The Social Process of Creating and Sustaining an Inclusive, Productive Science Culture

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Abstract

Over the past two decades, increasing numbers of women have pursued degrees in S.T.E.M. fields. However, beyond the degree, their participation as faculty in S.T.E.M. fields decreases as they move through the ranks in university departments. Previous research suggests that the organizational culture within academic departments affects this attrition and that more cooperative department cultures would better support the advancement of women and men. However, little research explores factors that create and sustain such a cooperative culture. In order to address this gap, I designed and conducted a case study of a top-ranked science department within a Research Extensive university. The department had maintained a record of attracting, retaining and advancing women, and had a reputation for cooperation and high quality science. Over a six-month period, I collected data using multiple qualitative methods including interviews, direct observation, and archival research. My analysis of this data revealed five overarching concepts that appeared to contribute formation and maintenance of a cooperative, inclusive, and productive work culture. The five overarching concepts include a shared scientific identity; constructive interactions; participative department activities, integrative leadership practices, and learning and inclusion sub-processes. Using these concepts and existing literature, I developed a process model of how an inclusive, productive work culture is created and sustained. The work links identity theory and concepts of group culture to day-to-day interpersonal interactions, thus supporting theory building for creating high performing work groups across demographic differences.
For more than two decades, women have entered science, technology, engineering, and mathematics (S.T.E.M.) fields in unprecedented numbers. Yet, the number of women choosing and persisting in academic careers drops significantly at each level of the academy, from assistant professor to full professor ranks in S.T.E.M. departments (Long, 2001; National Science Foundation Division of Science Resources Statistics, 2004; Shepherd, 1993; Valian, 1999). Explanations for this attrition include lack of mentoring relationships, the disproportionate demands of family on women’s time, and inherent sex differences between women and men (Ely, Scully, Foldy, & Center for Gender in Organizations, 2003; Rayman & Stewart, 2000). However, recent surveys conducted at Research Extensive universities reveal that sexual harassment and more subtle forms of exclusion still create a chilly climate for women in S.T.E.M. departments. Even women who had achieved tenure reported experiences of exclusion and isolation (Lawler, 1999, 2002; Pearson Jr, 2006; Steward, Stubbs, & Malley, 2002; Zakian et al., 2003). Thus, some scholars suggest that an additional factor influencing the persistence and advancement of women in S.T.E.M. fields is the culture of S.T.E.M. academic departments. Rayman (2000), asserts: “A key issue in women’s participation in science is whether the scientific community of which we are all members can nurture and develop a sense of cooperation and collaboration in a culture of competition” (Goldberg, 1999, p. 9). Meyerson and Fletcher (2003) point out that “gender inequity is rooted in our cultural patterns and therefore in our organizational systems….existing systems can be reinvented by altering the raw materials of organizing – concrete everyday practices in which biases are expressed” (Meyerson et al., 2003, 234-235). While many studies document evidence of a culture of continuing gender inequity in science and engineering, I found little empirical research exploring the everyday
practices and interactions within positive workplace cultures that benefit both female and male
faculty.

PREVIOUS THEORY AND RESEARCH

Schein (1992) asserts, “The most useful way to think about culture is to view it as the
accumulated shared learning of a given group, covering behavioral, emotional, and cognitive
elements of the group members’ total psychological functioning.” (Schein, 1992, p. 10). A key
feature of Schein’s concept of culture is its persistence over time once embedded in an
organization (Schein, 1992). Even as the organizational actors rotate and change, certain
interactions, expectations and ways of doing things persist over time. Culture results from the
practices, processes, structure, organizational rites, design of the physical space, stories or
legends and formal statements of philosophy employed by group members (Schein, 1992). An
important aspect of culture is climate, or the closely related term work environment. Edgar
Schein (1992) defines climate as “the feeling that is conveyed in a group by the physical layout
and the way in which members of the organization interact with each other, with customers, or
with other outsiders” (Schein, 1992,9). Climate encompasses the physical factors and social
interactions that people experience daily. Scholars have defined work environment as having
both physical aspects, such as lighting, comfort of equipment, noise, space and access to material
resources needed to do the work and social aspects including work processes, norms, and social
support (Hammer, Saksvik, Nytrø, & Torvatn, 2004). In this paper, I use the terms climate and
work environment interchangeably. I use the term culture to refer to the ongoing the phenomena
within a group that is consciously or unconsciously passed on to new members or replicated to
maintain the group’s identity and functioning.

The culture of a group and its impact on women in non-traditional fields are of interest
for two reasons. First, research indicates that there is a relationship between the social
environment in which a person must operate and outcomes such as satisfaction, emotional well-
being, and performance (August & Waltman, 2004; Carr, Schmidt, Ford, & Deshon, 2003).
Second, prior research suggests that the work culture of a department can be a key deterrent to or
facilitator of women’s careers in science and engineering (Etzkowitz, Kemelgor, & Uzzi, 2000;
Rayman et al., 2000; Rosser, 1999). Several studies and articles provide accounts of academic
department climates that were chilly, isolating, and hostile for women. A common theme of
these reports and studies is women’s experiences of isolation, whether the source was sexual
harassment or benign disinterest and neglect. On the other hand, both Rosser (1999) and
Etzkowitz (2000) found that women in more cooperative, collaborative and collegial science
departments felt more engaged in their work, connected to their peers, and better able to develop
their professional potential. However, none of these works explains how these cooperative work
environments, which appeared to be supportive of women scientists, come to exist. What are the
antecedents? What do people do to create a cooperative, inclusive work culture? Thus, my first
research question was:

1. How does a cooperative inclusive science culture form and develop?

Another aspect of the cooperative science cultures not fully explained in prior research is
what day-to-day interactions create a productive, inclusive work climate. Thus, my second
research question was:
2. How do people interact in a cooperative science department to create cooperation, inclusion and positive work outcomes?

