Making a marriage of materials: The role of gatekeepers and shepherds in the absorption of external knowledge and innovation performance

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Abstract

Through interviews and a large-scale survey of R&D scientists and engineers, this paper explores individuals' attempts to absorb external knowledge, focusing on their efforts to identify and assimilate external knowledge and promote its utilization. Extant research does not explicitly address whether individuals should better specialize in certain absorption efforts or rather work as generalists dedicated to a range of efforts. We suggest that assimilation efforts increase the value of individuals' efforts at external search and at promoting the utilization of external knowledge, which culminates in two main absorption roles that can help individuals achieve greater innovation performance. We argue that gatekeepers who combine external search with assimilation effort help to achieve innovation by contributing to building potential absorptive capacity, while shepherds who combine assimilation with utilization effort aid innovation by building realized absorptive capacity. We find support for these predictions and discuss the implications for research and managerial practice in open innovation.

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1. Introduction

By embracing more open forms of innovation, organizations are increasingly requiring their staff to make greater efforts to identify, assimilate, and utilize external knowledge (Chesbrough, 2003; West et al., 2014). Underpinning these efforts is the expectation that the use of external sources of knowledge might spur innovativeness by helping firms to explore new opportunities and to translate them into new products, processes, and services (Foss et al., 2013; Laursen and Salter, 2006; Leiponen and Helfat, 2010; Rosenkopf and Nerkar, 2001). Despite interest in the potential of external knowledge as an enabler of firm-level and individual innovation, relatively little is known about how individuals organize these tasks and how the roles they take on in the knowledge absorption process affect their ability to innovate, i.e. to contribute to the development of new products and processes for their organization (Volberda et al., 2010). In particular, previous research does not explicitly address how the external knowledge absorption process can best be deconstructed among individuals, leaving it unclear whether individuals should better specialize in certain processes or rather work as generalists dedicated to a range of absorption efforts. As a consequence, the roles that individuals take on in absorbing external knowledge for their organization remain not well understood, and there is limited evidence of the performance implications of combinations of individuals' absorption efforts.

This paper aims to unveil the roles of individuals in external knowledge absorption by uncovering productive combinations of individual absorption activities. In part I of our study, we use interviews with R&D scientists and engineers in Neptune – pseudonym for a diversified multinational firm – in a bid to describe the activities of individuals involved in the absorption of external knowledge with greater detail and granularity than hitherto portrayed in the literature. Part II is a deductive study that draws upon a large-scale survey of R&D scientists and engineers in Neptune to examine how individuals combine those activities in distinct absorption roles and how those roles affect their innovation performance. This multi-method approach allows us to pose and try to answer the following questions: Do individuals who search for and assimilate external knowledge contribute more to a firm's innovative performance than individuals dedicated exclusively to external search? Can individuals effectively utilize external knowledge if they are not involved also in the assimilation of external knowledge?
By examining these questions, the paper makes three contributions. First, in documenting synergies between types of absorption activities at the individual level, we delineate two main roles that individuals engage in when they combine different types of activities, and analyze how these roles can influence their innovative performance. We argue that gatekeepers who combine external search with assimilation effort help to achieve innovation by building potential absorptive capacity. Gatekeepers help create a pool of internalized external knowledge with potential for internal application because their involvement in assimilation helps them better target their external search activities, whilst their involvement in external search offers opportunities to coach external parties to facilitate easier assimilation. Shepherds who combine assimilation with utilization effort aid innovation by building realized absorptive capacity (Zahra and George, 2002). Opportunities to tailor the assimilation process to championing needs and to deepen the background knowledge used during championing make individuals more effective in facilitating the application of internalized external knowledge.

