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Academic Entrepreneurs: Organizational Change at the Individual Level

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This study explores the process of organizational change by examining localized social learning in organizational subunits. Specifically, we examine participation in university technology transfer, a new organizational initiative, by tracking 1,780 faculty members, examining their backgrounds and work environments, and following their engagement with academic entrepreneurship. We find that individual adoption of the new initiative may be either substantive or symbolic. Our results suggest that individual attributes, while important, are conditioned by the local work environment. In terms of personal attributes, individuals are more likely to participate if they trained at institutions that had accepted the new initiative and been active in technology transfer. In addition, we find that the longer the time that had elapsed since graduate training, the less likely the individual was to actively embrace the new commercialization norm. Considering the localized social environment, we find that when the chair of the department is active in technology transfer, other members of the department are also likely to participate, if only for symbolic reasons. We also find that technology transfer behavior is calibrated by the experience of those in the relevant cohort. If an individual can observe others with whom they identify engaging in the new initiative, then they are more likely to follow with substantive compliance. Finally, when individuals face dissonance, a situation where their individual training norms are not congruent with the localized social norms in their work environment, they will conform to the local norms, rather than adhering to the norms from their prior experience.

Key words: organizational change; entrepreneurship; localized learning; technology transfer
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Change, through the pursuit of new strategic initiatives, is essential to organizational survival (Van de Ven 1986). All too often, however, organizations fail to adapt to exogenous shifts in their environment (Kotter 1996, Christensen and Bowers 1996). The literature highlights the forces that favor organizational stability and resistance to change (Hannan and Freeman 1984, Leonard-Barton 1992, Nelson and Winter 1982, Tolbert and Zucker 1983). Even when top management recognize the need to change, publicly announce new strategic initiatives, modify incentives, and divert significant resources to develop supportive organizational structures, the persistence of existing routines and older norms of behavior frequently impede organizational transformation. The challenge of change is even more daunting for organizations embedded in highly institutionalized contexts with strong traditions and well-established norms of behavior (DiMaggio and Powell 1983, Kraatz and Moore 2002). However, some organizations do adapt, survive, and prosper. Understanding the differential capability of organizations to change remains a central, ongoing research question in organizational theory (see Greenwood and Hinings 2006 for a review).

Recent research suggests that understanding variation in organizational response to external pressure requires examining intraorganizational dynamics and the actions of individuals in context (Greenwood and Hinings 1996). The mere presence of macrolevel pressures does not guarantee that new initiatives will be embraced. The ability of organizations to change depends on the willingness of individuals to adopt supportive norms, routines, and behaviors (Whelan-Berry et al. 2003). Organizational change occurs via the individual as "pressures are interpreted, given meaning, and responded to by actors within organizations" (Dacin et al. 2002, p. 48). Individual behavior may be influenced by prior experience and by new information gained from physical space proximity or professional relationships that provide an opportunity to observe and learn. Thus, professional imprinting and localized social context are material microlevel influences (Schien 1985, DiMaggio and Powell 1983, Bandura 1977). However, in the process of organizational change, individuals may find themselves in situations of dissonance where social imprinting conflicts with the norms of local environment (Festinger 1957). Ultimately, resolution will involve trade-offs between competing influences and reflect the individual's choice to either engage in substantive compliance, or merely make a symbolic gesture. Understanding the decisions made by individuals about the adoption of a new initiative requires consideration of the localized social context and professional imprinting, while controlling for financial incentives and opportunities.

Currently, there is a gap in our knowledge, as few empirical studies link individual actions and the influence of organizational subunits to the implementation of strategic initiatives. This paper addresses that gap in the context of an initiative adopted by American research universities to promote active technology transfer and research commercialization. Traditionally, academic institutions operated under Mertonian norms that emphasized the open dissemination of research discoveries and eschewed direct commercial activity (Powell and Owen-Smith 1996, Nelson 2001). Because of a convergence of technical, legal, political, and economic factors that culminated with the passage of the Bayh-Dole Act in 1980, an alternative archetype of academic entrepreneurship that encourages commercial activity has been articulated (Mowery et al. 1999). Slaughter and Leslie (1997) describe initiatives in support of these new norms as "academic capitalism," while Etzkowitz (1983) coins the descriptive term "entrepreneurial universities." However, for universities, the process of organizational change has been challenging. Although, by 1998, every Carnegie I and II American Research University had technology transfer offices (TTOs) and were moving toward standard technology transfer practices (Feldman et al. 2002), there remained a noted performance gap in the realization of these new technology transfer initiatives (Siegel et al. 2003). The decisions by individual faculty members to actively engage in technology transfer signal their acceptance of the university's initiative for academic entrepreneurship. Our study of those decisions offers the rare opportunity to gauge the factors influencing the adoption of an organizational initiative at the individual level, within an intra-organizational context.

This study examines the behavior of 1,780 faculty members in 15 matched departments at the medical schools of two prominent research universities. Medical schools were chosen as they are a key venue for academic activity with commercial potential. Our results suggest that the decision to participate in strategic initiatives is influenced by both social learning prior to an individual joining the organization, and subsequently, by the individual's exposure to relevant peer behaviors within the organizational subunit. We find that those individuals who trained at institutions at the forefront of technology transfer benchmarking, or who completed their training recently, are more likely to participate in academic entrepreneurship. Furthermore, we find that, when the chair of the department is active in technology transfer, other members of the department are also likely to be active, if only for symbolic reasons. We also find evidence of localized learning, as technology transfer behavior of individuals is calibrated by the activity of their peers. If an individual can observe participation by peers at the same academic rank in their department, then they are more likely to follow with substantive compliance, other things being equal. Finally, we find that when an individual has been imprinted with norms that conflict with the norms of their local environment, it is the latter that tends to dominate in the choice of subsequent behavior. In sum, our empirical study illuminates the intraorganizational dynamics that are critical to orchestrating organizational change.

The paper proceeds as follows. We begin with an overview of the technology transfer process and details on the context we study. The second section draws on the literature and the results of interviews with technology transfer managers and faculty members to develop a set of hypotheses about the individual faculty member's decision to disclose new inventions. The third section of the paper introduces the data and methodology. The fourth section provides empirical results. Discussion and reflective conclusions are offered in section five.

Faculty Participation in Technology Transfer

The decision of individual faculty members to become entrepreneurial academics and engage in commercial activity with industry begins when an invention disclosure is filed with the university's TTO. While the university's success with entrepreneurial activity is measured with a variety of indicators such as the number of patents applied for and received, the number of licenses and the amount of licensing revenue, and the number of start-up companies, these outcomes are only possible if individual faculty members disclose their ideas to the university TTO. Filing an invention disclosure is the initiating stage of the technology transfer process, and all of the subsequent measures of the university's progress toward this new organizational initiative depend on individual faculty disclosing their research results.

At face value, the decision to disclose research results should be straightforward. First, increased technology transfer activity has become an articulated goal of the university administration and is espoused as a strategic initiative. Royalty-sharing incentives have been adopted and TTOs have been organized to actively encourage faculty participation. Second, disclosing research results to the TTO is a stipulation of federal research grants, which constitute the largest source of university research funding. Faculty may be driven to disclose to remain in compliance with, and thus eligible for, future government grants. Third, the costs associated with disclosing an invention are negligible, and forms are readily available online. Fourth, any idea may be disclosed, as there are no objective standards that faculty discoveries are required to meet to warrant filing an invention disclosure with the TTO.[1] Indeed, technology transfer managers actively try to encourage faculty to disclose all ideas that may qualify as inventions because the number of faculty disclosures is one criterion used to evaluate TTO performance.[2]

Thursby et al. (2001) argue that invention disclosures represent only a subset of university research with commercial potential. Thursby and Thursby (2002) discuss reasons why faculty would choose not to disclose research results. First, faculty may not disclose because they are unwilling to spend time on the applied R&D required to interest businesses in licensing the invention. This claim is perhaps countered by the trend toward patenting basic scientific results from projects like the human genome which, though basic, may have immediate commercial potential. Second, faculty may not disclose because they are unwilling to risk publication delays, which may be required to allow prospective licensees to initiate the patenting process.[3] Our interviews with both faculty members and TTO officials, however, indicate that this is more a perceptual problem than reality. There are strategies to accommodate both academic and commercial interests and experienced peers can help navigate the process. Finally, faculty members may not disclose because they believe that commercial activity is inappropriate for an academic. This view represents an older norm of open academic science. However, to the extent faculty members do disclose inventions, academic norms appear to be changing (Krimsky 2003).

An additional concern is that faculty may behave opportunistically, bypassing the technology transfer process, and not disclosing inventions to commercialize them without university involvement. Our interviews indicate that this is not a substantial concern as commercial interests are cognizant of the potential for disputes over intellectual property and generally require evidence of ownership before committing funds. Potential investors conduct due diligence to clarify the origins of an idea, and confirm that if intellectual property is being claimed by the inventor, the inventor, not the university, holds the rights to the invention. In contrast to software or electronic devices, biomedical inventions require infrastructure that would be difficult for an individual or small company to assemble. Furthermore, universities are increasingly active in claiming and defending their rights to intellectual property developed by faculty under federal grants or with the use of university facilities. Owen-Smith and Powell (2001b) suggest that incentives favor disclosure in the life sciences, as licensing of biomedical patents is a demonstrated way for faculty to earn economic returns and protect academic freedom for follow-on research. Of course, faculty participation will be influenced by the perceptions of the competence and capabilities of the university TTO (Colyvas et al. 2002). These perceptions, in turn, are shaped by institutional history and environments.

