



Academics or entrepreneurs? Investigating role identity modification of university scientists involved in commercialization activity

Sanjay Jain ^{a,*}, Gerard George ^{b,1}, Mark Maltarich ^{c,2}

^a San Francisco State University, Department of Management, 1600 Holloway Avenue, San Francisco, CA 94132, United States

^b Imperial College London, Business School, South Kensington Campus, London SW7 2AZ, United Kingdom

^c Saint Ambrose University, Department of Managerial Studies, 518W. Locust St., Davenport, IA 52803, United States

ARTICLE INFO

Article history:

Received 9 May 2006

Received in revised form 25 February 2009

Accepted 27 February 2009

Available online 3 April 2009

Keywords:

Academic entrepreneurship

Role identity

Identity work

Technology transfer policy

ABSTRACT

Establishing the microfoundations of academic entrepreneurship requires closer scrutiny of a key actor contributing to this phenomenon—the university scientist. We investigate the sense-making that scientists engage in as part of their participation in technology transfer and postulate that this process involves a potential modification in their role identity. We analyzed more than 70 h of interview data at a premier U.S. public research university. We observe that scientists invoke rationales for involvement that are congruent with their academic role identity. They typically adopt a hybrid role identity that comprises a focal academic self and a secondary commercial persona. We delineate two mechanisms – *delegating* and *buffering* – that these individuals deploy to facilitate such salience in their hybrid role identity. Overall, these patterns suggest that university scientists take active steps to preserve their academic role identity even as they participate in technology transfer. Our findings clarify the social psychological processes underlying scientist involvement in commercialization activity, and offer fresh insights to the academic entrepreneurship, science policy and role identity literatures.

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1. Introduction

There is a growing interest in understanding the microfoundations of academic entrepreneurship (Louis et al., 1989; Shane, 2004). This partly stems from the emphasis across universities to create organizational structures that encourage technology transfer to commercial entities through the licensing of patents or the creation of new ventures. While the norm of open science with the goal of publication and widespread dissemination of findings has dominated academia historically, the past decade has witnessed a remarkable change in the disposition of universities towards commercialization activity (Etzkowitz, 1998; Owen-Smith, 2005). Now these institutions are taking an increasingly proactive role in funneling academic research from the laboratory bench to the commercial market, as evidenced by the proliferation of studies that examine this phenomena at different levels of analysis—technology (Jain and George, 2007; Murray, 2002), university (Dasgupta and David, 1994; Rosenberg and Nelson, 1994), technology transfer offices (George, 2005; Thursby and Thursby,

2002) and academic spin-outs (Miner et al., 2001; Phan et al., 2005).

Missing from much of this conversation is a deeper understanding of the involvement of a key actor—the university scientist. We contend that in order to gain a better appreciation of the changes being wrought by academic entrepreneurship, it is critical to focus on the scientists. Zucker and Darby's (1996) seminal work on the emergence of the biotechnology industry indicated that star scientists, or prolific publishers of research articles, played a disproportionately significant role in the commercialization of bioscience inventions. Lockett et al. (2005) further highlight the involvement of academic scientists in processes of opportunity search and technology transfer within universities. Indeed, participation by such individuals in the commercialization process is integral to the emergence of new knowledge-intensive fields. And yet, very little is known about the cognitive and social-psychological processes associated with scientists reshaping their career trajectories and pursuing entrepreneurial paths (Audretsch and Erdem, 2004). What kinds of sense-making activity do these individuals undertake as part of getting involved with commercialization endeavors? How do they perceive such participation as impacting their professional persona? And how do they manage their work priorities within this shifting landscape?

Answers to these questions can illuminate key policy debates related to the evolving character of universities. In this regard, a number of influential observers have criticized the commer-

* Corresponding author. Tel.: +1 415 338 2202.

E-mail addresses: sanjay@sfsu.edu (S. Jain), g.george@imperial.ac.uk (G. George), maltarichmark@sau.edu (M. Maltarich).

¹ Tel.: +44 20 7594 1876.

² Tel.: +1 563 333 6119.

cial agenda of universities (Nelson, 2001; Bok, 2003), indicating that commercial activity places universities on a slippery slope that could jeopardize the conduct of open science and make them indistinguishable from firms. Others have articulated apprehension regarding increasing secrecy related to the dissemination of scientific results (Louis et al., 2001). In contrast, some researchers have suggested that a virtuous cycle may exist between involvement in commercialization activity and academic productivity (Azoulay et al., 2008). Other scholars have indicated that universities have long possessed a mixed culture combining basic and applied orientations (Kleinman, 2003). Our study provides a unique window to address these different viewpoints by detailing the perspective of a central actor—the university scientist. Making sense of the sense-making processes that these individuals undertake as part of their engagement with commercialization activity enables us to better understand the cognitive micro-mechanisms underlying technology transfer. In addition, it provides us with a better appreciation of the impact that such involvement is likely to have on the macro-culture of our academic institutions.

To the extent that prior research has postulated factors that influence a scientist's decision to undertake commercialization activity, it can be divided into two perspectives: supply-side and demand-side (Thornton, 1999). The former focuses on examining characteristics and attitudes of individuals and specifies related agency mechanisms. For instance, some academics are attitudinally more predisposed to commercialize their findings or possess idiosyncratic prior knowledge that makes them better able to recognize entrepreneurial opportunity (Etzkowitz, 1983; Azoulay et al., 2007; Shane, 2000). The demand-side perspective, on the other hand, identifies contextual conditions that prompt scientists to engage in technology transfer. Changes in the broader institutional framework (e.g. the Bayh-Dole Act), research funding pressures, institutional histories, culture of the university/department and peer influence have been identified as determinants of a faculty member's decision to transition to entrepreneurship (Etzkowitz, 2002; Kenney and Goe, 2004; Pelz and Andrews, 1976; Stuart and Ding, 2006). While these perspectives are useful, our contention is that in highlighting personal disposition or social context, they offer simplified accounts of actor agency and considerably downplay the introspection and action that these individuals engage in as part of their involvement in such endeavors.

For most scientists at universities, taking the leap into the world of commercialization represents a non-trivial challenge. Such involvement typically requires these individuals to modify their role identity—which is defined in the social psychology literature as a self-view or a meaning attributed to oneself in relation to a specific role (Burke and Tully, 1977). This modification can manifest itself at various levels. It can involve altering the set of activities that constitute a scientist's normal workload. It often entails addressing conflicting pressures that originate from the differing normative cultures of the academic and business worlds. Taken further, it may require a fundamental reassessment of their abilities, beliefs and priorities, and even their view of the meaning of their work. Such role identity modification, in turn, impacts both the manner in which these individuals participate in technology transfer as well as the mechanisms that they put into place (or rely on) to do so. A close examination of the "identity work" (Pratt et al., 2006) that university scientists engage in under these circumstances can provide a deeper theoretical understanding of the drivers and nature of role identity modification as well as offer insights to administrators and policy makers involved in designing interactions between different actors within this context.

In this article, we ask the following research questions: What factors contribute to a university scientist's willingness to modify their role identity as part of their involvement with commercialization activity? How does such role identity modification manifest itself?

And, what mechanisms do these individuals deploy to manage their modified role identity? The results of our qualitative analysis suggest that scientists who participate in commercialization activity invoke rationales for involvement that are congruent with their academic role identity. They typically adopt a hybrid role identity that often comprises a focal academic self and a secondary commercial persona. We delineate two mechanisms – *delegating* and *buffering* – that these individuals deploy to facilitate such salience in their hybrid role identity. Overall, these patterns suggest that scientists take active steps to preserve their academic role identity even as they participate in technology transfer. In illuminating these cognitive and social-psychological micro-dynamics, we offer a new perspective to the discourse on the nature and merits of academic entrepreneurship.

2. Theoretical framing

A promising approach for exploring the underlying sense-making processes of university scientists engaged in commercialization activity lies in invoking the concept of role identity from the social psychology literature. Roles are defined as social positions that carry with them expectations for behavior and obligations to other actors (Merton, 1957). Identity, on the other hand, helps individuals orient to their context, give meaning to their experience, and provide guidelines for action (Gecas, 1982). The concept of role identity was developed to highlight the close link between socially defined elements that underlie a role and an individual's interpretation of that role (McCall and Simmons, 1978). That is, roles guide action in a broad way, but are given fuller meaning when individualized by the occupant (Ibarra, 1999). As a role becomes closely tied to an individual's sense of self or identity, the individual tends to behave in accordance with this role identity. Indeed, there is an established tradition of coupling the role and identity constructs within the field (Barley, 1989; Hughes, 1958; Mead, 1934).

Much of the research using this concept is located within the careers and professions literatures and highlights the subjective experiences – i.e., the perceptions and interpretations – and related actions that actors undertake as part of crafting their role identity. Pratt et al. (2006) examined how medical residents employ customization mechanisms – which they refer to as *enriching*, *patching* and *splinting* – to develop their professional role identity. Ibarra (1999) described how junior consultants and investment bankers adapt to senior roles by experimenting with provisional selves that serve as trials for possible, but not yet fully elaborated role identities. These rich qualitative studies expound on the types of "identity work" that individual's engage in as part of establishing their role identity. They also highlight how the concept of role identity is integral to the manner in which individual's interpret and act in work situations, providing normative support and cognitive focus regarding what constitutes appropriate behaviors and outputs within one's chosen profession.³

The studies reviewed above have examined how individuals construct their role identity during the formative stages of their professional life. Other research has suggested that an individual's subsequent career transitions (involving alterations in their work-role) also induce heightened self-awareness of abilities, interests and beliefs that lead to identity changes as skills, behaviors, and patterns of interaction are adjusted to meet the demands of the new role (Ebaugh, 1988; Louis, 1980; Van Maanen and Schein, 1979). Nicholson (1984) elaborated on the modes of adjustment employed by individuals in response to career transitions. He articulated that such shifts involve varying degrees of *personal development*, in

³ We thank an anonymous reviewer for providing this insight.

which people alter their values or other identity-related attributes and *role development*, in which people change role requirements to better match their individual abilities and identity.

