Normative Dissonance in Science: Results from a National Survey of U.S. Scientists

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ABSTRACT: **NORMS OF BEHAVIOR IN SCIENTIFIC RESEARCH** represent ideals to which most scientists subscribe. Our analysis of the extent of dissonance between these widely espoused ideals and scientists' perceptions of their own and others' behavior is based on survey responses from 3,247 mid- and early-career scientists who had research funding from the U.S. National Institutes of Health. We found substantial normative dissonance, particularly between espoused ideals and respondents' perceptions of other scientists' typical behavior. Also, respondents on average saw other scientists' behavior as more counternormative than normative. Scientists' views of their fields as cooperative or competitive were associated with their normative perspectives, with competitive fields showing more counternormative behavior. The high levels of normative dissonance documented here represent a persistent source of stress in science.

KEY WORDS: research integrity, norms, competition

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NORMATIVE PRINCIPLES EXPRESS COLLECTIVE understandings about how one should behave in a particular social system. They derive their authority from the moral imperatives that they represent and from the degree of consensus that they elicit in the social system. Certain aspects of the nature of science make norms particularly salient in the scientific research community. Self-regulation, substantial autonomy, the complexity of scientific projects, professional expertise, innovative work on cutting-edge problems, and a system of largely voluntary compliance with regulation and codes of ethics all point to the futility and inadvisability of direct administrative control over scientists' behavior. Instead, scientific work is subject to scientists' shared, common understandings about behaviors that are or are not appropriate in some context—work group, laboratory, department or discipline.

The broadest normative principles to which most scientists subscribe, across virtually all fields of science, have been termed the "norms of science"; these are the focus of our analysis. Scientists show high levels of agreement about certain norms of science, notably Robert Merton's (1942) four norms of communality (called "communism" in Merton's original work), universalism, disinterestedness and organized skepticism. These norms have been shown to evoke high levels of subscription among scientists, regardless of disciplinary field (Anderson, 2000).

As Merton pointed out, however, the norms represent ideal behavior, and so it is to be expected that scientists' actual behavior will fall short of perfect adherence to the norms. The issue we address is the *extent* to which behaviors differ from the norms that scientists espouse, both scientists' own self-reported behavior and their perceptions of other scientists' typical behavior. Depending on how great a gap scientists perceive between actions and normative ideals, these behaviors are potential sources of normative dissonance in the research environment, by which we mean inconsistency or lack of consonance between beliefs and behaviors related to norms. (Note that normative dissonance is a way of characterizing the research environment. It is not to be confused or compared with cognitive dissonance [Festinger, 1957], which refers to inconsistency in an individual's cognitions.) The difference between scientists' assessments of their own behavior and their perceptions of others' is another source of potential dissonance in the environment. Our analysis addresses the question, to what

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extent does normative dissonance characterize the research environment?

Scientists who work in environments whose normative character is at odds with their own beliefs about how people should act may feel pressure to change their own behavior, adjust their own beliefs, or seek work in a different environment. Persistent mismatches between beliefs and actions can contribute to work strain, disillusionment and alienation. Confusion or ambiguity about right action can prompt people to try to reduce dissonance by aligning their behavior with their peers', especially if they think that not doing so would put them at a competitive disadvantage. It may also give them license, or at least a rationale, for doing the easier thing instead of the right thing, when these are in conflict.

In an effort to understand sources of normative dissonance, we examine relationships between normative perspectives on the one hand, and personal, experiential and contextual variables on the other. In particular, we assess which is more strongly associated with subscription to norms and perceptions of normative behavior: socialization through mentoring or scientists' current work context.

We address all of the above considerations with respect to both norms and alternative counternorms. The latter represent alternative principles, essentially a system of alternative norms, that are directly contrary to more traditional normative principles, yet they attract some support among scientists.

Background

A normative system, within a given social system, is a complex web of shared expectations and understandings of right behavior, most of which are implicit, unexpressed and taken for granted. When an implicit normative assumption is challenged by an event or by emergent alternative perspectives, the members of the social system may articulate it in ways that make it more visible. For example, if someone in a lab started to discard test tubes after a single use, others would quickly point out that conserving and reusing resources is a norm in that context; reminder signs would likely appear to articulate and reinforce that norm. Most of a systems' articulated norms thus owe their expression to two competing pressures: some kind of challenge to the *status quo* and some kind of institutional response. We refer to these articulated norms as *institutional* norms, to distinguish them from implicit norms.

Institutional norms are sometimes expressed as principles, as in Merton's characterization of the norms of science. These principles must be understood as a kind of shorthand for more complex, shared understandings of appropriate behavior. In a background paper to the current analysis (Anderson, Ronning, Martinson & De Vries, in press), we have discussed at length the emergence of the Mertonian norms and the attendant controversies about their use as indicators of the normative system of science. We do not repeat that discussion here, but instead characterize the norms and counternorms that we employ in our analyses below.

