interactions focused on establishing relationships that, in turn, support effective task-related work (Robledo, Peterson, and Mumford 2012; Bennett and Gadlin 2012).

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Furthermore, cultivating such an environment is important for fostering ethical research (DuBois and Antes 2017). Investigators are responsible for ensuring that their groups' procedures and interactions support doing rigorous science and following research rules and regulations, such as standards for protecting research subjects or reporting on findings transparently and accurately. To do this, principal investigators (PIs) must engage in a host of leadership behaviors like communicating the importance of following the rules and ethical principles in research. They must also structure the research environment to ensure the day-to-day behaviors of the team put ethical principles into practice; for example, by requiring the use of standard operating procedures to ensure consistency in tasks like obtaining informed consent and managing research data. Additionally, they must direct regulars meetings where emerging concerns can be raised and addressed (Antes, Kuykendall, and DuBois under review).

Providing for respectful relationships among those conducting research bolsters rigor and integrity by fostering an environment where individuals feel safe and valued (Antes, Kuykendall, and DuBois under review). In turn, research team members are more likely to engage in behaviors like admitting they do not know something or disclosing they made a mistake. These behaviors are essential to producing good research, especially reliable data. Furthermore, the practices modeled by research mentors instill early-career researchers with an understanding of responsible conduct of research, influencing the behaviors of researchers not only as they work in that research group but beyond in their career (Wright, Titus, and Cornelison 2008; Bird and Sprague 2001; Anderson et al. 2007).

The purpose of the current study was to identify the practices principal investigators report employing as leaders of their research groups to establish good working relationships. We interviewed accomplished, federally-funded investigators nominated by their colleagues as "Research Exemplars" for their professionalism, integrity, and scientific achievement. We asked them about the practices they employ to foster good relationships in their immediate research group or laboratory.

Leadership is the exercise of influence to achieve collective success (Kaiser, Hogan, and Craig 2008). There are myriad models of leadership; largely due the complexity of the phenomenon and the number of contexts in which leadership is needed (Mumford et al. 2017; Mumford et al. 2008). Broadly speaking models of leadership aim to understand the nature of leaders as individuals (e.g., their traits, characteristics, and behaviors), their interactions with followers, the effective direction and structuring of the work, and the leader's interactions with the broader environment within the organization and external networks (Mumford and Licuanan 2004). In general, effective leadership involves all of these elements and the interactions between them.

A model specific to leading creative efforts and scientists is required to account for the unique aspects of the work and the people who do it (Robledo, Peterson, and Mumford 2012; Mumford et al. 2002). The model provided by Mumford and colleagues emphasizes *leading work*—for example, defining the research agenda, planning projects, and evaluating ideas and giving feedback—and *leading people* who perform research—for example, forming collaborative teams, resolving conflict, creating a supportive work climate, and

fostering positive interactions. There are, however, limited data to inform what constitutes effective leadership in science. Furthermore, the role of leadership in fostering research integrity has received almost no attention.

Therefore, we aimed to obtain evidence of practices associated with an investigator being successful and having a reputation for integrity. In a separate report, we described management practices focused on “leading work” such as holding meetings to scrutinize data and coordinate tasks, writing standard operating procedures to promote consistency, and training staff to ensure competence. In the present report, we focus on the practices emphasized for “leading people.” We also describe the ways in which several of the same practices that exemplars linked to rigor and compliance—holding meetings, supervision and guidance, shared ownership, and expressing values—also function to build good relationships. Furthermore, we discuss new practices that exemplars relayed were important to developing relationships. Thus, the first research question addressed:

RQ1: What practices do exemplary PIs report employing to foster good relationships in their research groups?

In addition to establishing effective relationships in their groups, leadership requires navigating challenges, making tough decisions under uncertainty, and managing one’s own stress (Thiel et al. 2012). This is certainly true in research, as scientists routinely encounter challenges, uncertainty, and pressures (DuBois et al. 2015). The ability to be self-aware in one’s approach to leadership and work, and to engage effective strategies for ‘self-influence’ have long been recognized as central to effective leadership (Neck and Manz 1996; Neck and Houghton 2006; Boyatzis et al. 2013). Similarly, the importance of emotional intelligence among researchers has received some attention (Cohen and Cohen 2018). We aimed to explore the professional strategies the exemplars employed to manage the demands of their work. Thus, our second research question was:

RQ2: What strategies do exemplary PIs report adopting to manage the demands of their work?

For example, we asked them directly about navigating uncertainty and how they prioritized their time. However, we also had an exploratory question focused on values or priorities that might guide them as professionals. One’s actions, including ethical behavior, as a professional and leader have been associated with core values, or a sense of central purpose, that guide patterns of thought and behavior (Wurm-Schaar 2015; Trevino, Hartman, and Brown 2000; Paine 1994). Therefore, we also aimed to identify key priorities that manifested in how the exemplars spoke about their approach to their work. Our third and final research question included:

RQ3: What overarching priorities are reflected in how exemplars describe approaching their work?

Methods

We examined our research questions using a qualitative research design. This open-ended, exploratory approach used in-depth, semi-structured interviews to draw out practices used by researchers without imposing an existing framework. We sampled purposively to obtain a cohort of “Research Exemplars”—investigators meeting several criteria. They were required to do empirical research, to be outstanding in their record as federally-funded investigators, and to have a reputation for professionalism and integrity. We recruited participants by soliciting nominations from research institutions in the United States, and asked a review panel to score nominations to identify finalists. Our project team then reviewed the panel’s feedback and selected a cohort of “Exemplars” who participated. The Washington University Institutional Review Board reviewed and approved this study (IRB# 201601121).

Nomination procedure

We sought nominees who were federally-funded principal investigators leading a research lab or team. Specifically, we invited nominations of principal investigators in any career stage who were exemplary in terms of two criteria: (1) they perform high-quality, high-impact, federally-funded research and (2) exemplify integrity and professionalism. Our call for nominations indicated we wanted to “learn their practices for leading research teams” and honor outstanding researchers. The announcement indicated that finalists would be asked to complete a 1-hour interview, and they would receive a plaque and be highlighted on the project’s website (https://integrityprogram.org/exemplar-project/). We did not define ‘professionalism and integrity’, but stated our goal to advance the scientific community’s understanding of leadership and integrity. Instead of defining the qualities we sought, we allowed individuals in the research community to interpret exemplary integrity and professionalism (then we reviewed, as described below, to find explicit behaviors and qualities).

