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Standard vs. Partnership-Embedded Licensing: Attention and the Relationship between Licensing and Product Innovations

Thomas Klueter
IESE Business School, tmklueter@iese.edu

L. Felipe Monteiro
INSEAD, felipe.monteiro@insead.edu

Denise R. Dunlap
University of Massachusetts, deniserdunlap@gmail.com

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This paper examines the relationship between the licensing of knowledge and the creation of product innovations. We consider that firms organize licensing activities in different ways and that licensees are heterogeneous with respect to the attention available to apply and transform in-licensed knowledge to create new product innovations. We suggest that standard licensing, which typically entails a simple exchange of knowledge for money, is less likely to lead to a product innovation than licensing embedded in a broader partnership. However, we also reveal that standard licensing can lead to an innovation outcome similar to that of partnership-embedded licensing once we take into account the levels of attention of both the R&D unit receiving the licensed knowledge (bottom-up attention) and the licensee organization's top-level managers (top-down attention). Examination of 555 bio-pharmaceutical-industry licensing agreements from 1997 to 2015 yielded support for our theoretical framework. The paper showcases the value of connecting the literatures on licensing and attention to develop a more comprehensive understanding of how licensing affects innovation.

Keywords: Licensing; Product Innovation; Bottom-Up Attention; Top-Down Attention

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1. Introduction

To cope with a rapidly changing technological environment and to support their innovation activities, many firms rely on licensing knowledge from external sources (Arora & Gambardella, 2010; Conti, Gambardella, & Novelli, 2013; Hagedoorn & Hesen, 2007; Steensma & Corley, 2000; Van de Vrande, 2013). Licensing consists of a contract that affords the licensee the right to use patented knowledge, scientific insights, or proprietary databases of a licensor in exchange for an up-front fee and/or royalties to the licensor (Jensen & Thursby, 2001). Prior research has shown that licensing allows firms to add variety to their knowledge repertoire, facilitate exploratory searches and learning, and can substantially speed up innovation cycles (Laursen, Leone, & Torrisi, 2010; Leone & Reichstein, 2012; Markman, Gianiodis, Phan, & Balkin, 2005). However, still missing is a comprehensive understanding of how licensing knowledge in the form of technologies, intellectual property, or scientific know-how ultimately leads to the creation of product innovations.

While much empirical literature has examined licensing as a uniform type of external knowledge-sourcing strategy (e.g., Leone & Reichstein, 2012; Mowery & Ziedonis, 2015; Nicholls-Nixon & Woo, 2003), researchers have recently suggested that firms across a number of industries approach licensing in two fundamentally different ways (Kranenburg, Hagedoorn, & Lorenz‐Orlean, 2014; Luo, 2008; Reuer & Devarakonda, 2015; Steensma & Corley, 2000). On the one hand, many licensing agreements embed licensing in a broader partnership or an alliance that includes the mutual sharing of resources and joint R&D efforts between the licensor and licensee.[1] On the other hand, a simpler form of licensing gives the licensee the right to use the

[1] Hagedoorn et al. (2009) identify that 70% of all licensing agreements are in this category. In the context of our study, the bio-pharmaceutical industry, about 60% of licensing agreements were embedded in a broader partnership.

knowledge developed by another firm in exchange for money but without mutual interactions and resource sharing between licensee and licensor and with little ex ante commitment of resources to the licensing activities (Agrawal, 2006; Hagedoorn & Hesen, 2007). Following prior research (Hagedoorn et al., 2009), we label the first type "partnership-embedded licensing" and the simpler type "standard licensing." While we know that those two types of licensing are qualitatively different, a key unanswered question is whether they have a different impact on the licensee's ability to use and transform licensed knowledge into new product innovations. More precisely, is partnership-embedded licensing more likely than standard licensing to lead to product innovations? As we suggest below, the answer is both "yes" and "no."

Building on the knowledge- and attention-based views of the firm, we model product innovation as a lengthy and resource-intensive process in which pieces of knowledge are recombined and transformed to create product innovations (e.g., Carlile, 2004; Dougherty & Hardy, 1996; Galunic & Rodan, 1998; Luo, 2008; Mudambi & Swift, 2009; Ocasio, 1997, 2011).[2] We suggest that while both standard and partnership-embedded licensing add knowledge variety to the licensee's repertoire, the two types of licensing fundamentally differ in terms of how knowledge is transferred between the licensor and licensee and the extent to which scientists and managers are assigned to support and carry on the product innovation process (Agrawal, 2006; Arora, 1996; Eisenhardt & Schoonhoven, 1996; Steensma & Corley, 2000). Standard licensing is characterized by lower coordination and setup costs because it relies on fewer interactions between the involved licensor and licensee and commits fewer resources (in the form of scientists and managers) ex ante to support the innovation activity (Contractor, 1990). In the context of new

[2] We examine the effect of licensing as an input to knowledge creation and, in particular, the transformation of knowledge into specific product designs, which researchers refer to as product innovation (Carlile, 2004; Smith, Collins, & Clark, 2005; Zhou & Wu, 2010). It is beyond the scope of this paper to examine product innovation performance, which relates to the commercial performance once products are introduced to markets (e.g., Köhler, Sofka, & Grimpe, 2012; Mulotte, Dussauge, & Mitchell, 2013).

product development, however, the characteristics of standard licensing may limit the application of licensed knowledge and may constrain the support needed to facilitate the product innovation process in the long run. Thus, when compared to partnership-embedded licensing, standard licensing appears less likely to lead to the creation of a product innovation.

In this paper, we go beyond examining the direct impact of these two types of licensing on product innovation and conceptually develop and show how standard licensing's limitations can be overcome once the licensee's organizational context is taken into account (Bierly, Damanpour, & Santoro, 2009; Eisenhardt & Santos, 2002). Specifically, we examine the role of organizational attention that shapes the processing and application of knowledge in organizations and the allocation of resources to organizational activities (Ocasio, 1997, 2011). Building on previous literature, we distinguish "bottom-up attention" from scientists in R&D units, who are responsible for receiving the licensed knowledge and applying it toward productive uses (Ghosh, Martin, Pennings, & Wezel, 2014; Hansen & Haas, 2001; Nonaka, 1994; Ocasio, 2011:1287), and "top-down attention" from top managers who influence R&D units' activities and help sustain the innovation processes within the organization (Cyert & March, 1963; Eggers & Kaplan, 2009; Li, Maggitti, Smith, Tesluk, & Katila, 2013; Ocasio, 2011:1287). We argue that both bottom-up and top-down attention are particularly relevant for standard licensing agreements, as the responsibility for applying external knowledge more likely lies with the licensee (Bierly et al., 2009; Kapoor & Klueter, 2015). As a result, bottom-up and top-down attention within the licensee's organization can attenuate some of the limitations inherent in standard licensing and allow those agreements to yield product innovation results similar to those of partnership-embedded licensing agreements.

We test our hypotheses in the global bio-pharmaceutical industry using a sample of over 500 licensing agreements by the world's Top 50 global bio-pharmaceutical firms over two decades. In the bio-pharmaceutical industry, product innovations (i.e., new-to-the-industry

molecular entities) are central to firm survival and success (Roberts, 1999), and the availability of high-quality, detailed data allows us to clearly distinguish between standard and partnership-embedded licensing agreements. Drawing on multiple data sources (e.g., ReCap, Pharmaprojects, Adis R&D Insights, Scifinder, and Factiva), we examine each licensing agreement separately and determine whether the agreement resulted in a product innovation in the form of a new molecular entity in clinical trials. Our results reveal the importance of unbundling licensing into standard and partnership-embedded licensing. The impact of standard licensing on the creation of product innovations is statistically inferior to that of partnership-embedded licensing agreements, even when controlling for the initial selection into the licensing type. However, standard licensing can bring about the same innovation benefits as partnership-embedded licensing if there is availability of top-down and bottom-up attention within the licensee.

To the best of our knowledge, this study is one of the first to systematically contrast the differences between standard licensing and partnership-embedded licensing in terms of their effect on product innovations. Prior studies have predominantly contrasted the learning benefits of joint (equity) alliances with various forms of knowledge sourcing, including licensing (Mowery, Oxley, & Silverman, 1996; Oxley & Wada, 2009), or have focused on the commercial performance of different knowledge-sourcing agreements (Mulotte, 2013; Mulotte et al., 2013). Our study focuses explicitly on heterogeneity between two types of licensing activities and demonstrates the consequential differences in outcomes of these licensing types with respect to the lengthy, resource-intensive product innovation process. The findings therefore stress the value of disentangling different types of licensing in future innovation studies.

Second, besides revealing the differential direct effect of two licensing types, we show that innovation benefits from licensing agreements not only depend on the licensing activity per se, but are also determined by the licensee's organizational context. In particular, bottom-up and top-

down attention are both valuable for standard licensing. Our study makes a novel contribution by combining two previously disconnected research streams: the licensing literature (e.g., Arora, Fosfuri, & Gambardella, 2001; Laursen et al., 2010; Leone & Reichstein, 2011) and the attention literature (e.g., Li et al., 2013; Ocasio, 1997; Ocasio, 2011). With respect to bottom-up attention, we reveal that the innovation activities in standard licensing depend substantially on the R&D unit receiving the knowledge and that the availability of attention in such a unit is a key catalyst for innovation when licensing is a simple exchange of knowledge for money. With respect to top-down attention, we find that top management attention is critically important for standard licensing as it allows the licensee to sustain the innovation process. This contributes to the broader discussion on how attention from top-level managers shapes innovation behaviors and outcomes (Eggers & Kaplan, 2009; Li et al., 2013; Ocasio, 2011).

Overall, the study reveals an intriguing set of results. On the one hand, our findings show that standard and partnership-embedded licensing differ substantially with respect to their (main) effect on product innovations. On the other hand, the results also suggest that under specific organizational conditions (i.e., when bottom-up or top-down attention is available), standard and partnership-embedded licensing can lead to similar product innovation outcomes. In the following sections, we develop a more nuanced examination of how licensing affects product innovation as we take into consideration (a) heterogeneity in the type of licensing used by firms and (b) heterogeneity with respect to the attention available within the licensee.

2. Theory and hypotheses

2.1. Licensing external knowledge and innovation

The ability to generate product innovations lies at the heart of firms' competitiveness in environments characterized by rapid technological change (Ahuja & Morris Lampert, 2001; Li et

al., 2013; Roberts, 1999). An important prerequisite for the creation of product innovations is the recombination of knowledge from a range of disciplines that no single firm is likely to possess (Carlile, 2004; Steensma & Corley, 2000). In response, many established firms increasingly license knowledge from young firms or universities that work on the scientific and technological frontiers (Hagedoorn, 1993; Laursen & Salter, 2004, 2006; Rothaermel, 2001). In the early 1990s, for example, most bio-pharmaceutical firms lacked competencies in the rapidly emerging field of genetics. Established firms responded by licensing knowledge from universities and smaller startups to augment their own knowledge in an attempt to better understand information derived from genes (Gilsing & Nooteboom, 2006).

