

## Organizational And Psychological Issues In The Commercialization Of Research At Universities And Federal Labs

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### Introduction

In the 1980s, the U.S. Congress enacted two landmark pieces of legislation designed to facilitate technology transfer from universities and federal laboratories to firms. The first law was the Bayh-Dole Act, which applied mainly to research universities. The second was the Stevenson-Wydler Act, which applied to federal labs (*e.g.*, Los Alamos, Livermore, and Sandia). Soon after enactment of this legislation, many universities and federal labs established technology transfer offices (henceforth, TTOs) to facilitate the patenting and licensing of federally-funded research. As a result, there has been a substantial increase in patenting, licensing, and startup creation at U.S. research universities (Grimaldi, Kenney, Siegel, & Wright, 2011) and federal labs (Link, Siegel, & Van Fleet, 2011). We have also seen a burgeoning academic literature on university technology transfer and academic engagement with industry (*e.g.*, Balven, Fenters, Siegel, & Waldman, 2018).

In this essay, we identify several major gaps in this literature. These gaps address important organizational issues both for academics who study technology transfer and for technology transfer practitioners, who are interested in improving technology transfer performance at universities and federal/national labs. We hope that this essay will highlight the importance of these issues and encourage both academic researchers and practitioners to devote greater attention to the human side of technology transfer.

### Bypassing the TTO and the Role of Organizational Justice

As noted in Balven *et al.* (2018), the academic literature on technology transfer has focused mainly on formal means of technology transfer, such as patenting, licensing, and startup activity, whereby scientists follow sanctioned protocols to commercialize their inventions through TTOs. With rare exceptions (*e.g.*, Link, Siegel, & Bozeman, 2007; Markman, Gianiodis, & Phan, 2006, 2008; Thursby, Fuller, & Thursby, 2009), there has been little theory development or empirical research on what could be referred to as deviant technology transfer, or “bypassing” the TTO. Such activity could involve patenting outside a university or federal lab, commercializing research through consulting, or leaving to launch a startup company on the basis of technology that was conceived under the auspices of that university or federal lab.

That is unfortunate because, as recently reported in Waldman, Balven, Vaulont, Rupp, and Siegel (2018), the incidence of such deviant behavior is fairly high. Balven *et al.* (2018) also pointed out that most research on the commercialization of science has been conducted at the macro level, focusing on institutional, economic, and demographic variables from an economic or sociological perspective, rather than from a psychological perspective, which incorporates micro-level processes. Thus, to fully understand the causes and consequences of the commercialization of science, we need to consider a psychological,

organizational behavior perspective to determine how individual-level phenomena such as organizational justice, championing, leadership, motivation, and work-life balance explain why researchers in universities and federal labs engage in formal or deviant commercialization efforts.

For example, one important reason why faculty and scientists at federal labs may “bypass” TTOs is a lack of “organizational justice.” In this context, organizational justice refers to perceptions of fairness on the part of university or federal lab scientists with regard to their organizations. Simply put, if a scientist believes that he/she is being treated unfairly by the university or federal/national lab TTO (or perhaps another academic administrator, such as a department chair or a dean), that person may choose not to disclose an invention and patent, license, or may commercialize that technology outside the university or federal lab.

Traditional conceptualizations of organizational justice include distributive, procedural justice, and interactional justice (Colquitt, 2001, 2012; Rupp & Cropanzano, 2007). We believe that these concepts may be useful in terms of predicting formal and informal technology transfer. Distributive justice refers to the extent to which an individual’s outcomes (*i.e.*, rewards, recognition, and so forth) are perceived to be in line with the effort, accomplishments, and other contributions of the individual to the organization. Procedural justice pertains to the extent to which the individual perceives consistency, lack of bias, and so forth, in the determination of his or her attained outcomes from the organization. Interactional justice involves both interpersonal and informational components in terms of whether individuals perceive that they are treated with dignity and respect, as well as whether procedures are explained in a candid, timely, and individualized or personalized manner.