More recently, these ideas have been incorporated into the entrepreneurship literature, with studies that conceptualize the decision of individuals to become entrepreneurs as involving a transition in their role identity (Hoang and Gimeno, 2005). According to this work, a key aspect of an individual's decision to pursue this trajectory involves them comparing the demands of an entrepreneurial role identity to that of a referent (often their own occupation or societal role). This comparison involves an appraisal of the benefits obtained in engaging in this new role vis-à-vis the referent as well as an estimation of the transition costs involved in switching role identity. Such assessments call attention to the sense-making processes that individuals undergo as part of adopting an entrepreneurial persona (George and Bock, 2008).

While both these strands of research highlight the significance of role identity modification as part of an individual's career transitions, they are largely conceptual in nature and do not elucidate the underlying processes that these people engage in as part of such change. Our study aims to address this gap. In particular, we are interested in studying scenarios in which individuals who already possess a well-developed role identity take steps to modify it in directions that represent perceived deviations from their current professional trajectory. While personal and social-structural considerations might precipitate this, the specific interpretations and activities that constitute "identity work" under these circumstances remain unexplored in the literature. Our study examines the following aspects of role identity modification: how does one's extant role identity impact the manner in which individual's recast themselves? How do these actors address conflicts that exist between their extant role identity and the one they intend to adopt? And what processes do they engage in to ensure that such change is sustained? In exploring these issues, our intent is to explicate the underlying micro-mechanisms that individuals employ as part of reconfiguring their entrenched role identity.

We use the case of university scientists – and their growing participation in commercialization activity – as the empirical context to examine these questions and develop theoretical insights. Specifically, we conceptualize a university scientist's sense-making activity when they engage in technology transfer as reflecting potential role identity modification on their part. For scientists, the pursuit of an academic career typically involves an arduous and lengthy training and socialization process (Van Maanen and Schein, 1979). During this period, they are immersed in a normative system that Merton (1968) identified as constituting the ethos of science. The four facets comprising this system include: *universalism*, which implies that scientific observations should be verifiable and independent of the observer; *communism*, implying that scientists share their work with their community for the common good; *disinterestedness*, which suggests that scientists have no emotional or financial attachments to their work, and *organized skepticism*, which refers to the need for scientists to wait until all the facts are in before a judgment is made about a particular theory. Individuals trained along the career path of a university scientist typically undergo a unique set of experiences related to these norms that become inextricably intertwined with their role identity, with such outcomes of academic prestige as publications, citations and peer status becoming relevant (Latour and Woolgar, 1979; Merton, 1957).

For university scientists, participation in commercialization activity typically involves evaluating the demands that an entrepreneurial role identity places on them and then initiating attempts to incorporate these into their persona. This is easier said than done, given the entrenchment of the existing role identity and the fact that these two role identities are often viewed as being the opposite of one another. As Merton (1968, p. 273) observed,

Table 1
Academic and entrepreneurial role identity compared.

	Academic	Entrepreneurial
Norms	Universalism Communism Disinterestedness Skepticism	Uniqueness Private property Passion Optimism
Processes	Experimentation Long-term orientation Individualistic/Small group	Focus Short-term orientation Team management
Outputs	Papers Peer recognition/status	Products Profits

"the communism of the scientific ethos is abstractly incompatible with the definition of technology as 'private property' in a capitalistic economy." Similarly, the academic ideal of disinterestedness exists at odds with the entrepreneurial ideal of passion (Baum and Locke, 2004), which has been referred to as "perhaps the most observed phenomenon of the entrepreneurial process" (Smilor, 1997, p. 7–8). Likewise, the Mertonian belief in skepticism contrasts with the frequently observed entrepreneurial norm of optimism (see Camerer and Lovallo, 1999). Finally, the scientist's notion of universality is often in conflict with an entrepreneur's belief in the need to develop unique and distinctive competencies (Barney, 1991). These normative incongruities are further reflected in the behavioral and output differences that exist between the two role identities. An entrepreneurial orientation typically requires intense single-mindedness of effort, a short-term focus, and an emphasis on execution with products and profit representing the key outcomes (see Table 1). For academics, while the prospect of taking on a role identity that is more commercially focused might sound attractive, it needs to be balanced against the prospect of giving up an existing role identity that is cherished, more stable, and dramatically different to the new one.

Given these incompatibilities, what kinds of "identity work" do university scientists engage in when they get involved with commercialization activity? To answer this question, we developed a qualitative study that seeks to identify reasons behind their willingness to modify their role identity, to characterize the nature of their new role identity and to explicate mechanisms by which they manage their altered role identity. Our analysis highlights the existence of a hybrid role identity among these scientists, as well as elucidates processes that they put into place to maintain such a role identity. In doing so, this study makes key contributions to the role identity and academic entrepreneurship literatures and provides a fresh perspective on the ongoing debate on the changing character of academic institutions. We elaborate on these insights in the sections that follow.

3. Research method

We conducted an inductive study involving over 40 h of in-depth personal interviews of scientists and technology transfer specialists employed at a large public Midwest research university and its technology transfer office. All of the 20 scientists interviewed were tenured faculty, had been involved in some form of commercialization activity and had interacted with the TTO.⁴ By engaging in theoretical sampling, our intent was to capture the integral aspects

⁴ We acknowledge that our sample only includes individuals who have, in most part, retained an academic affiliation while engaging in commercialization activity. It does not include those that have given up their academic position completely and become full-time entrepreneurs—a potential source of bias. However, our conversations with the university's TTO personnel indicated that the number of academics constituting this group is negligible.

Table 2

Descriptive statistics—interviewees.

Designation	College (faculty only)	N	Mean years since degree	Mean years at university	Mean patents issued
Faculty		20	23.7	18.3	19.4 ^a
	Engineering	6	21.8	14.2	13.8
	Agricultural and life sciences	6	26.8	22.0	43.0
	Medicine and public health	5	23.8	16.6	8.2
Faculty that initiated a start-up	Letters and science	3	22.3	22.0	1.7
		10	26.1	20.4	30.8
Administration		6	—	—	—
TTO		2	—	—	—

^a The patenting statistics were considerably influenced by one scientist in the College of Agricultural and life sciences who had 173 patents. This scientist had (very recently) initiated a start-up. If he is removed from the sample, patents per faculty dropped to 11.3. Scientists that had initiated start-ups, on average, still had a higher number of patents compared to those that had not done so.

of the phenomena under examination—i.e., a more comprehensive understanding of these individuals' perceptions related to their participation in technology transfer. Employing such a sampling frame implies that our findings need to be generalized in an analytical rather than statistical sense to similar contexts (Eisenhardt, 1989; Glaser and Strauss, 1967).

Additionally, to refine our interpretive accounts, we relied on about 30 h of interviews conducted by historians through the University's *Oral History Project*, which was established as a division of the University Archives in 1971. The *Project* includes interviews with campus administrators and faculty from the early 1970s onwards. Individually, these interviews reflect the careers of the interviewees; collectively, they constitute a narrative of the history of the university. This source provided us with a window for understanding field-level changes in scientists' role identity over the past few decades.

We used a pooled logic approach to theory building that treats each observation as being part of a larger sample from which patterns are discerned (Yin, 1994).⁵ This method allowed us to explain drivers of role identity modification by leveraging specific referents from our data. Initially, our interviews were unstructured and helped us gain an understanding of the issues associated with university commercialization as well as the idiosyncratic nature of research conducted across departments within the university. Subsequently, we employed a semi-structured approach that facilitated free expression of ideas as well as allowed us to infer themes and compare them across interviews. In total, we conducted 20 interviews with scientists and 8 interviews with administration and technology transfer officials, with the length of each interview ranging from 60 to 90 min. In all cases, our team invested a substantial amount of time in background research on the scientist, which provided us with information on the individual's invention disclosure and patenting behavior, prior entrepreneurial ventures (if any) and history of their interaction with the TTO. These preparatory notes helped enliven the discussion by providing us with cues to engage the scientist in a meaningful conversation.

To ensure accuracy of interpretation, two team members were present for all interviews. Most interviews were audio taped and transcribed and about 15 h of interviews were video taped. One team member conducted the interview while the other observed and made copious notes. Subsequent to the interview, both team members independently prepared transcribed notes for circulation. These were discussed and merged to provide a comprehensive database of interviewee comments. The presence of multiple interviewers increased the reliability of interpretation. To avoid errors from halo effects and other interpretation biases (Strauss and

Corbin, 1998), all team members used the transcribed notes as the basis for developing our preliminary insights. We engaged in an iterative process of marking quotes and concepts on note cards and systematically arranged these cards into specific themes and conceptual categories across interviews. We reviewed our notes to discern patterns relating to multiple appearances of themes across interviewees, consistent with the norms of inductive research (Lee, 1999). This enabled us to explicate key drivers underlying role identity modification as well as the identity work carried out by scientists.