To solicit nominations, we sent approximately 1,500 emails to academic deans and chairs along with institutional research administrators at universities classified as “highest” or “higher” research activity by Carnegie classifications, accredited schools of medicine and of public health, and the National Institutes of Health (NIH) Intramural Research Program. Additional recruitment outreach included contacting the principal investigators of centers funded by the NIH Clinical and Translational Science Award program. We asked the recipients of our call for nominations to nominate a principal investigator and invite colleagues at their institutions to consider submitting a nomination.

Nominations were submitted online and included attaching the nominee’s curriculum vitae and providing a narrative describing the nominee’s successful research program and their reputation for professionalism and integrity. The specific prompts included: (1) Please describe the nature of the nominee’s high-quality, high-impact, federally-funded empirical research program; (2) How does the nominee specifically demonstrate professionalism and integrity as a researcher?; (3) How confident are you that the researcher’s colleagues share the opinion that this individual exemplifies professionalism and integrity? Please explain.; (4) If you would like to make additional comments, please include them below. Finally, the nomination form also requested contact information for three individuals who work closely

with the nominee and could corroborate their reputation. We followed up with these individuals via email for a secondary endorsement. The email asked them, if they supported the nomination, to submit narrative providing examples of the nominee's professionalism and integrity; specifically, we asked question 2 and 3 noted above in the prompts given to the initial nominator.

We also asked the nominators and endorsers to describe their relationship to the nominee. The initial nominators were primarily (80%) administrators, academic deans, department chairpersons, or research directors; the remaining were research collaborators or trainees. Primary nominators reported having had professional relationships with the nominees for an average of 9.96 years (SD = 6.37). The secondary, corroborating endorsers were mostly (59%) the nominees' colleagues—either research collaborators, faculty in the same department, or trainees; the remaining were chairpersons or other academic leaders. They reported relationships, on average, of 14.62 years (SD = 8.95) with the nominees.

Of an initial 81 nominations, 74 earned at least one accompanying endorsement. Out of these 74 corroborated nominees, 73 agreed to take part in the study if selected as finalists by a review panel. A panel was convened to review the nominations.

Panel review procedure

Ten federally-funded researchers volunteered as reviewers. Reviewers read the nominator and endorser narratives describing the nominees' professionalism and integrity, nominees' CVs, and a summary listing their academic rank, institution, total funding amounts and sources, and number of publications. The reviewers' areas of research represented disciplines in which the nominees worked. Public health, biomedical, and social sciences panelists reviewed the bulk of nominations. The four other panelists read nominations of researchers working in engineering, earth sciences, and physical sciences. Individual panelists reviewed no more than 12 nominations each, and two panelists reviewed each nomination.

Panelists received a one-page instruction guide describing the purpose of our study and the criteria we sought in nominees: scientific achievement as a federally-funded investigator and a reputation for professionalism and integrity. They used a 7-item Likert scale to rate the nominated principal investigators on both the quality of their research and their demonstrated professionalism and integrity, as reported by the nominators and endorsers. The scale ranged from 1 (*far below expectations*) to 7 (*far above expectations*). We instructed the panelists that considerations for scientific accomplishment included: "receiving substantial grant funding, producing high-quality peer-reviewed journal articles, and addressing issues of social import." Considerations for professionalism and integrity were: "whether the practices and characteristics reflected in the nominations would be ideal for mentors and leaders in research to widely adopt." Panelists also responded to the following prompt: "Do you have any reservations about this person being identified as an exemplar?" Lastly, reviewers explained their concern, if any, and added general comments.

Review by the project team and selection

AA and JD, experts in responsible conduct in research and research integrity, reviewed all of the nominations, in addition to the panelists' scoring sheets and comments. We averaged across the two panelists' scores and identified those finalists scoring 5 or higher. The average panelist rating for the final cohort was 6.0 (SD = .60). In the nomination narratives, we looked for concrete examples of how the nominees were exemplary in their approach to their work; for example, being meticulous in their methods, establishing collaborative work environments, and taking the utmost care not to publish findings without confidence in their robustness.

As noted above, we did not articulate to nominators specific qualities we sought, rather allowed those to emerge. Our review of the nomination materials found that the exemplars were described as fair, altruistic, meticulous, hardworking, and well-respected. Additionally, they were known as outstanding mentors, and many had highly accomplished mentees working independently in research. Many were known nationally and internationally for their contributions and innovations. Additionally, many held institutional or field leadership roles, including positions as academic journal editors. The high scores provided in the review panel process also underscore the claim that our procedures generated the outstanding cohort we aimed to identify.

Our review of the materials for selection of exemplars also considered diversity of research disciplines, gender, and nation of birth. Despite an initial target of 30 participants for our study, we selected 55 exemplars. Of the 55 investigators selected and invited to participate in the study, 52 consented, enrolled, and participated.

Participants

Most (71%) exemplars are male, and the majority were born in the United States (73%). They were mostly (74%) 50 years of age or older (39% were 50–59 and 35% were 60+; the remaining were 40–49, 23%, and 30–39, 4%). The majority (83%) reported their race as White (n=45); 8% as Asian (n = 4); 4% reported multiple races (n = 2); and 2% did not report their race (n = 1). A small group (12%, n = 6) reported being Hispanic or Latino. Most of the researchers have a PhD (71%, n = 37), 17% have an MD (n = 9), and 12% have both an MD and a PhD (n = 6). The academic disciplines in which they were trained were both in the biomedical sciences (e.g., biomedical, biological, and public health) and STEM sciences (e.g., physical, psychological, earth, and applied sciences); 56% (n = 29) and 44% (n = 23), respectively. The majority of the exemplars hold the academic rank of professor (83%, n = 43). 10% hold ranks of associate professor (n = 5), and 8% hold other titles, such as senior investigator or lab chief (n = 4).

The exemplars have been conducting research for an average of 28.18 years (SD = 11.89). The average career number of peer-reviewed publications for an exemplar is 137.9 (SD = 95.95); median = 106.5. The investigators were awarded an average of $26,923,344 (SD = 26,155,063) in grant funding throughout their careers; the median amount was $18,500,000. The exemplars reported spending an average of 59.81 (SD = 9.97) hours a week working.

The exemplars conduct diverse types of research in a range of health, behavioral, physical, life, and earth sciences. The exemplars were asked to report which types of research they conduct, and many indicated that they were involved in more than one type. Fifty-one percent reported being involved with wet lab research, 49% with animal subjects research, 41% with clinical human subjects research, 25% with dry lab research, 24% with social or behavioral human subjects research, and 18% engage in other research types like chemical synthesis and materials processing.