NORMS AND COUNTERNORMS

Merton (1942) identified four norms of science, which he expressed as principles of desirable behavior. He saw the normative principles as morally binding, but most other commentators now see them as representing ideals that are not binding on behavior (Hess, 1997; Ziman, 2000). They do, however, carry the weight of a group's near-consensus and therefore influence behavior. *Communality* refers to the shared ownership of scientific methods and findings. *Universalism* is the principle that a scientist's findings and body of work should be judged on the basis of their merit, without reference to the scientist's personal or other irrelevant characteristics. *Disinterestedness* represents the understanding that scientists' work should be free of self-interested motivation and pursuit of wealth. *Organized skepticism* requires that scientific findings be made available for scrutiny and that such scrutiny be performed in accordance with accepted scientific standards.

In our prior work, we proposed two additional norms: *governance* as a mode of decision-making, and *quality* as an evaluative standard (Anderson, Ronning, Martinson & De Vries, in press). We discussed in detail the grounding of these norms in focus-group discussions with scientists. In analyses of survey data, these norms proved to exhibit subscription patterns consistent with those of the Mertonian norms.

Merton anticipated the existence of counternorms, which was verified by Mitroff (1974) through interviews with elite Apollo moon scientists. Mitroff found counternorms to be prevalent in the context of "fierce, sometimes bitter competitive races for discovery" (p. 585) and personal, emotional commitment to theories and ideas. These counternorms are point-for-point contrary to Merton's norms: *secrecy*, *particularism*, *self-interestedness*, and *organized dogmatism*. The norms that we added likewise have counterparts in *administration* as opposed to governance, and *quantity* as opposed to quality as an evaluative standard.

As cultural elements of a social system, norms are subject to evolution over time. Counterpressures,

changes within or without the system, and generational changes can all lead to changes in a normative system. Behavior that is out of alignment with prevailing norms may over time become a familiar, if not accepted, expression of an alternative counternorm. For example, the passage of the Bayh-Dole Act, which was intended to promote commercial development of the results of federally funded university research, has led to more entrepreneurial activities among faculty and behavior that previously would have been more characteristic of for-profit corporations. There is no clear demarcation between behavior that violates a norm and behavior that expresses an emergent counternorm. We maintain that identification of a counternorm depends on documenting non-trivial levels of support for a principle that is directly opposed to a recognized normative principle, as we found in the case of administration and quantity as counternorms (Anderson, Ronning, Martinson & De Vries, in press).

Empirical analyses of norms and counternorms have employed both direct and indirect measures of subscription to normative principles. Some researchers have based survey items on particular principles, such as Merton's, and have asked respondents to what extent they subscribe to the principles. Others have followed Durkheim's ([1912] 1995) lead in framing survey questions as behaviors that violate normative principles, and then asking respondents about the extent to which the behaviors merit sanction (Braxton & Bayer, 1999). Another approach has been to measure the extent to which respondents see normative principles enacted in the behavior of others (Anderson, 2000). Yet another possible approach is to ask respondents to estimate the extent to which their own behaviors align with particular principles.

Our study uses three of these approaches: subscription, the extent to which people espouse particular norms or counternorms; enactment, the extent to which people see their behaviors as normative or counternormative; and others' enactment, the extent to which people see others' typical behavior as normative or counternormative. In a kind of shorthand, we refer below to these six measures of norms as a person's "normative perspective."

RELATIONSHIP BETWEEN NORMS AND MENTORING, CONTEXTUAL VARIABLES, AND PERSONAL BACKGROUND

Normative perspectives are shaped by socialization and other experiences in a social system. Norms are often expressed and transmitted informally, through interactions and discussions between newcomers and veterans of the social system. Informal socialization to the norms of a field is generally considered one of the primary functions of a mentor. In science, mentoring is often referenced as one of the most critical means of transmitting normative understandings (Institute of Medicine and National Research Council Committee on Assessing Integrity in Research Environments, 2002).

Lessons gleaned from work environments are also important in the development of normative perspectives. Some are related to objective characteristics of employing organizations and others reflect subjective perceptions of the work environment. In the former category, the difference between for-profit and academic institutions has been linked to differences in normative perspectives (Slaughter & Rhoades, 2004). Perceptions of work environments, notably scientists' sense of community and competition in their fields, have also been shown to be related to norm measures (Anderson, 1996).

Methods

Data for the analyses presented here are derived from our survey of U.S. scientists whose research was funded by the National Institutes of Health. The study was approved by the Institutional Review Boards of the HealthPartners Research Foundation and the University of Minnesota. We constructed two random samples of researchers from NIH records: a mid-career sample of 3,600 selected from those who had received their first research grants (R01) between 1999 and 2001, and an early-career sample of 4,160 who had received institutional (T32) or individual (F32) postdoctoral training grants during 2000 or 2001. The scientists in the samples represent the full range of disciplines funded by NIH. The anonymous, mailed survey was administered in the fall of 2002. The adjusted response rates for the two samples were 52% and 43%, respectively, for a total $N = 3{,}247$. (For further details, see Martinson, Anderson & De Vries, 2006.)