In addition to these traditional ways of conceiving organizational justice, we also recognize that more recent, deontological perspectives may be relevant (Cropanzano, Goldman, & Folger, 2003). In contrast to the above justice dimensions that stress the individual’s personal needs or interpersonal factors, deontic justice emphasizes the role that morality and the needs of others (*e.g.*, society as a whole) can play in organizational justice perceptions (Cropanzano *et al.*, 2003; Folger, 2001). In sum, it would be useful for researchers to examine whether different types of justice perceptions can predict a propensity for scientists to engage specifically in informal technology transfer.

### Include Postdocs in the Study of Technology Transfer

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It is also important to extend the analysis of technology transfer to postdoctoral research fellows (henceforth, postdocs). Most research on technology transfer has ignored the role of postdocs, and instead has focused on tenure-track and tenured faculty. This represents an important omission, given the key role that postdocs play in the advancement of science. The National Science Board reports that 42 percent of Ph.D. graduates secured a postdoc upon graduation. Unlike tenure-track faculty, who have teaching and service obligations, postdocs typically have full-time research appointments in labs. In most scientific fields, the common career path for a Ph.D. graduate is to secure a postdoc before applying for a tenure-track faculty position. Thus, the postdoc constitutes an important apprenticeship or rite of passage for many tenure-track faculty members. In certain scientific fields, such as biology, chemistry, and physics, postdocs are required for a tenure-track faculty position (Miller & Feldman, 2015; Nolan *et al.*, 2004). NSF (National Science Board, 2016) reports that there are approximately 62,000 postdocs in the U.S., with about 43,000 employed at academic institutions—an increase of 381 percent since 1973.

Postdocs constitute an ideal target population for assessing micro-processes of technology transfer for three key reasons. First, postdocs are relatively young and impressionable, and, consequently, may be receptive to pursuing a career path that includes technology transfer and commercialization. In recent years, many postdocs have been exposed to entrepreneurial training programs at federal agencies (*e.g.*, NSF's I-Corps program) and universities (Wright, Siegel, & Mustar, 2017). Thus, postdocs are becoming increasingly aware of commercial opportunities and familiar with the entrepreneurial community. The enhanced entrepreneurial focus of postdocs may also be due to their diminishing prospects for securing tenure-track faculty positions. For example, Sauermann and Roach (2016) found that only 10.6 percent of PhDs graduating in the past five years from life and biological science programs were able to land a tenure-track faculty job.

Second, there are secular trends that highlight the need to study postdocs in the context of technology transfer. For example, there has been an increase in industry funding of university research. Some postdocs receive industry funding, as well as support from a federal agency. In addition, there has been an increase in university-industry collaborations and “entrepreneurial ecosystems” at universities (Siegel & Wright, 2015). Moreover, NSF (National Science Board, 2016) reports that the percentage of foreign-born postdocs rose from 17.5 percent in 1973 to a record 47.5 percent in 2013. Some studies have shown that foreign-born scientists are more likely to engage in academic entrepreneurship than their native-born counterparts (Krabel, Siegel, & Slavtchev, 2012).

Third, from an intellectual merit standpoint, and, particularly in the context of technology transfer, assessing the relationship between postdocs and their supervisors constitutes a unique opportunity to examine critical organizational phenomena, including championing, leadership, and motivation. In universities, postdocs are directly supervised by academics who serve as lab managers or center/institute directors (hereafter referred to collectively as lab managers). According to the NSF (National Science Board, 2016), a postdoc appointment “serves as a period of apprenticeship for the purpose of gaining additional scientific, technical, and professional skills.” Ideally, the individual employed in a postdoc position acquires these skills under the guidance of an adviser, with the administrative and infrastructural support of a host institu-

tion, and with the financial support of a funding organization.”