Second, we suggest that assimilation efforts—which involve the translation of external knowledge into a form understood internally and its transfer to colleagues who may adopt it— increase the value of individuals’ efforts at external search and at promoting the utilization of external knowledge. That is, individuals who combine the assimilation of external knowledge with external search efforts or with championing the use of external knowledge are better able to broker a marriage between internal and external materials, gaining a premium in terms of innovative performance over those who specialize on one of these tasks. This finding allows us to contribute to the literature on the drivers of individual-level innovation performance by highlighting the value associated with individuals combining different roles in the absorption process.

Finally, drawing on the dimensions of absorptive capacity as distinguished at the organizational level, we help to open the black box of individuals’ role in assimilation and utilization, documenting the efforts individuals make to assimilate external knowledge in the organization’s pre-existing expertise, capabilities, and categories, and promote its utilization within the organization for the development of innovations. Jointly with existing measures of external search (Dahlander et al., 2016; Salter et al., 2015), our proposed measures of individual assimilation and utilization effort offer a broad assessment of individuals’ contributions to external knowledge absorption in organizations. Fig. 1 summarizes the gatekeeping and shepherding roles, detailing the type of individual absorption efforts involved and the synergies between them.

2. Part I: qualitative study of individual absorption effort

Part I of the study aims to take stock of how the extant literature has described the activities of individuals involved in external knowledge absorption, and to extend this body of work with qualitative accounts of three main types of absorption efforts.

2.1. Theoretical background

The use of external knowledge within organizations is rarely straightforward. Finding valuable external knowledge requires time and effort. When found, external knowledge may not only be subject to Intellectual Property restrictions that may retard its use by the firm, it is also often sticky to the context in which it was developed (Murray and O’Mahony, 2007; Von Hippel, 1994). External knowledge needs to be translated and transformed for it to cross organizational boundaries (Carille, 2004). The assimilation of external knowledge is required to enable it to be integrated into a firm’s innovation outputs. Research shows that involvement in open innovation requires that organizations develop new human resource practices (Foss et al., 2013), redesign job roles and tasks (Alexy et al., 2013), and form dedicated ‘open innovation’ teams or units (Birkinshaw and Monteiro, 2007; Dahlander et al., 2016; Whelan et al., 2011). It may also require the recruitment of new types of staff (Henkel, 2009), and the shifting of resources from internally oriented projects towards more externally facing ones (Du et al., 2014). These changes to organizational practices have profound implications for Research and Development (R&D) staff who are increasingly expected to work with external parties to develop ideas that blend internal and external knowledge (Cohen and Levinthal, 1990; Giarratana and Mariani, 2014).

Extant research studying the role of individuals in the absorption of external knowledge includes the literatures on technological gatekeepers and boundary-spanners. Despite the fact that the original work on gatekeepers paid ample attention to the translation work of gatekeepers that makes external knowledge understandable to an internal audience, later work in that tradition has focused predominantly on how gatekeepers build internal and external networks to source external knowledge (Allen, 1977; Macdonald and Williams, 1994; Tushman and Katz, 1980). As such, it provides little insight into the types of activities that individuals undertake to achieve the identification, assimilation, and utilization of external knowledge.

More recently, research has renewed attention to the internal side of boundary-spanning and developed richer descriptions of how individuals process external knowledge. Exploring the innovativeness of members of the IBM Academy of Technology, Dahlander et al. (2010) found an association between external search breadth and individual-level innovativeness. Importantly, they argue this association is conditional on how much time individuals spend attending to relationships within and outside the firm, suggesting that ‘cosmopolitans’ benefit from external search if they devote attention to external partners and sources of knowledge, whereas ‘locals’ may be inventive without external search if they devote attention to their internal colleagues. Monteiro and Birkinshaw (2017) develop a process view on boundary-spanning by documenting the processes that knowledge scouts in a dedicated scouting unit of a multinational corporation engage in to enable the use of external knowledge by their home organization. They found that scouts systematically translate external knowledge to facilitate internal understanding, engage in matchmaking to find a suitable internal application for it, and often transform or ‘redefine’ the internal business need to ensure fit with the external solution.