MEASURES OF NORMS AND COUNTERNORMS

In developing the norm and counternorm items for the survey, we began with a battery of items used in an earlier study (Anderson, 2000). These items correspond to the four Mertonian norms of communality, universalism, disinterestedness, and organized skepticism, as well as their counterparts: secrecy, particularism, self-interestedness, and organized dogmatism. (The counternorm "secrecy" was called "individualism" in Anderson, 2000, and other papers based on the same research project.) We then added the two norm/counternorm sets (governance/administration

Communality: Scientists openly share findings with colleagues.	*Secrecy*: Scientists protect their newest findings to ensure priority in publishing, patenting, or applications.
Universalism: Scientists evaluate research only on its merit, i.e., according to accepted standards of the field.	*Particularism*: Scientists assess new knowledge and its applications based on the reputation and past productivity of the individual or research group.
Disinterestedness: Scientists are motivated by the desire for knowledge and discovery, and not by the possibility of personal gain.	*Self-Interestedness*: Scientists compete with others in the same field for funding and recognition of their achievements.
Organized Skepticism: Scientists consider all new evidence, hypotheses, theories, and innovations, even those that challenge or contradict their own work.	*Organized Dogmatism*: Scientists invest their careers in promoting their own most important findings, theories, or innovations.
Governance: Scientists are responsible for the direction and control of science through governance, self-regulation and peer review.	*Administration*: Scientists rely on administrators to direct the scientific enterprise through management decisions.
Quality: Scientists judge each others' contributions to science primarily on the basis of quality.	*Quantity*: Scientists assess each others' work primarily on the basis of numbers of publications and grants.

FIG. 1. Norm and Counternorm Survey Items.

and quality/quantity) that we derived from focus-group discussions (as discussed in Anderson, Ronning, Martinson & De Vries [in press]). The survey items that we used are displayed in Figure 1.

The questionnaire included items to measure subscription, enactment, and perceptions of other's typical behavior, each in terms of norms and counternorms. For subscription, the instructions were, "For each item, please indicate the extent to which you personally feel it *should* represent behavior of scientists." Respondents' assessments of their own behavior were prompted by, "Please indicate the extent to which it represents *your own* behavior." For respondents' assessment of other scientists' behavior, we asked them to "Please indicate the extent to which you feel that it *actually does* represent *the typical behavior of scientists*" (all emphases in the original). The response choices for all three sets of items were the same: to a great extent (2), to some extent (1), very little or not at all (0).

In analyses reported here, the measure of norm subscription is the sum of responses to the six norm items in the subscription category. The other norm and counternorm measures (enactment and perceptions of typical behavior) were constructed in the same way. The potential range of each measure is from 0 to 12.

MEASURES OF MENTORING, WORK CONTEXT AND PERSONAL CHARACTERISTICS

The analyses below involve three other sets of variables: mentoring, work context, and personal characteristics. The *mentoring* items were introduced on the survey by the following: "In your graduate program, postdoctoral work or related professional experience, how much of the following kinds of help have you received from your mentor(s)?" The response categories were: a lot (2), some (1), and none (0). Each of the five mentoring variables is a sum of responses to two survey items, thus with a potential range from 0 to 4. The five mentoring variables are: mentoring in ethical issues, mentoring in the proper conduct of research, mentoring related to financial issues and support, mentoring about the art of survival in science and establishing professional networks, and personal mentoring expressed as continuing interest and emotional support. Our previous work has shown these forms of mentoring to have distinct associations with self-reported misbehavior (Anderson, Horn, Risbey, Ronning, De Vries & Martinson, 2007), and so we include them here to examine how different forms of mentoring might influence normative perspectives.

The second set of variables concerns the *work context* of scientists' research. Normative perspectives may be shaped by context in both objective and subjective ways. Regarding objective differences in work environments, preliminary analyses showed that type of employing institution (private, for-profit as opposed to academic or non-profit) is associated with some norm variables, but only for the mid-career group, probably because few of the early-career respondents were employed in such organizations.

We therefore include a measure of type of employing institution for the mid-career sample only: private-for-profit (1) or not (0).

Regarding subjective differences in work environments, perceptions of the degree of cooperation and competition in a field appear more relevant to the development of normative perspectives than objective measures of these environmental characteristics. A strong sense that one's field is highly competitive may be grounded in objective indicators, but the conviction itself is likely the more influential factor in shaping one's normative orientation and perceptions. We include measures of researchers' perceptions of science as cooperative or competitive. Each is measured as a sum of responses to three items (e.g., for cooperation, "Science is a vast, collaborative effort to advance human understanding" and for competition, "Competition is the driving force behind scientific progress today"). Response options ranged from strongly agree (3) to strongly disagree (0), and so the potential ranges are from 0 to 9.