Research has found substantial benefits from licensing knowledge (Laursen et al., 2010; Leone & Reichstein, 2012). Licensing allows firms to add distinct pieces of knowledge and new perspectives on technological trajectories that would be difficult to obtain through internal R&D because of embedded and path-dependent competencies (Ahuja & Morris Lampert, 2001; Oxley & Wada, 2009). Another key benefit associated with licensing is the instant access to specialized knowledge from outside the firm (Mowery et al., 1996), allowing firms that engage in licensing to accelerate innovation cycles and introduce new inventions more rapidly than organizations that do not engage in licensing activities (Leone & Reichstein, 2012). Finally, researchers have shown that, under certain conditions, licensing allows firms to engage in more exploratory search into knowledge domains new to the firm (Laursen et al., 2010).

Despite the many innovation benefits attributed to licensing, we argue that, to date, only a limited understanding exists of *when* licensing allows firms to actually innovate, and in particular when licensing new knowledge and technologies leads to the subsequent creation of product innovations. In fact, some studies have raised doubt as to whether licensing by itself allows firms to innovate at all (Eisenhardt & Schoonhoven, 1996; Fey & Birkinshaw, 2005). We believe these

doubts emerge largely because most innovation studies have not systematically examined how the creation of product innovations may depend on (1) the way licensing agreements are actually configured (Hagedoorn, Lorenz-Orlean, & Van Kranenburg, 2009 and ; Oxley & Wada, 2009 are rare exceptions) and (2) the differences within the organizational context of the licensee.

2.2. Two key approaches to licensing external knowledge

Established firms can license external knowledge with the intent to create product innovations in various ways (Hagedoorn et al., 2009). Building on previous literature, we classify licensing agreements into two qualitatively different types based on the level of interorganizational dependence and the level of joint commitment between the licensor and licensee (Contractor, 1990; Koza & Lewin, 1998; Luo, 2008). On the one hand, we have "partnership-embedded" licensing, which includes not only a license to access new knowledge and technology in exchange for money but also the mutual exchange of knowledge, the commitment and sharing of personnel, and the pooling of resources among the partners.[3] As an example, we observe firms (licensees) licensing a proprietary technology or scientific insights and concomitantly engaging in a broader partnership with the licensor to learn about the underlying knowledge and employ the knowledge for productive use (see Table 1 for examples).

On the other hand, "standard" licensing is characterized by a predominantly unilateral flow of knowledge (Arora et al., 2001; Hagedoorn & Hesen, 2007; Mulotte, 2013; Steensma & Corley, 2000). For example, a firm may pay a license fee for access to a proprietary technology (e.g., scientific data or database access) but forego substantial interactions with the licensor following

[3] Licenses embedded in a broader partnership can be considered as a subset of broader R&D alliances, which have a licensing component for some form of predetermined knowledge (e.g., scientific insights, intellectual property). However, not all R&D alliances have a licensing component and predefined intellectual property. On the other hand, the scope of alliances is typically much broader with respect to the generation of new intellectual property, in some cases through a newly formed entity. We focus exclusively on agreements in which some intellectual property is exchanged through licensing.

the agreement (see Table 1 for examples). Many licensees choose to engage in standard licensing because of its lower set-up costs. Standard licensing agreements do not tend to pre-assign specific resources, such as scientists and managers, that are allocated ex ante when licensing is embedded in a broader partnership (Contractor, 1990). Such lower ex ante commitment of resources gives licensees the flexibility to quickly access highly specialized external knowledge (Steensma & Corley, 2000). In a similar vein, an exchange of knowledge for money tends to result in lower coordination costs because such agreements allow clear delineation of responsibilities of the licensor and licensee, whereas in partnership-embedded licensing the two partners work together to create new products (Luo, 2008; Reuer & Devarakonda, 2015). The label "standard licensing" thus refers to the agreement's simplicity in terms of allowing an exchange of knowledge for money without substantial ex ante commitment of resources and extensive coordination costs.

Given this fundamental dichotomy, we suggest that the relationship between licensing and product innovations can best be understood by contrasting the characteristics of these two types of licensing and by explicating how they facilitate product innovation.

--- Insert Table 1 about here ------

2.3. Standard licensing, partnership-embedded licensing, and product innovation

Both types of licensing agreements provide the licensee with a larger set of knowledge and technologies (Johnson, 2002), increasing the potential for recombination between externally and internally available elements of knowledge to create product innovation (Galunic & Rodan, 1998). At the same time, the creation of product innovations is highly uncertain and managers cannot easily calculate ex ante the net benefits of engaging in one type of licensing over the other (i.e., what costs firms would incur ex ante by engaging in a particular type of licensing and the resulting benefits in the form of new product innovations) (Dougherty & Hardy, 1996; Dunlap, McDonough, Mudambi, & Swift, 2015). Our baseline hypothesis is that the two types of licensing

agreements will have differing impacts on product innovation since the mere addition of knowledge through licensing may not be sufficient.

The creation of product innovations requires firms to learn about and transform elements of licensed knowledge and technologies (Bierly et al., 2009; Carlile, 2004; Dougherty & Hardy, 1996). Such external knowledge is rarely tightly packaged and fully codified, making the transfer of knowledge from the licensor to the licensee challenging and the absorption and application of such knowledge non-trivial (Gerwin & Ferris, 2004). A unilateral flow of knowledge, as found in standard licensing, precludes frequent interaction and exchange of information, resulting in a weaker understanding of the cause-and-effect mechanisms underlying the knowledge exchanged (Agrawal, 2006; Dyer & Singh, 1998; Galunic & Rodan, 1998; Steensma & Corley, 2000). The problem is exacerbated in standard licensing agreements because the licensee and licensor typically define the content of the knowledge exchange ex ante, leaving limited room for subsequent explorations about the underlying knowledge between the knowledge source and the licensee (Das & Teng, 2000; Koza & Lewin, 1998). In contrast, when licensing is embedded in a broader partnership, the licensee and licensor typically work closely together to ensure that the exchange of knowledge and the subsequent application of knowledge are successful (Luo, 2008). Research has shown that when knowledge is obtained in a unilateral way, as found in standard licensing, learning and transfer are conceivably less valuable than in partnership-embedded arrangements that involve mutually collaborative efforts (Mowery et al., 1996; Oxley & Wada, 2009). It stands to reason that knowledge acquired from standard licensing, when contrasted to partnership-embedded licensing, may be less effective in the creation of product innovations.

In addition, product innovation is inherently uncertain, and it does not happen instantaneously since new knowledge needs to be applied and new ways of using the knowledge need to be identified (Basalla, 1988). This effort requires support (e.g., with respect to resources)

throughout a prolonged period (Brown & Eisenhardt, 1995; Dougherty & Hardy, 1996; Monteiro, 2015). Standard licensing, in contrast to partnership-embedded licensing, relies less on predefined and ex ante committed resources such as scientists and managers from the licensor and licensee. This difference can affect the uncertain, resource-intensive, and lengthy product innovation process, as the licensor and licensee typically commit fewer resources and can withdraw or reallocate resources more easily since these are not specific to the agreement (Luo, 2008). Conversely, in partnership-embedded licensing agreements, the licensor and licensee commit resources ex ante to sustain projects and move them forward along the innovation value chain for example, by a joint steering committee (see Table 1, example 9 that exemplifies this type of partnership-embedded licensing commitment between Addex and Johnson & Johnson). (Contractor, 1990; Hagedoorn & Hesen, 2007; Steensma & Corley, 2000).

Taking these two arguments together, we suggest that standard licensing, despite adding valuable knowledge to the licensee's knowledge base and involving fewer coordination costs, is less likely to lead to the creation of product innovations when compared to partnership-embedded licensing agreements.[4]

Hypothesis 1: A standard licensing agreement is less likely to lead to the creation of a product innovation than a partnership-embedded licensing agreement.

2.4. The importance of bottom-up and top-down attention

Thus far, we have focused exclusively on two key types of licensing agreements and discussed their possible benefits and limitations. However, the benefits that licensees accumulate from accessing external knowledge is unlikely to only depend on the direct effect of the licensing activity per se, but may also be significanlty shaped by the licensee's organizational setting, in

[4] We acknowledge that firms may also select a specific type of licensing agreement. To alleviate selection effects, we illustrate in our method section how we ensure that the licensing agreements observed are as similar as possible and we empirically address that organizations may choose to select a particular licensing type.

particular the internal context into which the licensed knowledge is added (Eisenhardt & Santos, 2002; Volberda, Foss, & Lyles, 2010).

Researchers have long suggested that external knowledge may benefit some organizations more than others (Bierly et al., 2009; Garriga, von Krogh, & Spaeth, 2013; Jansen, Tempelaar, Van den Bosch, & Volberda, 2009; Monteiro, Mol, & Birkinshaw, 2017). For example, Laursen and colleagues (2010) found that licensing in conjunction with distinct organizational monitoring capabilities can enhance an organization's ability to engage in more distant innovative search. To understand how different types of licensing agreements may result in product innovations (or not) therefore requires examination of not merely these agreements and their characteristics but also how they interact with the organizational context of the licensee. Compared to partnership-embedded licensing, standard licensing agreements have limitations in the application of licensed knowledge and in sustaining the innovation process for the creation of product innovations. Thus, our theory focuses on the characteristics of the licensee's organizational context, which can compensate for those limitations.

Specifically, we examine the role of attention available within the organization, which shapes the processing of information (i.e., knowledge added through licensing) and the allocation of resources to organizational activities (i.e., the product innovation process) (Ocasio, 1997, 2011). Grounded in organizational theory (Cyert & March, 1963; March & Simon, 1958), the attention literature stream has examined attention emerging through both bottom-up and top-down processes in organizations (Gavetti, Greve, Levinthal, & Ocasio, 2012; Ocasio, 2011) and how attention affects information processing and organizational actions. Accordingly, we next consider two important dimensions of organizational attention: (1) "bottom-up attention" from scientists in R&D units, who receive the licensed knowledge and can apply such knowledge in productive use (Ghosh et al., 2014; Hansen & Haas, 2001; Nonaka, 1994; Ocasio, 2011:1287), and (2) "top-down

attention" from top-level managers, who can influence an R&D unit's activities that help sustain the organization's innovation processes (Cyert & March, 1963; Eggers & Kaplan, 2009; Li et al., 2013; Ocasio, 2011:1287). We argue that considering bottom-up and top-down attention is critical to discerning what conditions attenuate the gap between standard and partnership-embedded licensing agreements in terms of the likelihood of creating product innovations.

2.5. Bottom-up attention through R&D units

R&D units serve as a key bottom-up information-processing mechanism because they keep an organization updated about emerging technological trajectories and developments (Dollinger, 1984; Monteiro, 2015; Tushman & Katz, 1980). Since R&D units have limited information-processing capacity, they have to choose which initiatives and problems to attend to (Lavie, 1995; Ocasio, 2011). Bottom-up attention has emerged from the ecological perspective on crowding (Hansen & Haas, 2001), which acknowledges that information and knowledge within organizational units are not used automatically but require the attention of organizational actors. We argue that such bottom-up attention may be particularly relevant for standard licensing and product innovation for the following reasons.