Last, culture, by definition, is a feature of a group that group members pass on over time. Thus, my third research question was:

3. What processes, activities, and practices maintain a cooperative, inclusive and productive work culture?

METHODS

To find answers to my research questions and attempt to develop theory, I designed a case study to identify the factors that constitute a process that creates an inclusive work culture in which women and men can be productive and successful. The setting of my study was a science department at a private, Research Extensive, university located in the Midwestern United States. I selected this department for this study due to its reputation throughout the university, for cooperation, research productivity and successful teaching and training of students and post-docs. In addition, over its fifteen-year history, this department had attracted, retained and/or advanced women throughout the faculty, including two female chairs. Most faculty members had international reputations as experts in their area of research including one Academy of Science member. A science association, within the same field as the department, ranked the department above average in terms of number of women faculty and number of female students. Two women faculty members joined the department in tenured ranks. One woman had advanced from junior to associate rank. Of eight faculty members who joined the department as junior faculty over an eleven-year period, including one woman, only one male did not advance to tenure. Women comprised about 56% of the students in the graduate program, which awards
masters or Ph.D. degrees. The department attracted top students as indicated by higher than average student GRE scores for the field.

I was exploring how a phenomenon presented itself through interactions occurring in a field setting; thus, I designed an exploratory case study and employed the grounded theory approach to data collection and analysis of data. I identified the sampling frame as primary and active secondary faculty, research staff, post docs and students.

My data collection methods included archival research, direct observation and interviews. I obtained data about the department’s history, membership and achievements from archival records, the department website, and published interviews with the chairs. The archival records contained eleven years of the chair’s Annual Reports and included arrivals and departures of faculty, goals, and accomplishments of the department.

I conducted direct observation of department seminars, meetings, routine lab work and casual interactions in halls and offices. I also observed between scheduled interviews and at various times during and after regular work hours. Direct observation consisted of overt observation, occasional inquiry about observed activities and recording of descriptive, non-interpretive notes. I attended and observed three meetings in connection with the recruitment of faculty candidate, a dissertation defense, a department party, two department presentations and a faculty meeting. I notified participants of the observation schedule in advance. I initially selected the observation activities based on the regular published schedule of events posted on the department’s website as well as suggestions from the chair. However, faculty invited me to observe additional events and activities.

I conducted semi-structured interviews with 29 department members, which included all 16 primary faculty members, three of whom were women. Among these women, there were two
full professors and one associate. There were four male full professors, seven male associate
professors, and two male assistant professors. I interviewed four secondary faculty members
based on available participants from among the seven active secondary faculty members.
“Active” secondary faculty members were identified as those faculty members who were training
students from the department, involved in teaching, supported recruiting and attended
department presentations. Secondary faculty members were not directly involved in department
decision-making. The secondary faculty participants consisted of two women at the associate
rank and two men, one at the associate rank and the other at assistant rank. I interviewed two
staff researchers, both female and six doctoral students and post-docs. These six participants
mirrored the overall evenly divided sex representation within the student and post-doc
population. They also represented a mix of large and small labs, and new student, advanced
student and post-doc stages.

Overall, two participants identified themselves as minorities, both Hispanic, one of which
was a faculty member. The remaining faculty identified themselves as “white” or “caucation”.
Three faculty members, all male, were from Western Europe. Half of the students and post-doc
participants were U.S. born, the remaining three, all males, were from Asia, Western Europe, and
South America.

I recruited faculty for interviews via email and telephone. To maintain confidentiality of
the participation of students, staff and post-docs, I recruited them via email, direct mail, and
personal invitations in private locations, since they did not have private offices or phones on
campus.

During the interviews, participants were asked to talk about: 1) what brought them to
work in or with the department, 2.) what they found most engaging about their work and how
others in the department helped them pursue that work and their overall career. 3.) what perceptions they had about who becomes a successful academic scientist and how one becomes a successful scientist.

Consistent with the grounded theory approach, data collection and analysis activities overlapped. The interviewer took notes after each interview regarding ideas, emerging concepts, additional questions, and other general observations like, for example, the manner and affect of the participant. These notes guided development of the open-ended follow-up questions asked in subsequent interviews. These notes also guided the initial coding of a subset of transcribed interviews into topic areas, ideas and examples or “analytic categories” (Knight, 2002). Based on their relevance to the research questions and elaboration from further interviews, descriptive ideas or categories were assigned conceptual terms. I further described and defined these terms as I coded each transcribed interview line by line.

Using linkages from the data and using the social science literature from a variety of disciplines, I identified more conceptual linkages. Thus, I developed a model of a cooperative, inclusive, productive science culture. To verify the concepts within the model, researchers provided participants with the concepts and the participant’s own supporting quote(s) for review. Most participants approved the text as provided, some asked for revisions for clarity or style. I provided a report of the findings and the model to all faculty members for review and comment. Two faculty members provided additional data, which helped to verify some concepts supporting the model.

FINDINGS
A Model of a Cooperative, Inclusive and Productive Science Culture

The model created from the concepts I identified is shown in Figure 1. The model links five main concepts developed from the study. In this section, I will discuss each concept in turn and explain its linkages to other concepts in the model.