Finally, the analyses reported below take into account some personal variables. Preliminary analyses indicated that both gender and country of highest degree (U.S. versus other) were related to some of the norm measures, and so they are included here. Gender is coded as: female (1) and male (0). An indicator for location of the institution from which the respondent received his or her highest degree is coded as: outside the U.S. (1) and in the U.S. (0). Disciplinary field was originally included but then dropped as a control variable, because it added no explanatory power to the models.

Given the large number of statistical tests involved in our analyses, we use the $p < .01$ or better level of significance as a cutoff point, instead of the more standard $p < .05$ level.

Results

We examine normative dissonance in three ways. First, we present a group-level analysis of all the norm measures for our two samples. Second, we document within-person differences in norm and counternorm measures for individuals in our samples. Third, we examine correlations among the norm variables.

We conclude with a multivariate analysis of factors associated with the 6 norm variables. This analysis measures relationships between normative perspectives and the backgrounds and work contexts of scientists.

OVERALL DISSONANCE

Figure 2 presents the means of the six norm and counternorm measures by career stage. All differences by career stage are statistically significant by *t* tests, except for subscription to the norms, which has identical means for the two groups.

Overall, our respondents indicate high levels of subscription to the norms and notably low subscription to the counternorms. They assign their own normative behavior somewhat lower scores than the subscribed ideal, while also giving their counternormative behavior somewhat higher scores than their subscription to the counternorms. On average, though, they see their behavior as more normative than counternormative. On the other hand, they perceive others' behavior to be less normative and more counternormative than their own. It is notable that, on average, respondents see others' behavior as aligning more with the counternorms than with the norms.

In a similar analysis of earlier data (Anderson, 2000), the difference between normative subscription and others' behavior was termed the "disappointment gap," reflecting the difference between ideals and behavior observed in one's peers. On the counternormative side, this difference was called the "disillusionment gap," because it represents a difference between behaviors that scientists do not in general espouse and the evidence of these behaviors among other scientists. In the present analysis, the fit of one's own behavior between subscription levels and others' behavior represents another kind of gap. We suggest that it be termed a "candor/conceit" gap to capture the message that scientists admit that their behavior falls short of ideals, but believe that it comes closer than their colleagues' behavior.

Where differences are significant, normative measures are higher for mid-career than for early-career respondents, with one exception (others' counternormative behavior). It is possible that the two groups actually differ in their normative orientations and perceptions, or perhaps the mid-career group is simply more definite about their own normative stance.

Figure 2 represents substantial normative dissonance, in that scientists who, as a group, espouse traditional norms to a high degree nonetheless report that the typical behavior of other scientists is highly counternormative. As decades of social-psychological work show, one's own behavior is influenced strongly by the behavior of those in one's reference group (Festinger, 1954; Asch, 1956; Sherif & Hovland, 1961). We speculate that observations of others' counternormative behavior may explain, in part, why scientists' own behavior is less normative, and more counternormative, than their subscribed principles would suggest.

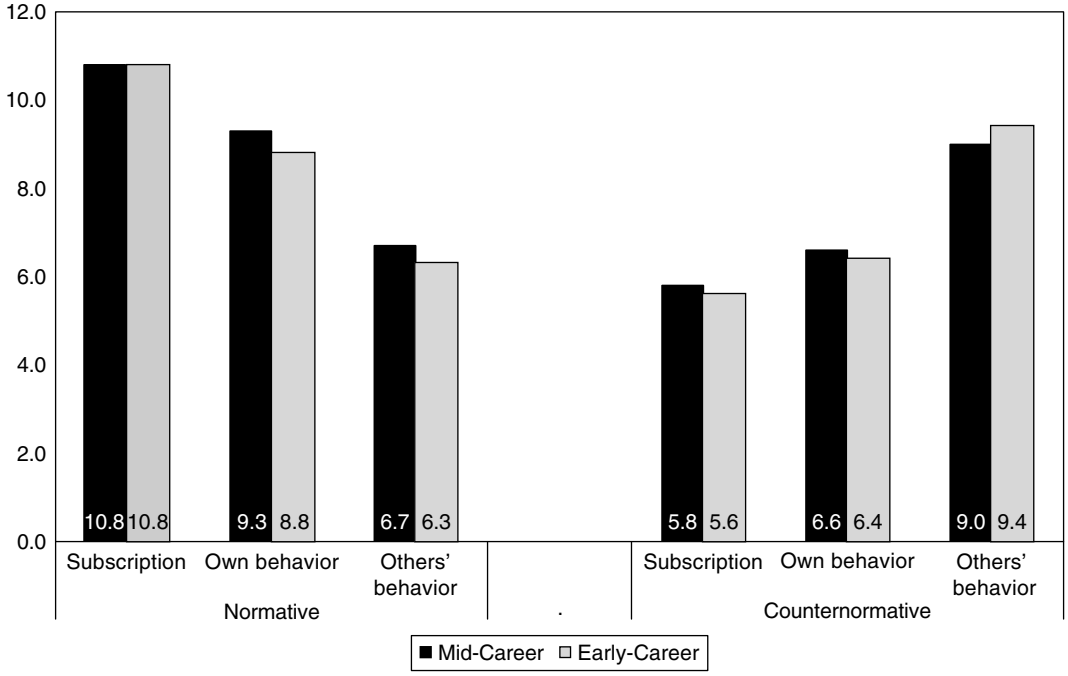

FIG. 2. Means of Normative and Counternormative Subscription and Behavior.