The exemplars work with a myriad of team members including research coordinators, managers, technicians, and other full-time staff, in addition to trainees at the high school, undergraduate, graduate, and post-doctoral levels. The investigators reported an average of 12.31 (SD = 10.06) personnel working in their groups. They also indicated that, on average, they work in the same physical space or building as their teams 4.69 (SD = 1.28) days a week. They described their teams as running an average of 7.23 (SD = 4.72) projects at a given time, submitting an average of 5.40 (SD = 4.27) grant proposals per year, and an average of 9.98 (SD = 7.35) papers for publication each year.

Most of the researchers are based at public U.S. universities (77%); however, some are at private U.S. universities and NIH's Intramural Research Program (15% and 8%, respectively). These institutions were located all across the country. Medical schools accounted for about half of the universities represented (48%). Most (73%) of the universities were designated as "R1" universities, meaning they are classified by the Carnegie classifications as among institutions with the highest degree of research activity.

Data collection

We interviewed exemplars via telephone using an 18-question semi-structured interview guide (see Appendix). Interviews were one-hour in duration and conducted by two trained graduate research assistants. AA oversaw the conduct of interviews to address any concerns, but issues were negligible. Prior to the interviews, exemplars received consent information and completed a brief demographic form and survey of work practices (e.g., hours worked per week; number of research personnel). Exemplars were encouraged to reach out with questions prior to the interview, and prompted to ask any questions before the interview began.

AA, an industrial-organizational psychologist with expertise in leadership and responsible conduct of research, and JD, a psychologist and expert in bioethics and research integrity, developed the questions asked of exemplars. JD is also an experienced PI of large federally-funded research grants, and directs a program for investigators referred for lapses in research integrity or compliance (DuBois et al. 2016). The interviewers informed participants that we were interested in learning about factors involved in their success and outstanding professional reputations. Interviewers told exemplars to focus on actions they do intentionally to be an excellent researcher, or things they believe may not be done by other researchers.

Interviewers did not mention that the study was focused on "leadership and management" practices, so as to allow practices to emerge organically without biasing researchers'

thinking about the types of things we sought to learn about. The interview questions asked exemplars directly asked about their personal traits, work strategies and practices, environmental and experiential factors influencing success, and professional lessons learned. The questions about work strategies and practices focused on particular outcomes of interest, specifically ensuring rigor and reproducibility, good relationships, compliance, and balancing work demands. Recordings of the interview conversations were transcribed verbatim, which resulted in 600 single-spaced pages of data.

Data coding and analysis

A codebook was created through an inductive process wherein AA and JD read transcripts and took note of emerging practices, themes, and concepts. They used these notes to create a "parent code" structure that represented emerging higher-order themes: professional priorities; relational and self-management practices; research operations practices; experience and environmental factors. They generated an initial set of "child codes" under each parent code that were the specific practices and concepts under broader themes. Following a causation coding framework (Saldaña 2016), the relationship/self-management and operations practices were linked to the outcomes—rigor and reproducibility; compliance; good team relationships; balancing demands; and doing exemplary research—the exemplars intended them to promote. The "doing exemplary research" code was employed only if a practice was not connected to one of the more specific outcomes. We expected the practices to broadly follow an existing framework of leadership behaviors that suggests behaviors generally relate to relationship-building or to structuring work (Lambert et al. 2012).

With this initially developed framework for the codebook, AK coded 10 transcripts to add child codes where necessary and develop definitions, examples, and rules for applying the codes. Next, AK and AA applied this revised codebook to a new set of 10 transcripts each to ensure the child codes were exhaustive. The full research team discussed the updated codebook at each stage of its development.

To analyze the transcripts, the research team used Dedoose qualitative data analysis software (Dedoose 2018). First, to train on the codebook and software, the coders (AK and AA) coded the same set of 10 transcripts and discussed their results, adding rules and information to the codebook to refine it. Then, a selection of 50 representative excerpts from the transcripts was used to assess Kappa, an estimate of interrater reliability. The Kappa score for AA and AK was .81, a score that indicates "excellent" reliability. From there, AA and AK both coded 26 separate transcripts. AA and AK paused coding when 10 transcripts had been completed in order to re-assess kappa on a set of common excerpts to examine the potential for major rater-drift in applying the codes. Kappa at this stage was .73, which is considered good; thus they resumed independent coding after discussing areas of disagreement in their coding of the practice excerpts.

Data analysis focused on synthesizing the key themes and strategies for each practice. The results described for each practice provide a detailed explanation of the ways in which the exemplars discussed each practice, including specific strategies when they were highlighted

by the exemplars. We also report the number of exemplars, out of 52 total exemplars, who discussed each of the practices.

Results

Our study identified the self-reported practices that exemplars engage in when leading their labs, including their perceptions of how these practices relate to two outcomes: good work team relationships and meeting work demands. In all, the exemplars described 9 practices focused on cultivating workplace relationships. All of the practices and professional strategies codes linked by exemplars to the outcomes of good relationships and managing work demands were discussed in at least 30% of interviews (n = 16), with one exception. The need to recognize cross-cultural dynamics was mentioned by 9 (17%) of investigators who led especially diverse research groups; this may suggest an area for future work. We report all of the guiding priorities we identified, which we found in participants' responses ranging in frequency from 17% to 79%.

Practices to Foster Good Relationships

This collection of practices offers guidance regarding developing positive work relationships. However, it is important to note that not all exemplars mentioned all of the practices, nor did they perform them perfectly. A number indicated that they continually consider how to refine their approach to leading their groups.

Four of these practices—regular team meetings, shared decision-making and ownership, supervision and feedback, values and expectations—were also reported as critical to high-quality research—these findings are summarized briefly below and described in a separate report (Antes, Kuykendall, and DuBois under review). In addition, two practices associated with good relationships—encourage shared ownership and decision-making and tailor approach to individual needs—were linked as well to balancing work demands.

Cultivate a positive team environment.—The most common response regarding how exemplars foster good relationships in their groups was that they intentionally cultivate a positive, team-oriented environment. Mentioned by 85% (n = 44) of exemplars, this code focused on deliberately taking actions to develop and maintain a positive environment, which included actively reflecting on whether they had achieved a thriving, positive team environment. As one described it:

> I reflect a lot on not only creating a good working environment and a kind of creative space…but also making sure that the culture of my research group is actually that of a family as opposed to a bunch of individualized people working on their projects with a competitive chip on their shoulder.
>
> (Participant 24)

According to the exemplars, at the heart of a positive team environment are respectful relationships and trust among members. They noted that this fosters collaboration and collective success and, in turn, success reinforces team morale. They sought a group that viewed success as a collective effort versus one based in competition. One exemplar

described the mindset this way: "…what comes out of your work, it's not me and it's not you, it's a product of the interaction between us, and therefore it is something that is truly original because you couldn't do it alone, I couldn't do it alone…" (Participant 46).