Medical schools account for the majority of university invention disclosures (Mowery and Ziedonis 2002) and are the focus of our analysis. The two universities we study are similar in a number of ways. Both have well-established and renowned medical schools with a strong emphasis on research and knowledge creation. Both had little experience with patenting and licensing prior to the passage of the Bayh-Dole Act. Both established TTOs in the mid-1980s and, by 1991, had adopted similar royalty-sharing incentives for faculty inventors. Moreover, beginning in the late 1980s and accelerating during the 1990s, the administration of both institutions articulated technology transfer activities as a strategic initiative.

Yet, even within institutions, we observe significant differences in faculty participation. Table 1 demonstrates variation in disclosing behavior by faculty members in 15 matched academic departments within the medical schools at these two universities.[4] In most cases, the universities have a similar number of faculty members within each department. The exceptions being Cell Biology (Cell Anatomy and Biology) with 53 faculty members at University A and 19 at University B; Ophthalmology with 34 at University A and 112 at University B; and Neurobiology (Neuroscience) with 42 at University A and 70 at University B.

Technology transfer activity is concentrated within certain departments at the medical schools, as demonstrated by the number of faculty members filing disclosures. We might expect that technological opportunity would be greater in some fields than in others and that these high-opportunity departments would have a similar share of faculty who disclose inventions.[5] This does not appear to hold. What is rather striking is the variation in the number of disclosures normalized by department size or stated as the number of invention disclosure events per faculty member.[6] In aggregate, there were 0.384 disclosures per faculty member at University A and 0.414 at University B. However, there was substantial variation between similar departments across the two universities. For example, ophthalmology faculty members at University B averaged 1.2 disclosures each, while individual University A ophthalmology faculty averaged 0.38 disclosures. Conversely, surgery faculty members at University A were approximately twice as likely to be involved with disclosing as the University B surgery faculty. Considering the eight departments across both universities, where disclosure events per faculty members are relatively high (greater than 0.75), we see that only 50% of the time do the similar departments at both universities fall within this set. Further, only 30% of the disclosure events in our data set originate from these four high-opportunity departments. While technical opportunity matters, it is clearly not the only driver of faculty disclosure behavior.

Table 1 Invention Disclosures Are Concentrated in Different Departments Within Medical Schools

		Number of faculty members		Number of faculty members who have filed invention disclosures				Number of invention disclosure events			
University A	University B	A	B	A	Percentage of disclosing faculty (%)	B	Percentage of disclosing faculty (%)	A	Disclosure events per faculty member	B	Disclosure events per faculty member
Anesthesiology	Anesthesiology	76	88	12	7.36	13	7.43	27	0.355	23	0.261
Cardiology	Cardiovascular division medicine	43	39	11	6.75	10	5.71	26	0.605	48	1.231
Cell biology	Cell anatomy and biology	53	19	13	7.98	5	2.86	49	0.925	9	0.474
Genetics	Molecular biology and genetics	12	25	7	4.29	4	2.29	23	1.917	53	2.120
Immunology	Immunology	40	16	14	8.59	9	5.14	42	1.050	18	1.125
Microbiology	Biological chemistry	37	37	5	3.07	4	2.29	13	0.351	11	0.297
Ophthalmology	Ophthalmology	34	112	5	3.07	17	9.71	13	0.382	130	1.161
Pathology	Pathology	62	91	11	6.75	20	11.43	25	0.403	70	0.769
Pharmacology	Pharmacology and molecular science	38	25	13	7.98	13	7.43	43	1.132	40	1.600
Radiology	Radiology	61	84	8	4.91	10	5.71	13	0.213	27	0.321
Neurobiology	Neuroscience	42	70	14	8.59	22	12.50	32	0.762	53	0.757
OB/GYN	Ob/Gyn	85	85	5	3.07	1	0.57	8	0.094	8	0.094
Pediatrics	Pediatrics	121	246	11	6.75	19	10.86	14	0.116	28	0.114
Psychiatry	Psychiatry	158	191	9	5.52	5	2.86	19	0.120	17	0.089
Surgery	Surgery	194	258	25	15.34	23	13.14	58	0.299	39	0.151
Total		1,056	1,386	163	100.00	175	100.00	405	0.384	574	0.414

The question thus becomes: Who discloses in the faculty, what are their characteristics, and to what types of incentives do they respond? This intraorganizational heterogeneity in participation in technology transfer among academic departments suggests that acceptance of the new norms of academic entrepreneurship are highly localized. As such, an understanding of the individual actions as influenced by their local social context is arguably key to promoting change at the organizational level (Greenwood and Hinings 1996, pp. 1023–1024). To develop hypotheses, we rely on interviews with technology transfer officials and faculty members.[7] Every individual in the medical school is expected to conduct novel research that could yield publications and might generate inventions with commercial potential. High-prestige publications and patent productivity increasingly are complementary (Blumenthal et al. 1996, Powell and Owen-Smith 1998). Of course, individuals differ in their inventive capacity, but it should be recognized that inventive capacity differs from entrepreneurial propensity (Bercovitz and Feldman 2007). While we may expect that certain fields of research would be more amenable to disclosure, the lack of objective standards indicates disclosure is an individual decision.

We expect that faculty would be responsive to financial incentives and that there would be a direct relationship between licensing royalty distribution rates and the amount of technology transfer activity across universities (Lach and Schankerman 2003). Our focus on departments within institutions holds these rates relatively constant because there is a convergence in incentives during the time period we studied. Both universities have a similar distribution rate with one-third of future revenue going to the individual faculty member, one-third going to the central administration, and one-third to the department.[8]

Though the expected value of individual inventions may vary, two factors limit the differentiating influence this may have on faculty disclosure behavior. First, as noted by Lowe and Ziedonis (2006), most faculty members, as with other types of entrepreneurs, greatly overestimate the value of their ideas. American academics are also known for being intensely competitive (Whitley 2003). Slaughter and Rhoades (2004, pp. 152–153) find that professors are familiar with stories of the success of academic licenses and start-up companies, and liken these stories to fairytales that can capture the imagination and set expectations of potential value. Second, history has shown the payoff distribution of faculty inventions is both uncertain and highly skewed with less than

45% of active licenses receiving any licensing revenue at all. Of those licenses that earn royalties, only 1.5% generate an annual return greater than $1 million dollars (AUTM 2003). Thus, the decision to participate in technology transfer may be viewed as an option on potential future wealth rather than a direct payoff.

Given that opportunity to disclose appears not to be dictated solely by technological field and given that royalty distribution rates are relatively constant, this paper focuses on the role of social interaction in the decision of faculty members to disclose their inventions. Specifically, the decision to disclose appears to be influenced by three categories of social interaction and organizational learning that we term training effects, leadership effects, and peer effects. Each of these is described below. Further, when faced with strategic initiatives, individuals have a variety of response options. We explore the resolution of possible conflict between professional imprinting and localized norms, as well as factors underlying variation in individual response.

Training Effects. Many authors have argued that social institutions, with educational institutions being a key subset, mold individual perspective by promoting, both implicitly and explicitly, a particular set of norms and values (Schein 1985, Locke 1985, Haas 1992, Calori et al. 1997, Biglaiser 2002). DiMaggio and Powell (1983, p. 153) emphasize the role universities play in this socialization process, stating that those "drawn from the same universities and filtered on a common set of attributes,...will tend to view problems in a similar fashion, see the same policies, procedures and structures as normatively sanctioned and legitimated, and approach decisions in much the same way."[9] Support for these arguments exists across academic domains. For example, in a series of studies, Frank et al. (1993) find evidence that economics students, particularly those trained by an instructor with research interests in game theory, are more likely to adopt self-interested behavior than their peers. Similarly, recent work in political economy shows that the presence of U.S.-trained economists is a key predictor of the adoption of various types of neoliberal reform (for example, tariff rate reduction, capital account liberalization) in emerging markets (Biglaiser and Brown 2003, Chwieroth 2003). In sum, the empirical evidence suggests that professional training can imprint a particular set of norms. Acting according to these norms, students may serve as a critical conduit for the diffusion of new ideas and practices.

In our context, the logic of imprinting implies that individuals trained at institutions where participation in technology transfer was actively practiced will be more likely to adopt these practices in their own careers. Interviews support this conjecture. For example, one professor active in technology transfer indicated that he learned about disclosing from his graduate school mentors, and this influenced his expectations for a professional career. While he recognized that the academic culture did not support technology transfer when he joined the faculty, he believed that participating in technology transfer would provide a vehicle for implementing his ideas. Similarly, the current president of one of the institutions we studied, started as assistant professor in 1972. This individual learned about technology transfer during graduate study at Stanford University, in a very active department in terms of involvement with industry. At the current institution, he continued to actively disclose inventions and subsequently started a company. His expectation was that technology transfer would be part of his career. In contrast, faculty who received their medical school training at institutions where technology transfer was not perceived as a legitimate activity often question the long-term impacts of this activity, both on their careers and on the broader pursuit of science. Several, including the chair of one department who trained at Cornell, had no intention of disclosing inventions and expressed strong sentiments against technology transfer pursuits even though this activity was supported by the university administration. This foundation of theoretical logic and anecdotal evidence leads to the following testable hypothesis:

HYPOTHESIS 1 (H1). *Individuals whose graduate training incorporated technology transfer objectives will be more likely to participate in technology transfer initiatives by disclosing innovations.*

The length of time an individual has been out of training is also likely to influence their disclosure decisions. As Ryder (1965) notes, individuals are imprinted, to some degree, by the major events that occur and accepted norms that are prevalent during their formative stages of development. The doctoral and/or medical training experience is clearly a formative period for academic researchers (Cartwright 1979). Levin and Stephan (1991) confirm the importance of timing in a scientist's training finding that vintage, based on the year of doctorate degree award, affected scientific productivity in their study of the research productivity of academic scientists.[10]

Though never static, views about the proper role of academic scientists in commercialization activities have evolved considerably in the recent past, both as drivers of, and in response to, the 1980 Bayh-Dole Act. The historic norm of open science, with the goal of publication and wide dissemination of findings, was previously dominant in academic communities. Recently, however, both academic institutions and individual scientists have accepted that they have a responsibility to become entrepreneurial and to work with industry to leverage academic research for commercial purposes and broader economic growth. Recent studies show that it is becoming increasingly common for academic administrators and individual scientists to consider commercialization as a key part of their missions (Zucker et al. 1998, Thursby and Thursby 2002, Murray 2004).