Standard licensing is characterized by the unilateral flow of knowledge and the lack of specific resources committed by licensor and licensee. Hence, the onus of absorbing and applying external knowledge from standard licensing more likely lies within the licensee's R&D unit into which licensed knowledge is added (Bierly et al., 2009; Kapoor & Klueter, 2015). In partnership-embedded licensing, the identification of recombination possibilities is catalyzed by the mutual interactions among personnel from licensor and licensee. In the absence of such interactions, learning about the technology and its recombination possibilities occurs within the receiving R&D unit. We argue that the more attention available in the R&D unit, the more likely valuable knowledge recombinations will be discovered. If R&D units receiving licensed knowledge are

focused on a narrower range of problems, then they can reduce and minimize potential distractions from alternative activities and thus can "concentrate their energy, effort and mindfulness on a limited number of issues" (Ocasio, 1997:203). Therefore, the more focused the R&D unit is, the more likely it can learn about the recombination possibilities associated with licensed knowledge. Such attention by the licensee's R&D units will be particularly relevant when adding knowledge through standard licensing agreements. In a similar vein, research has shown that crowding, or the density of alternative initiatives, in an organizational unit can be a key constraint for knowledge related tasks and that such crowding can be compensated for by the focus and concentration within the respective organizational unit (Hansen & Haas, 2001). Thus, when the licensing exchange is unilateral, the attention available within the receiving R&D unit can compensate for a lack of mutual interactions and will be more likely to focus on the licensed knowledge and its recombination possibilities.

Prior research has also highlighted that attention is particularly valuable in applying and transforming complex new knowledge to inventions or innovations (Ghosh et al., 2013). In partnership-embedded licensing, scientists from both licensor and licensee work together on their assigned tasks to apply external knowledge. However, for standard licensing agreements, complex tasks are managed within the licensee's R&D unit. In the presence of bottom-up attention, an R&D unit is more likely to make mindful abstractions about cause-and-effect relationships and effectively apply knowledge from standard licensing toward productive use (Ghosh et al., 2013). Therefore, the net benefits from bottom-up attention are likely to be greater for standard licensing than for partnership-embedded licensing as in standard licensing the R&D unit is mainly responsible for the product innovation process.

Taking our arguments in tandem, we hypothesize that an R&D unit with more bottom-up attention available is more likely to effectively learn from and subsequently recombine and apply

licensed knowledge to the creation of innovative products. Bottom-up attention can thus compensate for the inherent limitations of standard licensing relative to partnership-embedded licensing.[5]

Hypothesis 2: The difference in the likelihood of creating a product innovation between standard licensing and partnership-embedded licensing is attenuated in the presence of bottom-up attention by the licensee's R&D unit.

2.6. Top-down attention from management

Beyond the attention of R&D units receiving the licensed knowledge, the attention given by the licensee's top managers is also an important consideration. Researchers have long identified top managers as an important locus of information processing (Li et al., 2013; Ocasio, 2011), decision-making, and resource allocation in organizations (Eggers & Kaplan, 2009; Simons, 1994). Managers need to be selective as to which events they attend to and which they screen out (Cyert & March, 1963; March & Simon, 1958), particularly when outcomes cannot be predicted accurately, such as in a lengthy product innovation process. Although top managers are not actively involved in the actual creation of product innovations, their attention shapes the noticing, encoding, and interpreting of information and guides the organization in focusing time and effort (Kaplan, Murray, & Henderson, 2003; Li et al., 2013; Ocasio, 1997). Top managers can help galvanize scientific teams and middle managers to learn about and apply licensed knowledge in productive ways (Mudambi & Swift, 2009). We argue that attention from top-level managers may be particularly valuable for standard licensing, as their attention can help to compensate for some of the inherent limitations of standard licensing agreements relative to partnership-embedded licensing agreements.

[5] We hypothesize about the narrowing of the difference between standard and partnership-embedded licensing. The flip side of this argument, which we come back to in the discussion section, is that differences between standard and partnership-embedded licensing may be particularly large when the R&D unit receiving the knowledge has little attention available.

First, top managers' attention is likely to lead to a heightened organizational awareness of the knowledge underlying the agreement, which is important if the firm wants to take full advantage of learning about the licensed knowledge and how it can envision possible novel recombinations from it (Cyert & March, 1963). Unlike standard licensing, partnership-embedded licensing allows awareness to emerge directly from the agreements themselves, in which the licensor and licensee work together more closely and have pre-assigned "champions" (e.g., making decisions in a joint steering committee) to promote the underlying knowledge and its usefulness for product innovations (Dutton, Ashford, O'Neill, & Lawrence, 2001). However, for standard licensing such is not the case, and as a result top management attention is particularly useful if organizations want to make licensed knowledge more visible, heighten awareness regarding the knowledge itself, and create incentives for scientists to use such knowledge in product innovations (Li et al., 2013; Ocasio, 2011).

Second, management attention also determines the sustained allocation of resources toward innovation-related tasks (Cyert & March, 1963; Simons, 1994). What managers pay attention to matters for current and future investments and resource commitments (Kaplan & Tripsas, 2008). For partnership-embedded licensing, a sustained innovation process emerges from the licensor's and licensee's pre-commitments of resources and the mutual sharing of resources within the partnership. Standard licensing agreements, however, have lower resources initially committed to them, and those committed resources can be more easily withdrawn by the licensee (Contractor, 1990; Steensma & Corley, 2000). This fact suggests that the net benefits of giving managerial attention to a licensing activity may be stronger for standard licensing than for partnership-embedded licensing.

Overall, we expect that in the presence of top-down managerial attention, knowledge added through standard licensing is more likely to be applied by the licensing organization and the

product innovation process is more likely to be sustained in the long run. Thus, in the presence of top management attention, standard licensing may lead to outcomes in new product development similar to those of partnership-embedded licensing.

Hypothesis 3: The difference in the likelihood of creating a product innovation between standard licensing and partnership-embedded licensing is attenuated when top management pays attention to a licensing agreement.

3. Methods

3.1. Setting: The global bio-pharmaceutical industry

The bio-pharmaceutical industry offers an appropriate setting to test our hypotheses on how the type of licensing (and the availability of bottom-up and top-down attention) influence the licensee's ability to create product innovations. Since the earning potential of old drugs diminishes once patents expire, bio-pharmaceutical firms must create product innovations in the form of new therapeutic drugs (Bierly & Chakrabarti, 1996; Roberts, 1999). The bio-pharmaceutical industry is characterized by rapid technological change, in which licensing by established firms is highly prevalent and considered to be a key organizational activity to access new knowledge (Nicholls-Nixon & Woo, 2003; Nishimura & Okada, 2014). With the proliferation of new technologies (e.g., gene expression, gene sequencing) and new therapeutic approaches (e.g., monoclonal antibodies, stem cells), firms have increasingly relied on licensing to tap into the knowledge of universities and small startups in these emerging fields (Gilsing & Nooteboom, 2006; Nishimura & Okada, 2014). Hence, licensing is a principal way firms in this industry try to create product innovations.

Importantly, since ideas and knowledge can readily be codified, the bio-pharmaceutical industry is characterized by a strong intellectual property protection regime (Levin et al., 1987; Teece, 1986). In such environments, it is very hard for the licensee to invent around or reverse engineer the licensed knowledge (Dushnitsky & Shaver, 2009), so that the use of the knowledge in a subsequent product innovation most likely can be traced and documented. Indeed, recent

research has highlighted that licensors owning uncertain technological discoveries can use contractual mechanisms to force the licensee to revert improvements in the licensed technology back to the licensor (Laursen, Moreira, Reichstein, & Leone, 2017), a practice that further supports the idea that a licensee cannot easily expropriate the licensor's discovery in this setting.

Finally, the drug development process follows highly a regulated process with well documented dedicated steps. The granularity of the data available in the industry allows clear distinction of the types of agreements firms engage in and the unambiguous identification of product innovations, which are the outcomes of such agreements.

3.2. Sample

We focused exclusively on the early research stage of drug development initiated with the intention to create a product innovation. The innovation process begins with the discovery of a chemical compound or biologically based treatment, which is subsequently tested in animals in preclinical trials before the firm can file an investigational new drug (IND) application. With the approval of regulatory authorities, the firm can begin testing the drug on humans, which is the first regulatory step in the drug development process. Approval to begin clinical trials, given by an external authority (such as the Food and Drug Administration), validates that a product innovation in the form of a therapy in development was created (see Figure 1) (Girotra, Terwiesch, & Ulrich, 2007). Thus, we focus on licensing deals made with the intention to create product innovations in which a specific compound has not yet been created or put into clinical trials. To sample such licensing agreements we used ReCap, a comprehensive database covering the interorganizational agreements in the bio-pharmaceutical industry (Rothaermel, 2001; Schilling, 2009). In ReCap, licensing agreements are flagged through the field type, called "stage at signing." This stage encompasses the research and lead development stage related to licensing deals and reflects that the license is in an early stage within the innovation value chain. However, once a molecule is in

later stages of development, such as clinical trials or approval, it cannot be altered and thus does not represent the creation of a product innovation. Since agreements for ready-to-commercialize products were not germane to our study they were excluded from our sample. Hence, we focused solely on early-stage, signed licensing agreements.

---------- Insert Figure 1 about here ----------

Our firm sample was based on a comprehensive list of publicly traded firms in the bio-pharmaceutical industry. Using Compustat, annual reports, and the Top 50 pharma report in 1999, we took the Top 50 bio-pharmaceutical firms in terms of prescription drug sales. The sample comprises firms in the US (46%), Japan (18%), and Europe (36%), including Denmark, France, Germany, the Netherlands, Sweden, Switzerland, and the UK. Limiting the sample to the leading firms is consistent with our theoretical arguments on established bio-pharmaceutical firms, and this constraint also facilitated the data triangulation across multiple data sources (Jick, 1979). For each firm, we constructed a detailed history of divisions and subsidiaries using the *Directory of Corporate Affiliations*, Factiva, and corporate websites to ensure that we were able to identify licensing and the creation of product innovation for each firm. ReCap indicates which firm is the technology provider (licensor) and which firm is the client (licensee), allowing us to clearly identify incumbents who were licensing knowledge from other parties. All sample firms were engaged in at least one licensing deal during the sample period. For each agreement found in ReCap, we identified whether it included a licensing component, either through its classification in ReCap (agreement type L) or through the press release announcing the agreement. To ensure that the licensing agreements were signed with the goal of creating a product innovation, we focused on agreements in a specific therapeutic area (e.g., cancer, neurology, cardiovascular).[6]

[6] Some licensing agreements have goals other than the generation of therapeutic product innovations. For example, they may aim to make the drug development process more efficient, but not to create new therapies.

Following the above sampling criteria, we identified 615 licensing agreements signed by the 50 incumbent firms between 1997 and 2006.

