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Extending the Mertonian Norms: Scientists' Subscription to Norms of Research

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Abstract

This analysis, based on focus groups and a national survey, assesses scientists' subscription to the Mertonian norms of science and associated counternorms. It also supports extension of these norms to governance (as opposed to administration), as a norm of decision-making, and quality (as opposed to quantity), as a evaluative norm.

When someone is introduced or identified as a scientist, there is no way initially to know if she studies butterfly wings, nanostructures, brain waves, glaciers or organic molecules. What is more certain is that she has been trained in scientific methods and likely does her research in accordance with them. Her work is subject to rules, regulations, policies and laws, some general and some specific to her area of inquiry. As a member of the broad scientific community, she is also subject to general expectations about how she should behave in her role as a scientist, expectations that encompass her motivations, relations with other scientists, standards for and evaluation of her work, and her autonomy. All of these conditions are invoked by a person's self-identification with science as a social system.

Our focus in this analysis is on the norms associated with scientific research in academic institutions. Norms are collective expectations for and understandings of appropriate and desired behavior within a given social system. A *normative system* is the set of all norms associated with a particular social system, together with the members' collective subscription to the norms and weighting of the norms' importance and applicability. An individual's *normative orientation* is his or her unique pattern of subscription and resistance to all the norms in the social system, as he or she understands them. Neither a normative system nor an individual's normative orientation is fully knowable, since many of a social system's norms remain latent until they are challenged or violated.

Robert Merton (1942) sought to give shape (literally, "structure") to the normative system of science overall by specifying norms that fairly and uniquely characterize the system. His pithy formulation of four norms was never intended as an exhaustive specification of the entire normative system of science. He specifically omitted from consideration what he

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termed “technical norms” (such as empirical evidence and logical consistency) that had to do with methodology. He chose norms that were not only manifest but also appeared to him to have high, if not universal, rates of subscription among scientists. Each norm was matched by what he later referred to as a “counter-norm,” that is, an impetus for action contrary to that enjoined by the norm. Finally, these norms, unlike rules or policies, were to be understood as largely informal in expression and transmission. The Mertonian norms are *communality*, *universalism*, *disinterestedness*, and *organized skepticism*.

We set out to investigate scientists’ subscription to the Mertonian norms, as part of a broader study on research integrity in science. Before proceeding, however, we became convinced, on the basis of extensive reading on current and recent scientific work and environments, that the Mertonian norms offered too spare a characterization of the scientific normative system or of any individual’s normative orientation.[1] We sought, therefore, 1) to investigate the extent to which scientists subscribe to the original Mertonian norms and counternorms, 2) to derive a further set of normative and counternormative principles from discussions with scientists, and 3) to investigate the extent to which scientists subscribe to the derived principles. The discussions with scientists took place in focus groups, and the investigations of scientists’ subscription to the original and derived principles were based on a national survey, as described below.

Background

Norms are specific to a social group, though the group may be very broadly defined. The term “norm” is used in two distinct ways in the social science literature: norm may be a behavior that is typical within the social group, or it may refer to a behavior that is deemed desirable or ideal for the social group. These two types of norms have been described, respectively, as statistical versus professed (Barnes and Dolby, 1970), and descriptive versus injunctive (Christensen, Rothgerber, Wood and Matz, 2004). The research we report here focuses on the latter type of norms.

Mertonian Norms

Merton (1942) distinguished between technical and moral norms (what Zuckerman (1988) later referred to as cognitive versus social norms). Among the former, Merton identified two methodological principles (adequate, valid and reliable empirical evidence, as well as logical consistency) that guide and support the “extension of certified knowledge,” which is “the institutional goal of science” (1942, p.117). The moral norms likewise support this overarching goal, but in a different way: “The mores of science possess a methodological rationale but they are binding, not because they are procedurally efficient, but because they are believed right and good. They are moral, not technical, prescriptions” (p.118). Zuckerman (1988) has noted that these moral norms all relate to scientists’ attitudes and behaviors in relation to each other and their research.

Merton’s (1942) original article on the norms of science does not specify the method by which he derived four specific norms. In particular, there is no reason to suspect that the norms were empirically derived from observations of scientists or other data-based means. They appear to be grounded, however, in Merton’s vast reading about and familiarity with scientific work, methods and social organization. It is important to note that the four “moral” norms, like the technical norms, are presented not as desired behaviors, but as principles with which various behaviors may be aligned or not.

[1]Of course, any discrete measure based on only a few norms offers only a cursory indication of either, but we argue below that such measures should not be dismissed from survey-based research.

The first Mertonian norm is *communality* (“communism,” in the original), the common ownership of scientific results and methods and the consequent imperative to share both freely. This principle is based on the fact that scientific findings are always a product of collaborative efforts and “constitute a common heritage in which the equity of the individual producer is severely limited” (1942, p.121). Merton identified secrecy as the antithesis of communality.

The principle of *universalism* specifies that scientific work and findings should be evaluated on the basis of “*preestablished impersonal criteria*: consonance with observation and with previously confirmed knowledge” (1942, p.118, emphasis in original), and not on the personal or social attributes of the scientists involved. Such objectivity ensures that the merits of scientific findings, as well as the excellence of scientists’ accomplishments, be evaluated without reference to the scientists’ nationality, race, religion, professional affiliations and other irrelevant characteristics.

The principle of *disinterestedness* demands that scientists’ work remain uncorrupted by self-interested motivations. It precludes the pursuit of science for the sake of riches, though Merton recognized the powerful influence of competition for scientific priority. He carefully distinguished between personal altruism and the institutional mandate in favor of disinterestedness.

Finally, *organized skepticism* refers to the “detached scrutiny of beliefs in terms of empirical and logical criteria” (p.126). This principle has implications for both producers and consumers of scientific findings: the former need to present their findings and methods transparently so that their value can be assessed, and the latter need to suspend judgment until they have examined findings and methods according to accepted standards and criteria.

Merton’s claims for these norms are expressed in his original work:

> “The ethos of science is that affectively toned complex of values and norms which is held to be binding on the man of science. The norms are expressed in the form of prescriptions, proscription and permissions. These are legitimatized in terms of institutional values. These imperatives, transmitted by precept and example and reenforced [sic] by sanctions, are in varying degrees internalized by the scientist…. Although the ethos of science has not been codified, it can be inferred from the moral consensus of scientists as expressed in use and wont, in countless writings on the ‘scientific spirit’ and in moral indignation directed toward contraventions of the ethos” (1942, p.116–117).