The training and exposure received by medical and doctoral students were likely colored by this evolution in thought (Cartwright 1979). The earlier an individual completed her training, the more likely she is to have been exposed to, and adopted, the traditional norms of science that do not favor disclosing. Conversely, the more recently trained the scientist, the more likely she encountered an environment supportive of commercialization activity. Thus we hypothesize:

Hypothesis 2 (H2). *The likelihood that an individual will engage in technology transfer through invention disclosure will increase the more recent the vintage of their last graduate degree.*

Leadership Effects. Leaders influence behavior in organizations both by building culture and by acting as role models. The visible behavior of those in leadership roles drives organizational culture by signaling what actions are expected, valued, and likely to be rewarded (House 1977, Schein 1985). Furthermore, given that individual behavior is shaped by the observation and imitation of others in a social context, subordinates vicariously learn what activities are deemed legitimate and worthy of emulation by observing the actions of the leader (Bandura 1977, 1986). Specifically, the stance taken by a leader motivates a particular set of behaviors that influence the value systems of the followers (Shamir et al. 1993). Culture and role-modeling cues are most pertinent in environments beset with ambiguity. For example, when the criteria for advancement are not clearly delineated, individuals tend to adjust their expectations relative to the behavior of their leaders. Individuals may follow their leaders' cues not only because they have adjusted their attitudes but rather because they seek to avoid disfavor and potential sanctions.

In academic departments, the department chair is the leader. In medical schools, the power and influence of the chair is particularly strong and appointments are of long tenure. The chair plays a direct and powerful role in reviewing and evaluating individual performance related to promotion and tenure. One contentious issue is how technology transfer activity is treated in those decisions.[11] The rules appear to be subjective and the problem for individual faculty members is to discern how activity will be evaluated.[12]

One signal that the chair is predisposed to consider technology transfer as a legitimate activity would be the observed behavior of the chair. If the chair is active in technology transfer as demonstrated by his or her prior disclosures, then he or she sends a signal that technology transfer is a valid activity. In this case, other members of the department may be more likely to disclose.[13] We might expect that these social cues would be stronger for junior faculty members who face greater uncertainty about expectations regarding promotion and tenure. However, our interviews suggest that senior faculty members also benchmark their performance against the department chair.

Hypothesis 3 (H3). *Individuals in departments where the chair is actively involved in technology transfer are more likely to engage in technology transfer activities.*

Local Peer Effects. In addition to leaders, peer groups also act as a reference point. When faced with uncertainty about the proper course of action, social learning theory posits that individuals will model the behaviors of referent others (Bandura 1986). Numerous prior studies provide evidence that learning activity occurs within a cohort of peers, as individuals draw inferences about value by observing the choices of similar others (Duflo and Saez 2000, Sorensen 2002). There is an expectation that individuals with similar characteristics will face similar payoffs from engaging in comparable activities (Ellison and Fudenberg 1993). Moreover, individuals may learn from those with whom they frequently interact—a localized effect in which the ability to take up a new activity is defined by spatial and social proximity (Wright and Mischel 1987). Indeed, we expect that knowledge spillovers will more easily flow along corridors and benefit those with frequent social interaction. For scientists, both industrial and academic, local reference group or peer norms have been shown to play a significant role in determining individual behavior (Kenney and Goe 2004, Louis et al. 1989, Pelz and Andrews 1976, Stuart and Ding 2006).

We expect that individuals will be more likely to engage in technology transfer activities when they observe individuals with similar characteristics in their departments disclosing. In academic communities, peer groups commonly form based on professional rank within departments. Social proximity in the work environment is reinforced by spatial proximity. Having entered the institution at a similar time, and facing similar issues in managing their careers, those of similar rank tend to look to each other for information, advice, and examples.

Hypothesis 4 (H4). *Individuals are more likely to disclose their inventions if their local peers engage in technology transfer activities.*

When facing pressure to adopt new organizational initiatives, individuals have a variety of response options. If all of the influences are aligned, the choice appears to be relatively simple: the individual will either participate, or not, according to the inherent logic. However, when the training effects and organization influence are opposed, the individual faces trade-offs. A coherent response to these mixed signals requires resolution that can occur in one of two ways. First, individuals may resolve this dissonance by updating their beliefs and wholeheartedly responding to localized social influences. In this case, they would either engage in disclosing or not, based on the prevailing departmental logics. Second, those individuals who feel ambivalent about technology transfer may respond symbolically—moderating their behavior just enough to gain legitimacy. This suggests two additional hypotheses that investigate individual resolution of these conflicting norms.

Dissonance. Individuals may be subjected to conflicting influences. Specifically, there may be tension between beliefs instilled through professional imprinting (macro) and norms supported by local (micro) social influences. According to dissonance theory, there is a tendency for individuals to seek consistency in their beliefs, attitudes, and behavior (Festinger 1957).[14] Reconciling diverse exposures to select a particular behavior requires that individuals engage in intersubjective sensemaking (Wiley 1988, Weick 1995). Sensemaking involves a conversational and narrative process that is likely to be mediated between those with frequent interaction (Gephart 1993, Balogun and Johnson 2005). Because intensity of interaction with current peers is likely to be greater than intensity of interaction with those associated with previous professional situations, it may be argued that dissonance will often be resolved through conformation with the localized social norms (Deutsch and Gerard 1955, Festinger 1957, Festinger et al. 1950, Chattopadhyay et al. 1999).

Being subjected to conflicting influences is a common occurrence for faculty regarding technology transfer issues. For example, faculty members who trained at universities with a strong technology transfer norm may find themselves in departments that do not actively pursue commercialization. Conversely, an individual who trained under traditional norms may be situated with peers who are actively engaged in technology transfer. Exposure to such mixed messages can create dissonance. As Owen-Smith and Powell (2001a, pp. 221, 137) note, faculty often hold contradictory values simultaneously, expressing some values that fit with traditional Mertonian science, while other values fit with the new entrepreneurial norms. Dissonance, being psychologically uncomfortable, motivates the person to take action to reduce the discord. This can be accomplished by discounting the arguments of the group to rationalize one's established position or by altering current beliefs to match those of the dominant group.

One of our interviews with an individual who had been trained with the newer commercialization norms, but had joined a department that followed the older academic norms, provided a clear example of dissonance. This individual disclosed immediately after arriving on campus but never disclosed subsequently. The initial disclosure is noteworthy as it converted to a patent, was subsequently licensed and generated licensing revenue—seemingly an outcome that would encourage additional disclosure. This faculty member, having joined a department that did not value commercialization efforts, was firmly told that patenting was not an appropriate activity for faculty in the department. While this individual believed that filing the disclosure was appropriate given his prior training, he found himself at odds with the expectations of his new position. This led him to question his initial position, and subsequently, he chose to adhere to the values of his peer group, directing his attention to the more traditional academic outlets.

Both the theoretical logic and our interviews suggest that localized social norms may trump the individual norms instilled via professional training when these norms are in conflict. As such, we hypothesize:

Hypothesis 5 (H5). *When individuals are faced with a situation where their individual training norms are not congruent with the localized social norms in the work environment, they will conform to the localized, rather than individual, norms.*

Symbolic Compliance. The individual decision to disclose inventions indicates compliance with the university's technology transfer initiative. However, this observed behavior may or may not indicate that the individual has adopted the new norms of behavior: They may simply be going through the motions and complying at the minimum level. Alvesson and Willmott (1992) find that, in the face of new organization initiatives, some employees experience what they term microemancipation, a genuine value reorientation, becoming almost evangelical in their pursuit of the organizational initiative. This may be regarded as a substantive adoption of new norms and signals a change in the individual's attitude. However, it is also possible that social pressure may induce only symbolic compliance: Some individuals may comply with organizational initiatives simply to avoid sanctions (O'Reilly et al. 1991).[15] For example, a recent study of responses to new National Institutes of Health (NIH) requirements for ethics training finds that life science faculty take minimal action so as to appear to follow the new guidelines while, in truth, resisting the real change the initiative seeks (Smith-Doerr 2006).

Individuals who engage in symbolic compliance would be expected to disclose nominally, perhaps only once a period. In contrast, individuals who have undergone microemancipation would disclose frequently. We expect that these two groups may respond to different motives in their disclosure decision. Substantive disclosers are likely to be strongly influenced by peers as congruence between individual and organizational values is one product of social identification (O'Reilly and Chatman 1986). Symbolic disclosers, on the other hand, may be less responsive to the localized pressure from their cohort, but may be more influenced by the possibility of organizational sanctions. Our interviews suggest that symbolic individuals are more responsive to legal rules and authority. Certainly, in our example, individuals with NIH grants may engage in symbolic compliance to conform to agency guidelines. Further, we would expect symbolic disclosers to take heed of the position of those with authority to enforce the rules—in our context this would be the department chair. Thus we hypothesize:

Hypothesis 6 (H6). *Symbolic compliers will respond more to formal organizational mandates than substantive adopters.*

Data, Variables, and Methods

Our empirical analysis uses an original database compiled from administrative records at two prominent research universities with medical schools. We have data for faculty members across 15 matched departments in the two medical schools for the academic years 1991–1999. Our selection of departments was constrained by the degree to which departments were present at both universities. Under the advice of medical school faculty, we selected closely aligned departments—that is, places where similar work was being done despite slight differences in the name of the academic departments.