3.3. Measures

3.3.1. Dependent variable: Product innovation

To measure product innovations, we focused on the first regulatory milestone, which documents that the firm was granted permission to test the therapy on humans in clinical trials (see Figure 1). Obtaining permission to test is a key hurdle for a product innovation and occurs long before the product can be launched on the market.[7] Importantly, the commencement of clinical trials is subject to scrutiny by regulators, which makes it observable to researchers and validates that the firm has in fact created a product innovation.

In our study, for each licensing agreement, two researchers independently examined whether the agreement resulted in a clinical trial. First, the researchers examined licensor and licensee names in Pharmaprojects and ADIS R&D Insights to determine whether the licensing agreement led to the initiation of a clinical trial. Both Pharmaprojects and ADIS R&D Insights cover drug development activities and have been used in prior bio-pharmaceutical studies (Girotra et al., 2007; Hess & Rothaermel, 2011; Kapoor & Klueter, 2015). If the researchers found no unambiguous results in either database, then they continued to search for clinical trials by using licensor and licensee names and the technology associated with the license in Factiva (i.e., the research tool to extract press releases), Scifinder (i.e., the database for preclinical and clinical trials) and ClinicalTrials.gov (e.g., the database for clinical trials). In particular, we found that smaller firms quite often reported that their technology was deployed by a larger corporation—this use tends to trigger milestone payments and smaller firms are eager to report such advancements to increase reputation. The results from the second search were then cross-checked

[7] In the bio-pharmaceutical industry, only a few drugs get approved each year (Girotra et al., 2007). Of the 615 licensing agreements signed between 1997 and 2006, only 9 (or about 1.5%) led to an approved therapy as of December 2015.

with Pharmaprojects and ADIS R&D Insight.[8] The dependent variable, *Product Innovation,* is an indicator variable, which takes the value 1 if we identified at least one clinical trial associated with the licensing agreement in the 10 years following the license agreement, which means the final year considered is 2015.[9]

3.3.2. Independent variables

Licensing Type. We took several steps to classify the licensing deals in the two categories examined. First, we used ReCap to classify the identified licensing agreements into standard and partnership-embedded licensing. ReCap adds identifiers to a licensing agreement to indicate that an agreement contains a collaborative part and that resources (beyond financial) are shared among licensor and licensee. We confirmed with ReCap representatives that such agreement types are added to a deal if both parties actively participate in R&D activities through sharing resources. We consider this distinction to be close to our theoretical argument in which we characterize partnership-embedded licensing as a mutual and often reciprocal exchange of knowledge. Conversely, we characterized licensing agreements identified in our sample as standard licensing if they did not have an additional collaborative identifier, as this arrangement more likely represented an exchange of knowledge for money. Finally, we verified this distinction through the press announcements associated with the start of the licensing deals. The variable *Standard Licensing* takes the value of 1 in the case of standard licensing and 0 in the case of partnership-embedded licensing. Table 1 showcases examples of both types of licensing agreements.

Bottom-up Attention. Following the literature on crowding and attention (Ghosh et al., 2014; Hansen & Haas, 2001), we proxy *Bottom-up Attention* by the concentration of the search activities by the R&D unit involved in the alliance. While previous research has examined the

[8] Clinical trials tend to be exhaustively covered in Pharmaprojects and ADIS R&D Insights, but the information on who participated in the trials was missing in some cases. Moreover, in some cases the licensor name in Pharmaprojects had been updated owing to name changes. Factiva, Scifinder and searches on ClinicalTrials.gov ensured that we could accurately link a licensing agreement to a clinical trial.

[9] In 20% of all cases, we found a clinical trial. A licensee can get approval to start a clinical trial by amalgamating two or more licensed pieces of knowledge. In our sample, approval was very rare (i.e., 6% of all clinical trials identified). Excluding these licensing agreements did not change our results.

concentration of topic areas of documents within a focal unit in an organization (e.g., Hansen and Haas, 2001), we use the R&D units patenting activity method (Ghosh et al., 2014) to proxy their concentration in R&D-related searches. We obtained this information from the Derwent patent index. Through the ReCap database and the press announcement of the licensing agreement, we identified the main therapeutic area of the licensing agreement, such as cancer, cardiovascular, or ophthalmic types of diseases. We then matched these ReCap therapy codes to Derwent patenting activities using keywords.[10] Hence, we could identify the patenting activity in the R&D unit working in the therapeutic area for which the licensing deal is signed.

The variable *Bottom-up Attention* captures the concentration of patent class combinations within a distinct therapeutic area (i.e., the R&D unit) and represents the unit's search focus. It consists of a Herfindahl index computed as the sum of the squares of the shares of each distinct combination of the six-digit Derwent code associated with the therapeutic area (e.g., oncology, cardiovascular, ophthalmology). As an example, we can consider the R&D units of two firms, both with nine patents in the therapeutic area of cancer. We would examine these units if they engaged in a licensing agreement for cancer. For Firm 1, seven of its nine cancer patents are associated with patent code A, one with B, and one with C. Firm 2 has three patents associated with each patent code. For our *Bottom-up Attention* variable, Firm 1's value in cancer would be higher (computed as $\left(\frac{7}{9}\right)^2 + \left(\frac{1}{9}\right)^2 + \left(\frac{1}{9}\right)^2 = 0.63$) than Firm 2's (computed as $\left(\frac{3}{9}\right)^2 + \left(\frac{3}{9}\right)^2 + \left(\frac{3}{9}\right)^2 = 0.33$). A low value of this variable indicates a dispersion of the research unit's activities among various combinations in a therapeutic area (i.e., low attention), whereas a high value indicates focus (i.e.,

[10] Derwent has a dedicated section for therapies (B14-Pharmaceutical activities). The concordance matches Recap therapies to Derwent pharmaceutical activities in this section (B14). The translation table can be downloaded from https://www.dropbox.com/s/8nhjye6xxp2f4ii/NSA_Therapy_Codes_Recap_Derwent_Broad.xlsx?dl=0.

high attention). To ensure we had enough observations for each firm and were not influenced by outliers, we used the three years before the agreement was signed to build this measure.

Top-down Attention. The attention top management pays to a licensing agreement is difficult to discern as it is not codified anywhere. Hence, we followed prior research, which emphasizes that top-down attention can be proxied by statements managers make (Cho & Hambrick, 2006; Kaplan & Tripsas, 2008). Importantly, we wanted to rule out any retrospective bias and therefore searched for a contemporary measure of top-down attention for a specific licensing agreement (Eggers & Kaplan, 2009). We considered managers' statements on the press announcements related to a licensing deal to be an appropriate proxy to capture such top-down attention and hence collected press announcements from the news wire service Factiva using a multiple-step process. First, we examined whether an official press announcement appeared on the website (or archived website) of the licensee or licensor or in Factiva. Second, using the agreement date from ReCap, we searched for any type of news articles in Factiva in the 15 days before and after the ReCap agreement date. For only 17 (3%) of the 615 licensing agreements were we unable to find related press announcements or news articles, which led to missing data.[11] Next, we read the press announcements and articles to determine whether a top manager within the licensee firm made a formal statement regarding the relevance of the agreement.[12] The variable *Top-down Attention* takes the value of 1 if we found at least one statement by a top-level manager within the press announcements or articles and 0 if not (see Examples 2 and 7 in Table 1 for statements by managers).

[11] In such cases, Recap records agreements on the basis of annual reports or other sources. In a robustness test, we included these observations (i.e., our top-down attention variable value was 0) to verify that our results are not sensitive to their exclusion.

[12] Top managers include CEOs, Board members, CFOs, Chief Scientists, Department Heads, Presidents, Vice Presidents, and Senior Vice Presidents. Prior studies on top management attention have often focused on the CEO. However, in our sample CEOs directly commented on only a very few licensing deals, leading us to examine a broader range of top managers. We excluded statements by non-managers such as pure scientists and public relations personnel.

Controls. We controlled for a number of factors that may affect the likelihood of creating a product innovation at the licensee level, the licensor–licensee level, and the agreement level (i.e., the license). First, we controlled for key characteristics of the licensing agreement. While we explicitly excluded late-stage licensing for more ready-to-commercialize therapeutic compounds, we recognized that the underlying technologies of the licensing agreements in the sample might still be at different stages in the innovation cycle. We added an indicator referred to as *Leadmolecule* if the licensing agreement involved a technology that was already in the stage of lead selection (the stage after discovery). For about 60% of all licensing deals Recap also reports the *Deal Size* of the agreement, with a larger size suggesting higher strategic value and greater likelihood of achieving a clinical trial. This variable was coded as 0 if we found no information about the *Deal Size*, and we added a binary variable *Size Reported* (1 if deal size is reported in ReCap) to control for such cases. Another important contractual detail is the existence of milestones, which would lead to contingent payments and more likely be geared to achieving the creation of a product innovation in clinical trials. The variable *Milestones* takes the value 1 if we found evidence of milestones in the agreement and 0 if not.[13] We also considered that some agreements may be more complex than others, which may adversely affect innovative outputs (Steensma & Corley, 2000). We captured *Complexity* by counting the number of technological domains in ReCap assigned to the agreement. Finally, a minority of licensing agreements (about 6%) fulfilling our sampling criteria also included diagnostic technology. Such agreements do not necessarily have the generation of a clinical trial as a priority, as they also pursue goals to improve diagnosis. Thus, we added an indicator when we found *Diagnostics* as part of the licensing agreement.

[13] We include only contractual elements reported by ReCap and did not code alternative terms (e.g., grant-back) as this would have substantially reduced our sample (only 26% of the agreements included a contract).

In addition, we controlled for dyadic relationships between licensor and licensee, as prior relationships may be important in the choice of the contractual structure of the agreement and in the project's ultimate performance (Li, Eden, Hitt, & Ireland, 2008). Our variable *Prior Agreements* counts the number of agreements signed between the licensor and licensor in the previous 10 years prior to the licensing agreement. Licensing outcomes have also been attributed to how well the licensee can absorb the knowledge of the licensor. An important mechanism facilitating integration is the overlap between licensor and licensee. We followed prior research and used patent data to calculate *Knowledge Overlap*, which takes the value 1 when firms are identical in their patenting (strong overlap) and 0 if they are completely orthogonal (no overlap) (Mowery, Oxley, & Silverman, 1998; Sampson, 2007).[14]

We also controlled for several characteristics of the licensor and licensee. We controlled for the quality of the licensor by examining its prior success in moving products into clinical trials. In particular, *Licensor Quality* captures the number of clinical trials initiated in the previous three years. Further, we examined the licensor's specialization within the therapeutic activity of the licensing agreement by counting the number of patents *(Licensor Unit Specialization)* using the ReCap–Derwent concordance. We also added indicators if the licensor was a *University* (reference category) or *Top 50 Bio-Pharmaceutical Firm* or a *Small Biotech* firm.

For the licensee, we controlled for characteristics that could affect the likelihood of generating a product innovation. To capture technological competence in the therapeutic area of the licensing agreement, we counted all patents in the prior three years using the Derwent–ReCap concordance, a variable we call *Licensee Patents*. To capture the existence of complementary assets, a variable we refer to as *Licensee Sales*, we included the sales in the therapeutic area of the licensing agreement using the database Evaluate Pharma. For our variable *Licensee Pipeline*, we also capture the current clinical pipeline by counting the number of clinical trials found in

[14] We used a three-year window and considered all four-digit IPCs associated with a patent family in Derwent.