We used transcripts of interviews from the *Oral History Project* in two specific ways. First, we scanned for specific comments on the historical context and the conduct of science. These interviews provided a temporal grounding and documentation for the changing views of science and commercialization within the university. Second, these interviews provided narratives of the constituent elements of academic life. While the *Project* had a different goal, to document the experiences of scientists and administrators as they related to university life, these interviews were useful for gaining a deeper appreciation of the everyday lives, dialogs, controversies, and exemplary moments that defined these individuals' careers.

Our insights, then, were based on more than 70 h of personal and historical semi-structured interviews with faculty (identified as F), administrators (including deans and university-level administrators; identified as A), and technology transfer managers (identified as T). Individuals who initiated a start-up are identified as E (for entrepreneur), and others as N (non-entrepreneur). The notation [F E], for example, represents a faculty member who has also founded a business. Table 2 summarizes some of the characteristics of our interviewees. Our sample had 20 faculty members, 6 administrators and 2 TTO representatives. 10 of our faculty interviewees had started businesses at the time of our interviews. Faculty members in the sample had about 19 patents on average, with those that had initiated start-ups having a higher mean. The emergent themes from our data are discussed next.

4. Role identity modification by university scientists participating in technology transfer

A number of studies have highlighted the involvement of academics in commercialization activity and indicated that the distinction between science and entrepreneurship is increasingly blurred (Owen-Smith and Powell, 2004). According to Etzkowitz (2002), scientists' attitude towards commercial involvement has evolved from opposition to acquiescence to acceptance. Moreover, the designation of "academic entrepreneur" has often been used to describe the involvement of university scientists in forming start-ups related to their inventions (Lockett et al., 2005; Shane, 2004; Stuart and Ding, 2006).

⁵ This is in contrast to a replication logic approach to theory building (Eisenhardt, 1989) in which each case represents an independent unit from which patterns are inferred and then extended to the other cases.

In contrast to externally imposed definitions of academic entrepreneurship (as the one provided above), a number of our interviewees indicated that for them the conceptual break from their academic role identity came when they considered involvement in any form of technology transfer activity that had potential commercial benefit. Participation in such activity was typically preceded by significant sense-making on their part. As an interviewee put it,

The fundamental issue at that time [a decade ago] was that people were very uncomfortable with the prospect of faculty or students, or anybody doing work with university facilities that could personally benefit anybody. Now that has changed. [F E]

In this paper, we suggest that participation in a broad set of commercialization activity – including patenting, licensing, industry research, consulting or the formation of a start-up – typically involves active contemplation by scientists that reflects potential modification of their role identity.

For many scientists, department and institutional norms enabled their participation in commercialization activity, consistent with research on the importance of local context on a scientist's decision to engage in commercialization activity (Louis et al., 1989; Stuart and Ding, 2006; Bercovitz and Feldman, 2008). Along these lines, some of our interviewees indicated that their departments had an applied orientation to start with.

I work in a department that is a very interesting mix of basic and applied science. I think most departments would define themselves one way or the other but plant pathology has always been an integrated field that integrates from the most basic level of how cells work to the most applied level of how farmers keep their crops healthy. So I think it's a natural outcome that we think about applications of our work and thinking about the applications leads to some consideration of patenting [F N]

In other instances, the leadership of the department looked favorably on relationships between faculty and industry. One of them affirmed:

We are actively encouraging faculty to work with industry and we're actively encouraging faculty to file – to disclose any inventions that they make and to have [TTO] file for patents for them. And we're actively encouraging faculty, if it's their inclination, to start companies. [A N]

Echoing this sentiment, a scientist associated with a biomedical device invention stated:

Both the department and the medical school have obviously a very forward-looking view of faculty spin-off and startup companies. They realize, like I do, that it is a way of multiplying their effect in the state and around the world. [F E]

Department norms and policies such as academic workload reduction and part-time appointments provided facilitating conditions for role identity modification by university scientists. However, a more fine-grained understanding of this process requires surfacing the rationales that these individuals invoke for participation in commercialization activity. On this front, our interview data identified a surprisingly wide range of individual-level motivations for involvement in technology transfer that we chronicle below.

Clearly, an important factor driving this process was the economic incentive. However, even here the reasons put forth were often quite nuanced and did not reflect a simple desire to cash in on their laboratory inventions. As one scientist indicated,

I decided not to accept any ownership in their company or accept any fees from them, so there was kind of discordance in where

the rewards were going. For me, I don't mind doing work in the public interest, for which I don't directly get compensated, but if somebody else is earning a large profit on it that seems a little wrong to me. [F E]

In addition to monetary reasons, a large proportion of the scientists indicated that non-economic factors had influenced their decision to initiate commercialization activities. Two salient reasons put forth were: (a) assuming the role of custodian of the nascent technology, and (b) leveraging the invention for a larger societal benefit. Regarding the former, several faculty members were concerned that their inventions could be used in undesirable contexts:

The primary motivation, especially in today's environment, I think, is maintaining some control over your own technology. If you've patented it then you have some voice, at least, in who uses it and how they use it. This is going to be very important in the area of stem cells for example, because there are uses we would rather not see people make of this technology, and I feel a lot more comfortable knowing that [TTO] holds the patents than I would if they were held by a private entity because [private entities] are not accountable to anyone. [A N]

Here, cautionary narratives involving historical referents of faculty who allowed their inventions to enter the public domain, with disastrous results, were often cited. One example was a test for the butterfat content of milk that a professor elected to place in the public domain. Milk producers who invoked his name purportedly abused the university's insignia to certify inappropriately diluted milk. Given that the invention was not patented, there was limited legal recourse.

The second salient benefit invoked in our interviews related to leveraging the invention to generate greater societal impact. Scientists who believed that their technology had the potential to make a substantial improvement to business or society feared that, without commercialization, their improvement would lay fallow on a laboratory shelf or on journal pages. These inventors saw intellectual property protection as a viable means to encourage commercial development.

The minute you publish it, it's in the public domain. Companies cannot afford to develop technology if *anybody* can develop it. They *can* afford to develop a technology if they have 17, 18, 20 years to develop it, because you can expect 5, sometimes 10 years to move through the process of developing a technology. [F E]

Along these lines, this group of scientists indicated that creating an entrepreneurial venture represented a mechanism through which they could realize social benefits by transitioning the technology to the marketplace. As one of them stated,

If you start a company that can take your ideas out from one site to multiple others...it's a tremendous lever. Rather than just affecting 1,000 patients a year – or less because not everything we do would be used on every patient – it's multiplied by the number of clinics that have the equipment. For example, the company we had, the software to calculate dosage in radiation therapy for cancer has been used to treat two million patients throughout the world. [F E]

One scientist emphasized that creating a new venture to get the technology to market represented one of many ways in which they had a broader societal impact. According to him,

The way I looked at the new company was that it allows me to bring the technology out of my lab. It is no use for academic research if it is not put to test or good use in the society...The

way professors look at their career accomplishments is through their publications or graduate students. By the time a student graduates and sets up a lab and conducts high quality research it takes say 10 years or more. That is when we can say, see what we've done...there is good in that. But for a company, we can perhaps do that in five years or so. They are not the same thing and they do not compete but they are both ways in which we can realize that what we are working on is useful to humanity in some way. [F E]

Interestingly, for a significant proportion of our interviewees that were involved with initiating a start-up, this course of action was selected only after a number of other commercialization options had been explored and abandoned. This was often due to the reluctance of existing industry players to experiment with novel technologies, as their level of investment in an existing technology precluded introduction of radical changes to their platform. As one scientist elaborated,

Working with industry was very good as long as we were trying to bring incremental technology developments to the market, but as soon as you had something that was disruptive to their business, there was really no interest on their part to embrace these technologies. I kept looking at the potential for change, and 'how do you bring these ideas to market?' The preferred path would have been through the industry leaders, but that wasn't working. So finally, we came back to, 'if you've got to do it, you've got to do it'...My foray into the entrepreneurial space really came about because I couldn't see any other mechanism for taking the technology I was developing and coupling it to the market space. [F E]

The desire to prevent their nascent technologies from languishing coupled with the aspiration of making a broader societal impact were key factors that shaped the willingness of these scientists to initiate a start-up. Significantly, involvement in entrepreneurial activity was more due to a perceived lack of other options than active desire; implying that in a non-trivial number of cases, individuals reluctantly got more involved with commercialization of their technologies.

A variation on this theme was the scenario in which a knowledgeable outsider made the scientist aware of commercialization possibilities inherent in the technologies they were developing. The path to technology transfer in such cases was fortuitous in nature. As one of our interviewees described this situation:

Part of this is that we were scientifically driven and not commercially driven. It was only as we were publishing papers about drugs and drug interactions with this channel that industry really saw this. And they really came knocking on our door for it. Obviously, we now pay a little more attention to the commercial applications of this. [F N]

Overall, our data suggest that university scientists are increasingly tuned into participation in commercialization activity and the attendant change to their role identity that such association is likely to bring. However, the wide variety of reasons invoked for involvement – ranging from economic to social to fortuitous to reluctant embracement – suggest that their existing role identity plays a key role in framing rationales for such participation. Put differently, these individuals typically seek out justifications that are congruent with their extant role identity. In this case, the non-economic factors resonated with an academic role identity; scenarios of reluctant embracement and fortuity further highlight the attractiveness of this role identity. Such congruence in rationales allows these individuals to minimize any dissonance engendered as a result of being associated with a role identity that is perceived as inconsistent with

their current one.⁶ At another level, maintaining such congruence also enables these actors to more creatively craft their new role identity. For these individuals, taking on an entrepreneurial orientation clearly has a wider variety of connotations and meanings than its conventional narrow definition – economic gain – would indicate.