Several aspects of these claims have drawn fire since they were originally published, notably the “binding” nature of the norms, the degree of internalization of the norms by scientists, and the extent of moral consensus that the norms represent. The critiques are addressed below.

Counternorms

Ian Mitroff’s (1974) study of the Apollo moon scientists provided empirical evidence of the influence of “counternorms” in science. These counternorms (solitariness, particularism, interestedness and organized dogmatism, in Mitroff’s words) are point-for-point contrary to the Mertonian norms. Mulkay (1976) has argued that these counternorms “can also be interpreted, by participants as well as by observers, as being essential to the furtherance of science” (p.639). For example, scientists see a bias in favor of the work of those whom they trust as a matter of efficiency, without likely or perceptible loss of quality.

Merton anticipated the existence of counternorms, discussing some of them in his original article (1942). In later work, he emphasized the workings of sociological ambivalence, which results when people are subject to two or more conflicting normative systems. Such ambivalence finds expression when people choose to conform alternately to the conflicting systems. Mitroff (1974) has argued that the dominance of one set or the other is situationally dependent.

Counternorms do not, however, represent merely an alternative expression of the scientific ethos. They retain their status as contrary normative principles, which nonetheless attract at least some allegiance, in at least some circumstances, in ways that are validated to some extent by the institutions of science. In this sense, counternorms always exist in normative systems; otherwise, as Ziman (2000) has noted, there would be no need for a social system to assert preference for actions aligned with original norms.

Critiques of the Mertonian Norms

Foremost among Merton's critics has been Michael Mulkay (1976, 1980). Mulkay (1976) has argued that neither the Mertonian norms, nor Mitroff's counternorms, nor both together represent the normative structure of science. Instead, he argues that the (Mertonian) norms are "better conceived as vocabularies of justification, which are used to evaluate, justify and describe the professional actions of scientists, but which are not institutionalised within the scientific community in such a way that general conformity is maintained" (1976, p.653–654). Their use is in providing a kind of verbal shorthand by which scientists reference ideologies that support their interests, political and otherwise, in the funding and social arenas of science. (For a rebuttal, see Zuckerman (1988, p.517).

Mulkay's perspective suggests that the Mertonian norms exist largely as part of scientists' intentional presentation of science to outsiders. Institutional theories of organizations (Meyer and Rowan, 1977) emphasizes the critical importance of such facades as a means of protecting an institution's core activities from external interference and maintaining institutional legitimacy, which is the basis for continued support from external agents. The Mertonian norms then can be seen as reflecting and supporting the "social stereotype" (Mulkay, 1976, p.647) of scientists. They are statements that align with the expectations of outsiders. This perspective not only rejects the role of norms as binding on behavior, but also suggests that it is more critical for normative statements to reflect the behavioral expectations of outsiders than to correspond to those of insiders. One might argue, then, that relative newcomers to science (students, postdoctoral fellows) would exhibit levels of subscription to standard formulations of normative principles that are at least as high as, if not higher than, those of established scientists.

Others have likewise criticized the Mertonian norms. Barnes and Dolby (1970) argue against the binding nature of the norms on scientists' behavior. Gibbs (1981) raises a five-point challenge to norms in general, and concludes that the notion of norms be abandoned and replaced by a focus on the "normative properties" (p.18) of behaviors. Slaughter and Rhoades (2004) note that critical and social constructionist strands in the literature on norms and values in science have raised challenges to Merton's formulation of the norms.

Controversies about the Mertonian norms have raised and clarified certain points relevant to the interpretation of the norms. Despite occasional renewed objections to the norms, many of the major points of controversy have been largely settled. Do the Mertonian norms, with their positive valence, adequately represent the norms of science? No, as Mitroff's work has shown. Do the Mertonian norms together with Mitroff's counternorms adequately represent the norms of science? No, as there have been suggestions (not based on empirical evidence) that principles such as autonomy and rationality (Barnes and Dolby, 1970; Barber 1952), emotional neutrality and emotional commitment (Mitroff, 1974), individualism (Hess, 1997), independence (Hagstrom, 1965), originality (Ziman, 2000) and openness (Slaughter and Rhoades, 2004) be added to the list. Are the norms binding on behavior or expressive of ideal behaviors? Hess represents the majority view: "For decades the consensus among social scientists has been that, as descriptions of the norms that actually guide scientists' action, Merton's norms do not exist in any pervasive form…. It is possible to salvage Merton's delineation of the norms of science, but only as a prescription of how scientists should behave ideally" (1997, p.57). Ziman concurs: "Indeed, norms only affirm ideals; they do not describe realities. They function precisely to resist contrary impulses" (2000, p.31).[2]

Two other points of controversy relate directly to our own analysis below. First, are the norms of science directed to insiders in their prescriptions of ideal behavior, or are they aimed at outsiders as Mulkay has suggested? It seems likely that both perspectives are at least partially valid, and that the issue can be addressed empirically. If the norms are essentially a part of the culture of science, then insiders might be expected to subscribe to the norms more strongly than outsiders and even newcomers. If, instead, they function largely as signals and points of reference for outsiders, then the insiders might be expected to show lower levels of subscription to the norms. The same kind of test could be applied to determine whether the norms are largely the province of the scientific elite or of the scientific community in general.

Second, do the norms (and counternorms) adequately capture the overall normative system of science? The consensus is that they do not -- nor could any finite list of normative principles represent the complex normative system. In an analysis of normative statements by scientists studying pulsars, Mulkay has noted the "striking contrast between the simplicity and uniformity of sociologists' version of the norm of communality and the complexity and diversity" of scientists' interpretations of the rules for communicating results (1980, p.121). The normative system of science is affected by interpretation (Mulkay, 1980), context, contingencies, and differential power (Gibbs, 1981), among other factors. If the normative system of science is largely latent, as we have argued above, then it remains largely unknowable. One might conclude, then, that the construct of "norm" must then be omitted from empirical analyses of scientists and their behavior.