This adviser is typically the lab manager who hires the postdoc. The natural association of an adviser-advisee arrangement places postdocs in a malleable position, in terms of considering a variety of career options (*e.g.*, technology transfer), and it offers lab managers a high degree of behavioral and career influence over postdocs. In other words, behavior shown by a lab manager can have a significant impact on a postdoc's motivation and subsequent technology transfer endeavors. Furthermore, given that these arrangements have short-term appointments, many postdocs will be less committed to a university or federal lab, as compared to a tenure-track professor or scientist with a permanent position. Consequently, if postdocs pursue technology transfer, they may be more susceptible to intellectual property theft, bypassing behaviors, and other forms of technology transfer behavior that constitute organizational deviance—in other words, behavior that breaches organizational norms and is harmful to the organization (Robinson & Bennett, 1995).

In sum, postdocs represent an important yet under-researched population, especially with regard to micro-level, organizational phenomena that are relevant to technology transfer. They are an ideal population to study the importance of championing and leadership behavior by lab managers, postdocs' motivation toward technology transfer, perceived organizational constraints, and the extent to which postdocs pursue technology transfer and commercialization.

One could use this population to assess both formal technology transfer (*i.e.*, working through sanctioned organizational procedures), as well as deviant technology transfer (*i.e.*, bypassing sanctioned organizational procedures). When researchers engage in such behavior, it is harmful to the organization and its members because the organization supports the process by which the lab facilitates and develops the technology. Also, lab members, including postdocs, sign an intellectual property agreement with the university or federal lab stipulating that the technologies developed in the lab are owned by university or federal lab. Consequently, when the technology is not vetted through the formal technology transfer process, and instead is bypassed to the public, the ownership of the technology, its profits, and other benefits are not afforded to the university (or federal lab). Bypassing the TTO is also technically against the law (*e.g.*, the Bayh-Dole Act), although such violations are rarely enforced by the federal government.

It is important to note that studying technology transfer based on a micro psychological, organizational behavior framework addresses important public policy concerns related to the commercialization of federally-funded research. Specifically, variables such as organizational justice, championing, leadership, and perceived organizational constraints can potentially be changed through organizational interventions.

## Work-life and Role Balance

Another human dimension of technology transfer that requires attention by academics and practitioners is work-life and multiple role balancing. In the management literature, work-life balance typically refers to organizational support for such key dimensions of a worker's personal life, such as flexible work hours, dependent care, and family/personal leave (Estes & Michael, 2005; Bearegard & Henry, 2009). Work-life and role balance is dependent on the interaction of organizational and personal factors. In an effort to provide a better work environment and to recruit and retain employees, many organizations have implemented policies such as family-leave programs, job sharing, and on-site childcare in order to offer their employees

more personal support. We believe that such issues are likely to be important for researchers at universities and federal labs and could influence the rate of commercialization of research.

University researchers also have to deal with multiple roles. A faculty member is a researcher, teacher, inventor, and possibly, an entrepreneur. These are roles that may conflict, for example, in terms of competing time demands. Adding to this burden is the reality that faculty members are complex, in terms of identification (discussed further below) and levels of organizational commitment (Benson & Brown, 2007). For example, faculty members are typically more committed to their academic field than their department or university.

As noted earlier, postdocs represent an ideal target population for examining technology transfer behavior and intentions. As noted earlier, it is common in many scientific fields to do a postdoc as a “rite of passage” before securing a tenure-track faculty. Akerlind (2009) pointed out that postdocs are specifically taught by their supervisors how to manage a lab. Also, as compared to senior faculty members who are more established and set in their ways, postdocs are more malleable, impressionable, and open to non-faculty-oriented career possibilities, including those that might emphasize technology transfer and commercialization. Specifically, postdocs may be open to influence and role modeling on the part of lab managers, which could affect their motivation. These aspects of motives could, in turn, affect technology transfer behaviors and intentions.