The maintenance of such congruence suggests that role identity modification, in these instances, involves overlaying facets of a new role identity over the extant one. In other words, role identity change is more akin to accretion or layering onto an existing state rather than a complete switch from one state to another. Individuals with a well-developed role identity are either unable or unwilling to abandon cherished facets of this identity. To the extent that these individuals possess high levels of discretion, they retain valued aspects of their role identity even as they modify it. As individuals add elements of the new role identity onto their extant one, they create a more composite identity, which we characterize in detail next.

4.1. Hybrid role identity

Our data suggest that role identity modification for university scientists participating in technology transfer activity typically involves them crafting a hybrid role identity in which they overlay elements of a commercial orientation onto an academic one. As an interviewee put it:

Although most people come to the university for scientific reasons, in this day and age, you have to keep an eye on business. And that's certainly a lesson I had to learn. [F E]

This hybrid role identity was deeply imbued in the practices and thought processes of our interviewees. One of them indicated:

There are 50 problems that are interesting from a technical perspective. The question is which one of those 50 am I going to spend my next hour working on? I would probably make it a mix of is it interesting from a technology perspective, and is it high impact in our ability to transition this into the marketplace and to make it meaningful? So that's been a significant shift in my thinking from the time I was at the university to where I am today. [F E]

Another interviewee described how the domains of science and commerce interacted in his mind as follows:

There's a thought process that goes into a patentable discovery, and it's different from making a scientific discovery.... so you think through: 'So I have this compound. Can I deliver it in a practical way, and what can it be used in?' [F E]

He went on to elaborate:

I learned about...how discovery must be taken beyond simple discovery – you must follow into the use of them, to protect the use from abuse, and also to return funds to where they were generated so that further work can be done. [F E]

These quotations highlight how a hybrid role identity manifests itself in the mindset and practices of our interviewees. Acknowledging the existence of such hybrids enables us to significantly expand our understanding of the repertoire of role identities that university scientists assume (see also Owen-Smith and Powell, 2004). At the simplest level, these role identities can be mapped along a continuum that ranges from "pure" scientist (largely adhering

⁶ By contrast, to the extent that financial factors were emphasized, they often served to compensate individuals for perceived losses to their extant role identity. We thank a reviewer for this observation.

to Mertonian ideals and focused on such outputs as publications) to “pure” entrepreneur (possessing a strong commercial mindset and heavily involved with technology transfer). Statements made by our interviewees indicated that they all viewed themselves as possessing a hybrid role identity, albeit at different points on this continuum.⁷

We observed that the adoption of a hybrid role identity by scientists was often dependent on their stage of career (see also [Stuart and Ding, 2006](#)). Typically, involvement in commercialization activity (and related role identity modification) took place after these individuals had obtained tenure and no longer faced the pressure of producing academically oriented output. Another pattern was the adoption by some individuals of a hybrid role identity on an “experimental” basis. In this case, scientists used their sabbaticals (or took time off) to work on their start-up or other forms of technology transfer. Such experimentation gave them a taste of the challenges involved in adopting a hybrid role identity and helped them clarify their zone of comfort along the continuum defined above. At one level, this highlights the care and deliberation with which these individuals modify their role identity. At another, this suggests that a hybrid role identity itself is amenable to change over time.

Adopting a hybrid role identity, however, did pose significant challenges within this context. Some of our interviewees articulated pragmatic concerns—for example, the amount of time that patenting and licensing inventions as well as supporting the licensees’ requirements demanded of them, which they felt, interfered with research and teaching efforts. As an interviewee indicated:

I'm a scientist. And for me to go off and try to do what business people do or what patent attorneys do is a waste of my time. The more time I spend in the laboratory developing new technologies, the better off everybody is. [F E]

For others, the appropriateness of becoming engaged in commercialization activity was a significant concern. They perceived hurdles related to delay in the dissemination of results and possible interference with academic pursuits that could arise from such involvement. Often, the TTO requested them to maintain secrecy regarding their discovery to ensure patent protection and prevent potential intellectual property from being compromised through premature disclosure in conferences. To the extent that this interfered with a cherished value of their profession – that of open research and publication ([Merton, 1968](#)) – adopting a hybrid role identity represented a dilemma to these individuals.

Finally, there was the realization that the skills and attributes required for commercialization activity were quite different from that of being a scientist. As one of our interviewees indicated:

I think, in my department I would probably be considered a very hands-on guy. I had done some start-up work before, and I was very familiar with the industrial domain. But, in hindsight, I really didn't know much about what was required to be able to take technology and actually create markets, and actually take products to success. [F E]

At a broader level, participation in technology transfer provided some of our interviewees with a better appreciation of the fundamental differences in practices and orientation that existed between academics and entrepreneurs. One of our interviewees described this as follows:

I don't think I could be (a CEO). As for me, I think being a CEO is hard...with the science, it's me against nature – there's no other person involved...I really like academic research. At the company you have to be so focused on applications you can't really do basic science. I like basic science.

Another interviewee elaborated on these differences:

When I was at the university, I was working on 20 different things and having a lot of fun. Once I went into a start-up environment, I necessarily had to focus my effort. You can't afford to work on things that are not offering commercial value in the near term. So a lot of things that were interesting from a potential opportunity perspective, from a technology perspective, I couldn't do. [F E]

And another interviewee put it in this manner:

I would never ever claim to be a good project manager. I think I ran a relatively slipshod project management (within the university), but it was a very creative one. You have to evolve to a company; you need to have well-defined procedures; you have to document everything very well – and that runs counter to how it goes at the university.

These quotations suggest that the challenges that academics perceive in adopting a hybrid role identity manifested themselves at multiple levels. Pragmatically, it involved allocating time and effort across a larger set of activities. Normatively, it led to dilemmas relating to what constitutes appropriate professional conduct. Functionally, it required developing abilities and skill sets more appropriate to the new role. Overall, these individuals viewed the work required to effectively contribute to commercialization activity as being substantial, multi-layered and somewhat contentious. Many were acutely aware of these challenges involved in constructing a hybrid role identity. One of our interviewees evocatively articulated these as follows:

You accomplish a lot by publishing papers and doing technology development... you're doing ideas development, you're moving knowledge forward, and there's high value in that. It's when you decide that this kernel is one that needs to be a commercial product – that's when the fun starts. Or that's when the trouble starts. [F E]

Prior research has suggested that a composite role identity contribute to identity interference that occurs when the pressures of one identity inhibit the performance of another one ([Settles, 2004](#)). Such interference is especially likely if the normative expectations associated with the two role identities differ. This, in turn, can have a depleting effect on an individual's cognitive and emotional resources and result in them experiencing psychological strain ([Thoits, 1983](#)). Given the challenges articulated above, what steps did the academics that we interviewed take to sustain their hybrid role identity? We now turn to explicating some of the mechanisms employed by these individuals.

4.2. Managing a hybrid role identity

Key to understanding the identity work that the academics often engage in to maintain their hybrid role identity is the concept of salience ([Stryker and Serpe, 1982](#)). This is defined as the probability that a given role identity will be invoked across a variety of situations. Salience, in turn, is determined by the amount of commitment an individual has to an identity ([Stryker and Serpe, 1994](#)). Prior research suggests that identities are organized in a “salience hierarchy”, i.e., there are variations in the commitment that individuals have to the different facets of their hybrid identity ([Callero, 1985](#)). This perspective, then, assumes

⁷ However, it is important to note that our sample consists of individuals who have participated in some form of commercialization activity, which, even today, represents a minority of faculty members in universities. This implies that hybrid role identities (along the continuum identified) are still the exception rather than the rule at most campuses.

that some role identities are more central to one's self than others.

In this regard, many interviewees indicated that managing their hybrid role identity involved establishing priorities across their different personas. Specifically, they viewed their hybrid role identity as comprising a focal academic self and a secondary commercial persona. Participation in commercialization activity, for these individuals, represented an overlay over an established role identity that remained more central. For some of these individuals, this priority of role identity stemmed from pragmatic considerations:

I cannot be a CEO. Some people do but I could never do it. You have to realize that it is a different world, you can learn the business but you don't have knowledge yet. Even if you learn the business, it does not mean that you will be a good CEO...but I am a good scientist. Why should I not fully leverage my strong suit? [F E]

Others highlighted the significant benefits to be accrued by maintaining their academic role identity. As one scientist described:

A lot of investigators make a serious mistake of seeing this lucrative bunch of money, and they make all kinds of agreements, even before they talk to people knowledgeable at the university on intellectual property, or the [TTO]. And they sometimes give that all away. But even worse, they make agreements as to what they're going to work on. And that's a mistake because if you're an inventor or a university innovator, you want the freedom – that's why we're here at the university – you want the freedom to go whichever direction your mind tells you, and not some CEO at a company. [F E]

Another interviewee indicated that though he had been a scientist for more than 30 years and had encouraged others to start companies, "neither one (he or his venture partner) wanted to leave the university to join the business". For these individuals, the intellectual freedom, mental stimulation, breadth in scope of activity, and ability to take a long-term view in crafting projects—all contributed to their commitment to retaining a focal academic role identity alongside a secondary entrepreneurial one. This suggests that while the university scientists in our sample were increasingly adopting a hybrid role identity, they often took steps to ensure the primacy of their academic self. More generally, these dynamics attest to the unwillingness of individuals to deemphasize cherished facets of their extant role identity.

But what specific forms of identity work did the scientists perform to ensure higher salience of their academic persona? In posing this question, we took a constructionist stance and suggest that our interviewees were actively involved in managing their hybrid role identity. Our data analysis revealed two processes – which we term *delegating* and *buffering* – that these individuals engaged in. We detail these processes below.