We argue, however, that the situation is not quite so bleak. If the norms are viewed as a) ideals that b) are counterbalanced by opposing norms, and c) as a set are not exhaustive of the potential principles that could be used to characterize the normative system of science, and d) are indicative of the broader, far more complex, and largely unknowable normative system of science, then it is conceivable that a small set of normative principles could be usefully and profitably employed in empirical analyses. In particular, evidence-based investigations into the extent to which scientists subscribe to the normative indicators would inform discussions of the degree to which the norms elicit consensus among scientists and open the door to analyses of subscriptions' relationship to, for example, misconduct, competition, good citizenship within organizations, workplace sabotage, socialization, service and alienation.

Measures of Norms

How then might norms of science be represented in empirical studies of scientists and their work? Three analysts who have extensively studied the normative system of science have made similar suggestions. Mulkay (1976) notes that Mitroff advises examination of the "messy behavior and complicated attitudes found throughout the scientific community at

[2]Braxton (1986) presents a review of research on conformity to the Mertonian norms.

large" (p. 641). Mulkay (1980) recommends the strategy of "trying to identify as directly as possible the full range of rules that scientists actually use in practice and to obtain as much detailed information as possible on the kind of interpretative work carried out by scientists themselves" (p.114). Braxton (1986) likewise suggests, "An alternative approach would be to identify norms through a more qualitative approach. Norms identified by qualitative methodology would be expressed in the words of the respondents rather than in *a priori* definitions of possible norms" (p.353).

Research designs based on these recommendations might employ ethnographic or anthropologic observation of scientists and their work (Latour and Woolgar, 1986), repeated and extensive interviews, or meta-analyses of biographical or other in-depth reports of scientists or particular initiatives (Kanigel, 1986; Watson, 1997). None of these approaches has been used specifically and deliberately to investigate the normative structure of science. Another approach, the one used for the present analysis, is to conduct discussions with scientists using the format of focus groups to elicit both individual and group assertions and reactions concerning scientific norms.

The most basic measurement issue related to the norms is how to elicit observable expressions of the norms and how to recognize them when they arise. As Ziman (2000) has noted, "newcomers to research soon discover that they are not just learning technical skills. They are entering a self-perpetuating 'tribe', where their behaviour is governed by many unspoken rules. These rules vary in detail from discipline to discipline, from country to country, and from decade to decade. But the sub-tribes of academia span a common culture" (p.31, citations in quotation omitted). The study of norms is thus subject to the problem common to all studies of culture: insiders are so thoroughly immersed in the culture that the normative system is invisible to them, while outsiders are not familiar enough with the culture to represent accurately the culture's deeply embedded assumptions about normative principles. (If we were to accept Mulkay's interpretation of the norms, that we should instead look to outsiders for articulation of expectations or normative principles, the situation is not much better, since the relevant reference groups outside science appear far too dispersed and diffuse in focus to provide reliable indications of the norms.)

The three-fold challenge in any case is to focus observation or questions on points that theory suggests are likely to reveal norms, to recognize the normative tone of statements or actions, and to assess in some way the consistency of normative indicators in order to separate aberrance from patterns. Two directions are helpful here. First, Durkheim (1995/1912) long ago posited that the significance of a norm is indicated by the extent of moral outrage or indignation than ensue when the norm is violated. Zuckerman adds, "Applying that rule to science, we note the uniformly intensive and angry responses of scientists to fraud, plagiarism, misallocation of recognition, efforts to impose curbs on free communication and to major errors of procedure, analysis or interpretation subjected to 'organized skepticism'" (1988, p.517). She then presents quotations from scientists who were reacting to specific instances of normative violations; the quotations include the words: heinous, scandal, desecration, shocking, intolerable (p.521). Ziman (2000) writes, "Indeed, the fact that such episodes [normative violations] are still generally regarded as both deviant and scandalous is a tribute to the continuing moral authority of the ethos that they flout" (p. 32). Following this direction, researchers would do well to focus attention on behaviors that do or might elicit moral outrage or, in more pedestrian terms, get a scientist in trouble. Braxton and Bayer (1999) used a related approach in a somewhat different context.

We suggest that a second promising approach to revealing norms is to examine points of discontinuity or "joints" where one encounters new or somewhat different formulations of normative principles. The assumption underlying this approach is that norms are revealed in the surprise that people experience at such points of discontinuity. In general, norms associated with a social system may be revealed when: a) one enters the social system for the first time, as when a student in the sciences begins work on his first research project; b) one moves from the social system into a related but different arena, as when a recent graduate accepts employment in a corporate research lab; c) in times of environmental change, as when a faculty member discovers the extent of her institution’s patent or technology-transfer office’s control over dissemination of findings; and d) when violations or the potential for violation of latent norms leads to more deliberate articulation of the norms, as when new scientific instrumentation opens new possibilities for fraud. Qualitative methods that focus on such points of discontinuity may lead to insights about normative systems.

Once possible norms are identified through qualitative means, it is necessary to measure in some way the extent to which scientists subscribe to the potential norms (Gibbs, 1981). This task requires an expansive effort, in both geographical and disciplinary terms, if the assessment is to be anything but local. Likewise, if the norms are to be used in studies of other variables related to the scientific community and its work, some means must be found to represent the norms in an abbreviated way. Merton relied on simple labels to represent broad normative principles, but as Mulkay (1980) and Gibbs (1981) have pointed out, such labels are subject to widely differing interpretations.

Another approach is to construct statements of behaviors that fall under the rubric of normative principles and then measure scientists’ subscription to such behaviors. This approach clearly falls short of capturing complex norms, but it instead provides some measure of behaviors that indicate or reference norms. The approach was used in the Acadia study (Anderson, 1996, 2000; Anderson and Louis, 1994; Louis, Anderson and Earle, 1994; Louis, Anderson and Rosenberg, 1995), whose data were derived from two national surveys in the United States of faculty members and graduate students in four disciplinary fields. The norm items were used to assess subscription to the norms, as well as the relationship between normative subscription and other variables, such as exposure to misconduct, student experiences, mentoring, and departmental climate. The items constructed for use in the Acadia study (Anderson, 2000, p. 447–448) are as follows:

> Communality norm: Scientists openly share new findings with colleagues.
>
> Secrecy counternorm: Scientists protect their newest findings to ensure priority in publishing, patenting, or applications.
>
> Universalism norm: Scientists evaluate research only on its merit, i.e., according to accepted standards of the field.
>
> Particularism counternorm: Scientists assess new knowledge and its applications based on the reputation and past productivity of the individual or research group.
>
> Disinterestedness norm: Scientists are motivated by the desire for knowledge and discovery, and not by the possibility of personal gain.
>
> Self-interestedness counternorm: Scientists compete with others in the same field for funding and recognition of their achievements.
>
> Organized skepticism norm: Scientists consider all new evidence, hypotheses, theories, and innovations, even those that challenge or contradict their own work..
>
> Organized dogmatism counternorm: Scientists invest their careers in promoting their own most important findings, theories, or innovations..