The 15 departments used in our analysis are presented in Tables 1 and 2. We examined basic science departments such as cell biology, genetics, and immunology. These are high-opportunity departments in which we expect basic scientific discoveries that may easily lead to invention disclosures. Our analysis also included a set of clinical departments that provide primary patient care and are oriented toward a specific specialty such as cardiology, ophthalmology, pediatrics, or psychiatry. These departments include the largest number of medical school faculty. While the department names suggest a primary focus on patient care, the expectation is that faculty members also have an active research program. Finally, our selection included departments such as anesthesiology, pathology, radiology, and surgery that are oriented toward providing patient services and are ancillary to other departments. These departments are termed nexus departments. Our interviews suggest that faculty in these departments may be in a position to engage in greater inventive activity because they consult with multiple departments and may have more opportunity to learn from other faculty members. In addition, our interviews suggest that nexus departments have a practical problem-solving focus that promotes user-defined inventions.

Table 2 demonstrates the great variation in the rank of faculty members who disclose in each department.[16] For example, at University A Medical School, nearly half of the junior faculty in Pharmacology disclosed in the three-year period, while only about a quarter of senior faculty disclosed. Yet, in the Genetics Department, all senior faculty members disclosed, while only just over a quarter of junior faculty members disclosed. Table 2 provides information on department chairs who had disclosures in the prior time period. At University A Medical School, 9 of the 15 chairs had a history of disclosing, while 7 of the 15 chairs had a history of disclosing at University B.

We model the probability of disclosing in the current time period as a function of activity observed during the prior time period. We have a simple two-period model. The decision to file disclosures at time t is a function of

Table 2 Difference in Disclosures by Medical School Faculty by Department

		University A faculty disclosing: 1996–1998				University B faculty disclosing: 1996–1998			
			Percentage of faculty disclosing (%)				Percentage of faculty disclosing (%)		
Department	Type	Chair discloses	Full professor	Associate professor	Assistant professor	Chair discloses	Assistant professor	Associate professor	Assistant professor
Anesthesiology	Nexus	No	0	24	15	No	20	19	13
Cardiology	Clinical	Yes	33	31	17	Yes	29	46	25
Cell biology	Basic	Yes	27	0	39	No	17	25	60
Genetics	Basic	No	100	100	29	Yes	54	50	50
Immunology	Basic	Yes	54	20	25	Yes	60	57	75
Microbiology	Basic	Yes	38	0	25	Yes	45	17	100
Ophthalmology	Clinical	Yes	38	0	16	No	28	14	15
Pathology	Nexus	Yes	25	10	13	Yes	27	26	35
Pharmacology	Basic	Yes	23	25	47	Yes	69	100	66
Radiology	Nexus	No	24	5	12	Yes	31	23	10
Neurobiology	Basic	Yes	30	38	33	No	41	58	22
OB/GYN	Clinical	No	0	33	5	No	29	0	2
Pediatrics	Clinical	Yes	21	12	2	No	13	17	7
Psychiatry	Clinical	No	10	7	3	No	5	5	3
Surgery	Nexus	No	13	29	8	No	26	15	7

individual attributes and the behavior of the local cohort observed in the time period, $t-1$. Our dependent variable indicates disclosure activity in the academic year 1996–1997 through the academic year 1998–1999. We used a three-year window to track disclosures, chosen to capture a reasonable time period during which an individual faculty member might have results to disclose. The dependent variable is equal to zero if the individual did not file an invention disclosure in the three-year window for 1996–1998. The dependent variable is equal to one if the individual filed one or more invention disclosures. The probability of disclosing is estimated using a probit model (Maddala 1983).

The independent variables are measured for the prior time period, academic year 1991–1992 through academic year 1995–1996. This study period reflects a time of relative stability in terms of technology transfer policies at both institutions. Both TTOs opened in the late 1980s and had become established by 1991. Personnel records, university course catalogues and archival data were used to build records for faculty members. Data on disclosures are from the records of the TTOs at the two universities.

To test our hypothesis, we first estimate the training, leadership, and cohort effects on the observed filing of disclosures. We use three variables to investigate training effects. The first two variables capture the technology transfer culture of the institution where the faculty member received their graduate training. Certain universities have historically had greater receptiveness to, and greater involvement in, technology transfer activities than others. The intensity of a university's technology transfer culture can be proxied using the institution's patenting history (Mowery and Ziedonis 2002). We calculate the total number of patents applied for by an individual's graduate institution in the five years preceding the date of the faculty member's graduate degree. This is intended to capture the activity at the time that the individual was in training at the institution. To the extent that individuals' attitudes toward technology transfer are influenced by norms that they are exposed to during training, we expect that individuals educated at universities active in patenting will have a greater predisposition toward technology transfer, ceteras paribus. Stanford, mentioned several times in faculty interviews, stands out as a well-known example of a protechnology transfer university with a strong history of patenting activity. As such, we code a Stanford dummy variable equal to one if an individual has an advanced degree from Stanford, as a simple alternative measure of protechnology transfer imprinting.

Our third measure of protechnology transfer exposure explicitly captures the era in which the faculty member was trained. As noted earlier, the acceptance of technology transfer activities at most universities has increased substantially over the past few decades. To capture the timing effect associated with the individual's training, or experience years, we measure the number of years since the faculty member received their last advanced degree.

To explore the influence of key leadership on faculty's propensity to disclose, we include a dummy variable indicating whether or not the chair has disclosed an invention to the TTO in the 1991–1995 time period. This variable is coded 1 for yes, and 0 for no. It should be noted that the chairs of the medical school departments typically hold this leadership position for extended periods of time and there was no turnover in the chair in any of the departments during the period studied. We define an individual's cohort as those individuals of the same rank in the same department. The cohort effect is measured as the percentage of faculty at the same rank within the department who disclosed in the 1991–1995 time period.[17]

We include several control variables in the estimation. First, academic scientists may only file disclosures when they have results to disclose. Research productivity will matter. To control for this variation, we collected data on the total numbers of publications in the 1991–1995 time period for each of the scientists in our database using ISI Web of Science. Next, disclosure behavior may be influenced by the quality of the individual faculty member and the overall quality of the department. One measure of academic quality is research awards from NIH, which is the most prominent source of medical school and life sciences funding in the world. These research awards are highly competitive and may be interpreted as a sign of ability to conduct high-quality research. To control for the potential effect of individual ability, we include a dollar measure of NIH funding received by each faculty member in the previous time period. To control for departmental quality, we use the amount of NIH funding received by the department in 1998, normalized by department size.[18]

In addition, we also include two controls for individual inventive capacity. Entrepreneurial research has shown that individuals with interdisciplinary educational backgrounds are better positioned to recognize, and then act upon, innovation opportunities (Venkataraman 1997, Shane 2000). One sign of a breadth of knowledge is the subsequent appointment of a faculty member to multiple departments. As such, we include a boundary-spanning dummy variable, coded 1, if the faculty member is associated with more than one academic department. A second indication of breadth of knowledge is the attainment of multiple graduate degrees. Individuals who hold both a Ph.D. and an M.D. are expected to have training that encompasses research and practical application. In this respect, they may be in an advantageous position to develop new inventions with an eye to the commercial potential. Thus we include a dummy variable, coded as 1, to capture those individuals having both M.D.'s and Ph.D.'s. We also control for the number of

Figure 1 Alignment Between Training Norms and Localized Social Norms

Localized social norms	Training: Tech transfer norms	Training: No tech transfer norms
Cohort active in disclosing	I. Alignment toward disclosure ($n = 25$) New norms = 1	II. Pressure to disclosure ($n = 181$) Pressured = 1
Cohort not active in disclosing	III. Pressure to revert toward traditional norms ($n = 122$) Leading edge = 1	IV. Alignment toward traditional norms ($n = 1{,}452$) Traditional norms = 1

previous disclosures for each faculty member; we expect those individuals who have disclosed in the past to likely continue this behavior.

As a rough measure of technical opportunity, we include dummy variables to control for department type, basic science and nexus, with clinical as the omitted variable. We add rank dummy variables to control for faculty rank and a non-U.S. dummy to capture the effects of having been trained at a foreign institution. Finally, we include a university dummy variable to control for heterogeneity between the two TTOs and other institutional differences between the two universities.

To test H5, the effect of dissonance, we include a set of independent variables to consider how the individual's training experience may be situated in a local environment. According to the matrix in Figure 1, there are four potential combinations depending on whether the individual had been exposed to technology transfer norms during his or her professional training and whether the individual was part of a cohort that was active in disclosing. In the two groups along the diagonal, the training norms and local norms are aligned (Cells I and IV), and in the other two groups, these norms are in conflict (Cells II and III).

To characterize the local work environment, we consider cohort participation in the prior time period.[19] The mean cohort participation was 0.176 with a standard deviation of 0.154. We used the mean plus one standard deviation as the threshold for a sufficient number of individuals participating in tech transfer to create a local work environment that favored the new norms of active technology transfer. If one-third or more of the cohort participated in tech transfer, we consider the local work environment to be favorable toward technology transfer. If less than one-third of the cohort participated, then the traditional norms prevail. There were 206 individuals ($25 + 181$) in cohorts where technology transfer had gained traction.