4.2.1. Delegating

Our qualitative investigation indicated that many of our interviewees, in order to ensure primacy of their academic role identity, focused on establishing appropriate interfaces with other actors – within the university and beyond – whom they viewed as possessing skills related to commercializing their technologies. We refer to this practice as *delegating*. As one interviewee described his selective engagement with technology transfer activity:

I'm learning a lot about business, but that's not what I'm trained to do. I'm a scientist. I believe in getting very talented business people to manage the business side, and I think they need

ownership in it. My job is to train them about the science [F E]

And an administrator concurred:

Faculty may want to contribute to the technology. But, quite frequently, they will be much more satisfied if they hire somebody with technical business management experience to manage the company than if they try to do it themselves. [A N]

Our data suggest that perceptions of the efficacy of the TTO – manifested in the reduction in the time and effort required of them to engage in invention disclosure and patenting – significantly contributed to the decision to engage in delegation activity. On their part, TTO officials took steps to simplify this process.

We try to make it as user-friendly as possible. For disclosure, you are probably talking about a couple of hours of work. The disclosure documents are on the web site, they can download those. And we ask that they at least speak with our staff on the phone, or have a meeting with our staff, and they help gather whatever information is necessary. That may take an hour or so. The meeting with the outside patent lawyers, or copyright or trademark lawyers, can be more time intensive depending on the complexity of the invention. But again, we try to make it as user-friendly as possible. We try to accommodate whatever time constraints the faculty member may have. [T N]

Perceptions of the TTO were enhanced to the extent that they were seen as possessing complementary business-related skills and experience. Interestingly, they were often viewed as being a more responsible custodian of emerging technologies than a private firm (see also [Jain and George, 2007](#)). As one scientist described their utility:

[TTO] has a huge team of marketers, negotiators – they're just like a wonderful protection in dealing with this. They have experience. They also can deal with infringement. I can't deal with infringement. If I file a patent on my own, and somebody was going to infringe upon it, I don't have a million dollars to fight a lawsuit. [TTO] can handle those kinds of things. [F E]

One of our interviewees pointed to the TTOs professional network contacts as an attractive reason to delegate activity to them:

We have a large Rolodex file. We've been doing this for 80 years, and so we have a lot of contacts. We have, right now, about – I think the number is around 600 license agreements, about 300 of them right now are paying royalty support, so these are contacts that we look at if we decide to license the technology. Also, we know so many venture capital investors in our technology start-ups; these contacts could be useful when the inventor is looking for additional capital [T N]

The ability of scientists to delegate commercialization activity then depends on the extent to which they perceive the TTO as providing access to a large network of contacts and potential sources of investment capital as well as reducing the risk of patent infringement. By delegating, scientists are able to accord salience to their academic persona while TTOs take on a central role in the commercialization of these individuals' technologies. The scientist's commercial persona is then restricted to maintaining a sporadic interface with the TTO. On the other hand, if the TTO is perceived as being unable to provide such commercialization support, then these individuals are less likely to take on a hybrid role identity or do so outside the university context (see also [Siegel et al., 2003](#)).

One of our interviewees described how interfacing with the TTO enabled him to accord primary salience to his academic role identity:

Ultimately, you go into academics because you love a certain area. And it's very good to keep track of the fact that what you do does have commercial interest. It is important when you publish that you actually think it through a little bit and ask, "Does this have commercial value?" The process of going through [TTO] is pretty painless, and it doesn't take a lot of your time to file something, but at the end of the day that's probably not why you're at the university – and that's a good thing. [F N]

Besides the TTO, another actor that our interviewees often delegated commercialization activity to was a graduate student (typically their own). While these individuals often did not possess well-developed skills in running a business, they were very motivated and inclined to pursue such a path. Moreover they understood the underlying technology and were well suited to perform the critical bridging function linking basic science to real world application. One of our interviewees highlighted such delegation as follows:

We hired a graduate student and she has always been entrepreneurial. We hired her to be the first employee, and she helped me with those initial phases – helping me raise money from the angel group, present at venture fairs, and talk to venture capitalists...we paid her out of our pockets. [F E]

In summary, our data indicate that scientists craft arrangements with other actors within the university (and sometimes beyond) as part of participating in technology transfer.⁸ They are comfortable allowing others to provide the entrepreneurial energy required in the commercialization process. Significantly, this delegation allows them to focus on maintaining and nurturing their academic role identity, which is viewed by them with fondness and appreciation for the unique benefits it provides. By engaging in such delegation, they share in any benefits (financial and otherwise) that accrue while distancing themselves from aspects of commercialization that they find unpalatable or difficult.

4.2.2. Buffering

While delegation involved establishing relationships with other actors, our analysis also revealed that many scientists took steps to protect their role identity from the influence of norms typically associated with commercialization. These individuals were mindful of preserving certain cherished values associated with being an academic and made sure that these were not compromised as a result of their involvement with technology transfer. We refer to such internally focused initiatives at establishing role identity salience as *buffering*.

Our interviews provide evidence for the myriad ways in which scientists sought to buffer their academic role identity. In its simplest form, this involved establishing clarity in their work priorities. As one interviewee reflected:

The university is allowing us to do it [finance commercial work through the school] with very great care that we don't interfere with publication, or development of students and post-docs, and that our academic work comes first. And that's the way I operate – my academic work comes first. I'm department chair, and that's the first thing I do is execute my work as department chair. The next thing is to be sure that the students are progressing toward their theses and their publications get pub-

lished. With the remaining time, then, I direct that [commercial] development work. [F E]

In a similar vein, one of our interviewees said that he focused his efforts on ongoing research and the "top-end" of the business functions—making the final hiring decisions, closing investors and approving the laboratory plan.

At a deeper level, buffering one's role identity as a scientist involved reaffirming the kind of science that these individuals conducted in their laboratory. This often implied retaining a focus on doing basic research that advanced the state of knowledge in a field as opposed to adopting a largely applied orientation. As one of our interviewees elaborated:

Because we're an academic laboratory, we have tried to keep a scientific focus and to not allow the laboratory to make a turn into being just a cell line making laboratory. For example, we could have taken the cells and created a drug screening operation for industry. We elected not to go down that pathway. That was my decision because I thought that it would detract too much from our mission of research in human disease. [F N]

Finally, buffering often involved resolving situations in which there appeared to be direct conflict between the norms advocated by the two role identities. One common instance of such discordance involved the public vs. private nature of academic knowledge. To the extent that buffering involved according salience to one's academic role identity practices that weighed in favor of discussing research findings openly (vs. maintaining secrecy) were adopted. As an interviewee described such a scenario:

Where we found a conflict is between patenting and speaking about research in public. And I think the most common conflict is with students' thesis and student seminars. I just have a policy that I absolutely will not muzzle a student or tell them they can't talk about a certain aspect of their research because of patenting. If they choose to make that decision, that's their right. I don't think a student ever has, in my lab. They're usually too eager to share their results with the scientific community, and their peers, and their thesis committees that they don't want to limit what they can talk about. [F N]

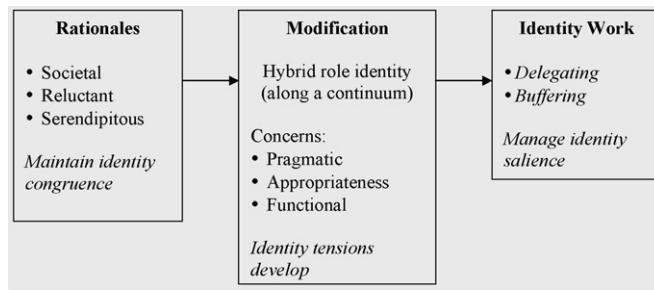
Taken together, these statements demonstrate the creative ways in which our interviewees ensured salience for their academic role identity even as they modified it to assume a more commercial orientation. Buffering one's extant role identity involved prioritizing work practices, ensuring conduct of cherished forms of research and resolving norms-based conflict in a manner compatible with this persona. More fundamentally, it entailed reconfiguring practices and routines in a manner that retained the essence of their academic role identity. Overall, engaging in buffering processes signify an individual's affinity to their extant role identity as well as represent a proactive means of preserving key elements of it.

We suggest that taken together, delegating and buffering constitute two key mechanisms that academics put into play when they engage in role identity modification. They enable actors to make salient their cherished role identity even as they take on more composite personas. In doing so, they mitigate the negative effects of identity interference. Variations in the form and manner in which individuals engage in these processes are reflected in the different positions they occupy along the academic-entrepreneur role identity continuum. Notably, individuals imbue these processes with ongoing energy and attention in order to maintain their hybrid role identity. Engaging in these processes enables individuals to construct a more complex role identity that straddles different professional worlds. These, in turn, can have unanticipated effects within these different domains. We now turn to discussing some of the implications of our findings.

⁸ We distinguish these from other actors – such as colleagues, co-authors and friends – who often play a facilitative role in a scientist's participation in commercialization activity (Stuart and Ding, 2006; Bercovitz and Feldman, 2008). We acknowledge that there can be overlap in the roles played by these different actors within a scientist's network.

Table 3

A process model of role identity modification.



5. Discussion and implications

The phenomenon of academic entrepreneurship offers a useful context to extend prior literature on role identity modification. Much of this work has been conceptual in nature (Nicholson, 1984) and has not focused on unpacking the specific mechanisms that individuals employ when they engage in such adaptation. While researchers have shifted their attention towards understanding forms of "identity work" (Ibarra, 1999; Pratt et al., 2006), they have examined role identity construction in the early stages of a professional's career. The emphasis in our study, by contrast, is on role identity reconstruction—i.e., the modification of an individual's entrenched role identity, often in the middle or later stages of one's career (see also Chreim et al., 2007).