Overview of the Study

As noted above our purpose is, first, to determine whether additional norms can be identified in scientists' discussions about their work, and then to measure levels of subscription to both the original norms and the additional norms that emerged from our analysis. We collected data through two means: focus group discussions and a national survey. Both phases of the study were approved by the relevant institutional review boards.

Focus Groups Methods

We conducted six focus-group discussions with a total of 51 scientists during the winter of 2002. Two discussions were held at each of three research universities: one with postdoctoral fellows and untenured assistant professors, and the other with associate professors. This plan ensured that junior scientists would not find themselves in open discussions with senior colleagues who might have supervisory or review authority over them. Two of the institutions are public, and the other is private.

We recruited participants from departments in the biomedical, clinical, biological and behavioral sciences. We selected individuals randomly from departmental lists from public websites and sent them personal email invitations. Though many people agreed to participate, we restricted the groups to 10 people to increase the likelihood that all participants would have opportunities to talk. (Some who were scheduled to participate were ultimately unable to attend.) We also designed the focus groups with no more than one person from a given academic department, as the discussions were intended to center on issues of departmental context. Approximately half of our discussants were women, and the groups overall represented a range of racial, ethnic and national identities.

The focus-group discussions lasted between 1.5 and 2 hours each. They centered on four sets of questions that we posed related to the normative environment of science. The first question asked discussants, “If you were to talk to newcomers (i.e., new graduate students and new faculty) in your field about what they have to do to keep out of trouble in their work, what would you tell them?” The other prompting questions concerned rules and standards in science, success in science and failure in science. Most of the findings presented here were derived from the discussions pursuant to the first question, which was designed to reflect the Durkheimian proposition above and to focus attention on a point of discontinuity, namely entry into the field.

In the details of the administration of the focus groups, we followed the protocols and recommendations of Krueger (2000). We audio-taped and transcribed each discussion, with the participants' permission. In the presentation below, some of the discussion material referenced or quoted has appeared in earlier publications that addressed different aspects of the findings (Anderson, Ronning, De Vries and Martinson, 2007; De Vries, Anderson, and Martinson, 2006).

Three of the four authors reviewed the focus-group transcripts to identify discussion and exchanges that reflected collective expectations about appropriate (and inappropriate) behavior in science, clustered into themes (Miles and Huberman, 1994). Through extensive discussion of the transcripts, these authors came to agreement on a set of four potential norm/counternorm pairs, as well as the wording of items to be included in the national survey to represent these norm/counternorm pairs.

Findings from the Focus-Group Discussions

The normative aspects of scientists' discussions about their work are revealed in their articulation of assumptions about proper or ideal behavior, as well as the uneasiness, surprise and cautiousness they expressed when discussing what they saw as inappropriate behavior. The participants appeared to welcome the opportunity to talk about the social, as opposed to technical, aspects of their work. One scientist noted, "The process of being trained in credentials includes an enculturation into what we mean when we talk about science. What constitutes good science?…. So I really see all of that as a cultural construct…. Although I think that recursiveness and self-examination are built into the process of the scientific method as we come to either methodologize it or understand it, I believe that same recursiveness and reflection regarding the subculture of science itself is quite lacking."

The discussions reflected to some extent the classic Mertonian norms of universalism, communality, disinterestedness and organized skepticism. Our discussants often referenced these norms through their disapproval of others' violation of the norms. For example, they expressed annoyance with senior colleagues who appear to get preferential treatment in the peer-review process because of their reputations, regardless of the quality of the manuscript or grant proposal under review, in violation of the norm of universalism. They mentioned increases in industry funding of academic research as leading inappropriately to secrecy and self-interestedness, which are counternorms to communality and disinterestedness respectively. They shook their heads over well-known self-promoters who market their own ideas and findings or are unwilling to open their work to public scrutiny and challenge, contrary to the norm of organized skepticism.

We were more interested, however, in themes recurring in the discussions that suggested norms beyond the Mertonian norms. In each case, the norm was countered to some extent by discussion of a competing and sometimes emergent counternorm. We found four such themes: governance versus administration, as a mode of decision-making in science; quality versus quantity of work, as an evaluative standard; calling (i.e., vocation) versus employment, as a supporting rationale for doing scientific work; and breadth versus narrowness as a measure of scope of responsibility in science. We present each of these in turn, along with the survey items that we subsequently constructed on the basis of these themes.

Governance versus Administration

Our discussants saw the overall responsibility for decision-making and for the control of science as resting squarely with scientists themselves, as opposed to administrators. Through the system of governance, scientists debate, negotiate and come to decisions about issues that drive scientific inquiry, methods to be used, distribution of resources, and attention to scientific initiatives. Peer review is a part of governance in the sense that it represents scientists' input into and control of decisions about the direction of science and its thousands of specialties. Professional self-regulation, by which scientists as a group take responsibility for creating and enforcing the formal and informal rules and policies that govern their work, is also a form of governance.

By contrast, administrative decision-making in the sense we use it here represents decisions about the direction of science by those whose primary responsibilities are administrative, even if they were formerly working as scientists. They are often responsible for financial aspects of projects, economies of scale, production, or advancement. Administrative decision-making is the province of managers who do not have the training or qualifications to be considered scientific peers of those whose work falls under their purview. Some of them never had such training, whereas others moved from research into oversight roles that gave them authority over areas in which they have not done research.