Despite these advances, a full appreciation of individual efforts in the absorption of external knowledge is still missing. The prior literature often tends to focus only on parts of the absorption process, such as external search. Detailed qualitative accounts of individual absorption efforts (e.g. Monteiro and Birkinshaw, 2017) capture a broader range of activities, although these may in part be specific to dedicated knowledge scouts, and it is unclear whether these generalize to R&D staff more broadly involved with external engagement.

2.2. Context

The research was undertaken in a large diversified multinational firm with global R&D efforts, which we refer to as Neptune. Neptune operates a dual career ladder system in its R&D department, which distinguishes between a management and a technical career ladder (Hoffmann et al., 2016; Katz et al., 1995). The study included all senior members of the technical career ladder — a total of just over 600 scientists and engineers. These individuals play a leading role in product and process development, and have impressive track records for developing valuable innovations for the company. Almost all of them have doctoral degrees, and on average they have
20 years of experience working in Neptune. However, their job role does not involve managerial responsibilities, because they do not directly manage any other members of staff.

All of the company’s R&D scientists and engineers are expected to source external knowledge regardless of the specific objectives of their job. At the start of enquiry, senior management believed that the potential for external engagement was not being fully realized, despite this explicit orientation toward external knowledge. They stated that too often the R&D staff relied on local, in-house knowledge, which was considered safe, was easily understood, and fitted with existing categories (see also Salter et al., 2014, 2015). It should be noted that these attitudes are consistent with individuals working in large corporate R&D departments, where the logic of practice has traditionally focused on internal discovery (Mowery, 2009). Our study was designed to provide insights into how senior scientists and engineers could become more effective at developing innovations through different forms of external engagement.

### 2.3. Method

We conducted interviews with 25 scientists and engineers and 10 senior R&D managers from different divisions, R&D sites, job functions and levels of seniority to broaden our understanding of Neptune’s R&D context, and the specific role of external knowledge in this process (see also Salter et al., 2014). Specifically, to gather information on the role of individuals in identifying, assimilating and utilizing external knowledge, we developed an interview protocol following a deductive approach. Despite the fact that most of the absorptive capacity literature is at the organizational level (see also Volberda et al., 2010), we took this literature as starting point to identify “active” elements of the external knowledge absorption process, compiling a list of verbs found in the most influential works on this topic, including the seminal work of Cohen and Levinthal (1990). We used this list to develop an interview protocol, which aimed at understanding individuals’ efforts to stay abreast of external developments; to relate and integrate external knowledge; and to incorporate that knowledge in the development of innovations.

### 2.4. Qualitative accounts of individual absorption efforts

To better understand the nature of individuals’ efforts to absorb external knowledge, we distinguish three different types of effort that individuals make in the knowledge absorption process: external search, assimilation effort, and championing effort for the utilization of external knowledge. Although this categorization is inspired by the literature on organizational-level absorptive capacity, our focus is on the efforts of individuals in each of these domains.

#### 2.4.1. External search effort

The first type of effort individuals engage in is external search. Identifying potentially useful external knowledge is essentially a search process that requires efforts from organization members to monitor, scan, and explore the wider technological and market environment (Hambrick, 1982; Levinthal and March, 1981). External search is costly in terms of organizational resources because individuals need time and freedom to invest in a range of potentially valuable search channels (Cockburn and Henderson, 1998; Laursen and Salter, 2006). Individuals may be members of communities of practice (Brown and Duguid, 1991), engage in standard-setting platforms (Rosenkopf et al., 2001), exploit their personal networks, and actively participate in formal inter-organizational relationships (Almeida et al., 2011; Davis and Eisenhardt, 2011) to get access to potentially valuable external knowledge. They may also reach out to suppliers, lead users, universities and consultants to help them learn about new developments. External search breadth provides scientists and engineers in a typical R&D department with greater alertness to external knowledge that may hold valuable opportunities for their organization (Howell and Shea, 2001; Salter et al., 2015) and enlarges the variety of knowledge that can serve as input for recombinatorial novelty (Dahlander et al., 2016; Fleming...
and Sorenson, 2001; Salter et al., 2015). As one process engineer explained:

It's from talking with people (…). You don't know when there will be a particular opportunity [to apply] that [external knowledge], but at some point it'll come up. … I mean, one good example was at a particle technology conference where there was a professor from Japan talking about how you keep liquid inside a particle. Somebody comes up with a solution for something before we've even realised it's a problem (…). Just (…), trying to be aware of interesting sort of stuff gives the best chance of knowing where you might go to.