Figure 1  A Model of a Productive and Inclusive Science Culture
Shared Science Identity

A shared view of the goals of science, who could do science, and how to do science, appeared to be an antecedent to interactions and subsequent activities, sub-processes and the selection and practices of leaders that constituted the culture of the department. This shared view, consisted of values, beliefs and orientations towards science that provided the basis for a shared scientific identity that included women and men.

The two core values mentioned consistently throughout the interviews were doing “good science” and engagement in professional interactions. Department faculty defined good science as the pursuit of answers to questions that produced new knowledge for the field in substantive, significant ways. Several faculty members, including well-established male and female scientists, saw developing future scientists as part of good science. In addition, good science did not involve tweaking the work of others, chasing “popular” topics, rushing to be first to publish results at the expense of accuracy, or "scooping" ideas from others (discussed by male and female faculty members, all tenured).

A study of Nobel Laureate scientists concluded that many of them were socially isolated, dependent on intellectual success to support their identities and uncomfortable with emotion (Etzkowitz et al., 2000). In contrast, faculty in the department I studied cited the importance of interacting within their own labs, among faculty, between labs and with other departments. A female associate professor explained: a scientist is not a “lone wolf...in his or her own world competing with the outside world to get a paper published or get more money. I think he or she has to be an interactive person to make the group better...You know they can't just sit in their labs and be great scientists and never talk to other people. It is good scientists that participate in group activities that have a broader impact on the department and university, because they
transmit their ideas to students, post-docs, and other faculty members in the department.”

Interaction was the means to disseminating knowledge and learning, which in turn, created a resource rich environment, which supported everyone’s work. A male associate professor illustrated how this worked: “You know, I think the environment is really important throughout one’s entire career, especially these days where it takes many different methodologies to complete a research project. For example, there are certain methodologies that I don’t know how to do, but my research would benefit from it. If I’m in an environment where that methodology is not available, I’m out of luck. But if I have a strong environment that’s relevant to my research, I may be able to go to go down the hall and ask someone to help me interpret data or help me to use a method that I don’t know how to use, to help advance my research”.

Faculty also expressed beliefs about who could do science, which appeared to support a gender-neutral scientific identity. In their view, anyone, male or female, could do high quality science if they could learn quickly; were well-trained; were excited about science; and were willing to work hard. Neither graduate students nor post-docs reported feeling stereotyped into certain roles or lines of scientific inquiry. Several faculty members cited the importance of providing developmental support to students, post-doc and peers and acted on this belief. For example, a female post-doc reported that her Principal Investigator, a male full professor, invited her to attend a conference, and supported her in writing her first grant for funded research. Department faculty also explicitly assessed their own ability and willingness to support the development of new junior faculty before extending job offers.

In addition, a core of six of the sixteen primary department scientists, specifically spoke about ideas of community, concern for department as a whole or the need to draw all scientists into relationships with other scientists. Their belief that a good department makes for good
science, motivated them to lead, encourage participation of other scientists and support activities
and lead to constructive interactions, which I will discuss in detail later. A male associate
professor explained, “The thing that makes the department different from being sixteen
independent entities is that there’s interaction and there can be guidance. There can be support
between these self-contained laboratories.” The "ladder story" perhaps best encapsulated the
orientation around community. Two faculty members, one male and one female, recounted the
story that a senior male professor told them: “So when I came here, when I interviewed here – a
professor told me a story of the department’s ladder. It turns out, that three or four of the faculty
got together and bought an extension ladder for cleaning their gutters. And every fall they’d
drive it around to their different homes and help each other do their gutters” (male associate
professor). The faculty member understood from this story that while professors have separate
labs, in this department they believed in gathering and sharing resources that support the success
of everyone’s lab and the department as a whole.

Thus, within the department the wide spread conception of a "good scientist" was of a
person who makes substantial contributions to scientific knowledge and interacts with other
scientists or budding scientists to advance the work of the group, and the field of science as a
whole. Within the department I studied, faculty professed and acted consistently with certain
values and belief orientations that supported more gender-integrated conceptions of who a
scientist is and what a scientist does. These values and beliefs did not appear to limit who can do
science by sex. Nor did these beliefs appear to reinforce limited gendered roles or behavior.

Both female and male scientists reported and displayed behaviors that were, for example,
nurturing or assertive. However, these values and beliefs did play an active role in determining
department membership. Several scientists specifically noted that criteria for department membership were good science and the ability to interact well with others.

An indicator of the more inclusive conception of a scientific identity was the broader focus of faculty scientific and work endeavors. A senior male professor noted that scientists in the department tended not to be “unimodal” - intently focused on only one aspect of science for career satisfaction and identity. He noted that scientists in the department exercised their love of science in a variety of ways including research, teaching, community outreach, training and development, or administration. Despite work pressures, some scientists, both male and female, had made adjustments to work roles and schedules to spend time with their children. Two senior professors willingly spent time counseling students during their lab placements or coordinating graduate course content and delivery.

Both men and women reported institutional pressures toward a single focus on obtaining funding, which conflicted with their goal of high quality science and the responsibility they felt for developing others, whether in the lab or at home. Despite these tensions, a multi-modal approach to a scientific career appeared to better support inclusion, engagement, and productive outcomes for many department members.