Our discussants affirmed the critical importance of governance. As one put it, “See, this is why I believe that you need to get involved in the politics, because I think we all make the rules…. If we don’t make [a rule], we accept it. If we don’t accept it, it is not going to stay.” Several respondents noted that being involved in governance becomes a matter of professional self-preservation: “In a sense I would say that sometimes it is necessary to be part of the politics…. I think sometimes that you need to know what is going on and what you can contribute to it. Otherwise you could be the loser.” A mid-career scientist noted,

> “As far as a piece of advice that I would offer graduate students to help them along, this idea would be to pay attention to the topic of governance -- faculty governance. Because I think too often that’s dismissed as, ‘That’s for other people. I’m going to focus on my science.’ … It won’t be probably too much longer, they’ll find themselves being victims of some possible decision-making at higher levels that is going to hurt their science…. Because in the end, it’s going to affect you. And it doesn’t mean you have to be on a university senate to participate in governance. It could be at your own faculty…. I think that would be something that I would encourage people to pay close attention to as they move into a career.”

Several other discussants mentioned the greater likelihood that mid- or late-career scientists will participate in governance, compared to their early-career counterparts.

The scientists in our focus groups considered at length the various entities that make and enforce rules and policies related to research. These include funding agencies (notably, the National Institutes of Health), professional associations, institutional review boards, journals and their own university administrations. Our respondents saw some people in these groups, those whom they see as representing the interests of scientific researchers, as engaging in a higher form of governance, in the sense of decision-making on behalf of the communities that they represent. By contrast, they saw others as serving in management capacities without identification with working scientists -- whether or not they were actually trained or formerly worked as research scientists. Decisions by those in the latter group fell under the rubric of administrative decision-making.

The counternormative nature of such administrative authority over decisions was revealed as our respondents railed at the “bureaucracy” and its “ridiculous” rules. When we asked one group, “Who makes the rules for science?”, one person immediately answered, “The administrators” and everyone else laughed. Their laughter suggested both their wry assent to the reality of administrative decision-making and the incongruity of administrative control of science by those without scientific credentials or the trust of their peers. Scientists see such administrators as having opposed interests; as one discussant put it, “I don’t think the office in [this university] really has the scientists’ best interests at heart. They have the university’s interest at heart.”

To represent the norm of governance and the counternorm of administration, we devised the following survey questions:

> Governance norm: Scientists are responsible for the direction and control of science through governance, self-regulation and peer review.

> Administration counternorm: Scientists rely on administrators to direct the scientific enterprise through management decisions.

Quality versus Quantity

Our discussants were keenly aware of both quality and quantity as standards by which their work is evaluated. The normative question is, which of the two should be dominant? One scientist talked about the different advice he had received from two mentors:

> "One of my mentors -- who is extremely productive -- his comment was, 'Early in your career, you need to publish a lot. Later in your career, you have the luxury to publish good things.' So he said, 'If you want to get to that point, publish a lot even if it doesn't seem like it is that interesting or that important. Do it in little bits. Swallow your pride a little bit.' … Another mentor [said], 'It doesn't matter what level you are at. Make sure that it is the best possible product you can get.'"

Both mentors were clearly signaling the importance of excellence, but the first saw quantity of publications as a prior and temporary necessity. Another focus-group member expressed the same kind of ambivalence about the relative importance of excellence and numbers, this time without reference to career stage:

> "There are some people who think that the good quality of work is more important than publishing some little things, you know. What determines your career is one or two good papers, as opposed to 10, 20, or 30 small papers. On the other hand, since the money is getting more important, and the *number* is getting more important, … some people say, 'Oh, you should publish something, I mean, whatever it is. It can be something that is not very important.'"

Our respondents tended to reference quality through comments about people whose work is substandard and pressures that compromise the quality of their own work. Several talked about competition and time-pressures that make people settle for lower-quality publications in order to keep their productivity high. They distinguished between short-term success and long-term excellence. One mentioned a colleague in his department who had a "very short-term attitude, putting out piles of stuff -- and there's no corpus of work there as far as I can tell." Another talked about people whose work does not stand up over time: "They might be the big cheese for five or ten years or something like that, but it doesn't last forever, and eventually the field readjusts itself and goes on…. But in the long front, I think the cream eventually does rise to the top."

Quantity as an evaluative standard kept coming up in the focus groups. A mid-career scientist said, "You got to have so many publications to move on to associate. You got to have so many more to move on to full. It's pretty spelled out. You've got to meet the criteria." The early-career discussants showed that they had received the message: "All they care about is how many papers you publish per year"; "It's just basically the numbers"; "You've got to have a billion publications in my field. That is the bottom line. That's the only thing that counts". Such strong statements led us to consider the possibility that quantity is emerging as a counternorm to quality as an evaluative criterion.

We represented the criteria of quality and quantity in the survey by the following items. Note that the priority given to these standards is what distinguishes them normatively, since both criteria are widely used.

> Quality norm: Scientists judge each others' contributions to science primarily on the basis of quality.

> Quantity counternorm: Scientists assess each others' work primarily on the basis of numbers of publications and grants.

Calling versus Employment

Our focus-group discussions revealed a potential norm/counternorm pair related to reasons why people go into science or why they do the work that they have chosen. Some of our discussants talked about a career in science as a calling, in contrast to mere employment. This calling has two aspects. First, it refers to scientists' service to society through the contributions that their research and teaching make to the public good. Second, it signifies that a career in science requires personal sacrifice.

Commitment expressed as a combination of personal interest and public trust undergirds the careers of many scientists. One focus-group member talked about an acquaintance who won a Nobel prize: "If you don't have a vision, a research agenda, then you're not going anywhere…. This guy, you talk about work! … He only went home every five or six days. He would sleep three or four hours on a couch and he would get up and start working again. He didn't even take a shower." Others talked about graduate students who observe the demands of the academic life and choose not to accept such a calling. In one group, the scientists were discussing students who are discouraged and unwilling to put in long hours every week to produce papers and grants, and one responded:

> You have a couple of moments that are like, "Oh my gosh, look at this result," and the rest is just plodding through the details of it. You get that every now and then. When you're in one of those, it makes up for all of the six years where you just plodded along, and you got a bad paper review back, and you redid it and you added six more tables, and you sent it back out. I don't know, there's some ability to fail over and over again and still do it, still come back the next day and do it…. I think this is where [some] students fail, is because they're not doing it because they love it. I love what I do. When I wake up in the morning, I can't wait to get into work. Do I think I'm going to have a Eureka moment today? Probably not, no. But I'm going to do the things that I have to do.