Next, to characterize the individual's training environment, we use patenting activity at the graduate institution in the five years while the individual was training. The range was from 0 to 114, a highly skewed distribution with a mean of 5.33 and a standard deviation of 9.96. To provide sufficient representation in each quadrant, the threshold used to characterize protech transfer training environments was 19 patents at the graduate institution (mean + 1.5 standard deviations). There were 147 ($25 + 122$) individuals who trained with protech transfer norms.

The majority of the academics are aligned toward the traditional norms. Cell IV, individuals whose training and social situation are aligned and provide no incentive to engage in invention disclosure, is the most populous in the database. Cell I, the protech transfer alignment cell, has the fewest members. These 25 individuals both trained with tech transfer norms and were located in cohorts that were actively disclosing, reflecting an alignment of training and local environment. As expected, virtually all of these individuals disclosed and were among the most active disclosers in our study. Both cells that reflect individuals facing dissonance are populated at a moderate level. Cell III captures individuals who trained with the newer norms of academic entrepreneurship, but now face local cohorts who are not actively engaged in technology transfer. We coded dummy variables to reflect which quadrant the individual inhabited.

To test H6, the differences between symbolic and substantive disclosers, we define new dependent variables. Symbolic is a dummy variable equal to one for those individuals who disclosed once in the current time period and had no more than one disclosure in the previous time period. Substantive is a dummy variable equal to one if the individual had more than one disclosure in the current time period. There were 168 symbolic individuals and 136 individuals who were considered substantive.

Descriptive statistics are presented in Table 3 and correlations are in Table 4. Correlations are generally low to moderate. Multicollinearity is generally not a problem for the estimations.

Results

Table 5 provides results for medical school faculty members in the selected departments at the two medical schools.[20] Model (1) provides a baseline model. The number of publications in the prior time period has a positive and statistically significant effect on the propensity to disclose in the current time period ($p < 0.01$). This finding, in line with prior research, suggests that commercialization activity and traditional academic publication activity are complementary (Powell and Owen-Smith 1998, Stuart and Ding 2006, Zucker et al. 1998). Each additional publication increases the likelihood of disclosing by 0.1%. The number of disclosures in the prior time period also has a strong and statistically significant effect on the propensity to disclose in the current time period. This is, of course, to be expected as

Table 3 Descriptive Statistics

Variable	Mean	Std. dev.	Min.	Max.
Disclosure filed in current time period	0.170	0.376	0	1
Number of disclosures, current time period	0.391	1.475	0	36
Years since last graduate degree	23.216	9.401	3	60
Graduate institution patent activity	5.325	9.959	0	114
Stanford graduate degree dummy variable	0.014	0.118	0	1
Chair discloses, prior time period	0.375	0.484	0	1
Cohort disclosures, prior time period	0.176	0.154	0	1
Outside cohort disclosures, prior time period	0.191	0.135	0.020	0.830
Number of papers	13.892	21.583	0	470
Number of previous disclosures	0.515	1.813	0	31
Non-U.S. degree	0.113	0.317	0	1
Boundary-spanning individual	0.337	0.473	0	1
Dual degree, holds both Ph.D. and M.D.	0.074	0.262	0	1
Full professor	0.260	0.439	0	1
Assistant professor	0.458	0.498	0	1
Individual NIH awards ($1,000)	614.991	1,864.046	0	19,597
Department NIH awards ($1,000)	157.667	297.726	2.955	2,000
Basic science department	0.142	0.349	0	1
Nexus science department	0.411	0.492	0	1
University dummy variable	0.496	0.500	0	1
Symbolic participant in invention disclosures	0.094	0.292	0	1
Substantive participant in invention disclosures	0.076	0.265	0	1
Leading edge (Figure 1: Cell III)	0.069	0.253	0	1
Pressured (Figure 1: Cell II)	0.102	0.302	0	1

individuals tend to repeat established behaviors. Those who have previously disclosed are likely to continue this behavior if the experience was reasonable. Interestingly, the amount of individual NIH funding is not statistically significant in this estimation. Individual quality, as captured by individual NIH awards, does not appear to play a deterministic role in promoting disclosure activity. However, we do find that department quality, as captured by departmental NIH awards, is positively and significantly related to disclosure activity ($p < 0.01$). Faculty members from higher quality academic departments are more likely to participate in technology transfer activities. Faculty trained outside the United States are also significantly more likely to disclose inventions than those trained in the United States ($p < 0.001$). This finding is consistent with other studies that document high levels of entrepreneurial activity in many immigrant communities (Aldrich 1999, Saxenian 2002).

Measures of training breadth also contribute explanatory power. First, the coefficient on the dual-degree dummy variable is positive and significant ($p < 0.001$). Individuals having earned both an M.D. and a Ph.D. show a greater propensity to disclose than colleagues with single degrees. Holding both degrees increases the probability of disclosing by 13%. We also find a strong positive relationship between occupying a boundary position at the medical school and the likelihood of disclosure. Boundary spanning individuals, those with appointments in more than one academic department, are 4% more likely to disclose. Faculty in basic science and nexus departments are significantly more likely to disclose than faculty in clinical departments, the omitted category. This may reflect the more patient-oriented nature of departments like pediatrics and psychiatry, however, it should be noted that individuals in these departments do disclose inventions, and the expectation at prominent medical schools is that all faculty conduct research. Academic rank, using the rank of associate professor as the omitted category, is not statistically significant in this specification. Finally, we find no significant differences between the two universities.

Model (2) builds on the basic specification by adding the training (social imprinting) variables. The explanatory power of the model increases significantly with the addition of the independent variables of theoretical interest. A likelihood ratio test comparing Model (2) to Model (1) is significant with a p-value less than 0.01. Experience years, calculated as the number of years since the last graduate degree, is negatively and significantly related to participation in technology transfer ($p < 0.001$): the probability of disclosing decreases by 1% for each year since the completion of graduate study. This result, which supports H2, indicates that the earlier an individual completed her training, the less likely she was to pursue commercialization opportunities. Model (2) also adds in the influence of completing graduate training at historically protechnology transfer institutions. The coefficient on the institution patent activity variable is positive and significant ($p < 0.05$). A 1% increase in patenting activity at the institution

Table 4 Correlations

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1 Disclosure filed in current time period	1.00																						
2 Years since last graduate degree	−0.15	1.00																					
3 Graduate institution patent activity	0.15	−0.49	1.00																				
4 Stanford graduate degree	0.16	−0.05	0.21	1.00																			
5 Chair discloses, prior time period	0.19	0.01	0.01	0.08	1.00																		
6 Cohort discloses, prior time period	0.26	0.08	0.03	0.11	0.48	1.00																	
7 Outside cohort discloses, prior time period	0.17	−0.03	0.06	0.13	0.57	0.32	1.00																
8 Number of papers	0.23	0.00	0.05	0.03	0.12	0.29	0.05	1.00															
9 Number of previous disclosures	0.39	−0.04	0.06	0.11	0.14	0.28	0.13	0.38	1.00														
10 Non-U.S. degree	0.05	0.01	−0.18	−0.04	−0.01	0.00	−0.03	−0.06	−0.02	1.00													
11 Boundary-spanning individual	0.16	−0.01	0.04	0.04	0.13	0.26	0.10	0.24	0.15	0.00	1.00												
12 Dual degree, holds both Ph.D. and M.D.	0.16	−0.10	0.12	0.11	0.12	0.16	0.10	0.07	0.08	−0.01	0.16	1.00											
13 Full professor	0.10	0.39	−0.20	0.01	0.13	0.39	−0.04	0.34	0.16	−0.02	0.18	0.01	1.00										
14 Assistant professor	−0.11	−0.31	0.17	−0.03	−0.14	−0.43	0.03	−0.33	−0.15	0.00	−0.24	−0.08	−0.54	1.00									
15 Individual NIH awards ($1,000)	0.16	0.10	−0.04	0.01	0.12	0.24	0.05	0.38	0.24	−0.02	0.15	0.06	0.32	−0.23	1.00								
16 Department NIH awards ($1,000)	0.09	−0.05	0.03	0.00	0.36	0.18	0.16	0.06	0.04	−0.02	−0.08	0.08	0.08	−0.09	0.04	1.00							
17 Basic science department	0.20	−0.02	0.09	0.13	0.48	0.37	0.29	0.11	0.15	−0.06	0.17	0.09	0.16	−0.16	0.17	0.09	1.00						
18 Nexus science department	0.01	−0.04	0.00	−0.04	−0.12	0.08	0.04	0.01	0.00	0.10	0.08	0.00	−0.01	0.02	−0.04	−0.23	−0.34	1.00					
19 University dummy variable	−0.05	0.08	−0.13	−0.03	0.14	−0.14	0.04	−0.09	−0.06	−0.05	−0.23	−0.07	−0.01	0.09	−0.03	−0.05	0.06	−0.01	1.00				
20 Symbolic participation in invention disclosures	0.71	−0.10	0.09	0.04	0.10	0.09	0.09	0.11	0.09	0.01	0.10	0.06	0.05	−0.07	0.10	0.05	0.09	0.03	−0.03	1.00			
21 Substantive participation in inventions disclosures	0.63	−0.11	0.12	0.18	0.16	0.27	0.14	0.20	0.45	0.06	0.12	0.17	0.09	−0.08	0.11	0.08	0.19	−0.02	−0.03	−0.09	1.00		
22 Leading edge	0.07	−0.32	0.75	0.10	−0.05	−0.09	−0.01	0.03	0.00	−0.10	0.00	0.04	−0.16	0.17	−0.06	0.03	0.02	0.00	−0.08	n/a	n/a	1.00	
23 Pressured	0.18	0.10	−0.07	0.10	0.42	0.68	0.33	0.17	0.19	0.03	0.22	0.09	0.27	−0.25	0.21	0.08	0.33	−0.01	−0.10	n/a	n/a	−0.09	1.00