DISSONANCE WITHIN INDIVIDUALS' PERSPECTIVES

Figure 3 compares normative and counternormative scores within the three categories: subscription, perceptions of one's own behavior, and perceptions of others' behavior. Specifically, it shows the percentages of respondents whose norm scores are higher than, equal to, or lower than their own counternorm scores, in each of the three categories. (Scores are considered "equal" if, on the 0–12 scale, they differ by 0 or 1 point.) The top two bars show that, in the case of subscription, the vast majority of respondents have higher norm scores than counternorm scores, with only 7 and 8% (mid-career and early-career respondents, respectively, here and below) rating them equally. In terms of their own behavior, most scientists still have higher norm than counternorm scores, though much larger percentages, 26 and 32%, have equal norm and counternorm scores, and 5 and 7% rate their own behavior as more counternormative than normative. Finally, and most strikingly, a majority of researchers in the two samples, 61 and 76%, rank the typical behavior of scientists as more counternormative than normative. Scant percentages of respondents, 9 and 4%, see their colleagues' behavior as dominantly normative. Differences between mid- and early-career scientists are significant by χ^2 tests for the behavioral measures, but not for subscription. In both behavioral cases, more mid-career respondents have norm-dominant scores than their early-career counterparts.

Here, normative dissonance lies within individuals, but the story is the same. Given a choice between characterizing their own and others' behavior as normative or counternormative, most put themselves quite solidly on the normative side but other scientists on the opposite. The question then is how so many scientists function effectively in an environment that they perceive as so at odds with their own behavior and, even more, with the principles to which they subscribe.

Finally, there is also substantial ambiguity in respondents' descriptions of behavior, with between 20 and 32 percent of respondents seeing their own or others' behavior as characterized equally by the norms and by the counternorms. This finding suggests either that they have no dominant normative orientation or that their sense of normative enactment is expansive enough to accommodate contrary principles. Such accommodation may be necessary in complex environments, where scientists can sometimes act according to scientific ideals, and other times, due to competition or bureaucracy, they need to defer to secrecy instead of openness or administration instead of governance.

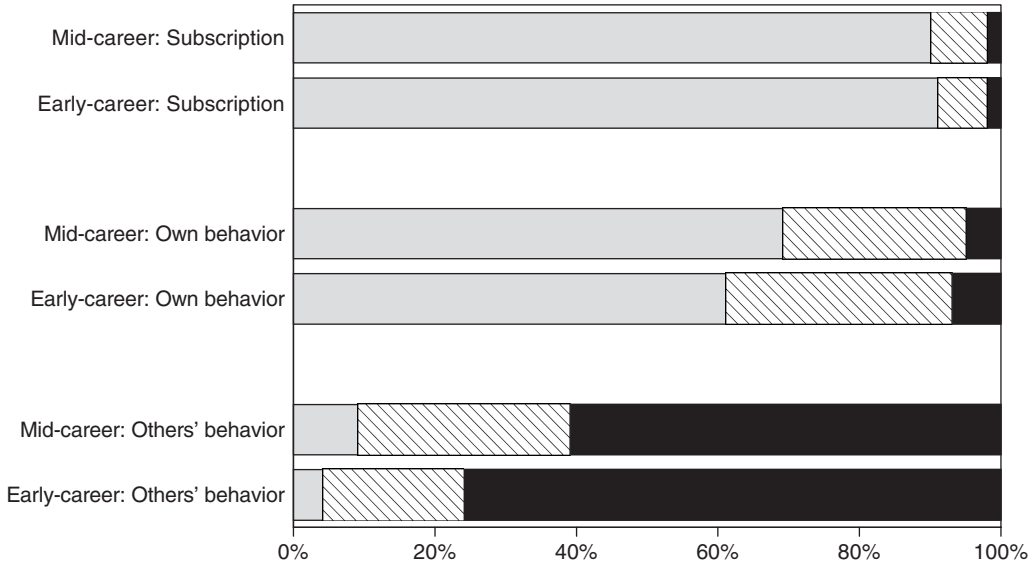

FIG. 3. Norm versus Counternorm Scores: Percent with Norm > Counternorm (dotted), Norm = Counternorm (striped), Norm < Counternorm (solid).

CORRELATIONAL DISSONANCE

A final way to examine normative dissonance is by correlations among the norm scores (see Table 1). This analysis extends the previous one by measuring not just dominance, but the degree to which higher scores on one measure correspond to higher scores on another. It also permits comparisons across all combinations of norm/counternorm pairs.