One discussant suggested that a sense of calling is what links faculty members' relatively low pay to ethical behavior:

> "You realize that people at a certain level, they do this because they actually have a genuine interest and they love what they are doing. They are certainly not getting paid at the level they would have when the industries do the same kind of work -- or for us to go into private practice or do something along those lines. So the fact that the money is a little bit less I think keeps -- I hate to say this -- that it keeps more ethical-minded people. But the incentive for the people that are in it is to do good work. I think they really do genuinely have that. I think that is why, in general, you don't hear about a ton of scandals."

References to science as a calling tended to focus on commitment and willingness to accept personal sacrifice on the basis of personal enjoyment in the work; however, the scientists did not reference public service as a basis for such commitment. One said, "In the past, I've always had the notion that people who go into science are somewhat altruistic. You know, they want to go into it because they want to contribute something to our understanding, help patients and all that kind of stuff. But I'm not sure that I really think that's true anymore." Another saw a shift away from altruism as a result of dynamics within science:

> The disassociation of research from service is the product of an enculturation process, I believe. Just the way we're taught to think about service, it could be argued that we're all public servants, even as we do our research. But yet, there's an enculturation force about the scientific community that, I think, pulls us away from that and towards a different concept of what research is for, or who benefits from it, or what forces our work -- what drives that. And I believe that that

> enculturation process is something that goes rather thoroughly unexamined. In other words, the concept of what we mean by success: we don't sit around a table and talk about, 'Well, what does success in science really involve?' We all understand it to be full professor, endowed chairs, NSF grants and this construct of achievement without, you know -- we just feel like that's the game, and so we have to play. And yet, by playing that game, I think we're a part of solidifying that construct."

Though our discussants spoke thoughtfully about the calling aspects of their work, they were much more blunt in addressing science as mere employment. Some talked about fulfilling federal or business imperatives in research that they viewed as unimportant, in return for the pay. Others mentioned the carelessness of scientists who view science as just a job, as in: "It's not their science. They don't care that much." The discussants expressed disdain for those who simply put in their time and work according to the terms of their employment.

On our survey, we sought respondents' views of science as a calling or as a job through these questions:

> Calling norm: Scientists view science as serving a purpose worthy of personal sacrifice.
>
> Employment counternorm: Scientists work in accordance with the terms of their employment, such as pay, benefits, working hours, and vacation time.

Breadth versus Narrowness

Our focus-group discussants talked about a broad range of responsibilities that they fulfill or, in the case of the postdoctoral fellows, anticipate fulfilling in faculty positions. These responsibilities included research, teaching, service (to the profession, the institution and the public), administration, graduate student advising, and so on -- all quite appropriately demanding attention and time. Research, however, clearly dominated the activities of our early- to mid-career discussants and brought the greatest rewards. Acceptance of a broad set of responsibilities versus an almost exclusive focus on research seemed to us to represent a fourth and final norm/counternorm pair.

Breadth was referenced by those who talked about the satisfaction that they derived from the variety of components of their work, from working on grants to making presentations to fifth-graders. Some remarked that their department chairs or tenure-review committees emphasized teaching as much -- or nearly as much -- as research: "We have teaching and research requirements. And the biggest problem that I see youngsters [i.e., younger colleagues] do is put all their eggs in one basket. And they must be successful at both of these. So what they tend to do is spend their time on what they either like the most or they do best at, and forget the other. Then, when it comes tenure time, they're done in."

Those who voiced a nearly exclusive focus on research were as concerned with grant acquisition as with publication. One said, "Another mistake would be to take on too many teaching responsibilities or certain community service things that you might really like to do, rather than focusing on getting grants or getting your lab up and running." Another member of the same focus group responded, "You have to know exactly what needs to be done to get the money -- certain amount of money -- to cover your expenses. If you're doing that, a lot of people leave you alone. If you're not doing that, no matter how good the things are that you are doing, there will still be a time when someone will come into your office and tell you you're not doing your job."

These discussions led us to construct the following pair of items for the national survey:

Breadth norm: Scientists fulfill a broad range of responsibilities in the areas of teaching, research and service.

Narrowness counternorm: Scientists put more of their time and effort into their research than into any other aspect of their work.

The four norm-counternorm pairs that we identified in the focus-group discussions may or may not represent an extension of the Mertonian norms. The findings from the focus groups could not, of course, reveal whether or not scientists subscribe to the proposed norms and counternorms in ways that parallel their subscription to the Mertonian norms and counternorms. The discussions simply indicated the normative valence of these features of academic work. Our national survey of NIH-funded scientists provided an opportunity to evaluate the robustness of these concepts, through the inclusion of measures of scientists' subscription to the norms and counternorms.

National Survey Methods

Analysis of normative orientation was part of a broader agenda informing our national survey of U.S. scientists. The survey was designed to collect data on misconduct and other questionable behaviors (Martinson, Anderson and De Vries, 2005), scientists' perceptions of organizational injustice (Martinson, Anderson, Crain and De Vries, 2006), and related matters. A particular focus of the overall project was comparison of early-and mid-career scientists' perceptions of their work environments and the culture of science. This comparison was included in the study design so that newcomers' reactions to the scientific ethos, which we assume to be particularly revealing of that ethos, could be juxtaposed to more established scientists' perspectives.

We drew samples from two groups of scientists. From lists of scientists supported by funding from the National Institutes of Health, we randomly sampled 3,600 from the group of scientists who had received initial R01 research grants between 1999 and 2001 (henceforth, "mid-career"), and also randomly sampled 4,160 postdoctoral trainees who received either institutional or individual postdoctoral support during 2000 or 2001 (henceforth, "early-career").

We administered an anonymous, mailed questionnaire in the fall of 2002. Following Dillman's (2000) tailored design method, we mailed each person the survey, a cover letter, a postage-paid return envelope, a $2 bill as an incentive and a postcard. We instructed recipients to return the survey and postcard separately, to notify us that they had completed the survey (and could therefore be removed from our follow-up process) without such notification being in any way connected to the completed survey. The response rates for the mid- and early-career samples, adjusted for undeliverable surveys, were 52% and 43%, respectively. It is important to note that many of the addresses in the NIH records from which our samples were drawn were associated with institutional grants offices instead of departmental or individual offices. In some cases we confirmed that institutional mailing systems did not forward the surveys to our sample members; the extent to which this complication reduced our response rates is unknown.