Our qualitative analysis highlights the significant influence that one's extant role identity casts on such change processes (see Table 3 for the process model of role identity modification that we developed in this study). Individuals often invoke rationales congruent with their existing role identity when they contemplate modifying it. Moreover, they retain cherished aspects of their extant role identity even as they alter it, typically according these facets a privileged status. And finally, they take proactive steps to ensure preservation of their existing role identity. Based on these observations, we suggest that an individual's role identity – especially if it is entrenched and treasured – is "sticky" by nature, and exerts a long shadow on the sense-making and associated identity work that they engage in.

As a consequence, we propose that role identity modification under these conditions is akin to a morphing process—i.e., it involves layering upon an extant role identity rather than abandoning it. Our perspective contrasts with much of prior discourse, which imputes a switch-like shift from one role identity to another (Ebaugh, 1988; Hoang and Gimeno, 2005). In doing so, we acknowledge that an individual's professional role identity is often a hybrid, combining elements from different vocations.⁹ This, in turn, focuses attention on the salience of the underlying role identities as well as the mechanisms that individuals employ to sustain such composite states. Our findings indicate that a hybrid role identity is negotiated, contested and dynamic in nature, particularly if there are inherent contradictions in the practices and norms of the professions being combined. More generally, we contend that recognizing the existence of a hybrid role identity enables us to better appreciate the micro-level identity work involved in creating and maintaining such states. This, in turn, facilitates a fine-grained understanding of the macro-level changes taking place in the culture of certain professions.

In this regard, our study explicates two mechanisms – *delegating* and *buffering* – that individuals often deploy as part of role identity modification. While delegating involves establishing interfaces with external actors who themselves take on many of the tasks associated with the new role, buffering entails protecting cherished aspects of an extant identity. Taken together, these processes enable individuals to accord salience to their existing role identity (if they so choose) even as they adopt a more composite persona. Put differently, delegating and buffering represent proactive "brakes" that individuals deploy to prevent untrammeled change in their personas and reflect the nuanced and deliberate effort that they undertake as part of modifying their role identity. Engaging in these processes enables actors to precisely calibrate their activities, outputs and even their value systems. In explicating these mechanisms, our study adds empirical flesh to prior research, which suggests that roles central to one's identity are given up reluctantly (Ebaugh, 1988; Deaux, 1993). Delegating and buffering, then, represent two distinct types of identity work that individuals engage in (see Pratt et al., 2006, for other examples). Their focus on preserving the past makes these mechanisms a useful counterpoint to actors experimenting with provisional selves (Ibarra, 1999), an action that is future-looking in its orientation.

In presenting our findings, it is important to acknowledge the boundary conditions unique to our context. First, individuals possessed relatively high levels of discretion in deciding if (and to what extent) they wanted to modify their role identity; this contrasts with scenarios in which role identity modification is externally imposed by environmental conditions (e.g., a job loss). That being said, there are many situations that are analogous to the one we explored and to which our findings might pertain—these include medical doctors getting more involved with the business aspects of their profession or professionals in a corporate job contemplating a move to entrepreneurship. A second assumption we made in our study is that modification in role identity was taking place at relatively advanced stage of one's career, once an extant identity was entrenched. While this is true for a large proportion of the current cohort of university scientists, this might be less valid for the newer generation, who might be constructing a hybrid role identity much earlier on as part of their socialization into the profession. Examining the identity work that this latter group engages in is a promising direction for future research.

In addition to contributing to the role identity literature, our findings highlight the value of utilizing a social-psychological perspective to examine commercialization activity in the university context as well as inform key policy debates within this arena. We now turn to elucidating these contributions.

5.1. Role identity as a lens to examine academic entrepreneurship

Employing the concept of role identity allows us to gain a richer and more grounded understanding of an integral actor contributing to the phenomenon of academic entrepreneurship—the university scientist. The bulk of prior research has largely focused on identifying objective factors such as personal characteristics or social context as determinants of these individuals commercialization activity. In doing so, it implicitly assumes that they make seamless transitions to their role identity when they participate in such activity. In contrast, by emphasizing their subjective experiences, our study highlights the careful sense-making and negotiated identity work that these individuals engage in as part of their involvement. This enables us to not only obtain an in-depth appreciation of the changes taking place on university campuses but also allows us to trace the unique patterns and outcomes of such role identity modification.

In developing the notion of a hybrid role identity, we depart from prior dichotomous conceptualizations and explore various

⁹ While considerable research has postulated that individuals possess multiple identities (Mead, 1934; Burke, 1937; McCall and Simmons, 1978; Stryker and Serpe, 1982), there is virtually no work that examines the processes by which hybrid professional role identities are constructed and maintained.

shades of what it means to be an academic entrepreneur. Moreover, we indicate that these variations stem from self-imposed boundaries that university scientists themselves define regarding their commercial involvement. For example, a scientist may engage in invention disclosure and patenting activity and view this as becoming “entrepreneurial”; any further involvement (e.g. initiating a start-up) may be perceived as a distraction from pursuing science. The consequences of this self-definition are likely to be different from the scenario in which all commercial activity is deemed acceptable. This suggests that among these individuals, there are multiple understandings of what it means to be “entrepreneurial”—this, in turn, contributing to their occupying different positions on the academic-entrepreneur continuum.

In addition, we observe that university scientists accord salience to their academic persona even as they assume a hybrid role identity; they do so partly from the sheer momentum associated with prior socialization but also because they genuinely cherish their extant role identity. Given this, they engage in identity work such as *delegating* and *buffering* to ensure priority of their academic persona. Doing so enables them to continue contributing as both academics and entrepreneurs. Our study, then, provides a social-psychological basis for the research finding that the academic productivity and commercial activity of university scientists reinforce one another (Agrawal and Henderson, 2002; Azoulay et al., 2008). However, we would also like to emphasize the fragility of such processes—i.e., delegating and buffering are sometimes not invoked or do not operate in practice, resulting in deviations from desired hybrid role identity and/or psychological strain. These dynamics attest to the negotiated and fluid nature of a hybrid role identity, requiring these individuals to constantly manage the contradictions that exist in their composite personae.

On this front, building on Pratt and Foreman's (2000) work on multiple organizational identities, we suggest that there is a range of strategies available to these individuals to manage their hybrid role identity. These include *compartmentalization*, in which the different identities are maintained but are separated from each other; *deletion*, where individuals actually rid themselves of one or more of their identities; *integration*, where individuals fuse identities into a distinct new whole; and *aggregation*, in which attempts are made to retain all their identities while forging links between them. We saw evidence of each of these strategies (except deletion) being employed by our interviewees. This further illustrates how the literature on role identity is uniquely suited to provide an understanding of how the new breed of scientist can navigate the challenges they face.

A scientist's management of their hybrid role identity can have profound effects on the entrepreneurial dynamics of a technological field (Schoonhoven and Romanelli, 2001). For example, such individuals, as part of buffering their role identity, may choose only to engage in invention disclosure activity, and hence license their innovations to an established firm. This is likely to produce very different consequences than the situation in which the scientist is willing to modify their extant role identity significantly as part of becoming involved in the creation of a start-up that competes with the incumbents. Likewise, avoiding delegating and taking on the role of chief executive of an academic start-up is likely to have different implications for the firm's survival and growth than making incremental modifications to one's role identity and serving as an advisor to the same firm. These scenarios reflect how micro-level decisions that university scientists make regarding constructing and maintaining their hybrid role identity impact key macro-level entrepreneurial outcomes such as start-up formation and regional development (see also Shane and Khurana, 2003). While the emphasis in prior inquiry has been on understanding the

impact of entrepreneurial involvement on scientific productivity, we suggest that a role identity lens can provide useful insights on the imprint that academics leave on the conduct and practice of entrepreneurship.

5.2. Policy implications offered by a role identity perspective

A role identity perspective allows us to assess policy issues and develop grounded prescriptions related to the phenomenon of academic entrepreneurship. Along these lines, scholars have expressed concern about the significant growth of a commercialization imperative within our institutions of higher learning (Bok, 2003; Nelson, 2001). According to them, research agendas are being shaped and scientific norms compromised by the profit motive. On the other hand, studies have indicated the existence of a more complementary relationship between academia and business (Azoulay et al., 2008). We contend that the micro-level social-psychological view developed in this study can help us better adjudicate these competing claims and more clearly comprehend the changes taking place, as the worlds of science and commerce collide and co-mingle within our universities.

Our qualitative analysis indicates that higher level changes in the legislative (e.g. Bayh-Dole Act) and normative environments are clearly fostering role identity modifications of university scientists. This is manifested both in their growing self-awareness of such possibilities as well as actual involvement in such activity. However, our data also reveal that even as these individuals adopt a hybrid role identity, they accord priority to their academic persona. They deploy mechanisms such as delegating and buffering to ensure this. They tend to meticulously avoid conflicts of interest and are scrupulous in managing their composite role identity.¹⁰ More fundamentally, these patterns highlight the unwillingness of most scientists to significantly forgo their existing role identity when they participate in commercialization activity. Rather, these individuals are mindful of the consequences of making such changes and take proactive steps to preserve their academic role identity.