Pharmaprojects in a given year in the therapeutic area of the license. A strong pipeline suggests strong development competencies in the therapeutic area in which the firm is aiming to create product innovations. Given the importance of prior experience in a licensing type, we captured the number of prior licensing agreements of the same licensing type *(Licensee Licensing Experience)*. Next, we took into account situational factors within the R&D unit of the licensee. The variable *Licensee Launches* captures the drug approvals by the licensee's R&D unit in the prior three years (source: Pharmaprojects). Units that have recently succeeded in a drug development attempt may have more freedom to operate and more financial resources available. In a similar vein, the variable *Licensee Failures* captures costly Phase 3 failures by the R&D unit (source: Pharmaprojects). Such failures have a profound effect on the firm's market value (Girotra et al., 2007), and hence proxy possible resource constraints within an R&D unit. Finally, we controlled for the growth of sales in the therapeutic area of a licensing agreement (*TA Sales Growth*) in the prior year using Evaluate Pharma data, as fast-growing segments represent attractive areas for organizations to which resources could flow more easily.

3.4. Selection issues and empirical specification

To accurately uncover the effect of standard versus partnership-embedded licensing, we need to consider that the choice of licensing structure may be determined by unobserved characteristics. Two prior studies have explicitly addressed this consideration (Hagedoorn et al., 2009; Trombini, 2012). Industry characteristics like technology sophistication and appropriability play an important role (Hagedoorn et al., 2009). As the context of our study is a single industry, these characteristics will be similar for all licensing agreements. Both prior studies have also shown that the degree to which the licensee and licensor play different roles in the value chain (e.g., indicated by size differential) affects the choice of standard versus partnership-embedded licensing. In our context, established firms licensed knowledge at an early stage predominantly from smaller entities—universities and startups represent 93% of our sample. Another key point in the bio-pharmaceutical industry is the stage of the technology development, which affects the

choice between partnership-embedded and standard licensing (Trombini, 2012). In our context, all licensing agreements have been reached before preclinical trials. Therefore, through our research design we ensure that the licensing agreements do not systematically differ on key variables that drive the choice licensing agreements.

We also addressed this selection concern empirically. We followed prior work that has examined the different outcomes related to interorganizational agreements (e.g., Mulotte, 2013; Sampson, 2007). Specifically, we used a first-stage model to create a selection term that corrects for the endogeneity in the outcome model (Shaver, 1998). We used a probit model to estimate whether a firm organizes the licensing agreement as standard licensing or partnership-embedded licensing. This selection model includes all independent variables of the outcome model. Hence, we are able to control for the possibility that the choice between standard and partnership-embedded licensing may be influenced by some of our theorized covariates, such as top-down or bottom-up attention. The selection model includes the propensity of all sample actors, except the focal firm, to select standard over partnership-embedded licensing in the year prior to the agreement *(Industry Standard Licensing Propensity)*. This variable may determine the choice of licensing type without affecting the outcome of the specific agreement of the focal firm.[15] The first-stage model allows us to calculate the inverse Mills ratio, which we use in the outcome model to correct for the selection of licensing type when we enter *Standard Licensing* in the model (Heckman, 1979; Shaver, 1998).[16]

[15] This instrument fulfills Anderson's under-identification test, for which we reject the null hypothesis that the instrument is not relevant at $p < 0.01$. The Wu Hausman F-test and the Durbin-Wu Hausman χ^2 test suggest exogeneity of our instrument (i.e., $p > 0.8$ and $p > 0.7$ respectively). We acknowledge that we cannot test exogeneity through the Sargan test as our regression equation is exactly identified (i.e., we have one instrument for one regressor).

[16] We replicated our analyses using a linear probability model and probit model in this second stage. These models produce very similar results for the key independent variable, *Standard Licensing*, and the interaction terms.

Throughout our analysis, we took into account that our dependent variable is binary and used a logistic regression including firm fixed effects, therapeutic area fixed effects, and year fixed effects. The inclusion of fixed effects led to a loss of eight additional observations, as four firms engaged in only one type of licensing in our sampling period and were dropped from the initial selection model. Moreover, not all firms achieved a clinical trial following their licensing agreements, which led to the exclusion of 35 observations of seven sample firms. As missing press announcements led to some missing data, our final sample using a fixed-effects model included 555 licensing agreements. All independent variables were lagged by one year, so we observe them a year before the licensing agreement was signed.

4. Results

4.1. Descriptive statistics

Table 2 depicts the descriptive statistics and the bivariate correlation matrix for our variables. The examination reveals no major correlations between the independent variables, in particular among the variables that are interacted to test the moderation effects (*Standard Licensing*, *Top-down Attention*, and *Bottom-up Attention).* The variance inflation factors also raised no concern.

---------- Insert Table 2 about here ----------

4.2. Estimation results

Selection Model: Model 1 in Table 3 shows the selection model for *Standard Licensing* and reveals factors that drive the selection of standard licensing and go beyond the factors we control through our research design (i.e., same stage, same industry, and same therapeutic area). First, we identify key deal characteristics, which are important for the choice between standard and partnership-embedded licensing. Namely, the *Complexity* of a licensing agreement and the

presence of *Milestones* negatively predict the choice of *Standard Licensing*. This result is consistent with the idea that partnership-embedded licensing is used for complex and potentially difficult-to-contract licensing deals. While prior studies have found a preference of licensing agreements at later stages, we observe this effect also when focusing on the early stage of R&D. Our variable *Leadmolecule*, while positive, shows no significant effect on the choice of standard licensing. We also find that *Licensor Quality* (i.e., the number of clinical trials in the prior three years) and *Prior Agreements* have a positive effect on the choice of *Standard Licensing and Licensor Unit Specialization* has a negative effect. This result suggests that a licensee's clinical trial competencies and research competencies may lead to different choices with respect to standard versus partnership-embedded licensing. Further, we find that licensing with a university rather than incumbent and biotech firms is less likely lead to standard licensing agreements. Results also reveal that general *Licensee Experience* in licensing more likely leads to standard licensing. Moreover, *Top-down Attention* is negatively related ($p < 0.1$) to the choice of *Standard Licensing*, while we find no effect for *Bottom-up Attention*. Hence, *Top-down Attention* and the choice of licensing agreements may be jointly determined, illustrating the importance of our selection model.[17] As previously suggested, we also find a positive effect of the *Industry Standard Licensing Propensity* (our instrument) on the likelihood for an agreement configured as standard licensing.

Main Results: The remaining models in Table 3 depict the results for our regressions predicting *Product Innovation* (i.e., a clinical trial resulting from the licensing agreement). Model

[17] Another concern related to top-down attention is that such attention may be endogenous to the expectation of top managers generating a clinical trial as an outcome of a licensing agreement. Top-down attention is captured in the month of deal signature, while the actual creation of a product innovation takes substantial time. The average number of years for which we identified a clinical trial following a license agreement was 3.85 years and the maximum was 9 years. Given the long time to ultimately generate a product innovation, we do not expect top managers to be able to accurately predict a product innovation at the time of signature of a licensing agreement.

2 shows the results without standard licensing and the selection term. We find that *Top-down Attention*, *Leadmolecule*, the presence of *Milestones* and *Deal Size* all have a significant effect on the creation of a product innovation. Conversely, the *Complexity* of the deal, the emphasis on *Diagnostics*, and recent *Failures* by the R&D unit influence *Product Innovation* negatively.

In Model 3, we add our independent variable *Standard Licensing* and *Selection Term. Selection Term* influences the significance values of the other independent variables as well, as they were included in the selection model for *Standard Licensing*. In Model 2, we observe that only *Leadmolecule*, *Diagnostics*, *Prior Agreement*, *Complexity*, and *Licensee R&D Failures* remain significant. From the covariates, *Top-down Attention* remains significant and the presence of top-down attention approximately doubles the odds of achieving a product innovation.[18] As predicted in H1, *Standard Licensing* has a significant negative effect on *Product Innovation*. The coefficient suggests that the odds of creating a product innovation through standard licensing are about half ($e^{-0.62} = 0.54$) the odds for partnership-embedded licensing. Overall, this finding suggests that, as expected, standard licensing has some limitations when compared to partnership-embedded licensing, and this difference is robust to controlling for the initial selection of the licensing type.

Hypothesis 2 predicts that bottom-up attention by the R&D unit licensing the knowledge moderates the effect of *Standard Licensing* on *Product Innovation*. In Model 4, we interacted *Standard Licensing* with *Bottom-up Attention* and our positive and significant effect ($p < 0.05$) supports the hypothesis. Despite this preliminary evidence of a moderation, we need to ensure that the observed effects are not merely an artifact of the non-linearity of our model. Following recent suggestions to interpret moderation effects in non-linear models (Ai & Norton, 2003; Bowen,

[18] Binary coefficients like *Top-down Attention* represent changes in the log-odds for a one-unit increase in the independent variables. If the x variable is a dummy variable, then we can simply exponentiate its coefficient β to get an "adjusted odds ratio" (Allison, 1999), and in this case, $e^{0.74}=2.09$.

2012), we conducted three distinct additional checks. First, owing to the nonlinearity of the model and a secondary effect arising from the introduction of the interaction term, we used Bowen's (2012) STATA code to decompose the moderating effect into a structural effect.[19] Following Bowen, the important effect is the structural effect of the *Bottom-up Attention* and *Standard Licensing* interaction, which continues to be positive and significant ($p < 0.05$), providing further evidence for the moderating effect of *Bottom-up Attention*. Second, we split our sample into observations with high (above-mean) and low (below-mean) *Bottom-up Attention* and observe the effect of *Standard Licensing* in Models 5 and 6. Model 5 reveals that when *Bottom-up Attention* is low, the effect of *Standard Licensing* is negative and significant, with the odds of standard licensing achieving a clinical trial only 0.33 ($e^{-1.12}$) times the odds of a partnership-embedded licensing agreement. However, when *Bottom-up Attention* is high (Model 6), we find no significant difference between standard and partnership-embedded licensing. This result suggests that standard licensing has disadvantages vis à vis partnership-embedded licensing at low *Bottom-up Attention*, but when attention is available these disadvantages are attenuated. Finally, we demonstrate the interaction effect graphically in Figure 2a. While the figure reveals that standard licensing benefits from a more focused R&D unit, the illustration also reveals a substantial difference between standard licensing and partnership-embedded licensing when the focus of inventive search by the R&D unit is lower. We consider the implications of this observation in the discussion section.