In constructing the survey instrument, we included the four Mertonian norms, their counternorms, and the eight proposed norm-counternorm pairs. We asked our respondents to indicate the extent to which they personally felt each behavior *should* represent the behavior of scientists, with responses ranging from "to a great extent" (2) to "very little or not at all" (0). (Note that the word "should" is critical to the indication of norms here.) In this paper, we use the "great extent" response as an indicator of subscription to a given norm or counternorm, to reflect unambiguous endorsement. In the norm/counternorm battery of the survey, we did not pair the norms with the counternorms or group the Mertonian and potential new norms in any way; the 16 items appeared in random order.

In the analyses reported below, we examine two additional variables based on the survey. One is career status, represented by mid- versus early-career standing. The other is discipline, which is based on the disciplinary field in which the respondent earned his or her highest degree. Here, disciplinary fields are aggregated into five groups (listed here with percentage representations in the mid-/early-career respondent sets, respectively): biology 16/20%, chemistry 16/16%, medicine 38/42%, physics/mathematics/engineering 7/3%, social sciences 19/17% and miscellaneous fields 5/3%.

To assess the extent to which the responder set is representative of the sample, we compared the demographic profiles of the first and last responders, in quartiles. The assumption is that the latter may be more representative of non-responders. There were no statistically significant differences between the two groups in gender, type of employing institution or location of degree-granting institution (U.S. versus non-U.S.). Those holding the M.D. degree were somewhat more likely than those without the M.D. degree to be in the last-responder category.

Findings from the National Survey

The questionnaire that we sent to our nationwide samples of early- and mid-career scientists in the U.S. included both the original Mertonian norms and counternorms as well as the proposed norm-counternorm pairs derived from the focus-group discussions. We measured subscription to each norm or counternorm by the percentage of scientists who indicated that they felt *to a great extent* that it *should* represent the behavior of scientists.

Figure 1 shows the percentages of respondents who subscribed to each norm or counternorm, by career status (mid- versus early-career). Subscription to the Mertonian norms ranged from 73 to 91 percent. Subscription to governance fell well within this range (80 percent in each sample), and subscription to quality was at the top of the range (91 percent in each sample). Subscription to the proposed norm of science as a calling barely exceeded the 50 percent level among mid-career respondents, and fell below 40 percent in the early-career group. The percentages of mid- and early-career scientists who subscribed to breadth as a norm (68 and 72 percent, respectively) were close to but below those for the Mertonian norms.

In general, subscription to the counternorms was much lower than for the norms, as one would expect. Between 18 and 23 percent of our respondents subscribed to the original counternorms, except for self-interestedness, to which 33 and 25 percent of the mid- and early-career respondents, respectively, subscribed. Administration and quantity, the counternorms corresponding to the norms of governance and quality, attracted relatively few adherents, but the other proposed counternorms, employment and narrowness, showed high subscription levels (between 44 and 65 percent).

Figure 1 also indicates the significance of differences between responses from the mid- and early-career samples. Of the 8 original norms and counternorms, 3 differ by career stage. The early-career respondents were more likely to subscribe to the norm of organized skepticism, but less likely to subscribe to the counternorms of particularism or self-interestedness, than the mid-career scientists. Like 3 of the 4 original norms, governance and quality do not differ in subscription by career stage. Administration likewise shows no career-stage effect. Subscription to the remaining norms and counternorms (quantity, as well as the calling/employment and breadth/narrowness pairs) differs by career stage. The early-career group is less likely to subscribe to quantity, calling and narrowness, but more likely to subscribe to employment and breadth. Our analyses do not provide any clear reasons for these differences, but we can speculate on differences inherent in the two groups. The early-career group is composed largely of postdoctoral fellows, while most of the mid-career respondents have attained faculty or other relatively secure positions in science. It is possible that the early-career group includes a higher percentage of respondents who do not yet realize the critical importance of numbers of publications, who view science more in terms of employment than calling, and who are more interested in positions with greater breadth of responsibility than in an exclusive focus on research. Such people may eventually have different kinds of careers than the NIH-funded, mid-career researchers who made up our other sample group.[3]

These findings lead us to conclude that scientists view our proposed norm/counternorm pairs of governance/administration and quality/quantity much as they view the original norm/counternorm pairs. We therefore recommend that these two pairs be included in conceptual or empirical examinations of normative orientation. The other proposed pairs, calling/employment and breadth/narrowness, do not show the same pattern of subscription as the original pairs. They may represent emergent but as yet indefinite normative principles, or they may prove in later analyses not to have the status of norms and counternorms.

The original Mertonian norms were assumed to apply across scientific fields and specialties. To determine what role, if any, disciplinary differences might play in subscription to the original and proposed norms, we performed χ^2 tests of the significance of differences in the percentage of subscribers across 5 broad disciplinary areas. We performed these tests for the 8 original norms and counternorms, as well as the 4 recommended norms, and separately for the mid- and early-career groups. The cross-disciplinary comparisons omitted respondents in a miscellaneous category, which included small numbers of people from fields not readily grouped with any others, as well as those who did not answer the question about field of study.

Of the 32 tests, only 7 showed statistically significant differences (Table 1 presents these 7 cases). Four significant differences are seen in the original norms or counternorms, and two are in our proposed norm of calling. Only one of the 8 tests of the proposed norms and counternorms, that of governance among early-career respondents, showed a significant difference across disciplinary areas: those in physics/mathematics/engineering were less likely to subscribe to this norm,[4] compared to those in biology and chemistry, with subscription rates of those in medicine and the social sciences between the others.

There are no clear patterns evident in the cross-disciplinary comparisons of the original norms and counternorms, except that the physics/mathematics/engineering group is at an extreme in each case: higher on the norm of communality and lower on the counternorms of particularism and self-interestedness among the early-career respondents, and higher on individualism in the mid-career group. Biology, chemistry and medicine are relatively low on communality, but the first two are relatively high on governance. Biologists are more likely to subscribe to the counternorm of self-interestedness, whereas chemists are more likely to subscribe to individualism. Those in medicine have a higher rate of subscription to particularism, while those in the social sciences are relatively low on self-interestedness and individualism.

[3]We note that our findings do not provide unequivocal support for or against Mulkay's (1976) argument that the norms are aligned with outsiders' expectations, as the early- and mid-career results vary by norm.

[4]As our respondents are all NIH-supported scientists, those in the physics/mathematics/engineering group may not be representative of their fields.