In elaborating on the role identity modifications taking place among university scientists, we propose that policy debates need to move away from dichotomous considerations (that prior work has reified) and instead focus on understanding the mindset of the wide variety of academic entrepreneurs we now see on our campuses (Etzkowitz, 1998; Owen-Smith and Powell, 2001). A key area for investigation involves elaborating on the various mechanisms that these individuals use to manage their hybrid role identity. In addition to identity work such as delegating and buffering, this includes the arrangements and support structures that universities design to facilitate construction and maintenance of a composite persona.

On this front, our study emphasizes the key role that TTOs play in enabling sustenance of a hybrid role identity. In line with prior work (George, 2005; Siegel et al., 2003), our data suggest that scientists view TTOs as an important source for delegation, i.e., they are willing to share the economic benefits arising from commercialization activity with these organizations in return for the critical business skills and resources they obtain from them. To the extent that they are perceived as competent intermediaries and enable scientists to largely preserve their role identity, TTOs can position themselves as key commercialization partners. In a different vein, by creating incentive systems that are not merely financial

¹⁰ A less charitable interpretation of our interviewee's statements would maintain that these individuals are engaging in self-serving attribution (see Greenwald, 1980). However, there was very little evidence to suggest that a majority of the scientists in our sample had profited significantly (to date) from their involvement in commercialization activity. Moreover, the deployment of mechanisms to protect their academic work (as well as their retention of an university affiliation) is suggestive of the salience of this role identity to them.

but instead broader in scope (such as acting as the custodian of an invention and leveraging it for greater societal benefit), these organizations can distinguish themselves from regular firms and more credibly attract scientist involvement to technology transfer activity.

At a more general level, our research highlights the importance of crafting innovative relationships among various actors within (and sometimes, outside) the university context that are geared towards realizing commercial aspirations while retaining an academic culture. For a scientist, maintaining a hybrid role identity effectively, like any balancing act, is no easy task. From a policy viewpoint, if scientists focus solely on retaining their extant role identity, there is the possibility that universities will not effectively leverage their nascent technologies. On the other hand, to the extent that these individuals adopt a commercial persona, there is a danger that not enough basic research will be done. Given our finding that a majority of commercially active academics prefer to accord priority to their academic role identity, we believe the onus is on administrators to design procedures that enable this salience. To the extent that processes such as delegating and buffering are suppressed or break down, they are likely to facilitate role identity confusion and psychological strain among academics.

6. Future research and conclusion

This study attempts to provide a deeper understanding of the subjective experiences and related identity work of university scientist's engaged in technology transfer. We believe that prior studies have either underemphasized or oversimplified the nature of involvement of these individuals in such activity. As a consequence there is a paucity of research that examines the sense-making processes that accompanies a scientist's decision to participate in commercialization of their ideas. Our study intends to address this theoretical gap as well as link these social-psychological micro-mechanisms to macro-level behavior related to university technology transfer. Doing so enables us to get a better appreciation of how these "mindful agents" are actively contributing to the remarkable changes taking place in the higher education landscape.

We conceptualize a scientist's engagement with commercialization activity as involving a modification to their extant role identity. In applying a rich stream of psychological theory (that is distinct from the economic and sociological perspectives that have pervaded prior research in this area) to this novel emergent context, we offer insights to both the role identity and academic entrepreneurship research streams. We emphasize the "sticky" nature of one's extant professional role identity and the manner in which it shapes subsequent modification initiatives. We elaborate on the hybrid role identity that these individuals adopt, that typically constitutes a focal academic self and a secondary commercial persona. Finally, we observe them engaging in *delegating* and *buffering*—processes that allow them to preserve the aforementioned hierarchy within their hybrid role identity. A somewhat counterintuitive theme that we highlight in this study is the strong propensity of these individuals to preserve their academic role identity even as they participate in entrepreneurial activity. At a broader level, our study demonstrates the mindfulness and agency displayed by scientists in navigating an increasingly complex landscape—one where they pay attention to both their science and its commercialization.

There are some important limitations in the design of this study that we need to acknowledge. First, all of our interviewees belong to single large public research university in the United States that has a well-established TTO. Given this, our findings may not apply equally to university settings where the TTO (or equivalent actor) is

inexperienced or the policies for commercialization and managing conflicts of interest are not clearly established. Second, our sample consists of scientists engaged in commercialization who have (largely) spent their careers within academia. It would be interesting to compare and contrast role identity modification of these individuals with those that choose not to get involved, failed to get their commercialization initiatives going or left academia to do so. We believe that our findings pertaining to a scientist's rationales for modifying their role identity, as well as the identity work they engage in, are likely to apply to other similar contexts. Still, future research that collects and analyzes data from multiple university settings could further specify and deepen the framework we have developed in this paper. Taken further, while the literature has predominantly focused on the conduct of academic entrepreneurship within advanced economies, there are several models of technology transfer being developed and experimented with in countries such as India and China. Cross-cultural and comparative studies of university scientist's role identity modification under these conditions would be a useful way to elaborate this line of inquiry.

Additionally, there are some other avenues for future research that we would like to outline. A fine-grained characterization of the key hybrid role identity archetypes that university scientists adopt would be a logical next step (see also Owen-Smith and Powell, 2004). Likewise, longitudinal studies that capture these individuals experimentation with their role identity across the course of their career would be instructive. What other rationales do these individuals rely on to embrace a hybrid role identity and do they sometimes end up withdrawing from such experimentation? To what extent are the mechanisms of delegating and buffering robust and in what ways can these be undermined or buttressed? What other forms of identity work do these individuals engage in? Can this result in the emergence of a new academic ethos that combines Mertonian and entrepreneurial norms? Taking a more critical perspective, is it plausible that scientists will continue to reaffirm their role identity even as their work takes on an increasingly commercial orientation (Kleinman, 2003)? Moreover, we need to gain a better understanding of the types of institutional arrangements that enable scientists to adopt a hybrid role identity. Ideally, such designs would allow these individuals to carefully balance the competing demands that the worlds of science and commerce place on them. Finally, given that a scientist's role identity potentially has a strong imprinting effect on the cultural, scientific, and commercial ethos of start-ups that they help create, research that traces out these impacts and its implications for entrepreneurship would be instructive.

The ongoing transformation of universities, and the coalescing of the worlds of academe and commerce has been the subject of much scholarly inquiry in recent years. Our study makes a useful contribution to this discourse by conceptualizing the involvement of university scientists in commercialization activity as a potential modification in their role identity. This, we believe, opens the door for much future research employing social-psychological and cognitive lenses to understand the micro-mechanisms driving academic entrepreneurship (see also Baron, 2002). Conversely, this fascinating context serves as fertile ground to extend our understanding of role identity modification and the identity work involved in managing hybrid personas. We contend that the notion of hybrid role identity provides us with a more accurate portrayal of the changes taking place within our academic institutions and can be gainfully employed to inform policy debates in this arena. We need to move beyond acknowledging the existence of such emergent forms to develop a deeper understanding of how a hybrid role identity can be managed as well as trace their impact on both science and entrepreneurship. In doing so, our attention will shift back to the actor at the center of it all—the university scientist. Or should we say, the academic entrepreneur!

Acknowledgements

The authors appreciate the comments of Anne Miner, Elaine Romanelli, participants of the UW-Madison MHR Department seminar series and our reviewers on previous versions of this manuscript. The second author gratefully acknowledges the support of the Advanced Institute of Management Research Fellowship (ESRC RES-331-27-0011).