At the level of individual team members, many exemplars noted a collaborative environment is motivating and engenders satisfaction, which fosters performance. One exemplar summed it up this way: "A recipe for success is teambuilding…that makes people also much happier when they work as a group. It just makes them much more motivated. If things go wrong they're not on their own, they have a support group…".(Participant 13)

The exemplars shared several specific strategies for cultivating a positive environment. First, it was critical to ensure fair and transparent practices regarding authorship and recognition in the group. Second, sharing their enthusiasm and passion for their research allowed exemplars to inspire excitement and team cohesion. Third, several noted that while they endeavored to build a team-oriented group, this did not obviate the importance of allowing individuals to express their unique personalities and interests within the group. Finally, another strategy included bringing the group together for social activities and celebrations of successes to allow time to make personal connections.

Hold regular team and one-on-one meetings.—Discussed by most exemplars (83%, n = 43), the function of meetings in their research groups was of the utmost importance. Meetings allow for reviewing data and findings, coordinating the work of the team, and overcoming problems (Antes, Kuykendall, and DuBois under review). With regard to good working relationships, meetings provide a venue for the full team to come together regularly. Exemplars were mindful that interactions at meetings set a tone for collaboration and positive workplace relationships outside of meetings. Within meetings, they wanted people to support and help one another, and find areas of common interest, to yield ongoing collaboration and support outside of meetings. One described it this way: "…meetings where we talk about what everyone's doing so that we can collaborate…somebody has primary ownership of a project, but they're not the sole person working on that project and people are intermixed…there's a variety of ideas coming in…" (Participant 17).

In addition to regular communication as a team, many exemplars also held regular, one-on-one meetings with trainees and staff. These meetings allow personalized relationships to develop so that exemplars can provide tailored mentoring to enhance team members' performance and promote their career development. One exemplar summed up the importance of one-on-one meetings as follows:

> …individual meetings on a regular basis so they feel that we're not just in lab meetings, but we're talking individually about what they're doing and where they want to go. That's really important. [The] personal relationship part of things is critical to people's motivation and their growth.
>
> (Participant 21)

Encourage shared ownership and decision-making.—Mentioned by 73% (n = 38) of exemplars, shared ownership of projects and participatory decision-making were

important to fostering shared accountability for research and its integrity (Antes, Kuykendall, and DuBois under review). With regard to good relationships, this practice encourages people's commitment and engagement in their work, and it cultivates the sense that their contribution is valued. One put it this way, "There should be joint ownership…for everything…making sure that we are all at the table as equals…there isn't so much…I'm the person telling then to do this, that or the other. It should come from their opinions and advice, and views…" (Participant 5).

Another noted:

> I'm very engaging and participatory in my decision making process…I think it's really important to make everyone feel that they are part of a process…their opinions count and they matter…they are being heard…everyone has, you know, their respective expertise…make everyone feel that they're a valued member of the team and also that they add value to the team.
>
> (Participant 44)

It is of note that shared ownership also requires that PIs give team members the autonomy to make independent decisions when appropriate, which empowers them to solve problems and develop their research and professional skills. Relatedly, the exemplars also linked this practice to balancing the demands of their work.

With empowered team members, they could confidently share their work tasks. One exemplar said:

> …it goes, again, back to trust…I trust…the people that help me on a day to day basis, I really trust them with my life and my research…You can't go over every single thing yourself, but you can have team leaders or trusted post-doctoral fellows, or other people in your group that can at least take first pass through things, and give you more of the reader's digest version.
>
> (Participant 34)

Almost unanimously, the exemplars noted that prior to employing this strategy for large or high-consequence tasks, it was crucial to develop trust in their team members. Some used a phased approach wherein they offered opportunities for increased responsibility as they developed confidence in a team member's competence through demonstrated effectiveness. When employing this strategy, exemplars were mindful to consider and match the skills and knowledge of the individual with the skills and knowledge necessary for the task. Several also reinforced that giving personnel the opportunity for increasing ownership and responsibility were elemental in retaining their most skilled and trusted staff.

Provide supervision and guidance.—As noted by 71% (n = 37) of exemplars, being an engaged, available mentor was essential to ensuring rigorous research that is done with integrity. This included giving scientific guidance, helping to trouble-shoot, and making sure people were comfortable approaching them with concerns and mistakes (Antes, Kuykendall, and DuBois under review). Providing guidance and encouragement to the members of their teams was also essential to establishing positive work relationships. One exemplar put it this

way: “You just have to be around. It’s encouragement and being accessible for questions, and for having a teaching moment now and then…” (Participant 16). They also strongly emphasized ensuring that people feel the PI is approachable, especially so team members are open and truthful. One described it as follows:

> I’ve worked with enough people myself as a trainee to know that those mentors that I had that I was scared of, I was more likely to hide stuff from them, and that’s not the kind of mentor that I want to be. I want to create an environment of openness with my students so that they’re able to present to me the truth and not be afraid.
>
> (Participant 35)

Another stated, “They need to come to me when something’s wrong, and they need to come to me quickly. I don’t want them thinking, ‘is this going to make him unhappy?’” (Participant 17).

A common point included the importance of providing positive, personalized feedback and expressing appreciation. People must feel their contributions are recognized and valued, as one exemplar noted: “Making people feel that they’re really valued. That no matter what their role is it’s a very valued role, and that I’m grateful for the quality of the work they do…” (Participant 21).

Several exemplars noted these opportunities also offer a moment to reiterate a sense of purpose. In particular, a PI can emphasize how the individual’s work contributes to the team’s broader mission. As one put it:

> …giving feedback to people, particularly positive feedback to people on their efforts and progress…find ways to make sure people…have a sense of the purpose underlying the research. People working in your lab shouldn’t feel like a cog in a wheel that’s otherwise kind of invisible and mysterious. They should share in the larger sense of purpose.
>
> (Participant 30)

Overall, through these opportunities for guidance and feedback, the PI shows their care for individuals and that they are a priority, and this helps to form mutual trust.