Table 5 Probability of Disclosing

	Probit model: Dependent variable = disclosure filed (0, 1)					
Variables	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
Years since last graduate degree		−0.031*** (0.006)	−0.037*** (0.006)	−0.032*** (0.006)	−0.025*** (0.006)	−0.024*** (0.006)
Graduate institution patent activity		0.010* (0.004)		0.010** (0.004)	0.009* (0.004)	0.009* (0.004)
Stanford graduate degree			0.880** (0.294)			
Chair discloses, prior time period				0.194* (0.103)	0.112 (0.111)	
Cohort disclosures, prior time period					0.553* (0.315)	0.558* (0.305)
Outside cohort disclosures, prior time period						0.422 (0.310)
Number of papers	0.005** (0.002)	0.003+ (0.002)	0.003+ (0.002)	0.003+ (0.002)	0.004* (0.002)	0.004* (0.002)
Number of prior disclosures	0.362*** (0.033)	0.348*** (0.033)	0.339*** (0.033)	0.342*** (0.033)	0.336*** (0.034)	0.335*** (0.034)
Non-U.S. degree	0.351** (0.114)	0.446*** (0.120)	0.394*** (0.117)	0.438*** (0.121)	0.428*** (0.120)	0.432*** (0.120)
Boundary-spanning individual	0.190* (0.088)	0.183* (0.090)	0.188* (0.090)	0.166+ (0.090)	0.189* (0.090)	0.193* (0.090)
Dual degree, holds both Ph.D. and M.D.	0.500*** (0.129)	0.418*** (0.131)	0.413** (0.132)	0.406** (0.131)	0.407** (0.131)	0.403** (0.132)
Full professor	−0.070 (0.108)	0.196+ (0.116)	0.189 (0.117)	0.202+ (0.117)		
Assistant professor	−0.011 (0.098)	−0.202+ (0.104)	−0.188+ (0.104)	−0.205* (0.104)		
Individual NIH awards	0.011 (0.021)	0.020 (0.022)	0.021 (0.022)	0.019 (0.022)	0.026 (0.021)	0.027 (0.021)
Department NIH awards	0.396*** (0.123)	0.338** (0.124)	0.348** (0.124)	0.228+ (0.138)	0.264* (0.138)	0.294* (0.129)
Basic science department	0.623*** (0.115)	0.537*** (0.118)	0.524*** (0.119)	0.416** (0.134)	0.422** (0.135)	0.438*** (0.129)
Nexus science department	0.250** (0.093)	0.225* (0.096)	0.230* (0.096)	0.195* (0.097)	0.166+ (0.098)	0.157 (0.099)
University dummy variable	−0.020 (0.082)	0.049 (0.085)	0.033 (0.084)	0.027 (0.086)	0.035 (0.087)	0.050 (0.085)
Constant	−1.696*** (0.114)	−1.050*** (0.191)	−0.867*** (0.172)	−1.043*** (0.192)	−1.319*** (0.168)	−1.376*** (0.172)
N	1,780	1,780	1,780	1,780	1,780	1,780
Log likelihood	−632.685	−607.346	−605.560	−605.587	−609.124	−608.715
Pseudo R^2	0.221	0.252	0.254	0.254	0.250	0.251

Note. Two-tailed tests for controls, one-tailed tests for hypothesized variables.
$^{+}p < 0.10$, $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

where an individual received his or her graduate training is associated with a 0.2% increase in the probability that the individual will disclose. In Model (3), we use the alternative measure of protechnology culture imprinting—receiving a graduate degree from Stanford. The effect of training at Stanford University, an institution that is particularly protechnology transfer was mentioned in several interviews. The coefficient on the Stanford degree dummy is positive and significant. Holding a Stanford degree increases the probability of engaging in technology transfer by 27%, all other things being equal. Thus, H1 is also supported: individuals whose graduate training incorporated technology transfer objectives are more likely to disclose inventions.

Though generally consistent, there is one noteworthy change to the control variables between Model (1) and Models (2) and (3). With the addition of the social imprinting variables, the rank controls become significant with full professors more likely, and assistant professors less likely to disclose, as compared to associate professors. These results are in line with the human capital argument that those individuals who are well estab-

Table 6 Probability of Disclosing: Department Fixed Effects

Probit model: Dependent variable = disclosure filed (0, 1)			
Variables	Model (1)	Variables (cont'd.)	Model (1)
Years since last graduate degree	−0.024*** (0.005)	Anesthesiology department	0.168 (0.171)
Graduate institution patent activity	0.008* (0.004)	Cardiology department	−0.103 (0.435)
Chair discloses, prior time period	0.100 (0.153)	Cell biology department	0.028 (0.250)
Cohort disclosures, prior time period	0.499+ (0.364)	Genetics department	0.489+ (0.284)
Outside cohort disclosures, prior time period	0.193 (0.402)	Immunology department	0.334 (0.301)
Number of papers	0.004 (0.002)	Neurobiology department	0.300** (0.230)
Number of prior disclosures	0.334*** (0.034)	Obstetrics department	−0.250 (0.229)
Non-U.S. degree	0.427*** (0.123)	Ophthalmology department	0.187 (0.190)
Boundary-spanning training	0.164+ (0.092)	Pathology department	0.0135 (0.207)
Dual degrees, both M.D. and Ph.D.	0.407** (0.133)	Pediatrics department	−0.096 (0.155)
Individual NIH awards	0.030 (0.021)	Pharmacology department	0.053** (0.285)
Department NIH awards	0.227 (0.290)	Psychiatry department	−0.440* (0.188)
University dummy variable	0.044 (0.091)	Radiology department	−0.079 (0.200)
Constant	−1.180*** (0.211)		
N	1,780		
Log likelihood	−603.251		
Pseudo R^2	0.257		

Note. Two-tailed tests for controls, one-tailed tests for hypothesized variables.
$^+p < 0.10$, $^*p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

lished in their academic careers will be more likely to leverage their reputations for commercial gain (Stephan and Levin 1992).

Model (4) investigates the effect of the chair's disclosing behavior and finds some evidence of a leadership effect ($p < 0.05$). It appears that, to a significant degree, individual faculty model their technology transfer behavior on the example set by their department chair. As shown in Model (4), if the chair has disclosed any inventions to the TTO in the past five years, then the probability that the faculty member will disclose increases by 4%. Thus, H3 also receives initial support. Model (5) considers the influence an individual's cohort has on disclosure activity. The coefficient on the cohort variable is positive and significant ($p < 0.05$), suggesting that an individual's disclosure choice is swayed by the actions of those of similar rank within the department, as predicted by H4. We find that a 1% increase in the percentage of faculty disclosing within the relevant cohort increases the probability of an individual disclosing by 12%.

Model (5) includes all independent variables of interest. The coefficients remain consistent for most variables, however, the chair effect is no longer statistically significant. This may be because of multicolinearity between the cohort and chair variables (rho = 0.48). The effect of cohort appears to dominate over the influence of the chair.

Robustness Checks. Though the result in Model (5) is supportive of a local peer effect, it is possible that this finding arises because of shared unobserved characteristics of the department. Common unobservables could lead to commonality of behavior without imitation (Bikhchandani et al. 1992). Manski (2000) notes that one problem that plagues social learning research is unobserved heterogeneity, the ability to distinguish endogenous interactions from correlated effects. To investigate this issue, we ran an additional model that includes an *other* cohort variable, those individuals in the same department but of a different rank, as well as the *own* cohort variable. Specifically, in Model (6), we investigate whether an individual's disclosure decision is differentially influenced by the actions of individuals inside versus outside the focal cohort. Under this specification, the coefficient for own cohort remains positive and significant, while the coefficient for the other cohort variable, although positive, does not reach statistical significance. Finding that only own cohort effects are important indicates that social learning, rather than departmental unobserved variables, is driving our results.

The results hold when we include departmental fixed effects. Table 6 estimates the model with departmental fixed effects. Fourteen academic departments are listed with surgery as the omitted department.

As a further robustness check, we estimate a negative binomial model with the count of the number of disclosures in the second time period, as the dependent variable. The number of current disclosures ranged from 0 to 36, with overdispersion (mean = 0.39 and standard deviation = 1.48). Table 7 demonstrates that the basic effects hold for the number of disclosures that an individual files.