The identity of “good scientist” as a person who contributes to science in multiple ways, both in the lab and in his or her interactions with others, appeared to be a shared group identity that transcended gender, nationality, and research area

**Constructive Interactions**

Regardless of gender, tenure, rank, or nationality, participants reported a variety of supportive, useful, and/or instructional interactions with peers, post-docs, and students.
Department members appeared to create and exchange three types of social and physical resources through their interactions with each other. The first type of resource participants exchanged involved, what Bouty termed, “common resources” (Bouty, 1999). Common resources include information on published papers, general scientific/technical information, or “non-committing services” such as the giving of names or addresses of other contacts. They require little effort to provide and are a very small part of what a person can offer another. Bouty (2000) found that the exchange of common resources may mark the beginning of interactions leading to exchange of “strategic resources”. Strategic resources consist of tools, techniques, samples, specimens or personal services that directly assist a scientist in advancing her or his work. Both common and strategic resources are instrumental in nature. They facilitate or directly support work outcomes and usually require effort and investment of time on the part of the giver (Bouty, 2000). A third resource is emotional support. Emotional support consists of “counseling, friendship, and role modeling (Kram, 1988), that helps participants develop self-esteem and professional identity (Thomas, 1993 p. 170).” (Gersick, Bartunek and Dutton, p. 1028) The exchange of emotional support is “characterized by minimal hierarchy, ease and freedom to be one’s offstage self, and mutuality” (Gersick et al., 2000, p. 1037). Such exchanges make work more enjoyable, the work environment more congenial and they help to build strong ties between colleagues.
I found a set of interaction behaviors among the faculty that appeared to support
exchange of all three types of resources among faculty members regardless of gender. I termed
these interactions "constructive interactions". Women and men reported these interactions
across rank and nationality and I observed other interactions in the course of day-to-day
department activities. I identified four types of constructive interactions.

**Collegial interactions.** Collegial interactions appeared to be the most basic type of
interaction that I observed or that participants reported. These interactions appeared to form the
basis for more complex and productive interactions. It was through these interactions that
department members initiated and maintained cordial and congenial relationships. I observed
such interactions at department meetings and events. A female student observed: "I kind of got
the feeling that people here at least spoke to each other as opposed to being locked up in their
labs all day and not getting along or having time to socialize."

Collegial interactions were mutually respectful, civil, regular exchanges that occurred
between department members in formal and informal settings. Collegial interactions do not
require much time, or deep personal interest or knowledge of another person. However, they
establish the ground for more complex relationships and interactions. For instance, several
participants reported that collegial interactions they experienced during pre-employment visits
gave them the impression of a positive work climate and set expectations for further positive
interactions. Most faculty members, both female and male, described their peers as "friendly"
and "non-competitive". Overall, participants characterized relations in the department as
"cooperative" and "smooth". One male full professor said, "So I would say the one thing that’s
very clear in this department, as opposed to some places where I’ve been, is that people get along with each other and that makes everything a lot easier”.

Examples of these interactions are greetings in the hallway, small talk before meetings, or listening and nodding attentively while others speak. The close proximity of some labs appeared to help promote collegial interactions, however since all labs were not on the same floor or even in the same building, departmental gatherings provided an important context for interactions. I observed that faculty engaged in collegial interactions during time before and after department presentations, faculty meetings as well as in the hallways between offices.

**Tacit learning interactions.** Collegial interactions provided the ground for what I called tacit learning interactions through which transmission of knowledge about norms, ways of doing things and or ideas occurred. Tacit learning interactions took place in the context of formal work roles and activities associated with faculty obligations. Examples of these contexts included formal mentoring of junior faculty, which was limited, serving on student committees, and activities that were a part of the graduate program such as teaching, advising, and weekly scientific presentations. Faculty members’ willingness to share their knowledge and experience in the context of their work made a typical task into learning opportunity. Intentionally sharing learning and experiences also required an interest in developing others. Tacit learning interactions provided important opportunities for faculty to observe and learn from each other. This was particularly important for junior faculty, since there was little formal ongoing mentoring that occurred in the department.

These interactions occurred in the context of shared tasks, and thus required more time in contact. Examples of these interactions included sharing thought processes around a research question or technique, or working directly with peers, students, or post-docs to show them how
work is done. Department wide activities that supported these interactions were team-teaching, committee work and department presentations.

Relational interactions. Relational interactions are interactions that help form, maintain, or strengthen professional and or personal relationships. These interactions consist of taking interest in others, providing care and or emotional support in the context of professional or personal friendship or colleagueship. Relational interactions appeared to require taking a human interest in others. A female staff researcher noted, “He [A male full professor] genuinely sounded interested in his research, which is usually the case, but he was also interested in what I had to say. And, he asked me how I felt about the idea of coming to work in the lab. I thought he seemed very interested in me and how I was, not just telling me what the lab is about, and finding out about my resume. He was just very upbeat, and overall just gave me the sense that it was a happy lab. You can tell, if you're paying attention, if somebody's running a really happy lab.” A female post-doc noted, and a male post-doc agreed: “But this environment is so much more like family than it is like work-mates who you don’t talk to or care about or see much outside of the work space”. Relational interactions move beyond collegial interactions and tacit learning interactions to interactions that build trust and concern for others and lead to significant expenditure of time in exchanging resources. Bouty (2000) called participants in such relationships “heart partners”.

Examples of relational interactions included, consoling others about a lab mishap or offering support and advice after loss of a grant. At a meeting, a researcher observed as faculty members offered condolences to a colleague about a research setback. As a sub-group of faculty grappled with a difficult administrative situation, a male full professor noted, “It’s been
interesting to me that many of the faculty have come up to me and said, “I’m really sorry this is a situation and if I can help, let us know”. That’s community.”

Participants reported professionally oriented, group level interactions as well. Several faculty members perceived that, as a whole, people were interested in each other’s success in doing good science. Several faculty provided examples of celebrations that highlighted the separate accomplishments of a male and a female peer.