Tailor approach to individual needs.—We also heard from 65% (n = 34) of exemplars of the need to recognize there is not a “one-size-fits-all” approach to mentoring and leading people. They noted that tailoring one’s approach to individuals fosters positive workplace dynamics through increased motivation and satisfaction, and results in performance that is more effective. They stated that tailoring one’s leadership approach requires being aware and tolerant of individual differences in career goals, work styles, and personalities. One put it simply, “People are motivated much more if they’re working on something that they see as important to their future” (Participant 23). Others also emphasized the effectiveness of matching tasks to career goals: “They’re enabling my dream, so I make it a point to identify their dreams…” (Participant 42). Of course, several mentioned the need to balance the needs and goals of the research team with the needs and goals of individuals, which can be a challenge at times.

Additionally, several PIs indicated that effectively tailoring one's approach requires reflecting on their typical leadership style and adapting. One noted:

> I have kind of one management style, and that's really tough, because everybody has a different management need, so I've worked really hard to see if I can…give people more of the management that they need, as opposed to my style.
>
> (Participant 37)

Another specific strategy included identifying how much direction people need to begin and persist with tasks. Moreover, this practice reinforces the need for frequent interaction and open communication. It takes time and effort to understand individuals well enough to tailor one's approach to their needs.

The exemplars also made connections between tailoring one's approach and balancing their own work demands. They felt that it fostered productivity to match people to the tasks most suitable to their skills and interests. Moreover, knowing the strengths and skillsets of their students and staff allowed the PIs to compensate for their own limitations by leveraging the skills of team members in ways that made everyone more effective.

Express values and expectations.—Another practice, noted by 60% (n = 31) of exemplars, included the importance of explicitly expressing values and expectations in their groups. To ensure rigorous, ethical research they focused on communicating high standards for quality, integrity, and transparency (Antes, Kuykendall, and DuBois under review).

With regard to work relationships, this meant plainly telling team members they expect them to work together as a respectful, collaborative team. One stated it this way: "We treat one another as human beings, how you'd want to be able to be treated, and people know, I tell them explicitly, everybody's in this together. We need to work together as a team" (Participant 52).

They noted that setting this tone is essential to making sure everyone, no matter their role in the lab, feels respected and valued. Several exemplars stated that they stress to lab members that it is unacceptable for anyone to act superior to others. Some exemplars described their research groups as a "family," and others relayed talking explicitly about supporting each other without necessarily expecting anything in return: "…we try to talk about being altruistic and helping each other without expecting anything in return…being altruistic and giving of yourself and your time to others will pay many more dividends in the end" (Participant 22).

Lead by example.—The importance of being mindful that their behavior sets the tone and standard was mentioned by 50% (n = 26) of exemplars. As one noted, "As the lab chief, you are setting an example. As a lab chief, if you're not doing something, but you expect someone else to do this, that's a problem. You need to set the standard" (Participant 13).

Of utmost importance to leading by example to cultivate positive relationships was approaching interactions in a kind manner. For team members to be respectful of each other, the PI must model this behavior. Additionally, PIs talked about specific actions like stepping

in to perform a menial or disliked task, if necessary, to help the team. Another action included working themselves on the weekend if that is expected of team members. A few noted sharing personal mistakes or disappointments, like a rejected manuscript, with team members to illustrate that these are normal aspects of research. Others described setting the standard in terms of work-life boundaries: “I lead by example…yes, I work very hard, but I also take my commitments to my family very seriously, so that they don’t feel like they have to be here 24/7. I respect them and those choices” (Participant 51).

Address interpersonal conflict.—It was important to exemplars to maintain harmony in their teams, and 48% (n =25) explicitly stated the importance of addressing conflict. They saw proactively addressing conflict as central to maintaining an environment of mutual respect. One described it this way:

> When there is disharmony, when I sense that something is not going well, I put myself in the middle of it, whoever and whatever is involved…until we figure out what the problem is. Usually it doesn’t take very long, and it’s just a matter of sitting down and talking through whatever the issue is….
>
> (Participant 46)

They defined ideal conflict resolution as quick, fair, and with a mutually agreeable outcome. They described directly talking to the people involved to ensure they have information from all perspectives and being sure to clearly define the problem. Several spoke about the need to assume the best of people when resolving conflict. For example, one stated: “I try when someone raises an issue not to be judgmental, but to hear both sides and work it out or get the people involved to work it out” (Participant 18).

Another strategy included focusing on shared goals when it was necessary to provide corrective feedback. A few noted a PI must remove people from the team who have consistently demonstrated a lack of willingness to behave respectfully. As one put it: “We just have that expectation that you don’t have to love each other, but you do have to get along, and grow, or you can leave. That’s the other option” (Participant 50).

Hire team members cautiously.—The final practice, noted by 46% (n = 24) of exemplars, included hiring new members carefully. When hiring personnel or inviting trainees to join their labs, they described the need to consciously maintain a good environment. Several exemplars emphasized bringing just one “toxic” person into the team can undermine a collaborative environment. In contrast, carefully hiring the right people can lead to decades-long partnerships. They described articulating in the interview process that the group works cooperatively and seeks collegial members. One put it this way: “I actually ask them the question, ‘are you nice?’ … most people are surprised, and most people say, yes I am. So basically, I set the tone at the interview that we are looking for people that are nice and effective” (Participant 42).

Many exemplars include existing team members in the interview process, so they can interact with candidates. As one exemplar described, “…the whole research group votes on whether to admit them to the group or not…” (Participant 22). Some exemplars had trial periods prior to formal acceptance to the team.

Professional Strategies to Manage Work Demands

In addition to directing their research programs, at least one-third were juggling administrative roles, and others mentioned clinical roles and teaching responsibilities. Not surprisingly, many exemplars noted the challenge of balancing their workload and the demands required for success as a researcher. Many noted that they constantly strive to improve in their personal strategies for professional effectiveness. Some facetiously indicated that they handle the demands of their work simply by "working all the time."

As noted above, shared ownership and decision-making and tailoring leadership, were linked to balancing work demands. These approaches entail a need to draw on the help and skills of others, as a PI cannot do it all. Depending on the extent to which the PI trusts the skills of their team members, empowers them, and understands how to lead each of them optimally, these practices can be effective strategies for balancing the PIs' own work demands. We also learned about 4 other professional strategies.

Adopt prioritization and planning techniques.—Exemplars varied in their specific approaches but nearly all (96%, n = 50) described adopting some approach to prioritizing and planning their time. One suggestion focused on scheduling unstructured time:

> So by blocking out time that's unscheduled, I can actually stop and think and think about the bigger picture of what we're doing, and I think that's very valuable in terms of managing time. It's a safety valve if you need that time, because you're overwhelmed, and if you're not overwhelmed then it's a really good time to think about stuff.
>
> (Participant 18)

In their responses, of course, many noted the challenges associated with managing their time. For instance, several reported the constant struggle it was to take time to plan for the future when easily becoming hyper-focused on day-to-day tasks.