In Model 7, we entered the interaction of *Standard Licensing* and *Top-down Attention*. As expected in Hypothesis 3, the interaction was positive and highly significant, indicating that the more attention top management pays to the licensing activity, the more effective standard licensing will be for the creation of product innovations. Following the procedure of Bowen (2012), we find

[19] Estimates using the procedure rely on logit models in STATA.

a significant and positive structural effect of *Top-down Attention* ($p < 0.05$). Once more, we split the sample into observations with and without *Top-down Attention* and report the results in Models 8 and 9. Without *Top-down Attention,* the *Standard Licensing* indicator has a negative and significant effect and the odds of standard licensing leading to a product innovation are only about 0.1 ($e^{-2.52}$) times the odds of partnership-embedded licensing leading to a product innovation. However, in the presence of *Top-down Attention* (Model 9) we observe no significant difference between standard and partnership-embedded licensing. We further demonstrate the result in Figure 2b, which reveals that absent top-down attention standard licensing has severe disadvantages to partnership-embedded licensing, but in the presence of top-down attention the two types of licensing agreements can yield similar effects on product innovations. Model 10 shows both interaction effects concomitantly, a result that continues to support the moderation hypotheses.

---------- Insert Figures 2a, b about here ----------

4.3. Robustness tests

We conducted several additional checks to establish the robustness of our findings. In particular, we employed different sampling techniques since the fixed-effects model reported led to the exclusion of observations. Models 11 and 12 are random-effects models, which allow the inclusion of firms that never created product innovations following licensing. The results continue to support our hypotheses. Next, we excluded the licensing agreements signed in 2005 and 2006 (Model 13) to ensure that our results are not driven by those years, as at the end of our sampling period we observed a shift toward more partnership-embedded licensing agreements. For consistency, we also replicate our results excluding the initial two years 1997 and 1998 in Model 14 with results very similar to the ones in Model 10. Another test included all licensing agreements for which we could not find a press release by including an indicator *No Press*, which takes the value 1 if we were not able to find a press release. This test allowed us to observe the full sample

615 licensing deals. Models 15 and 16 show random effects models that encompass all observations, once more supporting our prior results. Finally, we tried to increase the robustness of the results of top-down attention. First, we endogenized top management attention in the form of a selection model and found effects in the interaction of standard licensing and top management attention very similar to those reported, albeit without the support of a strong instrument. Second, we further unpacked the effect of top-down attention by separating top-down attention by the role of the managers in the announcements, distinguishing upper management (e.g., Vice President, Chief Scientist) from the highest management level (e.g., CEO, President). The results (Models 17) reveal that the observed interaction effects are strongly driven by attention from the highest management, such as CEOs (coefficient value 2.12, $p < 0.05$), and to a weaker extent by top managers like Vice Presidents (coefficient value 1.39, $p< 0.1$), but the difference of the two moderating effects is not significant.

5. Discussion and conclusion

This paper sheds light on the relationship between licensing—formal agreements through which firms access knowledge from other firms—and the creation of product innovations. We depart from prior research by disentangling different types of licensing affecting product innovation and by allowing for heterogeneity in the availability of bottom-up and top-down attention at the licensee's level.

We theorized and showed empirically that when compared to partnership-embedded licensing, standard licensing (i.e., the mere exchange of knowledge for money) is more limited in its ability to lead a focal licensee to come up with product innovations. This effect occurs because when knowledge is exchanged in a unilateral way, as in standard licensing, licensed knowledge may not be applied as effectively as it is in partnership-embedded arrangements. In addition,

sustaining the allocation of managerial and financial resources can be more challenging since resources are not ex ante assigned to the agreement (as in partnership-embedded licensing). As prior work has emphasized that licensing in general may have limitations in generating innovations (Koza & Lewin, 1998; Mulotte et al., 2013; Schoonhoven, Eisenhardt, & Lyman, 1990), revealing the difference between standard and partnership-embedded licensing extends that work by cautioning researchers to more systematically disentangle different forms of licensing. Otherwise, it remains unclear whether the effects from such agreements stem from licensing new knowledge per se or from the collaborative efforts of the licensor and licensee (Eisenhardt & Santos, 2002).

Another novel contribution of our research is that we reveal that differences between the two types of licensing are attenuated once we take into account the organizational context and, in particular, the attention given to the licensing activity by the R&D unit receiving the licensed knowledge (i.e., bottom-up attention) and by the organization's top managers (i.e., top-down attention). These insights connect the literatures on licensing and attention and reveal that both bottom-up and top-down processes play important moderating roles in the creation of new products following licensing agreements (Ghosh et al., 2014; Hansen & Haas, 2001; Ocasio, 1997, 2011). By examining the attention paid to the licensing agreement, we show that although standard and partnership-embedded licensing differ, they may be similar in their actual outcomes. While partnership-embedded licensing is more self-contained and requires little attention, standard licensing benefits disproportionally from attention within the licensee's R&D unit and top management. The study therefore expands the understanding of how attention may shape innovation (Ghosh et al., 2014; Li et al., 2013) by illustrating that the role of attention may differ by licensing type. These insights connect to a broader stream of research that examines the critical role of attention in the external knowledge-sourcing process (Monteiro, 2015; Monteiro & Birkinshaw, 2017). We extend this literature by focusing explicitly on licensing agreements and

by showing empirically how attention (i.e., bottom-up and top-down) can be a strategic resource when organizations are seeking to apply external knowledge through standard licensing. Moreover, the paper contributes to the attention literature (Ocasio, 1997, 2011) by explicitly breaking attention into bottom-up and top-down types and providing fine-grained evidence, at the licensing agreement level, of how both types can affect firms` innovative outcomes.

Notwithstanding the robustness of our results across models and the lack of obvious symptoms of bias, some limitations of this study should be borne in mind for future research. First, the bio-pharmaceutical industry distinguishes between the creation of knowledge and the development of knowledge. Once in development, a new molecular entity usually undergoes only marginal alteration—a distinction that does not prevail in less stringent settings. An alternative proxy for product innovation may therefore be necessary when replicating this study in other industries. However, given the nature of our study, knowledge creation happens much earlier than approval of the drug. A key issue in the bio-pharmaceutical industry is the attrition of products in development and the time that elapses between an early-stage licensing agreement and a product's actual debut in the market. From our sample, only 1% of all licensing deals reached the commercial market within the timeframe of our study. As in studies examining financial and commercial success (Mulotte, 2013), future research should find ways to examine how licensing actually affects commercial outcomes and should explore differences in early- versus late-stage licensing, as some firms simply may not have the capacity to create product innovations in the first place. Importantly, we observe standard and partnership-embedded licensing in a single industry. While research has identified that the distinction of licensing types applies to other industries, a more systematic testing of the relationship of licensing and product innovations in alternative settings is essential.

A second concern is that the product innovation in our study (i.e., new clinical molecules in development) captures only new-product announcements made by the licensee. Although bio-pharmaceutical industry trials are regulated, regulation does not guarantee that each compound is disclosed and reported. In an attempt to mitigate this risk, we complemented Pharmaprojects information with ADIS Insights to have two separate databases, and we cross-checked with other research and clinical-trial databases (Scifinder, ClinicalTrials.gov) and press announcements (Factiva) to ensure that we indeed captured all clinical trials that were the result of a licensing agreement. If some firms underreported their clinical trials, we hope to have remedied this shortcoming by using firm fixed effects and choosing an industry in which inventing around a licensed technology is difficult. Future research could examine more extensively how licensing and product innovations ultimately are linked (e.g., through the patent reported as part of the product in development) and by doing so also distinguish different types of outcomes achieved through licensing (e.g., a product innovation new to the firm vs. one incremental to the firm). Such inquiry could complement studies suggesting that standard licensing may have advantages in exploratory search and learning (Laursen et al., 2010; Oxley & Wada, 2009), but also could uncover whether, similar to joint ventures, benefits from licensing knowledge can lead to unintended consequences such as knowledge spillovers in domains unrelated to the licensing agreement (Beamish & Berdrow, 2003).

Finally, we observed top-down attention and the focus of inventive search of the R&D unit (i.e., bottom-up attention) at only the initial stages of the licensing agreement. While the starting conditions are a key determinant of subsequent outcomes in such agreements (Doz, 1996), a deeper need is to examine the process through which attention ultimately unfolds in such licensing agreements. We are optimistic that our way of capturing attention comes close to the actual licensing activities (i.e., the R&D unit, the top managers) and will be a good starting point for

future research. Such studies should also carefully disentangle how the choice of licensing may be affected by attention. The effect we found of top-down attention on partnership-embedded licensing could be a good starting point to investigate how project-level characteristics and organizational-level attention are related. Furthermore, we theorized only about an attenuating effect of standard and partnership-embedded licensing in the presence of attention, and more generally examined the conditions under which the types of attention may apply to the two types of licensing and could be equally useful. For example, Figure 2a demonstrates that R&D units with low attention may be best positioned to benefit from partnership-embedded licensing, but we observe a general decline, relative to standard licensing, in the likelihood of a product innovation when attention is high. Investigating these issues further would require researchers to carefully examine the effect of standard and partnership-embedded licensing and potentially contrast how attention shapes their relationship with innovation.

In conclusion, our study should stimulate innovation scholars to more systematically combine studies of licensing and attention and in particular examine how innovation outcomes are shaped by heterogeneity in the type of licensing used by firms and heterogeneity with respect to the attention available within the licensee. Our findings should also alert managers interested in product innovation to consider different paths toward the creation of new products. In sum, while standard and partnership-embedded licensing may seem different, our results show that standard licensing may be a feasible and less costly alternative for achieving a product innovation.

Table 1

Illustrative examples.

	Year	Licensor/Licensee	Press announcement excerpts	Type
1	1997	Corvas International/ Schering-Plough	Agreement to seek orally bioavailable inhibitors of a key protease necessary for hepatitis C virus replication. … will utilize Corvas' proprietary combinatorial chemistry program to identify and optimize lead protease inhibitors for which Schering-Plough will receive an exclusive worldwide license. "Hepatitis is an increasingly widespread and potentially fatal disease," said Jonathan Spicehandler, M.D., president of Schering-Plough Research "… enhances our internal antiviral research program and may offer a potential new pathway to discover innovative therapies for this medical area"…	SL
2	1997	Vical/Rhone Poulenc Rhorer	…announced signing of an agreement granting Rhone-Poulenc Rorer an exclusive worldwide license to use Vical's patented "naked" DNA gene delivery technology to develop certain gene therapy products treatment.	SL
3	1999	Oscient Pharma/ Wyeth	Initiation of a genomics-based research collaboration to develop novel therapeutics for the prevention and treatment of osteoporosis. Wyeth will pay Genome Therapeutics an undisclosed up-front license fee.	PEL
4	1999	Cerebrus/ Roche	Cerebrus Pharmaceuticals Limited …. announces that it has entered into an agreement to license to Hoffmann-La Roche its serotonin receptor based program for the treatment of obesity and related disorders.	SL
5	2000	3-D Pharma/ Bristol-Myers Squibb	Bristol-Myers Squibb and 3-Dimensional Pharmaceuticals drug discovery alliance that will apply 3DP's proprietary technologies… 3DP will receive up-front licensing and technology access fees.	PEL
6	2001	Array BioPharma / Amgen	Array will provide Amgen with an exclusive license to Array's existing PTP1B program for the identification and optimization of small molecule inhibitors. … also initiate a joint collaboration to develop PTP1B based therapeutics.	PEL
7	2001	Inhibitex, /Wyeth	Inhibitex, granted Wyeth an exclusive global license to its MSCRAMM protein technology for the global development of human vaccines targeting Staphylococcus aureus and Staphylococcus epidermidis.	SL
8	2003	Protein Design Labs /Abbott	Abbott Laboratories and Protein Design Labs, Inc. entered into a licensing agreement… provides exclusive rights to intellectual property related to antibodies capable of binding Interleukin-12.	SL
9	2005	Addex/ Johnson & Johnson	Exclusive worldwide research collaboration and license agreement to discover, develop and commercialize novel compounds for the treatment of anxiety, depression, schizophrenia and Alzheimer's disease. Through a joint steering committee, Addex and J&J will collaborate in all phases of research and development.	PEL
10	2006	Dynavax Technologies/ AstraZeneca	Research collaboration and license agreement for discovery and development of TLR-9 agonist-based therapies. …will utilize Dynavax's proprietary TLR-9 agonist immunostimulatory sequences. "New approaches that have the potential to reverse the course of respiratory disease are needed. AstraZeneca believes that Dynavax's technology represents an innovative, next-generation therapeutic intervention that could potentially expand and strengthen AstraZeneca's strong position in the respiratory disease field." (Claude Bertrand, Vice President Respiratory and Inflammation Research at AstraZeneca).	PEL