The majority of reported relational interactions, for both men and women, consisted of informal, sometimes lengthy conversations about science. Also, three female faculty and two male faculty members reported relational interactions with students and post-docs involving discussions of work-life balance in the context of informal mentoring relationships.

Relational interactions appeared to support more complex, riskier and high yielding interactions directly related to research productivity, which is the fourth type of interaction I identified.

**Generative interactions.** Generative interactions were the most overtly interdependent and complex of all interactions that I identified. Generative interactions appeared to be an important means of building and distributing knowledge and material resources within the department. These interactions appeared to occur in the department as part of ongoing relationships between dyads, and across labs. Interactions could start with a one-way provision of resources in response to a request from a peer. However, people tended to respond to receiving a resource, by not only reciprocating with the giver, but with other department members as well. Thus, collectively they made more resources available to the group.

Collegial, tacit learning and relational interactions appeared to build the ground for generative interactions by building knowledge of one another’s capabilities and trust. Various
faculty members both male and female reported that internal competition was “not a factor”
within the department. This avoidance of internal competition within the department, also
apparently facilitated generative interactions. Department members trusted that a peer, or
member of another lab would not use these shared resources to directly compete with or “scoop”
each other.

Faculty members provided many examples of generative interactions. A female faculty
member, who was an assistant professor at the time, reported that a senior male faculty member
approached her with a question. She provided him with materials to test an answer. This
collaboration eventually led to support of a graduate student from the male professors lab and a
funded stream of research for the female professor’s lab. In another example, a female full
professor received technical and material assistance from a male associate professor. She then
provided him with helpful data from her use of the resources he provided her. A mix of senior
and associate professors teamed to create in-house capacity for producing a needed resource. In
another case, three junior faculty members cooperatively secured a shared equipment grant
necessary to replace a vital but outdated piece of equipment. Other types of generative
interactions involved steering funding opportunities to other labs, and teaming to help peers,
even those in other departments, obtain research funding.

Faculty members talked about how important access to shared resources was to their
scientific work, as exemplified by this statement: “Here in the department, everybody is working
on completely different projects and topics. I think where I try to help each other is with the
techniques. So if I see somebody is doing, let’s say [name of a technique] and I can’t do this. I
go to him, and I try to learn it there. There are a lot of techniques in the department, which are
available, (and) that you could use and gather. That’s what a department is for.” (male assistant
professor)

One female professor referred to these cases of sharing resources as “looking out for each
other”. A male professor talked about how much the department had given him, and how he
believed, he had been successful in giving back. Being “looked out for” appears to promote a
kind of reciprocity in the receiver that encourages him or her to pass along resources to others
who are seen as part of the department community. A male associate professor summed up the
outcome of this orientation as follows: “I think the better the department is, the more cases there
are of faculty working together on things that benefit the department but not necessarily an
individual faculty member exclusively.”

Generative interactions provided resources that directly supported the research of
scientists. Thus, they have implications for the ability of scientists to pursue their work and
advance in their careers. Etzkowitz, Kemelgor, and Uzzi (2000) describe how these interactions
and the resources they call “social capital” work together, “Typically, men form close social ties
with other male colleagues within and beyond the department that facilitate access to collegial
resources and information, which in turn help them to identify promising studies, manage jobs,
or learn the politics of tenure and publishing” (Etzkowitz et al., 2000, p. 159). They go on to
report that this sort of social capital is typically unavailable to women scientists, who tend not be
a part of those social networks. In contrast, in the department I studied, both women and men
reported participation in generative interactions that advanced their research.

Another reported motivator for generative interactions was the external competitive
environment of science. Some scientists in the department had come to believe that going it
alone was a bad idea competitively. They actively supported interactions that maintained the
autonomy of labs while leveraging different resources available across labs to create new
resources. Some faculty members viewed more collaborative generative interactions as central
to survival and success in the increasingly competitive environment of science. A female full
professor explained, “Also, right now, I think the way the NIH is funding things, I think it
becomes more important to have these--And they’re really pushing these cross interactions. It’s
going to be hard for any lab to survive for a long period of time all by itself, without interacting
with anybody because no lab can do every technique. It just doesn’t work anymore… They’re
going to have to find their interactions among their colleagues.”

The reported activities that provided contexts for generative interactions included dyadic,
small group or cross-lab meetings, department presentations and informal activities such as beer
hour.

13

Department-Level Participative Activities

I identified several participative departmental activities that provided contexts for constructive
interactions. Given the independence of scientists’ labs, activities that bring people together
appeared to provide opportunities for interaction and exchange on a scale that might not occur
otherwise. Group activities are important because they can provide the opportunity for what
Milton and Westphal called "mutual identity confirmation". Mutual identity confirmation occurs
when group members reciprocally confirm each other’s identities such that individuals
experience congruence between how they view themselves, whether negatively or positively, and
found that mutual identity confirmation increased cooperation in work dyads. Thus, to promote
cooperation in work groups they recommend that managers facilitate mutual identity
confirmation by "creating opportunities for group members to disclose their self-identities and
get to know others in their group" (Milton & Westphal, 2005, p. 207). The following
department-level activities appeared to serve the function of providing contexts for mutual
confirmation of individual’s identities as good scientists and supporting an orientation towards
the collective advancement of science and constructive interactions.