The most common strategy shared by exemplars as essential was to selectively and intentionally say "yes" or "no," with one's goals and priorities in mind. Several noted this is especially hard for junior researchers. One noted, "…really think long and hard before you commit to something…you sometimes have to say no…over the years, we develop a pretty good feeling…how much research you really can do well…you cannot multiply yourself…" (Participant 6).

Another key technique for many exemplars was to be present and focused when working. To achieve this, they described the need to eliminate as many distractions as possible and focus on one thing at a time, in order to give that thing all of their attention. Several noted the particular importance of managing email and social media use, as they have the potential to be major distractions. Additionally, another strategy was to schedule their time and activities mindfully in accordance with their personal strengths and workflow habits. For example, scheduling their writing during the time of day when they write best, and holding meetings at the other times during the day.

In line with the findings with regard to shared ownership and tailoring leadership, in describing how they prioritize their time, several noted that it is essential to delegate tasks that are not in line with their strengths, or those that are not necessary for them to do personally. It is imperative to learn the capabilities of team members, and to learn to delegate to them, to trust them, and to follow-up with them. As described by one exemplar, "It is a key strategy to select carefully the members of your team, which are capable to receive delegated work… quickly learn the unique qualifications of each team member, the degree of support and oversight a team member needs…" (Participant 27).

Additionally, the exemplars described the need to identify how to define what is a priority. Their approaches to determining priorities were diverse. Some based first priority on the needs of the trainees, others focused on deadlines, the expected duration of a task (some described doing short tasks first, others did long tasks first), or their interest-level (some reported doing exciting tasks first, others did tasks they viewed as a chore first). Finally, they used techniques to plan ahead and set goals. For example, many described having to-do lists and timelines as a means to set goals and monitor their progress.

Seek advice.—Another strategy shared by 92% (n = 48) of exemplars was to seek guidance from trusted colleagues and confidantes. This strategy emerged largely in response to our question about how they manage uncertainty. They recognized that they need a core group of trusted people who they can go to for diverse, informed perspectives. Some noted that while they might not always act on all advice they receive, they used it to expand their perspective. The people they sought out included colleagues, friends, spouses, mentors, supervisors, and people working in their labs. If an issue involved a concern in the lab, several exemplars noted they would consult members of their lab for a fresh perspective, and that they would emphasize that they were in search of honest feedback. The exemplars shared the view that a researcher never outgrows the need for a mentor, and that they can, and must, learn from everybody around them. One exemplar put it this way:

> You know you're in the right place, the right university, and you've been there for the right amount of time when you have a group of experts, sort of a circle of experts, people that you know you can depend on going to for advice.
>
> (Participant 30)

Another exemplar shared the following:

> I will call on people whose opinions I highly respect, and that might be, depending on the problem, that might be colleagues, that might be former students, and I usually start off by saying tell me if I'm thinking about this in the wrong way. I think by asking people in that fashion it gives them permission to tell me their actual thoughts and not just to agree with what I think is the right answer, but I will call on the expertise of people that I trust and who I know are not just going to say yes.
>
> (Participant 4)

Finally, several noted there is a need for self-awareness, even humility, in asking for help. For example, one described, "I'm a little impulsive at times, so one of my confidantes is a

very concrete thinker so she helps me…it's very valuable…my eyes are a little more open" (Participant 25).

Engage in self-care.—We heard from 75% (n = 39) of the exemplars about the need to take deliberate steps to prioritize one's well-being and engage in activities that are restorative or that relieve stress. They spoke of the need to sustain their energy over the long-term. For many, this required allowing downtime away from work to avoid burnout. Several described creating some boundaries between work and life. As one put it, "…define boundaries on when you're working so that it gets all of your attention…then define boundaries on when you are not working" (Participant 28).

Others spoke of the importance of making time for family or that ensuring adequate sleep and exercise allowed them to maintain a healthy perspective and have greater focus while at work. Others noted that it is difficult to interact well with others if perpetually fatigued or anxious. One described self-care this way, "You need to get a good night's sleep. If you stay up late, you're not going to do as well at the job and your social skills are reduced" (Participant 23).

And, some exemplars were conscious of the example they set for others in their labs in terms of engaging in self-care behaviors. Not surprisingly, exemplars expressed the challenge of prioritizing self-care. As one exemplar noted: "It's not easy. Some people are never able to get away from what they're doing; their work is always with them. What we do is really intense…" (Participant 2).

Manage emotions and reframe thinking.—A strategy discussed by 60% (n = 31) of exemplars addressed how they mentally or emotionally approached their work. They described actively managing their thoughts and emotions, with the goal in particular of "keeping things in perspective." To do this, exemplars discussed the importance of finding gratitude in their work, looking for the positive in situations, cultivating self-confidence, and obtaining support from family or friends.

They also described several overarching mindsets that they bring to their approach to work. These included looking to find daily joy in their work, urging themselves to be flexible and adaptive, and embracing the inevitability of some degree of work overload. One exemplar described approaching research in the following manner:

> I try to have fun. I try to always remember that I'm just so blessed to have this job where I can mentor others, that I can impact science. It is stressful and it is difficult…and if I don't remember that this is the choice that I made, and try to focus on the fun aspects, then it really gets overwhelming.
>
> (Participant 35)

Many of the points focused on managing stress. They described four approaches to re-evaluating stressors: (1) recognizing that the stressors are not actually that urgent or serious, (2) accepting when they cannot control a stressor, (3) finding ways to remove a stressor, or (4) coping with stressors by keeping the bigger picture in mind. One exemplar spoke of balancing the realities of stressful work in the following manner:

> Try to be honest about…what's really bothering you, what is the real issue…. I try to really understand, especially when it's something that is unresolved, and I can't control it. I think the stress gets worse when you try to control things that you can't control, and the biggest stress I have is when I realize gosh, I'm doing something stupid. I am trying to fit a round peg in a square hole…. So, it's about getting real with what is causing the stress. Sometimes that can be hard to see….
>
> (Participant 26)

Another said:

> You need to be able to see beyond the immediate urgency of many different things and realize that life goes on regardless of what happens with the immediate emergency. It's hard…there is always pressure…it's a constant fight with basically making sure that the big picture, having the big picture in mind, and you do the best you can at the moment, and then let the chips fall.
>
> (Participant 32)

Finally, many exemplars explained that it was critical to manage responses to criticism and rejection. For example, allowing time to be angry after experiencing rejection, but then going back to work with renewed focus. One put it this way:

> …let me get over my initial emotion and say okay, what can I learn from this, what can I do differently in the future that will help this go in a better direction. So it's that ability to step back, look at it, evaluate it, and say is there something I can do to change this and make it better, and if there is you implement it. If there's not then sometimes you just have to accept it.
>
> (Participant 20)

Also, they describe the critical importance of not treating criticism as a personal attack, but as an opportunity for growth. Relatedly, when a specific situation becomes frustrating or upsetting, the exemplars recommended taking a day, or even an hour, to calm down before responding in order to better maintain objectivity.