An alternate explanation for our findings could be that selection, rather than socialization, drives the departmental results. Specifically, it could be argued that instead of being influenced by the action of leaders and peers, individuals predisposed to technology transfer are hired in departments supportive of this activity. To test for

Table 7 Number of Disclosures

Negative binomial model: Dependent variable = number of current disclosures	
Variables	Model (1)
Years since last graduate degree	−0.088*** (0.018)
Graduate institution patent activity	0.020+ (0.013)
Chair discloses, prior time period	0.357 (0.386)
Cohort disclosures, prior time period	2.445** (0.964)
Outside cohort disclosures, prior time period	−0.209 (1.058)
Number of papers	0.004* (0.002)
Number of prior disclosures	0.795*** (0.055)
Non-U.S. degree	1.394*** (0.382)
Boundary-spanning individual	0.478+ (0.284)
Dual degree, both Ph.D. and M.D.	1.196** (0.402)
Individual NIH awards	0.096 (0.063)
Department NIH awards	1.020* (0.433)
Basic science department	1.182** (0.423)
Nexus science department	0.600+ (0.317)
University dummy variable	0.340 (0.274)
Constant	−4.196*** (0.589)
N	1,780
Log likelihood	−1,165.384
Pseudo R^2	0.164

Notes. Two-tailed tests for controls, one-tailed tests for hypothesized variables.
$^+p < 0.10$, $^*p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

Table 8 Faculty Members Facing Conflicting Norms

Probit model: Dependent variable = disclosure filed (0, 1) Negative binomial model: Dependent variable = number of current disclosures		
Variables	Probit model Model (1)	Negative binomial model Model (2)
Leading edge	0.190 (0.152)	0.245 (0.246)
Pressured	0.210+ (0.132)	0.414* (0.195)
Years since last graduate degree	−0.027*** (0.005)	−0.048*** (0.009)
Number of papers	0.004* (0.034)	0.014** (0.043)
Non-U.S. degree	0.385*** (0.118)	0.842*** (0.182)
Boundary-spanning individual	0.216* (0.091)	0.279+ (0.145)
Dual degree, both Ph.D. and M.D.	0.415** (0.210)	0.668*** (0.210)
Individual NIH awards	0.023 (0.021)	0.048 (0.040)
Department NIH awards	0.368** (0.125)	0.639*** (0.192)
Basic science department	0.476*** (0.126)	0.850*** (0.195)
Nexus science department	0.215* (0.096)	0.451** (0.162)
University dummy variable	0.051 (0.085)	0.284* (0.138)
Constant	−1.177*** (0.150)	−1.850*** (0.259)
N	1,755	1,755
Log likelihood	−599.522	−1,032.011
Pseudo R^2	0.235	0.149

Notes. Two-tailed tests for controls, one-tailed tests for hypothesized variables.
$^+p < 0.10$, $^*p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

selection effects, we looked at the 190 individuals that were hired by either of the two universities in 1991, the first year of our panel. If selection was, in fact, a dominant determinant of the disclosure dynamic, we would expect to find evidence that department chairs with a history of disclosure would want to encourage technology transfer activity and might hire individuals whose training suggested that they might be more inclined to engage in commercial activity. An independent samples *t* test showed that there was no statistically significant difference ($t = 1.605$; $p > 0.10$) in the likelihood that an individual having a dual (both Ph.D. and M.D.) degree would be hired into a department in which the chair actively disclosed, versus a department with a chair who did not participate in technology transfer activities. Similarly, in a second independent samples *t* test, the hypothesis that the means of the patenting activity of the new hires' graduate institutions were equal across departments, led by technology transfer active versus nonactive chairs, could not be rejected ($t = 1.638$; $p > 0.10$).

As an additional test for selection effects, we ran the analysis on faculty who earned their degree prior to 1980 and joined the faculty prior to 1985. Before the passage of the Bayh-Dole Act in 1980, neither university in our sample had active technology transfer programs—though both established TTOs in the late 1980s. Because the schools did not operate with commercialization intent prior to 1985, there is little risk that before this point new faculty were selected based on being predisposed toward disclosing. Thus, if we restrict our sample to those hired before technology transfer became an organizational initiative, we can reduce the concern that our findings reflect selection rather than socialization. When we run the analysis on this subset, we find that training and cohort effects remain statistically significant in the expected direction.

Dissonance. Table 8 presents results for faculty members facing conflicting norms. Model (1) is a probit model with the dependent variable of current disclosure that we have used previously. We run our basic specification with dummy variables for those individuals who have not been trained with tech transfer norms but now find themselves in an active technology transfer cohort (pressured), and those individuals who have been trained with technology transfer norms but are now in inactive cohorts (leading edge), as defined in Figure 1. Given that the categories were constructed using cohort and graduate institution information, we do not include these variables in the model. There are 25 individuals whose training and cohort activity are aligned with the new norms. We dropped this group from estimation to allow a comparison of individuals in conflict against those individuals whose training and cohort activity are aligned with the traditional academic norms.[21] Thus our omitted category is category IV in Figure 1.

The basic results for the control variables are consistent with our earlier models. We find that the coefficient on the leading-edge dummy variable is positive but not statistically significant. This indicates that those individuals who trained with the new norms, but do not face localized social norms in support of such behavior, revert to the traditional norms and are not differentiated from those individuals in the reference category of traditional norms. The coefficient on the pressured dummy variable is positive and statistically significant ($p < 0.10$). Individuals who are not trained to the new commercialization norms but who work under localized social norms favoring the new activity are more likely to disclose than those individuals with a similar training who do not face this pressure. Indeed, location in an active cohort increases propensity to disclose by 5%, holding other variables constant.

Model (2) is a negative binomial with the count of current disclosures. Again, the control variables are consistent with our robustness check. As in Model (1), leading-edge individuals do not disclose at a greater rate than our reference group—those aligned toward the traditional academic norms. Those individuals who are under pressure to disclose, translate this into a higher and statistically significant level of disclosing. These results suggest that individuals are more responsive to immediate local social pressure than previous professional training.

Symbolic Behavior. Table 9 provides the results of the analysis of the symbolic and substantive adopters of the organizational technology transfer initiative. Symbolic, equal to one for those individuals who disclosed once in the current time period and had no more than one disclosure in the previous time period, is the dependent variable in Models (1)–(3). Substantive, equal to one if the individual had more than one disclosure in the current time period, is the dependent variable for Models (4)–(6).

The models build sequentially and follow the same logic for symbolic and substantive disclosers. Models (1) and (4) include the full slate of control variables and the influence of leader activity. Models (2) and (5) add in the influence of cohort disclosures in the prior time period. Models (3) and (6) include the effect of other cohort disclosures as a robustness check.

In support of H6, we find that symbolic and substantive disclosers appear to respond to different influences. The dollar amount of individual NIH awards is positive and strongly statistically significant ($p < 0.001$) for individuals who engage in symbolic disclosing. This suggests that individuals who engage in symbolic compliance are following the rules as dictated by NIH guidelines. Similarly, the activity of the department chair is also significantly associated with symbolic compliance. Neither individual NIH funding, nor chair activity, is statistically significant for individuals who appear to have internalized the new norms as seen in Models (4)–(6). In contrast, the substantive disclosers appear to be more responsive to local social norms. The coefficient on the cohort variable is positive and statistically significant ($p < 0.001$). Thus the disclosure behavior of the two groups appears to be subject to different influences. Substantive disclosers are more strongly influenced by their local peer groups, an illustration of the link between individual and organization values reflecting strong social identification. The influence of a non-U.S. degree, or status as a dual-degree holder, is statistically significant in the substantive regressions, while not significant for the symbolic individuals.

Discussion and Reflective Conclusions

The process of organizational change is neither straightforward nor simple. This challenge is exacerbated when the organization itself is embedded within a thick institutional context (Meyer and Rowan 1977, DiMaggio and Powell 1983). Certainly, this is the case in our study. University medical schools, like other academic settings, constitute an organizational field that is highly institutionalized and seen as resistant to change. The Mertonian norms of open science have long provided the archetype or template for academics and academic institutions (DiMaggio and Powell 1983). When the external environment changed because of a convergence of legal, political, and economic factors, an alternative archetype of academic entrepreneurship was articulated. The emergence of this alternative template was the first step, but not a sufficient condition for institutional or organizational change (Greenwood and Hinings 1993). Attempts to increase university interaction with industry and facilitate the commercialization of academic research have been ongoing for almost 25 years. Although virtually all universities have created formal TTOs, policies, and procedures, there have been great variations in realized commercial activity. Rather than solely a function of resources, these organizational outcomes appear to reflect differences in the organization's ability to move away from the older, more established norms and embrace new norms of academic entrepreneurship.

Understanding the roots of this difference requires a greater focus on intraorganizational dynamics, as organizations are heterogeneous entities composed of differentiated groups. This study explores individual actions in

Table 9 Probability of Disclosing: Symbolic vs. Substantive Participants in Invention Disclosures

Probit model: Dependent variable = disclosure filed (0, 1)

	Symbolic			Substantive		
Variables	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
Years since last graduate degree	−0.023***	−0.017**	−0.017**	−0.032***	−0.026***	−0.026***
	(0.007)	(0.006)	(0.006)	(0.009)	(0.008)	(0.008)
Graduate institution patent activity	0.008*	0.006+	0.007+	0.008+	0.007	0.007
	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)	(0.006)
Chair discloses, prior time period	0.223*		0.220+	0.165		−0.086
	(0.119)		(0.142)	(0.136)		(0.166)
Cohort disclosures, prior time period		−0.0193	−0.273		1.305***	1.380***
		(0.369)	(0.389)		(0.347)	(0.397)
Outside cohort disclosures, prior time period			0.205			0.052
			(0.409)			(0.445)
Number of papers	0.002	0.003	0.003	0.003	0.003	0.003
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Number of prior disclosures	−0.255***	−0.236***	−0.240***	0.293***	0.279***	0.279***
	(0.070)	(0.070)	(0.071)	(0.029)	(0.029)	(0.029)
Non-U.S. degree	0.196	0.195	0.182	0.634***	0.632***	0.637***
	(0.143)	(0.142)	(0.143)	(0.151)	(0.150)	(0.151)
Boundary-spanning individual	0.084	0.134	0.122	0.092	0.077	0.081
	(0.106)	(0.104)	(0.104)	(0.120)	(0.121)	(0.121)
Dual degree, both Ph.D. and M.D.	0.229	0.257	0.250	0.605***	0.552***	0.552***
	(0.156)	(0.156)	(0.157)	(0.152)	(0.154)	(0.154)
Full professor	0.036			0.371*		
	(0.136)			(0.157)		
Assistant professor	−0.243*			−0.025		
	(0.117)			(0.145)		
Individual NIH awards	0.056*	0.061**	0.062**	−0.018	−0.010	−0.011
	(0.024)	(0.023)	(0.023)	(0.029)	(0.028)	(0.028)
Department NIH awards	0.031	0.191	0.071	0.271	0.272*	0.311+
	(0.167)	(0.153)	(0.167)	(0.172)	(0.160)	(0.176)
Basic science department	0.237	0.406**	0.285+	0.470**	0.392**	0.425*
	(0.155)	(0.148)	(0.158)	(0.173)	(0.163)	(0.177)
Nexus science department	0.178	0.208+	0.188+	0.154	0.057	0.064
	(0.110)	(0.111)	(0.112)	(0.138)	(0.140)	(0.142)
University dummy variable	−0.015	−0.010	−0.047	0.079	0.137	0.150
	(0.099)	(0.098)	(0.100)	(0.114)	(0.115)	(0.118)
Constant	−1.172***	−1.406***	−1.425***	−1.798***	−1.979***	−1.987***
	(0.213)	(0.186)	(0.195)	(0.273)	(0.237)	(0.242)
N	1,780	1,780	1,780	1,780	1,780	1,780
Log likelihood	−432.072	−436.455	−434.350	−322.792	−319.721	−319.582
Pseudo R^2	0.072	0.062	0.067	0.325	0.331	0.331