References

- Agarwal, A., Henderson, R., 2002. Putting patents in context: Exploring knowledge transfer from MIT. *Management Science* 48 (1), 44–60.
- Audretsch, D.B., Erdem, D.K., 2004. Determinants of scientist entrepreneurship: an integrated research agenda. Discussion Paper #4204, Papers on Entrepreneurship, Growth, and Public Policy. Jena, Germany: Max Planck Institute of Economics, Group for Entrepreneurship, Growth and Public Policy.
- Azoulay, P., Ding, W., Stuart, T., 2007. The determinants of faculty patenting behavior: demographics or opportunities. *Journal of Economic Behavior and Organization* 63 (4), 599–623.
- Azoulay, P., Ding, W., Stuart, T., 2008. The impact of academic patenting on the rate, quality, and direction of (public) research output. *Journal of Industrial Economics* (forthcoming).
- Barley, S.R., 1989. Careers, identities and institutions: the legacy of the Chicago School of Sociology. In: Arthur, M.B., Hall, D.T., Lawrence, B.S. (Eds.), *Handbook of Career Theory*. Cambridge University Press, Cambridge, UK.
- Barney, J., 1991. Firm resources and sustained competitive advantage. *Journal of Management* 17 (1), 99–120.
- Baron, R.A., 2002. OB and entrepreneurship: the reciprocal benefits of closer conceptual links. In: Staw, B.M., Kramer, R. (Eds.), *Research in Organizational Behavior*. JAI Press, Greenwich, CT, pp. 225–269.
- Baum, J.R., Locke, E.A., 2004. The relationship between entrepreneurial traits, skill, and motivation to subsequent venture growth. *Journal of Applied Psychology* 89, 587–598.
- Bercovitz, J., Feldman, M., 2008. Academic entrepreneurs: organizational change at the individual level. *Organization Science* 19, 69–89.
- Bok, D.C., 2003. Universities in the Marketplace: The Commercialization of Higher Education. Princeton University Press, Princeton, NJ.
- Burke, K., 1937. Attitudes Towards History. New Republic, New York.
- Burke, P.J., Tully, J.C., 1977. The measurement of role identity. *Social Forces* 55, 881–897.
- Callero, P., 1985. Role identity salience. *Social Psychology Quarterly* 48 (3), 203–215.
- Camerer, C., Lovallo, D., 1999. Overconfidence and excess entry: an experimental approach. *The American Economic Review* 89, 306–318.
- Chreim, S., Williams, B.E., Hinings, C.R., 2007. Inter-level influences on the reconstruction of professional identity. *Academy of Management Review* 50 (6), 1515–1539.
- Dasgupta, P., David, P.A., 1994. Toward a new economics of science. *Research Policy* 23 (5), 487–521.
- Deaux, K., 1993. Reconstructing social identity. *Personality and Social Psychology Bulletin* 19 (1), 4–12.
- Ebaugh, H.R.F., 1988. *Becoming An Ex*. University of Chicago Press, Chicago.
- Eisenhardt, K.M., 1989. Building theories from case study research. *Academy of Management Review* 14, 532–550.
- Etzkowitz, H., 1983. Entrepreneurial scientists and entrepreneurial universities in American academic science. *Minerva* 21, 198–233.
- Etzkowitz, H., 1998. The norms of entrepreneurial science: cognitive effects of the new university–industry linkages. *Research Policy* 27, 823–833.
- Etzkowitz, H., 2002. *MIT and the Rise of Entrepreneurial Science*. Routledge, New York.
- Gecas, V., 1982. The Self-concept. *Annual Review of Sociology* 8, 1–33.
- George, G., 2005. Learning to be capable: patenting and licensing at the Wisconsin Alumni Research Foundation 1925–2002. *Industrial and Corporate Change*, 14, 119–151.
- George, G., Bock, A., 2008. *Inventing Entrepreneurs: Technology Innovators and their Entrepreneurial Journey*. Prentice-Hall Pearson, Upper Saddle River, NJ.
- Glaser, B.G., Strauss, A.L., 1967. *Discovery of Grounded Theory: Strategies for Qualitative Research*. Aldine Publishing, Chicago.
- Greenwald, A.C., 1980. The totalitarian ego: fabrication and revision of personal history. *American Psychologist* 35, 603–618.
- Hoang, H., Gimeno, J., 2005. Entrepreneurial identity: theory and measurement. Presentation at the First Annual Smith Entrepreneurship Research Conference, 22–23 April, University of Maryland.
- Hughes, E.C., 1958. *Men and their Work*. Free Press, Glencoe, IL.
- Ibarra, H., 1999. Provisional selves: experimenting with image and identity in professional adaptation. *Administrative Science Quarterly* 44 (4), 764–791.
- Jain, S., George, G., 2007. Building legitimacy for novel technologies: the case of Wisconsin Alumni Research Foundation and human embryonic stem cells. *Industrial and Corporate Change* 16 (4), 535–567.
- Kenney, M., Goe, W., 2004. A tale of two universities: entrepreneurship in the departments of electrical engineering and computer science at UC Berkeley and Stanford. *Research Policy* 33, 691–707.
- Kleinman, D., 2003. *Impure Cultures: University Biology and the World of Commerce*. University of Wisconsin Press, Madison, WI.
- Latour, B., Woolgar, S., 1979. *Laboratory Life: The Construction of Scientific Facts*. Princeton University Press, Princeton, NJ.
- Lee, T.W., 1999. *Using Qualitative Methods in Organizational Research*. Sage, Thousand Oaks, CA.
- Lockett, A., Siegel, D., Wright, M., Ensley, M., 2005. The creation of university spin-off firms at public research institutions: managerial and policy implications. *Research Policy* 34 (7), 981–993.
- Louis, M., 1980. Surprise and sense making: what newcomers experience in entering unfamiliar organizational settings. *Administrative Science Quarterly* 25, 225–261.
- Louis, K.S., Blumenthal, D., Gluck, M., Stoto, M.A., 1989. Entrepreneurs in academe: an exploration of behaviors among life scientists. *Administrative Science Quarterly* 34, 110–131.
- Louis, K., Anderson, M., Jones, L., Blumenthal, D., Campbell, E.G., 2001. Entrepreneurship, secrecy, and productivity: a comparison of clinical and non-clinical life sciences faculty. *Journal of Technology Transfer* 26 (3), 233–245.
- McCall, G.J., Simmons, J.L., 1978. *Identities and Interactions: An Examination of Human Associations in Everyday Life*. Free Press, New York.
- Mead, G.H., 1934. *Mind, Self, and Society*. University of Chicago Press, Chicago.
- Merton, R.K., 1957. Priorities in scientific discovery: a chapter in the sociology of science. *American Sociological Review* 22, 635–659.
- Merton, R.K., 1968. *Social Theory and Social Structure*. The Free Press, New York.
- Miner, A., Eesley, D., DeVaughn, M., Rura, T., 2001. The magic beanstalk vision: commercializing university inventions and research. In: Schoonhoven, C., Romanelli, E. (Eds.), *The Entrepreneurship Dynamic*. Stanford University Press, Palo Alto, CA, pp. 109–146.
- Murray, F., 2002. Innovation as co-evolution of scientific and technological networks: exploring tissue engineering. *Research Policy* 31 (8–9), 1389–1403.
- Nelson, R., 2001. Observations on the post Bayh-Dole rise of patenting at American universities. *Journal of Technology Transfer* 26, 13–19.
- Nicholson, N., 1984. A theory of work role transitions. *Administrative Science Quarterly* 29, 172–191.
- Owen-Smith, J., 2005. Trends and transitions in the institutional environment for public and private science. *Higher Education* 49 (1–2), 91–117.
- Owen-Smith, J., Powell, W.W., 2004. Careers and contradictions: faculty responses to the transformation of knowledge and its uses in the life sciences. *Sociologie Du Travail* 46 (3), 347–377.
- Owen-Smith, J., Powell, W.W., 2001. To patent or not: faculty decisions and institutional success at technology transfer. *Journal of Technology Transfer* 26, 99–114.
- Pelz, D.C., Andrews, F.M., 1976. *Scientists in Organizations: Productive Climates for Research and Development*. Institute for Social Research, University of Michigan, Ann Arbor.
- Phan, P., Siegel, D., Wright, M., 2005. Science parks and incubators: observations, synthesis and future research. *Journal of Business Venturing* 20, 165–182.
- Pratt, M.G., Foreman, P.O., 2000. Classifying managerial responses to multiple organizational identities. *Academy of Management Review* 25, 18–42.
- Pratt, M.G., Rockmann, K., Kaufmann, J.B., 2006. Constructing professional identity: the role of work and identity learning cycles in the customization of identity among medical residents. *Academy of Management Journal* 49, 235–262.
- Rosenberg, N., Nelson, R., 1994. American universities and technical advance in industry. *Research Policy* 23, 323–348.
- Schoonhoven, C.B., Romanelli, E., 2001. Emergent themes and the next wave of entrepreneurship research. In: Schoonhoven, C.B., Romanelli, E. (Eds.), *The Entrepreneurship Dynamic*. Stanford University Press, Palo Alto, CA, pp. 383–408.
- Settles, I.H., 2004. When multiple identities interfere: the role of identity centrality. *Personality and Social Psychology Bulletin* 30, 487–500.
- Shane, S., 2004. *Academic Entrepreneurship: University Spinoffs and Wealth Creation*. Edward Elgar, Northampton, MA.
- Shane, S., 2000. Prior knowledge and the discovery of entrepreneurial opportunities. *Organization Science* 11, 448–469.
- Shane, S., Khurana, R., 2003. Bringing individuals back in: the effects of career experience on new firm founding. *Industrial and Corporate Change* 12, 519–543.
- Siegel, D., Waldman, D., Link, A., 2003. Assessing the impact of organizational practices on the relative productivity of university technology transfer offices: an exploratory study. *Research Policy* 32, 27–48.
- Smilor, R.W., 1997. Entrepreneurship: reflections on a subversive activity. *Journal of Business Venturing* 12, 341–346.
- Strauss, A., Corbin, J., 1998. *Basics of Qualitative Research*. Sage, Thousand Oaks, CA.
- Stuart, T.E., Ding, W., 2006. When do scientists become entrepreneurs? The social structural antecedents of commercial activity in the academic life sciences. *American Journal of Sociology* 112, 97–114.
- Stryker, S., Serpe, R., 1982. Commitment, identity salience and role behavior: theory and research example. In: Ickes, W., Knowles, E.S. (Eds.), *Personality, Roles and Social Behavior*. Springer-Verlag, New York, pp. 199–218.
- Stryker, S., Serpe, R., 1994. Identity salience and psychological centrality: equivalent, overlapping or complementary concepts? *Social Psychology Quarterly* 57 (1), 16–35.
- Thoits, P.A., 1983. Multiple Identities and psychological well-being—a reformulation and test of the social-isolation hypothesis. *American Sociological Review* 48, 174–187.

- Thornton, P., 1999. The sociology of entrepreneurship. *Annual Review of Sociology* 25, 19–46.
- Thursby, J.G., Thursby, M.C., 2002. Who is selling the ivory tower? Sources of growth in university licensing. *Management Science* 48, 90–104.
- Van Maanen, J., Schein, E.H., 1979. Toward a theory of organizational socialization. In: Staw, B.M. (Ed.), *Research in Organizational Behavior*. JAI Press, Greenwich, CT, pp. 209–264.
- Yin, R.K., 1994. *Case Study Research—Design and Methods*. Sage Publications, Thousand Oaks, CA.
- Zucker, L.G., Darby, M.R., 1996. Star scientists and institutional transformation: patterns of invention and innovation in the formation of the biotechnology industry. *Proceedings of the National Academy of Sciences of the United States of America* 93 (23), 12709–12716.