Within each career level, the norm measures are significantly, positively intercorrelated, as are the counternorm measures. The highest correlations are between subscription and one's own behavior, with the lowest between subscription and others' behavior.

Equally consistent are the correlations on the diagonal (shaded) between norm and counternorm subscription, between norm and counternorm measures of own behavior, and between norm and counternorm measures of others' behavior: all are negative in each sample, and all are significant but one. Most respondents thus see the norms and counternorms as inversely related, despite evidence in the previous section that substantial percentages of researchers see

TABLE 1. Correlations of Norm and Counternorm Scales.

Mid-Career Respondents (N = 1,768)	1	2	3	4	5	6
1 Norm subscription	1.00					
2 Norm own behavior	.46**	1.00				
3 Norm others' behavior	.13**	.37**	1.00			
4 Counternorm subscription	–.20**	.02	.19**	1.00		
5 Counternorm own behavior	–.07*	–.07*	.12**	.62**	1.00	
6 Counternorm others' behavior	.18**	–.00	–.24**	.15**	.38**	1.00

Early-Career Respondents (N = 1,479)	1	2	3	4	5	6
1 Norm subscription	1.00					
2 Norm own behavior	.42**	1.00				
3 Norm others' behavior	.08*	.37**	1.00			
4 Counternorm subscription	–.16**	.02	.20**	1.00		
5 Counternorm own behavior	–.02	–.01	.16**	.55**	1.00	
6 Counternorm others' behavior	.19**	.08*	–.15**	.17**	.34**	1.00

Significance levels: *$p < .01$, **$p < .001$

norms and counternorms expressed equally in behavior.

Normative dissonance is evident, however, in the (off-diagonal) correlations between norm and counternorm measures. One of these (norm subscription versus counternorm own behavior, in the mid-career group) is negative, as one might expect. All the other significant correlations are positive:

- norm subscription and others' counternormative behavior
- counternorm subscription and others' normative behavior
- own normative behavior and others' counternormative behavior (in the early-career group only)
- own counternormative behavior and others' normative behavior

The first two correlations suggest that those who most strongly believe in the norms are most likely to see others' behavior as counternormative; likewise, those who subscribe to the counternorms tend to see others behaving more normatively. The strength of these associations may simply reflect how others appear to a scientist who has a strong sense of principles, either normative or counternormative. Even so, these correlations, although small, reflect dissonance between what one espouses and what one sees in the environment.

The other two correlations extend the same kind of dissonance to one's own behavior in relation to others'. Not only are one's beliefs at odds with others' behavior, but so is one's own behavior: the more one sees one's own actions as aligning with the norms, the more likely it is that others will appear to behave counternormatively, and the more counternormative one's own behavior, the more others appear to enact the norms. Here, not only one's beliefs but one's actions are apparently in contradiction with behavior one observes in the environment. Again, the correlations are not large, but they are evidence of complex ways of interpreting one's own behavior and that of others.

NORMATIVE PERSPECTIVES IN RELATION TO MENTORING AND CONTEXTUAL VARIABLES

The dissonance that characterizes our respondents' normative perspectives may have its roots in their past experiences, notably mentoring in their graduate training, or it may have been shaped largely by the current contexts of their work. Our data provide no means of estimating causal effects, but they do permit examination of associations between the norm variables and scientists' experiences and perceptions.

Table 2 presents standardized coefficients from ordinary least squares regression equations that estimate each of the norm variables as a function of scientists' mentoring experiences, aspects of their work contexts, and personal variables. The results are displayed separately for the mid- and early-career groups.

The various forms of mentoring have generally modest effects on the norm and counternorm variables. Ethics mentoring is positively associated with normative behavior in both groups, as is personal mentoring among the early-career respondents. Neither of these forms of mentoring has any relationship to the counternorm measures. Financial mentoring has negative associations with subscription to the counternorms in the early-career group. Research mentoring has no effect on any of the norm measures.

Survival mentoring shows an exception to the general pattern of mentor influence. In both groups, it is positively associated with enactment of the counternorms. Perhaps mentors who emphasize the art of survival in science and the development of professional relationships communicate implicitly or explicitly the need for or advisability of behaviors such as maintaining secrecy, protecting one's own self interests, and taking personal characteristics into account instead of adhering to strictly universalistic criteria in evaluations. This association does not, however, extend to perceptions of others' behavior, as survival mentoring has positive effects on perceptions of normative behavior (in the mid-career group).

Mid-career scientists who work at private, for-profit organizations are more likely than others to subscribe to and enact the counternorms. In such contexts, administrative control (as opposed to governance) and company policies to protect intellectual property (as opposed to communality) may play larger roles in scientific research.