**Team teaching across faculty ranks.** Team teaching of courses within the graduate
program had been part of department practice since the days of the first chair. A senior faculty
member provided leadership of this activity. Various faculty members, across ranks, participate
in teaching parts of the graduate program. As the coordinator of this activity said, “So I give
some of the lectures in the course [graduate level science course], but I also organize everything
like the exams and the handouts and grading, etc. Quite a few people in the department
cooperate. About six different people give lectures that have to be coordinated. It’s a very
positive experience. People are very willing to do it and they meet deadlines that I set for them
and do their best. And the students seem to like the course” (male full professor).

Advantages of team teaching mentioned by faculty included a manageable teaching load
for all faculty, a lower load for junior faculty, and more time to devote to lab start up,
opportunities for junior faculty to learn from more senior faculty, opportunities to interact with
faculty, who may not be encountered daily. A junior faculty member discussed the advantages
of team teaching as follows: “Doing the teaching, I found to be quite a lot of fun, because it was
a team-taught course. So I’ve actually interacted with people whom I wouldn’t normally interact
with (male assistant professor).

**Department level social events.** Early in the department’s history, the department was
small and close knit. Faculty tended to move in and out of the larger group and sub-groups
easily due to proximity and common interests. As the department grew, the opportunities for ad
hoc, informal social exchanges diminished. The second chair initiated department wide social
activities to afford faculty, students and post-docs opportunities to interact outside of their labs.
Faculty members have supported these initiatives by participating in and rotating the leadership
of activities. These activities include a weekly beer hour, which is sort of a “science happy
hour”. The chair also introduced a department picnic and retreat. These events provide
opportunities for a range of constructive interactions between faculty members, students, post-
docs, and staff.

**Participation in faculty meetings.** The second chair used faculty meetings to keep
faculty members informed and engaged in decisions that could affect their work. In the meeting
observed by a researcher, she noted that the chair and faculty followed a process of identification
of the objective, information exchange, preliminary decision formation and testing of the
decision for consensus. The chair listened and solicited input from faculty, particularly those
who would be most affected by particular aspects of the decision. Meeting participants took the
time to elicit and consider multiple viewpoints and information throughout the decision-making
process. The faculty appeared to listen attentively to others and tended to present contrasting
views as alternative points to consider. A couple faculty members used non-personalized or self-
effacing humor to divert discussion from dead ends or relieve tension. One faculty member was
particularly skilled at asking questions that opened the group to consider other possible outcomes
and test consensus. Overall, participants appeared to engage collegial interactions throughout the
meeting and remained focused on productive outcomes.

**Regular meaningful seminars and presentations.** Many faculty members mentioned the
importance of department seminars and presentations in stimulating ideas, helping them to
fashion their own projects and making contact with peers with mutual interests. Two students also indicated that the interactive, interesting, and well-attended research seminars attracted them to the department. The faculty emphasized the importance of these seminars for the development of young scientists by making the sessions mandatory for graduate students. Faculty, both primary and secondary, attended the session I observed. The room was abuzz with conversation among faculty before the presentation. Faculty members were responsive to the presenters. Some faculty nodded their heads in response to the speaker. Others asked questions that helped the presenter clarify points or consider new angles or ideas about the research. Afterward, some faculty lingered, talking with peers and students. Thus, seminars and presentations are an important means for constructive interactions.

Leadership Practices

Leadership is a key factor in the development and maintenance of a department’s culture (Schein, 1992) Several practices, employed by the two female chairs and leaders among the faculty, supported department level activities and thus constructive interactions within the department these practices also appeared to support the enculturation processes I will discuss later.

The current and past chairs employed very different leadership styles, but participants reported that both shared the goal of a high quality, cooperative science department. First, both chairs supported a workplace environment of people energized by the work itself—the advancement of science. Faculty perceived both chairs to be fair, equitable, and supportive of the advancement of science regardless of whose lab it emerged from. Several faculty members, both male and female, noted the fairness and forthrightness of the current chair. No one reported either chair as having favorites or supporting cliques. Second, both chairs sought the thoughts
and opinions of the faculty before making decisions. When the department was small, the first
class did so by talking to faculty one-on-one. The second chair employed more group-level
activities. Both provided the faculty with a sense that a wide range of opinions mattered, not just
the desires of the chair or a privileged subgroup. Both chairs created opportunities for faculty
members to engage meaningfully across ranks, through various activities and processes. Third,
neither chair treated the department as an extension of herself or her own work by monopolizing
resources and recognition for their own ends. They did not use their status to demand
unwarranted resources, authorship, or access. Instead, they created and shared resources to
support others’ labs, particularly those of junior faculty, both among primary and secondary
faculty. Participants cited many instances of the chairs securing funding for new faculty,
including one story of the current chair allowing a junior faculty member primary authorship of
work that the chair’s lab had supported. Thus, both chairs viewed their role in terms of doing a
service to the department and advancement of a scientific community, not as a reward to
leverage. These practices were recognizable, to varying degrees, among the faculty in their
individual labs.

**Inclusion and Learning Sub-Process**

Schein (1992) further elaborated on the concept of cultures as: “A pattern of shared basic
assumptions that the group learned as it solved its problems of external adaptation and internal
integration, that has worked well enough to be considered valid and, therefore, to be taught to
new members as the correct way to perceive, think and feel in relation to those problems”
(Schein, 1992, p. 12). However, for this pattern to become reenacted, expected, and self-
replicating over time, Schein (1992) suggests that embedding processes are required. I found
two processes that appeared to help embed an inclusive and productive work climate into the
ongoing culture of the department. I refer to this set of processes as “learning and inclusion sub-
processes”.