Overall, a key aspect of our approach is to address the type of “multilevel attributes [and] micro-organizational social processes” that Bercovitz and Feldman (2008: 86) stressed for future technology transfer research in their seminal article. As noted by Siegel and Wright (2014), most existing studies of TTOs have focused on organizational-level data, specifically, universities. Research has not sufficiently applied “micro” management theories to technology transfer activities; nor has such research been conducted outside of university settings. In our future research, we will explore this “black box” in both university and federal lab settings with a specific focus on postdocs. Our research goal is to form a better understanding of why postdocs pursue technology transfer and why such pursuits might be undertaken through formal versus deviant means.

## Lab Managers as Champions

Championing is also likely to play an important role in technology transfer processes. In the organizational behavior literature, championing has traditionally been associated with enthusiastic support for a new technological development or innovation (Schon, 1963). Howell and Shea (2001:15) defined champions as “individuals who informally emerge in an organization and make a decisive contribution to the innovation by actively and enthusiastically promoting its progress through the critical [organizational] stages.” Clarysse and Moray (2004) characterized championing as enthusiastically pushing an idea and then managing it all the way through development, which is similar to how Tushman and Nadler (1986) described championing. Through their communication with the scientists themselves or others (*e.g.*, TTO managers), champions within an organization increase the likelihood that a project will progress successfully throughout development (Howell & Shea, 2001). Further, champions are typically formal leaders within an organization’s structure who have the power and influence to promote such causes enthusiastically (Howell & Higgins, 1990).

Scholarly work also suggests that champions play a key role in university-based technology transfer. For example, Balven

*et al.* (2018) considered the possible championing role of department chairs, specifically resulting in faculty engagement in technology transfer. Bercovitz and Feldman (2008) found that the propensity of faculty members to disclose inventions was positively related to the propensity of their department chairs to disclose. As such, their findings demonstrated that department chairs may serve as important champions or role models in technology transfer.

## Policy and Practical Implications

Understanding individual-level organizational and psychological issues has important policy implications. First, to maximize the social returns to federally-funded basic research, it is important to have a better understanding of the factors that influence the decisions of scientists and engineers (*i.e.*, both postdocs and their lab managers) to engage in technology transfer and micro/managerial processes that can potentially accelerate the commercialization of research. Second and relatedly, our research efforts may be useful for those who design entrepreneurial training programs for both postdocs and senior faculty, such as NSF’s I-Corps, which do not currently include topics such as championing, leadership, and motivation. Third, understanding the human dimension of commercialization of research at universities and federal labs could help provide insights to alleviate a problem in the labor market for scientists and engineers. It is becoming increasingly apparent that there is a glut of postdocs in universities and other institutions (*e.g.*, federal laboratories). Realistically, many of these postdocs will not be able to secure tenure-track jobs at universities, even though they may be likely to desire such positions. Puljak and Sharif (2009) predicted that less than 15 percent of postdocs will find employment as tenure-track faculty members. However, there may be lucrative and society-benefitting opportunities if they pursue commercialization and entrepreneurship (*e.g.*, forming their own start-ups).

There are additional, important practical implications regarding our work. Specifically, we can envision the use of survey measures developed in our research in a range of organizations (*e.g.*, universities, federal laboratories, private businesses) to gauge the extent to which they engage in best practices pertaining to the organizational/psychological foundations of technology transfer. Such surveys should be targeted to actual knowledge workers, and in addition to relevant micro-level factors (*e.g.*, justice perceptions, role conflict, and leader championing), they might include items pertaining to individuals’ intentions to engage in various technology transfer activities. By gaining such information, managers of these organizations might be in a better position to implement policies that would help to maximize technology transfer activities.

## Conclusion

In conclusion, we assert that it is important for academics and practitioners to consider various organizational and psychological issues in the commercialization of research at universities and federal labs. These include the following important human dimensions of technology transfer: organizational justice, work-life balance, multiple roles and identity, and leadership/championing. These dimensions may be predictive of formal, as well as more informal (or deviant), means of technology transfer. Moreover, postdocs represent a potentially fertile population in which to examine the effects of micro-level factors on technology transfer processes. ■

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