Perceptions of one's field as cooperative or competitive are more strongly associated with the norm and counternorm variables than are the various forms of mentoring, though neither variable is related to subscription to the norms. Cooperation is positively associated with normative behavior (one's own and perceptions of others') and, in the mid-career group, negatively associated with perceptions of others' counternormative behavior. Conversely, competition is positively associated with all the counternorm measures, and negatively associated with perceptions of others' normative behavior. The exception to this pattern is in cooperation's positive association with subscription to and enactment of the counternorms, in both groups. It is possible that the more cooperation one perceives among

TABLE 2. Standardized Coefficients of Regressions of Norm and Counternorm Scales (Subscription, Own Behavior, Others' Behavior) on Mentoring, Contextual, and Personal Variables.

Mid-Career Respondents (N = 1,768)	Norm Subscription	Norm Own Behavior	Norm Others' Behavior	Counternorm Subscription	Counternorm Own Behavior	Counternorm Others' Behavior
Ethics mentoring	.03	.09*	.01	.04	–.01	–.00
Research mentoring	.01	–.02	.05	.06	.06	.02
Financial mentoring	–.04	–.07	–.01	–.07	–.06	.01
Survival mentoring	.04	.03	.10*	.07	.13**	–.07
Personal mentoring	–.02	–.01	–.01	–.05	–.05	–.01
Private for-profit institution	–.01	–.03	–.05	.08*	.07*	.02
Cooperative field	.04	.16**	.30**	.15**	.11**	–.09**
Competitive field	.03	–.02	–.12**	.12**	.24**	.30**
Female	.09**	.03	.00	–.04	–.05	.03
International degree	–.05	.00	–.00	.12**	.10**	.02
R^2	.02*	.04**	.16**	.07**	.10**	.12**
Early-Career Respondents (N = 1,768)	**Norm Subscription**	**Norm Own Behavior**	**Norm Others' Behavior**	**Counternorm Subscription**	**Counternorm Own Behavior**	**Counternorm Others' Behavior**
Ethics mentoring	.04	.10**	.05	.01	–.03	.01
Research mentoring	.06	.03	.08	.01	–.04	–.02
Financial mentoring	.03	.02	–.01	–.10*	.04	.00
Survival mentoring	–.04	–.08	.02	.07	.12*	–.07
Personal mentoring	.05	.12*	.07	–.02	.02	.02
Private for-profit institution	–	–	–	–	–	–
Cooperative field	–.02	.13**	.26**	.12**	.12**	.00
Competitive field	.04	.01	–.09*	.09*	.19**	.28**
Female	.03	–.06	–.04	–.06	–.07	.01
International degree	–.12**	–.04	.03	.13**	.01	–.04
R^2	.03**	.05**	.14**	.05**	.06**	.09**

Significance levels: *$p < .01$, **$p < .001$

scientists, the more one is aware of the need for and reality of both normative and counternormative actions.

Women are more likely than men to subscribe to the norms, but only in the mid-career group. Those who received their highest degrees from non-U.S. institutions are more likely to subscribe to the counternorms, less likely to subscribe to the norms (in the early-career group) and more likely to enact the counternorms (in the mid-career group).

Discussion

Norms represent ideals of behavior, and normative dissonance in the research environment represents in part the difference between ideals and reality. Behaviors—one's own and others'—seldom align perfectly with one's own highest standards. Nonetheless, the extent of normative dissonance documented here suggests that scientists' work environments are very much at odds with their own beliefs about right behavior.

In focusing on dissonance, we have emphasized comparisons between scientists' normative subscription and their views of others' behavior. It is important to note, however, that our respondents see their colleagues' behavior itself as out of step with the traditional norms of science, in absolute as well as relative terms. They see others' *typical* (not *exceptional*) behavior as substantially more counternormative than normative. This finding belies the status of traditional norms as institutionalized expressions of expected and appropriate behavior.

Normative dissonance is not equivalent to moral ambiguity. Scientists may have principled bases for the decisions they make, despite ample evidence that others make contrary choices. The power of dissonance lies instead in the persistent possibility of choosing to

align one's own behavior with others', instead of with one's principles, in cases where the two are opposed. Dissonance can thus provide a rationale for abandoning one's principles in a given situation. By this reasoning, normative dissonance may have implications for scientists' regulatory compliance, questionable research conduct and even misconduct.

We did not ask our respondents to speculate on the extent of others' subscription to the norms. If scientists infer the extent of their colleagues' subscription to the norms from behavior, it is likely that they underestimate that subscription. After all, we found very high levels of normative subscription in both our samples. Norms represent collective expectations of proper behavior, but if they are not perceived as collectively supported, their authority is diminished. In fact, our "off-diagonal" correlations show that the more a scientist subscribes to the norms, the more likely he or she is to perceive deviance in the behavior of others. Perversely, then, the strongest adherents to norms are the least likely to affirm the power of the norms in directing behavior. Concern about promoting normative behavior may focus attention on the seemingly many, but perhaps few in reality, examples of counternormative behavior in one's environment. By analogy, a few difficult students in one's classroom or a few irresponsible drivers on one's street capture a disproportionate amount of one's attention and color one's perception of what the entire situation is like.