Overall, we conclude that subscription to the proposed norm/counternorm pairs of governance/administration and quality/quantity is at least as consistent across disciplines as subscription to the original Mertonian pairs. This finding provides further support for our recommendation that the original Mertonian normative set be expanded to include these two pairs.

Discussion

The normative system of science is vastly complex, and we readily acknowledge that it cannot be captured in a few principles or behavioral statements. If, however, researchers were to yield to this complexity and conclude that the normative system is wholly unmeasurable, it would then be irrelevant to analyses of scientists and their work. If researchers were, instead, to make use of principles and survey items as imperfect but useful indicators of some of the broadest normative concepts in science, then scientists' normative orientations, measured by these indicators, can contribute to analyses and discussions of ethical issues and related aspects of scientific work. We recommend the latter option, because of the potential for insights into scientists' behavior and the institutional and broader environments of science.

We have identified what appear to be two additional norm/counternorm pairs beyond Merton's original set: governance/administration and quality/quantity. That the other potential normative pairs suggested by our focus-group discussions (breadth/narrowness and calling/employment) were not supported in our survey findings does not necessarily remove them from consideration. They may represent emergent normative principles. We may not have accurately represented these principles in the construction of our survey items. Perhaps the potential norms that we identified are actually broader or narrower or somewhat different than our focus-group discussions indicated. Further qualitative work might reveal more about the normative principles that our discussions suggested.

Our study invites discussion about the emergence of norms in science, whether at the broadest level of science overall or in more circumscribed social settings. We have argued that much of the normative system of science is *latent*. Most expectations and assumptions about appropriate and desirable behavior are thoroughly embedded in the culture(s) of science and remain unknown because they are never challenged. Suppose that a chemist announced to the members of his laboratory that thenceforth all research done in the lab would be based solely on Norwegian poetry. Such a preposterous challenge would immediately reveal a normative principle that we might label "relevance". Latent norms are conceivably powerful, but essentially unknown or unarticulated.

Other norms are known but attract little attention; let us call them *simple norms*. They are recognized as norms, but they invite only cursory attention because they are almost never violated. They represent principles of behavior for which self interest and institutional interest are nearly always aligned and violations are seen as inexplicable aberrations. Proper care of research equipment might be this kind of simple norm. It would be difficult to understand why any scientist would destroy the equipment on which her own research program depends, though such behavior is not beyond the reach of imagination or even reality. Simple norms attract simple compliance, because there is little to support any contrary behavior, beyond individual pathology. Such norms are reinforced by simple instruction (for example, people have to be properly trained to care for equipment), and tend to give rise to "bad apple" theories of deviance, rooted in explanations based on pathology.

Finally, *institutional norms* are the norms we have considered in this paper. Merton referred to the four norms as "institutional imperatives" (1942, p.118), and claimed that they are “legitimatized in terms of institutional values” (1942, p.116). These norms are the most clearly expressed precisely because of violations, the attention that violations do or would attract, and the degree of outrage that does or would accompany such attention. If the institutional norms satisfied only these conditions, they would differ in degree, but not in kind, from simple norms. Institutional norms, however, have the weight of institutional support behind them -- support in the form of affirmation by elites and leaders, deliberate and careful inculcation through training and socialization, noble-sounding references as justification for action, and high levels of subscription among working scientists (as shown above). Indeed, there is no reason for an institutional system to express, emphasize and teach norms so strongly if there are not counter-pressures in the social system. That such forces are marshaled behind the norms suggests at least some need to counter “contrary impulses”, as Ziman (2000) has suggested. These contrary impulses find expression in the counter-norms, which Merton claimed always exist as part of a normative system. In other words, institutional norms are those that explicitly resist contrary principles that are part of the institutional normative system. It follows, then, that when institutional norms are violated, one should look to contextual, environmental, institutional forces or pressures that encourage, reward or at least enable counternormative behavior. In other words, deviance from institutional norms may have roots in the structure and culture of the social system.

It is interesting to consider the identification of normative principles, as in this paper, in light of this distinction among latent, simple and institutional norms. For example, it is not always clear when a norm is simple or institutional in nature. According to the above logic, the greater the system’s deliberate attention to the norm, the more likely it would seem that counternormative pressures exist in the system. Merton himself called for attention to the question of determining when a violation is an aberration and when it is an expression of a counternorm (Zuckerman, 1988).

The Mertonian norms, as principles representative of the normative system of science, have been challenged, attacked, dismissed, contested, inconsistently referenced, and, in short, battered and bruised by controversy and careless application. They nonetheless have endured for over 65 years as part of the communal property of science. They have been referenced quite apart from any of Merton’s personal characteristics and perspectives (to the point of being dissociated from their original roles as elements of Merton’s arguments about democratic societies’ support for science). No self-interested scholar has ever gotten rich doing analyses of the norms, and, as the literature demonstrates, they have been clarified and improved because of the scientific community’s eloquent, organized skepticism.

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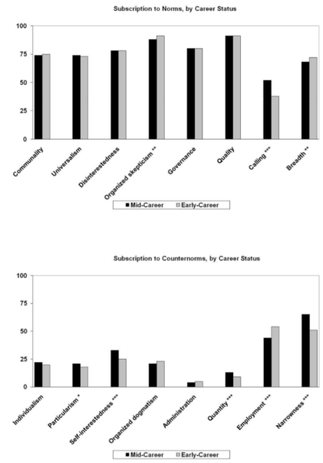

Figure 1.
Percentage of Respondents Who Subscribe to Norms and Counternorms, by Career Status

Table 1

Statistically Significant Differences, by Discipline, in the Percentages of Respondents Who Subscribe to the Indicated Norm or Counternorm

	Biology	Chemistry	Medicine	Phy/Math/Engin	Social Sciences
Early-career respondents					
Communality (original norm)	72%	73%	73%	84%	81%*
Governance (recommended norm)	83	84	78	68	78 *
Calling (dismissed norm)	40	36	41	32	31 *
Particularism (original counternorm)	16	15	22	10	16 *
Self-interestedness (original counternorm)	31	25	26	17	15 **
Mid-career respondents					
Individualism (original counternorm)	20	25	22	27	15 *
Calling (dismissed norm)	48	52	56	44	47 *

Significance of χ^2 test:

* $p<0.05$,

** $p<0.01$