Professional Priorities

The professional priorities of exemplars reflect the overarching commitments that guide them. The priorities include those commitments they explicitly noted they prioritize in their work, and, more commonly, the priorities were the themes the exemplars repeatedly emphasized throughout their responses. The priorities, shown in Table 1, were key motivators in their work. In line with the practices emphasized by exemplars, not surprisingly, many exemplars (79%) clearly prioritized their role as mentors. They were highly conscious of their responsibility for training and developing their trainees and staff. Another top priority among exemplars (63%) was conducting collaborative research. They described how relying on multiple perspectives improves their research. Next, many (54%) placed a heavy emphasis on creating good relations in their research teams, describing the desire for 'harmony' in their groups. They believed the best research is possible when there are positive interactions among people.

Other strong priorities included discovery and challenge (40%), along with strategically fostering a viable long-term research strategy (38%); for example, through pursuing the right topics or funding outlets, or learning new technologies. A number of exemplars (35%) emphasized their commitment to engaging communities in a responsible way and the need for researchers to be mindful of the potential impact of their research on society. Likewise, the desire to impact society in a positive manner emerged as an important focus for many exemplars (35%).

Discussion

Researchers need an extensive skillset to be successful. They must define important scientific problems and secure the resources they need to do their research. Furthermore, they must oversee the design and execution of projects and foster effective interactions—developing relationships is at the heart of these tasks. We sought to understand concrete approaches PIs nominated as exemplars for their scientific accomplishments and professional conduct use to foster effective workplace relationships in their immediate research groups. Our findings underscore the assertion that fostering and maintaining positive relationships among members of one's group is critical to successful science (Cohen and Cohen 2018). Furthermore, these findings align with the theoretical model of leadership that proposes effective scientific leadership requires expertise for integrating and managing people's activities to achieve the research mission and interacting with people in a manner that stimulates and supports them (Mumford et al. 2002; Robledo, Peterson, and Mumford 2012).

Although developing strong relationships may, at times, seem far removed from research, it is an essential task of investigators. One important approach to fostering good relationships—those that are respectful and characterized by trust—is awareness of the workplace environment created in a laboratory or research team. A collaborative spirit provides a foundation for accomplishing scientific aims together, and it establishes the basis for a healthy work environment. We found several actions were important to creating an ideal work environment: expressing appreciation for team member contributions, ensuring fairness in credit and recognition, providing mutual support and collaborating on projects, and, sometimes, coming together for non-work-related activities or celebrations. Consistent with recommendations for ethical leadership, exemplars also described setting the example through their own behaviors and articulating their values (Weaver, Trevino, and Agle 2005; Brown and Trevino 2014).

To form good working relationships, our findings suggest investigators should look to their interactions in meetings. Interactions at meetings should reinforce mutual support and collaboration, in addition to openness (Antes, Kuykendall, and DuBois under review). Inviting input and involvement from everyone supports engagement and productivity. In one-on-one meetings and interactions between PIs and members of their teams, exemplars encouraged tailoring leadership to individuals, taking care to express appreciation, and ensuring their availability and approachability. Many of these same strategies also helped them offset their workload by drawing on talents in the group. Over time, to maintain a positive environment and robust workplace relationships, maintenance strategies are also

important: these included resolving conflict when it arises, hiring cautiously the right people, and reflecting on the quality of the environment.

To achieve these goals, investigators require excellent communication and interpersonal skills, in addition to self-awareness. There is a growing dialogue about the need for investigators to have access to resources to develop leadership and management skills (Seeliger 2012; Antes and DuBois 2018; Van Noorden 2018), but it has not yet become the norm, and when it is available, it is usually optional. There are myriad issues to address in designing and implementing effective leadership development programs for researchers. For example, they should be evidence-based, address the concerns and values of researchers to attract their interest, and foster application of learning to real-world behavior and practice. Exemplars noted the need for self-care, stress management, and seeking help. We anticipate these are important topics for researchers, particularly early in their careers.

Systematic leadership training for principal investigators is critical, especially for early-career researchers when they go from primarily doing research to leading research. They should be aware that it is essential to establish their team and the work environment in an intentional manner, and their practices for going about this have implications for the quality of the work, the well-being of lab members, and compliance with ethics protocols. Investigators in a prior study described the early-career experience of setting up their labs as “jumping into the deep end,” “haphazard and hazardous,” and “playing it totally by ear” (Antes, Mart, and DuBois 2016). The scientific community should invest in preparing investigators for this transition in their role in producing excellent research. This task becomes even more critical if we consider the need for investigators to model and “pass down” these habits and practices to those researchers they train and supervise.

It is also important to recognize leadership development is an ongoing process of reflection and refinement; one is never finished learning to be an effective leader (Ashford and DeRue 2012). This is especially important given changes in one’s work and roles over a career, for example, as the size of one’s teams and collaborations increase. Thus, while we especially recommend leadership training for investigators early in their career, there is likely a need for ongoing leadership development among principal investigators across their careers.

It is important to note that while we found strong, consistent themes among exemplars, not all exemplars mentioned all practices, nor did they discuss demonstrating them identically. There are multiple ways to be effective in leading a scientific team. For example, while a focus on a positive, team-oriented environment may be rather universally important, some investigators might particularly promote this aim through fostering a shared sense of meaning in the group by emphasizing their scientific mission. Others might rely more heavily on creating a family-like environment in their group. PIs must develop a healthy work environment that is authentic to them; we are not suggesting a one-size-fits-all approach. On the other hand, researchers may find that they need to challenge themselves to try new things that could be uncomfortable at first. For example, explicitly stating their values and priorities to their teams, when it may seem to them that they are ‘obvious’ without being directly stated.

Furthermore, it is worth noting that there are multiple meanings of "successful" as a faculty researcher. Of course, publication output and funding, and then promotion, are typical markers of faculty success. It is plausible that many researchers who have advanced in their careers would be likely to report they engage in the behaviors reported by exemplars. However, it is also plausible that an investigator might be viewed as successful according to the productivity metrics, not use the practices, and also not have a reputation for integrity. Further, these individuals may be more at risk for high turnover of team members, noncompliance, or problems with data integrity leading to less than trustworthy results. Indeed, a meaningful task for leadership development for early-career researchers might be to reflect on, and define for themselves, what it means to be "successful."