Open and Transparent Decision Making. All faculty members, regardless of rank, had
the opportunity to be a part of important decision-making processes. The faculty meetings and,
in particular, participation of the entire faculty in recruiting, were the means, not only to
empowering the faculty but also transparency.

I observed a particularly important decision making process: that of recruiting new
members to a group. Recruiting is mechanism that Edgar Schein suggests is “One of the most
subtle yet most potent ways through which cultural assumptions get embedded and perpetuated”
(Schein 1992: 243). The first department chair exercised wide leeway in recruiting new faculty.
Many faculty members, both primary and secondary, recalled receiving personal invitations to
join the department from the first chair. Several participants recall that the chair’s main criteria,
aside from high quality science, was “no prima donnas” or jerks (per several faculty both male
and female). Several faculty members reported that they continue to use this criterion in
selection of new faculty. In discussing this criterion, some faculty acknowledged that it was not
foolproof. While six males and one female did advance to tenure within an eleven-year time
span, one male did not advance due to reported interaction “style” differences (male professors).
The second chair opened up the recruiting process to all primary and active secondary
faculty members. Faculty participated in initial screening of candidates for interviews. Sub-
groups of different faculty participate in recruiting dinners, presentations and the decision-
making discussion, limited to primary faculty, about the candidate. The criteria discussed in a faculty meeting about a potential candidate were consistent with the strategic direction to diversify the research areas and techniques within the department as indicated in the chair’s Annual Reports. Both male and female faculty, recruiters, and recruits, who discussed the open process, expressed satisfaction with the outcome.

An open decision-making process removed the mystery around important questions, such as who was involved in the selection of a new faculty member or how a newcomer fit into the department. Also important was that a single individual or sub-group (e.g., senior professors, professors of certain status or standing in the field, or by age or gender sub-group) did not monopolize decision-making power. Thus, transparency was an important tool for creating workplace inclusion. As one female full professor said, “So in general, for the recruiting, I think that everybody knew their input counted. In the end, I did go the way that the group decided for all the positions” (female full professor). A male full professor explained, “So there aren’t any politics, and nobody’s being forced to do things. People are genuinely interested in teaching or are certainly interested in the job search. And so it’s sort of a team effort, which makes it rewarding. I think that there is not very much of a hierarchy in the Department, between the junior faculty and the senior faculty. And, to some extent, the students feel like they’re part of the process. So people feel empowered. People’s opinions are asked and they receive feedback” (male full professor).

Another advantage of an open decision making process was that it provided the opportunity for the faculty to think as a group about how a new person would fit into the department, what the candidate could contribute, what the candidate’s developmental needs were, and whether department members were able and willing to help that person develop as a
scientist. I observed a seminar, “chalk talk”, and faculty meeting surrounding one candidate for a junior faculty position in the department. From this data, I noted that a significant portion of the discussion about a candidate was about both fit with the department, in terms of the person’s research direction, and his or her ability to interact with others. Faculty looked at the strengths and weaknesses of the candidate’s science. A faculty member referred to the same meeting as, “You could listen to the conversation and you could see people were thinking about how this person would contribute. This was particularly true in the meeting that you were sitting in on.

But also, we have to mentor them. So, are they [the candidate] in a position where they can be well mentored? Or, are they so far back that the faculty will be spending a lot of time, too much time, doing the mentoring? You want to see that, if you put in the mentoring, it’s really going to pay off. So I think everybody sees how the whole thing affects him or her” (female full professor). The result of this process was a candidate people felt good about, which provided the new person with a cache of social credit needed to weather any initial setbacks that may be part of the new faculty experience. As a female full professor explained, “… I think the recruiting as a group is important because you want to bring in people that everybody feels good about”.

Feeling good about a person promoted interest in that person’s success and encouraged acts of inclusion and development. A male associate professor summed up the influence of faculty participation in the recruiting process as follows: “But I think the strength of the department is that it’s got a large group of faculty that has been involved in hiring the people. [These faculty] are now invested in many people in the department because they played key roles in their recruitment. And so, we’re trying to work on ways, through the infrastructure of the department, to expand the circle. To have people more interconnected with other labs, so we’re trying to find ways to have the labs that aren’t involved in this central cluster of faculty be more involved in
having them on students committees, having them on exams. Try and reduce the ability of
people to be really isolated”

**Department level information flow and learning process.** Participative faculty
meetings, team teaching, and high quality research seminars and presentations began as
responses to problems faced by a growing department but they worked well enough to become
formalized activities that together form a continuous learning process within the department.
Constructive interactions fuel this process that provides department members with the
knowledge and information they need to advance their work. Participants reported access to role
models for approaches to the work, peers they could generate ideas with, and access to important
new techniques and methods being available for the asking. These activities provide the
structures for a process of dissemination of work-advancing information, tools, and materials, all
strategic resources.

This process appeared to be an outgrowth of constructive interactions through which
department members established good will and trust.

**DISCUSSION AND CONCLUSIONS**

With this work, I attempted to address the bias towards research that described disabling
work cultures for women in science with a model of an enabling work culture. The model I
developed identifies five concepts and relationships between them that appear to facilitate the
type of cooperative culture prior research suggests is particularly conducive to women in
S.T.E.M fields. This type of culture also appeared to work well for men, who were the majority
of faculty members in the department I studied. Thus, I agree with Tobias who asserts that
special exceptions are not required for women but that the “route to professional science [be]
made more humane. (Radcliffe Public Policy Institute, 1999)” (Rayman & Steward, 2000, p. 20).