Table 2. Summary statistics (n= 555)

	Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	Product Innovation	1.00																					
2	Top-down Attention	0.14	1.00																				
3	Bottom-up Attention	0.08	0.09	1.00																			
4	Standard Licensing	-0.10	-0.11	0.03	1.00																		
5	Leadmolecule	0.18	-0.01	0.08	0.09	1.00																	
6	Diagnostics	-0.12	0.07	0.00	0.01	-0.07	1.00																
7	Deal Size	0.21	0.19	0.02	-0.12	0.08	-0.05	1.00															
8	Size Reported	-0.18	-0.16	-0.10	0.10	-0.09	0.05	-0.48	1.00														
9	Milestones	0.23	0.09	0.04	-0.14	0.16	-0.08	0.40	-0.61	1.00													
10	Complexity	-0.10	0.04	-0.02	-0.17	-0.09	0.10	-0.03	-0.03	0.00	1.00												
11	Prior Agreements	0.09	-0.01	-0.06	0.06	0.02	0.01	0.04	-0.06	0.11	-0.07	1.00											
12	Knowledge Overlap	0.07	-0.04	0.00	0.00	0.13	0.01	0.11	-0.01	0.07	-0.08	0.11	1.00										
13	Licensor Quality	0.05	-0.06	-0.02	0.17	0.15	0.02	0.00	0.04	0.02	-0.18	0.26	0.22	1.00									
14	Licensor Unit Special.	0.07	-0.03	-0.03	0.01	0.08	0.05	0.16	-0.01	0.04	-0.12	0.32	0.18	0.55	1.00								
15	Patents Licensee	-0.08	-0.04	-0.30	-0.11	-0.05	0.03	0.08	0.03	-0.04	0.05	0.11	0.06	-0.08	0.03	1.00							
16	Sales Licensee	-0.07	-0.10	-0.29	-0.01	0.00	-0.03	-0.01	0.03	-0.05	0.09	0.06	0.01	0.06	0.07	0.25	1.00						
17	Licensee Pipeline	-0.13	0.02	-0.28	-0.05	-0.03	0.04	-0.02	0.09	-0.04	0.03	0.10	0.03	-0.02	0.07	0.36	0.39	1.00					
18	Licensee Launches	0.02	0.00	-0.07	0.01	0.01	0.06	-0.02	0.01	-0.02	-0.03	0.04	0.02	0.07	0.08	0.04	0.20	0.25	1.00				
19	Licensee Failure	-0.10	0.01	-0.07	0.00	0.02	0.09	0.03	0.05	0.02	-0.02	0.00	0.02	0.04	0.06	0.10	0.01	0.20	0.03	1.00			
20	Licensee Experience	-0.06	-0.06	-0.33	0.06	0.01	0.02	0.04	0.07	-0.04	0.00	0.15	0.14	-0.01	0.02	0.54	0.29	0.35	0.14	0.17	1.00		
21	Sales Growth (TA)	-0.02	-0.01	0.04	-0.09	-0.01	0.00	-0.05	-0.04	0.07	0.01	-0.05	0.00	-0.09	-0.05	0.10	-0.13	0.08	0.01	0.03	-0.04	1.00	
22	Selection Term	0.08	0.28	-0.08	-0.48	-0.14	-0.02	0.30	-0.23	0.35	0.32	-0.10	0.03	-0.29	0.01	0.27	0.05	0.08	-0.05	0.01	-0.08	0.16	1.00
	Mean	0.21	0.49	0.02	0.41	0.20	0.06	26.74	0.62	0.21	0.42	0.31	0.66	2.03	13.49	66.23	6.08	4.71	0.29	0.15	8.61	1.12	1.06
	SD	0.41	0.50	0.01	0.49	0.40	0.24	72.04	0.48	0.41	0.49	0.72	0.20	4.19	24.55	49.65	2.52	3.78	0.46	0.36	6.71	0.08	0.54
	Min	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.91	0.00
	Max	1.00	1.00	0.04	1.00	1.00	1.00	750	1.00	1.00	1.00	5.00	0.99	19.00	110.00	297	9.36	13	1.00	1.00	27	1.35	2.94

Table 3. Logit regression results, dependent variable: Product Innovation (PI)

	(1) Selection	(2) PI	(3) PI	(4) PI	(5) PI	(6) PI	(7) PI	(8) PI	(9) PI
Standard Licensing			-0.62*	-2.07**	-1.12*	0.46	-1.88**	-2.52*	0.63
			(0.31)	(0.72)	(0.55)	(0.58)	(0.50)	(1.12)	(0.49)
Standard Licensing X Bottom-up Attention				90.12*					
				(37.53)					
Standard Licensing X Top-down Attention							2.17**		
							(0.62)		
Industry SL Propensity	2.44*								
	(1.21)								
Top-down Attention	-0.31+	0.96**	0.74+	0.70+	1.13	1.43	-0.17		
	(0.18)	(0.31)	(0.43)	(0.42)	(0.74)	(0.92)	(0.50)		
Bottom-up Attention	6.82	-19.85	-22.64	-54.28			-15.77	-30.17	-19.54
	(15.41)	(37.67)	(37.96)	(42.00)			(38.48)	(102.90)	(68.10)
Leadmolecule	0.28	0.62*	0.87*	0.93*	1.07	-0.03	1.08*	-1.64	2.32**
	(0.22)	(0.31)	(0.44)	(0.43)	(0.65)	(0.87)	(0.44)	(1.53)	(0.71)
Diagnostics	0.08	-2.79*	-2.57*	-2.70*	-16.70	-3.93	-2.75*	-4.49	-19.02+
	(0.30)	(1.29)	(1.28)	(1.36)	(1377.37)	(3.78)	(1.29)	(6.85)	(10.59)
Deal Size	-0.00	0.00+	0.00	0.00	0.01+	0.00	0.00	0.03*	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)
Size Reported	-0.05	0.21	0.15	0.17	1.35	-0.33	0.20	0.10	-0.22
	(0.24)	(0.40)	(0.41)	(0.42)	(0.84)	(0.75)	(0.42)	(1.42)	(0.65)
Milestones	-0.55*	1.27**	0.85	0.83	1.39	2.20	0.55	3.24	-0.98
	(0.26)	(0.40)	(0.73)	(0.72)	(1.16)	(1.60)	(0.73)	(2.38)	(1.26)
Complexity	-0.42**	-0.64*	-0.96+	-1.05*	-0.77	-0.86	-1.32*	-4.05*	-1.88*
	(0.14)	(0.28)	(0.53)	(0.52)	(0.77)	(1.08)	(0.53)	(1.76)	(0.88)
Prior Agreements	0.15*	0.16	0.26	0.28	0.23	0.01	0.42+	0.68	0.91*
	(0.07)	(0.18)	(0.24)	(0.24)	(0.35)	(0.55)	(0.24)	(0.60)	(0.40)
Knowledge Overlap	-0.43	0.22	-0.04	-0.23	-1.35	-0.77	-0.51	3.40	-1.93
	(0.33)	(0.72)	(0.84)	(0.83)	(1.40)	(1.66)	(0.85)	(3.16)	(1.37)
Licensor Quality	0.08**	0.00	0.05	0.06	0.03	-0.12	0.11	0.28	0.34*
	(0.02)	(0.04)	(0.07)	(0.07)	(0.12)	(0.18)	(0.08)	(0.23)	(0.15)
Licensor Unit Specialization	-0.01**	0.00	-0.00	-0.00	0.00	0.03	-0.01	-0.03	-0.04+
	(0.00)	(0.01)	(0.01)	(0.01)	(0.02)	(0.03)	(0.01)	(0.04)	(0.02)
Licensee Patents	-0.01	0.00	0.00	-0.00	-0.00	0.02	-0.00	-0.07*	-0.01
	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.03)	(0.01)
Licensee Sales	-0.03	-0.07	-0.10	-0.09	-0.19	-0.03	-0.14+	-0.19	-0.24+
	(0.03)	(0.07)	(0.08)	(0.08)	(0.14)	(0.17)	(0.08)	(0.31)	(0.14)
Licensee Pipeline	0.01	-0.06	-0.05	-0.06	0.05	-0.27	-0.05	0.49*	-0.16+
	(0.02)	(0.06)	(0.06)	(0.06)	(0.08)	(0.19)	(0.06)	(0.22)	(0.09)
Licensee Launches	-0.04	0.28	0.25	0.27	0.62	-0.77	0.25	0.21	0.51
	(0.15)	(0.30)	(0.30)	(0.31)	(0.47)	(0.86)	(0.31)	(0.85)	(0.48)
Licensee Failures	0.14	-1.44**	-1.33*	-1.36*	-1.53+	-0.72	-1.35*	-3.19+	-1.58*
	(0.12)	(0.52)	(0.54)	(0.54)	(0.79)	(1.28)	(0.55)	(1.78)	(0.81)
Licensee Experience	0.07**	0.00	0.06	0.08	0.08	-0.13	0.11	0.26	0.26+
	(0.02)	(0.03)	(0.08)	(0.08)	(0.11)	(0.18)	(0.08)	(0.21)	(0.14)
TA Sales Growth	-0.74	-1.33	-1.94	-1.57	-4.62	1.42	-1.96	-8.54	-5.09
	(0.87)	(1.97)	(2.13)	(2.12)	(3.80)	(4.05)	(2.14)	(6.71)	(3.19)
Selection Term			0.81	0.93	1.34	-2.34	1.68	3.07	5.16*
			(1.47)	(1.44)	(2.11)	(3.09)	(1.46)	(4.65)	(2.45)
Firm Effects, Year	Included	Included	Included	Included	Included	Included	Included	Included	Included
Therapy, Licensor Type	Included	Included	Included	Included	Included	Included	Included	Included	Included
Log Likelihood	-315.99	-165.67	-163.69	-160.96	-71.41	-40.99	-157.11	-26.77	-66.94
Observations	590	555	555	555	287	210	555	220	255