Limitations and Future Research

We should consider several limitations of this study. First, institutional culture might influence the perception of different leadership practices and professional behaviors as effective and desirable. Our study did not capture the potential for an effect of institutional culture. Instead, we aimed to sample from varied institutions and scientific fields to increase the generalizability of our findings. It is even possible that institutional culture influenced the nominations we received. For instance, no 'Ivy League' institutions submitted a nomination. Overall, our rigorous process, which included nominations, secondary endorsements, a review panel, and large sample size for a qualitative study support the credibility of our findings.

Second, differences in specific leadership needs could vary according to research settings. For example, specific applications of some practices might differ among those doing basic lab science mostly with graduate students as personnel versus clinical trials research with mostly professional staff. This study focused on identifying a core set of practices that cut across different settings, but nuances by research setting should be explored in future research. Other contextual variables are also important to consider, for example, amount of funding and resources available to the PI, availability of institutional research support, cultural diversity among a research group, and size of a research group. Some of these factors especially tend to vary by the career stage of the investigator.

Third, another consideration, and avenue for future research, is that our findings are based on the self-report of exemplars. Thus, there is a potential for there to be disconnect between espoused practices and actual behaviors. Understanding these kinds of disconnects between perceptions of one's behavior and actual behaviors, are important in understanding leadership, particularly for efforts aimed at developing leaders. Thus, research designs that include speaking to individuals working in the research groups of successful researchers, or that compare self-ratings and others' ratings of behaviors, would be fruitful. Although there is the potential for some gap in reported and actual behavior, we think the practices described by exemplars still represent what they view as ideal. Thus, we think the potential for some bias does not undermine the interpretation of the findings. It is worth noting that many exemplars were forthright about their own limitations and challenges. Thus, we believe they were self-reflective and honest in the interviews.

Conclusion

For many reasons, leadership is a necessary component of research: researchers work in teams that require communication, coordination, and conflict resolution; deadlines, funding pressures, and competition contribute to stress; and scientific questions, cultural differences, and changing societal priorities require decision-making in the face of uncertainty. Research exemplars consistently and systematically reflect on leadership and engage in leadership practices. At the same time, variation exists in how exemplars lead and balance competing demands. This variation among exemplars, and the fact that leadership skills can be learned, suggests that the "soft skills" needed to be an exemplary researchers are within the grasp of most researchers.

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Appendix.: Interview Guide

Questions	**Probes**
Part A. Introductory statement, purpose of study, and verbal consent for recording	
Part B. Background information and rapport-building	
1. What motivated you to pursue a career in research?	*None*
2. How would you describe the research that you do to a lay audience?	*None*
3. What is the nature of your research team or lab?	Do you have staff, students, etc. who you work with and how many?
4. What are key ethical, compliance, and/or social issues that arise in your research?	*None*
Part C. Factors contributing to the success and integrity of research exemplars	
5. How would you describe your research personality? What key traits do you have as a researcher?	Do any other characteristics come to mind?
6. How do you think these traits have contributed to your success as a researcher and reputation for integrity?	Can you speak to both success as a researcher and reputation for integrity?
7. What are some of the habits or routine practices you have developed to foster scientific rigor and reproducibility in your lab?	Can you tell me more about that? How does that foster scientific rigor and reproducibility? Do any other habits or practices come to mind?
8. What are some of the habits or routine practices you have developed to support good working relationships in your lab?	Can you tell me more about that? How does that support good working relationships? Do any other habits or practices come to mind?
9. What are some of the habits or routine practices you have developed to ensure compliance, for example, compliance with regulations, ethical rules, or good clinical practice in your lab?	Can you tell me more about that? How does that ensure compliance? Do any other habits or practices come to mind?
10. What social responsibilities do you think you have as a researcher, and how do you engage these issues?	Are there other ways you engage these issues? Do any other responsibilities come to mind?

Questions	Probes
11. How do you manage your multiple obligations and workload? When you are juggling multiple priorities, how do you make decisions about what to focus on?	Can you describe other practices that you have found are essential to managing your time?
12. How do you manage stress or pressure in your work?	*None*
13. How do you find the right balance between detailed management and delegation to ensure efficiency and productivity while also ensuring quality and integrity?	*None*
14. When you encounter uncertainty about what to do regarding a particular situation or problem in your professional work, how do you address this?	*None*
15. How does your institution support your work?	*None*
Part D. Key experiences, factors, and lessons from exemplar's career	
16. What key events, situations, or experiences have shaped your approach to how you conduct yourself as a professional?	*None*
17. Are there any other factors that have contributed your success that we have not yet discussed?	Is there anything else you want to tell us before we ask our final question?
18. What is the top lesson or recommendation you would communicate to a new investigator about to embark on a career in research?	Is there another lesson you would like to share?

The full semi-structured interview guide (lightly edited for length). The themes reported in this manuscript arose primarily in response to questions 8, 11, 12, 13, and 14. However, relationships-related responses and professional priorities emerged throughout the interview and were coded accordingly.

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Table 1.

Professional Priorities

Priority	Description	No.	%
Mentoring and developing personnel	Commitment to ensuring that trainees are prepared with the skills and knowledge to be successful researchers; concern for the career goals of trainees and personnel; focused on developing the talents of personnel, students, and trainees.	41	79
Conducting collaborative research	Commitment to engaging in research as a partnership, within their own groups, and also with outside partners, often from other disciplines; believing collaboration yields the best research.	33	63
Fostering good relationships	Commitment to ensuring people in their groups understand that they are a priority; showing that they have concern for others and developing positive relationships.	28	54
Discovery and challenge	Commitment to discovery and innovation in research; desire for challenging work.	21	40
Planning for long-term sustainability and success	Commitment to ensuring a sustainable research agenda through scientific strategic planning and securing financial stability.	20	38
Engaging communities and doing socially important research	Commitment to directly engaging the community in their research or focusing on ensuring they are doing work of societal importance.	18	35
Helping people and having a positive impact on society	Commitment to helping individuals with a specific condition, or broadly benefiting society through discovering new knowledge, technologies, or procedures.	18	35
Ensuring a reputation for quality work	Commitment to ensuring that they or their team maintain a reputation for high-quality work among the scientific community.	16	31
Promoting diversity in science	Commitment to advancing opportunities for underrepresented and diverse individuals in science.	9	17