I believe this work contributes several concepts and linkages that are useful to the study of
women in S.T.E.M. fields. Although my study focused on women in a science department, this
work may also offer insights into the integration of other forms of difference in other contexts as
organizations strive to create diverse, high performing work groups and teams.

A concept that appears to be useful in thinking about the integration of difference is a
shared scientific identity. Women in science traditionally faced the challenge of assimilating
into a masculine culture and possibly facing the backlash of breaking with expected norms for
female behavior (Valian, 1999). In addition, social identity theory suggests that individuals
have a need to acquire a favorable self-image and attempt to do so via a process of “self
categorization”. They maintain this image by making self-enhancing comparisons between
themselves as members of a particular group and others as members of a different group. When
these self-enhancing comparisons occur between members of a work group, solidarity,
cooperation and support are diminished (Ely, 1994). A shared scientific identity appeared to
provide female and male scientists with a shared favorable identity. It provided a set of values
and beliefs that provided guidelines for acceptable member behavior, that both males and
females could embrace. This shared identity, represents a solid step towards a scientific identity
that incorporates masculine (technical skill) and feminine (concern for the development of
others) elements. A shared science identity appeared to override competitive self-categorization
and facilitate the inclusion of women in the types of interactions that supported progression of
their work.
A second important outcome of this study is the apparent link between access to a shared identity and the types of interactions that occur. Bouty (2000) found that strategic resources were exchanged under conditions of acquaintance and mutual trust. The concept of a shared science identity elaborates on the concepts of acquaintance and trust as conditions of exchange and links the basis for exchange relationships to overcoming demographic identity barriers. The initiation of resource exchanges appears to be related to how scientists see interaction as a part of her/his identity. In addition, the concept of constructive interactions perhaps better explains how actors progress from exchange of common to strategic resources as their interactions become increasingly complex and interdependent.

This work also supports and expands on the three indicators of workplace inclusion, articulated by Pelled, Ledford and Mohrman: decision-making influence, access to sensitive information, and job security (Pelled et al., 1999). Open and transparent decision-making and department level information flow and learning sub-processes provided faculty with influence over the decisions that affected their work. In addition, the faculty in the department I studied had access to sensitive information as well as knowledge important to their work. For career scientists, access to knowledge from peers can be just as important as the kind of strategic organizational information Pelled, Ledford and Mohrman refer to. In a knowledge intensive context, job-security, whether it comes in the form of tenure or avoiding downsizing in a firm, depends on access to knowledge that supports or enhances job productivity and performance. Thus, I suggest that the degree to which women and minorities have access to knowledge resources is also an important indicator of inclusion. Given the role of constructive interactions in the dissemination of knowledge resources that I found, access to knowledge resources may be
a useful indicator in accessing how deeply integrated women or minorities are into productive interactions in work groups.

A broader implication of my work is that department leaders in particular may need to broaden the range of skills they consider in new faculty to include interpersonal skills and interests that promote science or technological advancement beyond research. The wider a person’s interests and picture of who they are, the better chance they have of finding satisfaction in some aspect of their work and the more options they have for connecting with others (Milton & Westphal, 2005). Second, the wider the range of identities that can be confirmed within a group, the greater a group’s capacity for including and leveraging difference. Multi-modality within a group can support different identities and associated interests and thus, inclusion and engagement of diverse constituencies.

One clear limitation of this study was its focus on a single group. Thus, other factors such as formal policies were apparently not salient to participants in this study and thus, are not reflected in the model. However, survey data indicates that formal policies around time for childcare, and sexual harassment may have some role in prompting changes to how departments function. My model does suggest that to make institutional policies effective in department settings, interventions that influence how scientists see themselves and each other may be helpful. Also, although the department I studied had an above average number of women for a science department, they were still in the minority and had assumed the prevalent view among scientists that science was first or a close second to family. They had made decisions about timing of having families accordingly and or negotiated shared responsibility for family with supportive spouses. However, even the faculty participants noticed that students and post-docs both male and female tended to put their personal lives ahead of their professional work or
attempt to integrate them. As a result, faculty reported attrition among male students, who opted
to stay with family and support a spouse’s career. A more complete model would be possible
with the exploration of a science department or other scientific or technical work group in which
more members had successfully integrated work and personal life. Perhaps such a group could
also answer questions about how group members successfully embed family friendly work
practices and policies into the culture of a group.

Several additional questions remain for future research. Constructive interactions
appeared to be essential to faculty feelings of inclusion and work productivity. However, how
much interaction is enough interaction? Participants in a study of Chemistry departments
conducted by Rayman and Steward reported their perceptions that women, or any minority to a
group, require more invitations and more opportunities to interact than men, or individuals in the
majority (Rayman & Steward, 2000). Research conducted using methods that can measure such
differences would help verify this perception. Another question relates to the role of formal
mentoring in the development of faculty. In the department I studied, there was little formal
mentoring and disagreement about its appropriateness. One concern among faculty was that the
potential mentee, in this particular case a male, might feel singled out. Can a sense of shared
identity coupled with activities that promote interaction be enough to stimulate career advancing
informal mentoring relationships in various contexts? What are the implications for institutional
implementation of formal mentoring programs in the face of resistance from within even
cooperative, developmentally oriented departments? One thought is that a single approach to the
development of women, minorities, or faculty in general may not be appropriate. The other is
that there are long standing issues around faculty development that are now being highlighted by
the entrance of women and minorities in to S.T.E.M. fields. Further research is needed to
1 develop multiple approaches to faculty development as well as understand the cultural obstacles
2 to implementation of new practices.
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