Notes. Two-tailed tests for controls, one-tailed tests for hypothesized variables.
$^+p < 0.10$, $^*p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

the organizational context to understand the link between intraorganizational dynamics and organizational change. Specifically, we examine participation in university technology transfer as a new organizational initiative. Our work relies on tracking a large sample of individuals, examining their backgrounds and work environments, and following their invention disclosure activities, which signal their engagement with academic entrepreneurship. We find that adoption of the new initiative by individuals may be either substantive or symbolic. Our results suggest that individual attributes, while important, are conditioned by the local work environment. In terms of personal attributes, individuals are more likely to disclose inventions if they trained at institutions that have long established and relatively successful technology transfer operations. In addition, we find that the longer the elapsed time since graduate training, the less likely the faculty member was to actively embrace the new commercialization norm. Considering the localized social environment, we find that when the chair of the department is active in technology transfer, other members of the department are also likely to disclose, if only for symbolic reasons. We also find that technology transfer behavior is calibrated by the experience of those in a similar position, in terms of academic rank and departmental affiliation. If individuals can observe others at their academic rank disclosing, then they are more likely to follow with substantive compliance, other things being equal. Finally, when individuals face dissonance, a situation where their individual training norms are not congruent with the localized social norms in their work environment, they will conform to the localized norms rather than sticking with the norms from their prior experience.

Our results imply that social learning and local context influence an individual's decision to follow strategic initiatives and participate in new activities. However, we do not interpret these results as justifying the conclusion that selection plays no role in the adoption dynamic. Rather, both selection and socialization may be material in promoting organizational change (Kraatz and Moore 2002). The challenge for future research is to disentangle the contributions of these alternative drivers to better understand under what circumstances one is likely more pertinent than the other. Another challenge is clarifying what individuals specifically learn through social interactions. The decision to accept the institution's strategic initiative and actively participate in technology transfer may be driven by the legitimization of the practice that comes from the internalization of local behavioral norms. On the other hand, the decision to disclose may reflect a lowering of the cost to the faculty member of adopting this organizational innovation, because of the enhanced operational knowledge gained through exposure to the process. Our interviews suggest that both factors have been influential. However, the question remains as to whether the message received differs systematically across individuals, and/or over time, and how this affects the diffusion of the initiative. Future research that investigates these issues is clearly warranted.

In sum, introducing strategic initiatives requires thinking creatively about the process of organizational change and the influence of microorganizational social processes. Although the academic environment is unique in many respects, the findings of this study should have value for other organizations attempting to embrace new initiatives. Our study provides insights into the multilevel attributes of the change process, the importance of departmental (or subunit) composition and localized learning in promoting organizational change, and the tensions faced, and the response mechanisms employed, when individuals are subject to new expectations. Individual characteristics matter. However, they alone are not fully deterministic, as individuals respond to leaders and their local context. Even if subunit leaders do not participate in the strategic initiatives, this is not an insurmountable obstacle, as individuals may adopt the new behavior when they are able to observe their peers participating. The importance of localized learning through interaction with cohorts of similar individuals is provocative and suggests that internal configuration within the organization matters. Promoting new initiatives may be more likely when individuals are concentrated in the same work units, and thus able to support each other.

Additional insight can be gained, and prescriptions offered, by considering the role of dissonance and symbolic compliance in the change process. Individuals have multiple motives in their job performance and the management of their careers. Individuals facing conflicting norms may resolve discord by reverting to the prevalent localized norms. The need for a concentration in cohort activity, in combination with the potential reversion of leading-edge individuals, exacerbates the challenge of promoting organizational change. However, the option of symbolic disclosure suggests a potential strategy: An early emphasis on, and enforcement of, organizational rules may be beneficial in forestalling reversion to the prevailing norms, while also generating new symbolic compliers. In turn, this may create a critical mass that legitimizes the new initiative and provides the traction necessary to convert previously symbolic compliers into substantive compliers. Through this process organizational initiatives may be successfully realized, as the new archetype becomes the dominant norm. Our results suggest that successfully adopting strategic initiatives requires understanding organization heterogeneity, subunit dynamics, and the factors that influence individual compliance. This is suggestive of a more bottoms-up approach to organizational change and may mean rethinking how resources are allocated when implementing new initiatives.

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Endnotes

[1]Jensen et al. (2003) title a paper "The Disclosure and Licensing of University Inventions: Doing the Best We Can with the S**t We Get to Work With"—the title is from an interview with a technology transfer administrator who was bemoaning differential quality of faculty disclosures.

[2]Mowery et al. (1999) note that about 20% of disclosures were patented after six years, indicating that greater scrutiny accompanies the postdisclosure stage of the technology transfer process.

[3]It is common for the TTO at both institutions to delay initiation of the patenting process for an individual disclosure until a firm has signed on as a licensee. This helps with the office's

cash flow, as the licensing firm is then required to cover the patenting costs.

[4]Other individuals, such as staff, graduate students, and postdoctorates may disclose inventions, but this is a small percentage of activity. Disclosures that do involve nonfaculty are likely to have at least one faculty member listed as an inventor.

[5]The number of faculty members who have filed invention disclosures captures those who have disclosed in the three-year period, 1996–1998. This does not correspond directly to the absolute count of disclosures because more than one faculty member may be listed on a single disclosure. If a faculty member appeared on an invention disclosure, they are counted as having filed a disclosure.

[6]We use the term *invention disclosure events* to capture the number of times that an individual was listed on an invention disclosure.

[7]We conducted more than 50 interviews with technology transfer officials, university administrators, and faculty members as background for this study.

[8]Departments may *sweeten the deal* by distributing a share of their third of the royalties to the inventing faculty members' lab. This practice was first used to encourage technology transfer; however, it is now a well-established practice across departments at both universities.

[9]In a similar vein, Finnemore and Sikkink (1998, p. 905) argue: "Professional training does more than simply transfer technical knowledge; it actively socializes people to value certain things above others."

[10]In another context, Schewe and Meredith (1994) highlight vintage effects showing that an individual's attitude toward jobs, money, and savings is significantly influenced by the conditions encountered when the individual first becomes an "economic adult."

[11]This was mentioned as a problem in several interviews. While the university may promote technology transfer, if the department has not embraced it, then the individual will face difficulties. There is no hard and fast rule for evaluating technology transfer activity relative to academic work. We have been told that the MIT electrical engineering department values a patent as much as an academic article in a high-quality journal, although there does not appear to be any quantification of these trade-offs at the two universities examined here (Agrawal and Henderson 2002).

[12]The chair has a role in hiring decisions and could select individuals with similar technology transfer attitudes. Interview evidence revealed that criteria other than technology transfer are more important in hiring decisions. Robustness tests were conducted to confirm that selection biases were not significant in this context. These tests are described in detail in the results section of the paper.

[13]In sum, faculty use social cues to discern what type of behavior to pursue. This process is not inconsistent with individual utility maximization.

[14]Festinger considered the social group as an important source of dissonance noting, "The open expression of disagreement in a group leads to the existence of cognitive dissonance in the members. The knowledge that some other person, generally like oneself, holds one opinion is dissonant with holding a contrary opinion." (Festinger 1957, pp. 261–262).

[15]This type of symbolic response by an individual is akin to the adoption of symbolic structures by organizations in response to changes in the legal environment (Edelman 1990, 1992). The actions chosen may be those that confer legitimacy while being minimally disruptive to the status quo.

[16]A paired sample t-test of the equivalence of the percentage of faculty reveals that there are statistically significant differences at the two institutions ($t = -2.441$, 44 d.f.).

[17]We used the rank of the faculty member in 1993, the midpoint of the first period, to construct the cohort variables. Given the relatively long tenure process in medical schools, we find that few faculty members in the database changed ranks in the 1991–1995 period. Results are robust to using alternative anchors such as the rank at the beginning or end of the time period.

[18]The Association of American Medical Colleges uses NIH funding to differentiate quality among departments across schools. http://www.aamc.org/medicalschools.htm.

[19]When the faculty is segmented by cohort and training, there is not substantial variation among the disclosure behavior of the chair in the study time period. Unfortunately, there was not enough variation to consider the three-way conflict between training, cohort, and leadership effects.

[20]The sample size varies from the total reported in Table 1 because of missing data and movement of faculty.

[21]This yields 1,755 observations for our estimation in Table 8.

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