There is little evidence here that many scientists subscribe to counternormative principles. The overriding factor, however, may be the very widespread perception that the counternorms characterize (other) scientists' typical behavior. Scientists in our mid-career sample who work in the for-profit sector tend to see counternormative principles as reflective of their own beliefs and behavior. Perhaps an increasing influence of market-like activities within non-profit, mainly academic, institutions explains some of the perceptions of counternormative behavior (Slaughter & Rhoades, 2004).

Our multivariate results show that scientists do not just live in a world of normative dissonance: they are also subject to pressures and influences in their environments that compromise collective adherence to traditional norms (De Vries, Anderson & Martinson, 2006). Advice from mentors about how to be a successful scientist, alternative standards in international institutions and in commercial organizations, competition, and cooperation all contribute to counternormative subscription and enactment. All of these influences are projected to increase, as research projects require more expansive collaborative efforts, as corporate involvement in science increases, and as competitive pressures persist.

Our data do not permit us to measure change in normative dissonance over time. If it continues at the high levels we have identified, or increases, it may be difficult for scientists to maintain mutual respect for and trust in colleagues whose behavior they see as out of sync with their own beliefs. Such erosion in organizational climates can make people jaded, cynical, and alienated.

On the other hand, high levels of normative subscription, even in the face of contrary enactment, may indicate a well-developed sense of personal responsibility among scientists. That scientists rate their own behavior as more normative and less counternormative than their peers' may not be self-delusion: it may represent a sense of conscience and a desire for one's own behavior to meet a higher standard in normative terms.

In general, however, we see the findings presented here as more negative than positive. The high levels of normative dissonance that we have documented here represent a stress on scientists and on the organizational systems that support scientific research. As both normative principles and the behavior of colleagues are important elements of the context of research, contradictions between them imply persistent tensions in the scientific environment.

Best Practices

We have argued that social systems are more likely to articulate and clarify normative systems that are challenged. If our findings, particularly with regard to scientists' perceptions of others' behavior, are seen as a challenge to existing normative principles, then they may prompt more deliberate attention to norms in science. Scientists who, like our respondents, subscribe strongly to the traditional norms of science may find the normative dissonance documented here to be provocative of discussions about counternormative behavior in their own laboratories and departments. We see such openness as salutary, particularly for the sake of students, postdoctoral fellows, and other trainees. Institutional leaders, administrators, and lab directors would do well to make deliberate reference to normative principles when making decisions, frankly discuss contradictions between norms and counternormative behaviors, and openly debate the normative implications of new situations that give rise to ethical dilemmas. Such steps would call attention to normative dissonance, thereby diminishing its power as a covert force in science.

Research Agenda

Our findings reveal an uneasy tension in the research environment. Further research needs to explore the sources and development of this tension, as well as its correlates and consequences. Little is known about how students learn about the norms in the scientific research environment or what factors are most influential to their eventual subscription to certain norms, which our findings have documented. Likewise, the depth of that subscription is unknown. For example, we do not know if inconsistencies between scientists' professed subscription to the norms and their behavior are due largely to perfunctory allegiance to norms that readily crumbles when challenged, or to circumstances that lead scientists to violate deeply-held beliefs.

We have based our analysis on the Mertonian norms, as extended in our previous work. Subsequent research might employ a broader set of normative principles or sets of more specific principles underlying the work of certain scientific disciplines.

We have not considered here some of the potential results of normative dissonance. Striking differences between one's own beliefs or behavior and others' behavior, as documented here, might be a source of alienation among scientists. If so, normative dissonance may be associated with such negative outcomes as resistance, noncompliance or misbehavior. We suggest that studies of actual behaviors would be preferable to analyses of hypothetical or prospective behaviors.

Our emphasis on normative dissonance as a property of the research environment suggests that further analyses might usefully employ laboratories or departments as the unit of analysis. As an independent variable, the extent of normative dissonance in a research setting might contribute to explanations of such organization-level phenomena as collaboration, conflict, productivity, innovation, cohesiveness, turnover, and so on.

Educational Implications

Instruction in the responsible conduct of research (RCR) focuses largely on rules and procedures, good research practices, and cases that concern ethical questions or dilemmas. Little attention is typically paid to the fundamental normative underpinnings of scientific research. RCR training provides an opportunity for established scientists to articulate and affirm their own subscription to scientific norms, which we have documented here. Such a discussion would also need to address scientists' ambivalence about enactment of the norms and the circumstances under which adherence to norms might be violated. If such instruction were the joint responsibility of two or more instructors, the collective aspect of normative subscription and interpretation would be underscored in the minds of students and advanced trainees. Finally, attention to normative (and counternormative) principles in mentoring, at critical decision points in the laboratory or in the field, would link broad, abstract principles of behavior to everyday ethical issues. It would reinforce the power of normative principles as representations of scientists' implicit, collective understandings about how scientific research should be done.

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