Model 1: DV: Standard Licensing, All Models: +p < 0.10, *p < 0.05,**p < 0.01, Licensor Type (Incumbent, Startup, University)

Table 3 Cont. Logit regression results, dependent variable: Product Innovation (PI)

	(10) PI	(11) PI	(12) PI	(13) PI	(14) PI	(15) PI	(16) PI	(17) PI
Standard Licensing	-3.41**	-0.58*	-2.53**	-3.55**	-3.75**	-0.51+	-2.53**	-1.54**
	(0.87)	(0.28)	(0.71)	(0.97)	(0.97)	(0.28)	(0.71)	(0.46)
Standard Licensing X	89.00*		74.84*	76.14*	127.43**		78.43*	
Bottom-up Attention	(38.08)		(34.82)	(37.46)	(47.21)		(34.72)	
Standard Licensing X	2.22**		1.39*	3.00**	1.74*		1.31*	1.39+
Top-down Attention	(0.63)		(0.55)	(0.75)	(0.70)		(0.55)	(0.75)
Top-down Attention	-0.26	0.95+	0.42	-0.62	-0.03	1.15*	0.64	0.38
	(0.49)	(0.50)	(0.54)	(0.56)	(0.53)	(0.50)	(0.53)	(0.53)
Bottom-up Attention	-51.43	-50.84	-79.26*	-62.22	3.99	-63.26+	-93.51*	74.52
	(42.43)	(35.68)	(39.76)	(55.10)	(50.74)	(35.54)	(39.54)	(59.09)
Leadmolecule	1.18**	0.23	0.41	1.03*	1.10*	0.04	0.23	-0.13
	(0.44)	(0.53)	(0.54)	(0.49)	(0.48)	(0.53)	(0.54)	(0.74)
Diagnostics	-2.81*	-2.42*	-2.61*	-2.94*	-3.30+	-2.39*	-2.56*	-3.03*
	(1.30)	(1.14)	(1.16)	(1.47)	(1.76)	(1.11)	(1.13)	(1.29)
Deal Size	0.00	0.00*	0.00*	0.00	0.00	0.00*	0.00*	0.01*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Size Reported	0.24	0.03	0.10	0.25	0.15	0.04	0.10	0.23
	(0.43)	(0.36)	(0.36)	(0.49)	(0.46)	(0.36)	(0.36)	(0.40)
Milestones	0.51	1.86*	1.83+	0.67	0.52	2.21*	2.19*	2.70*
	(0.73)	(0.94)	(0.96)	(0.80)	(0.78)	(0.93)	(0.95)	(1.31)
Complexity	-1.42**	-0.13	-0.26	-1.16*	-1.51**	0.08	-0.04	0.14
	(0.53)	(0.59)	(0.60)	(0.57)	(0.56)	(0.59)	(0.60)	(0.81)
Prior Agreements	0.45+	0.03	0.04	0.57*	0.38	0.12	0.06	-0.02
	(0.25)	(0.23)	(0.24)	(0.28)	(0.26)	(0.23)	(0.23)	(0.28)
Knowledge Overlap	-0.72	1.45	1.20	-0.94	-0.29	1.75+	1.52	1.45
	(0.85)	(1.05)	(1.06)	(0.93)	(0.92)	(1.05)	(1.06)	(1.37)
Licensor Quality	0.12+	-0.13	-0.10	0.16+	0.09	-0.18	-0.15	-0.18
	(0.07)	(0.12)	(0.12)	(0.08)	(0.08)	(0.12)	(0.12)	(0.17)
Licensor Unit Specialization	-0.01	0.02	0.02	-0.01	-0.01	0.02+	0.02	0.02
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Licensee Patents	-0.00	0.01	0.01	-0.01	-0.00	0.01	0.01	0.02
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Licensee Sales	-0.14+	-0.00	-0.01	-0.12	-0.13	0.02	0.01	-0.04
	(0.08)	(0.07)	(0.07)	(0.10)	(0.09)	(0.07)	(0.07)	(0.09)
Licensee Pipeline	-0.05	-0.05	-0.06	-0.10	-0.06	-0.05	-0.06	-0.03
	(0.06)	(0.05)	(0.05)	(0.08)	(0.06)	(0.05)	(0.05)	(0.06)
Licensee Launches	0.27	0.45	0.46	0.28	0.62+	0.50+	0.52+	0.29
	(0.32)	(0.28)	(0.29)	(0.37)	(0.36)	(0.28)	(0.28)	(0.31)
Licensee Failures	-1.38*	-0.82+	-0.83+	-1.42*	-1.32*	-0.79+	-0.78	-1.41**
	(0.56)	(0.47)	(0.48)	(0.71)	(0.60)	(0.47)	(0.48)	(0.53)
Licensee Experience	0.13	-0.07	-0.05	0.11	0.11	-0.10	-0.08	-0.09
	(0.08)	(0.07)	(0.07)	(0.09)	(0.08)	(0.07)	(0.07)	(0.10)
TA Sales Growth	-1.56	0.30	0.79	-0.30	0.05	0.93	1.46	1.41
	(2.14)	(2.12)	(2.16)	(2.32)	(2.30)	(2.10)	(2.13)	(2.70)
Selection Term	1.84	-2.44	-2.13	1.64	1.43	-3.37	-3.22	-4.44
	(1.44)	(2.42)	(2.46)	(1.53)	(1.50)	(2.41)	(2.51)	(3.54)
Top Management Attention (CEO, President)								0.71
								(0.71)
Standard Licensing X Top Management Attention								2.12**
								(0.69)
Firm Effects, Year	Included	Included	Included	Included	Included	Included	Included	Included
Therapy & Licensor Type	Included	Included	Included	Included	Included	Included	Included	Included
Log Likelihood	-154.34	-239.21	-232.99	-114.17	-123.17	-241.71	-235.62	-159.52
Observations	555	598	598	414	468	615	615	555

+$p < 0.10$, *$p < 0.05$, **$p < 0.01$, Model 14,15: Unreported: No Press indicator (negative and significant at $p<0.1$)

Figure 1. Innovation Value Chain in the Bio-Pharmaceutical Industry

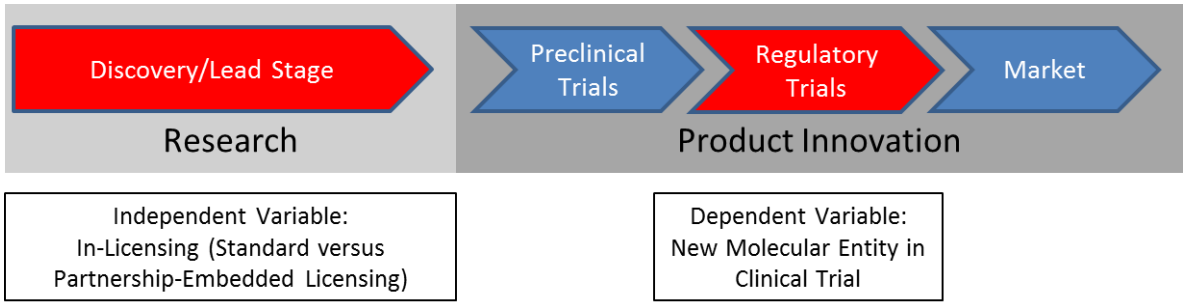


Figure 2a. Standard licensing x Bottom-up Attention.

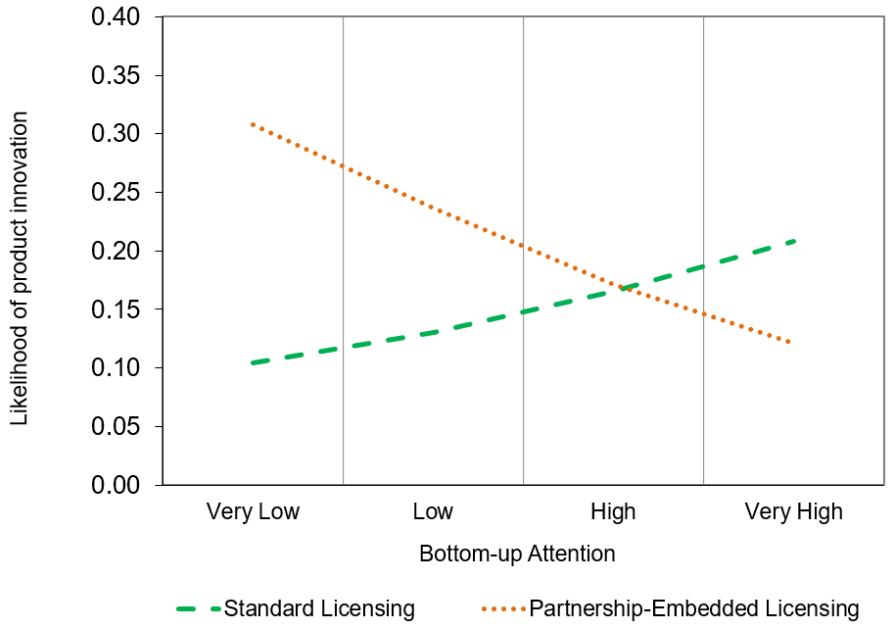
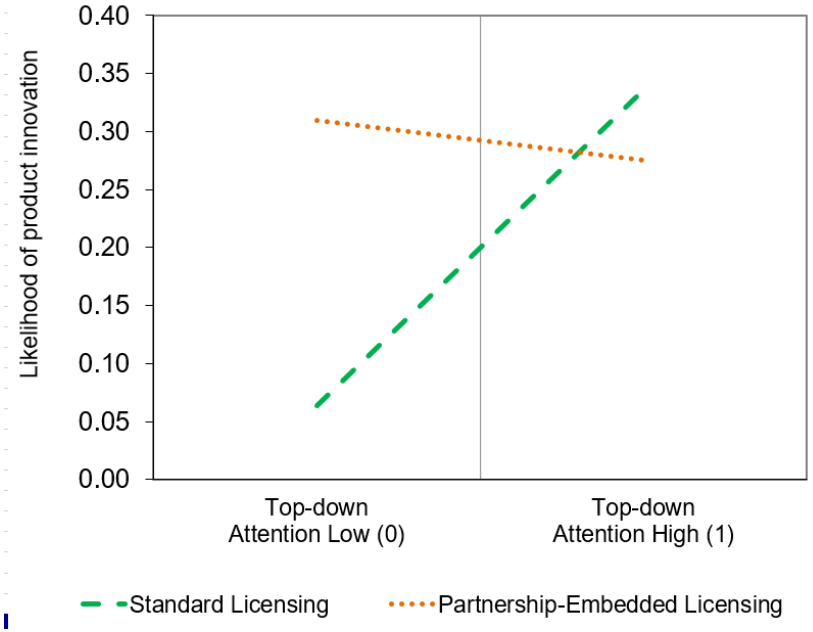


Figure 2b. Standard Licensing x Top-down Attention



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