2.4.2. Assimilation effort

The second type of absorption effort is assimilation. R&D staff to assimilate external knowledge by translating it into a form understood internally and transferring it to colleagues who may apply it in their ongoing innovative efforts (Monteiro and Birkinshaw, 2017). External knowledge is often incompatible with internal expertise, capabilities, language and culture – in short, internal categories. Knowledge is ‘sticky’ to the context in which it was first developed, which makes it costly to transfer in the organization (Von Hippel, 1994). The lack of background information on why and how external knowledge was generated makes it more difficult to see scope for how it may be applied in a new context and to build on it in internal innovation efforts (Murray and O'Mahony, 2007). One senior process engineer explained:

We like engineering drawings, we like flow charts, … if somebody phones up and says I've got this great idea, [I'll say] send me an engineering drawing, send me a flow chart, I want it three-dimensional, I want to know all the safety aspects.

Thus, bringing in external knowledge will require an individual to engage in significant integration and translation activities to align external knowledge with internal categories (Dougherty, 1992; Salter et al., 2015). More specifically, individuals will need to make an effort to understand the specific context of its origins, and then repackaging and translate the external knowledge to give it a ‘local feel’. This repackaging task involves an assessment of the value of the external knowledge against existing capabilities and ongoing R&D projects, finding associations – even synthesis – between the external knowledge and what is known internally (Lingo and O'Mahony, 2010). One interviewee described it as “a marriage of materials” involving the combination of external and internal knowledge prior to it being shared with decision makers. It often involves assessing the market potential of the external knowledge for the host organization, identifying the business needs it can address, and appraising how it relates to the firm’s strategic priorities or product groups. One product development scientist explained:

If there's an idea, an external idea, that you've identified, you go through that checklist to try to look for major pitfalls and then you work with the supplier to say okay, how are you dealing with this? Because it's got to satisfy you first. What benefit do they offer that's different from what I get today? The consequence of scale [scaling-up], patents, ... , and a business result ... , that's the language that you have to try to get to.

Another R&D scientist commented on helping to match external knowledge to internal needs:

Often [external] people come with an idea that they think is going to help you in a certain area. But because they don't know the business well enough, they don't know how or where the best fit is. So we've got an academic that came to us with an idea on acoustics. Now where we're trying to apply it is totally different to the idea he came [up] with, but it's still using the same technology because we can see that it's going to be more valuable to us here than it would be there.

Repackaging also includes putting external knowledge into a format that can be reviewed internally to allow it to be judged against other knowledge or ideas in internal selection procedures such as stage-gate processes. Critically, external knowledge needs to be reframed to match internal expectations, which requires someone with deep knowledge of the organization’s routines, expectations, and ways of working. Often this process will involve changing terminology and the way in which ideas are presented into a form that colleagues may be more accustomed to. One product development scientist explained how she reduced complexity to make external knowledge more digestible for an internal audience.

[The external] research was so complicated. So if we just presented that to the other stakeholders, we know that they'd get lost. So what we did was to simplify it. It was a PowerPoint with 170 slides. So that's a lot. … so what we did was to cut down to ten slides. Well, eventually I cut [it] down to five slides.

Another R&D scientist explained how reformulating externally obtained market insights in terms of internal categories helped clarify its potential.

We would generally work in partnership with these companies, because generally they have knowledge of the marketplace outside, and what we have is knowledge of our technologies, our consumers (…). So you almost have to add a few different levels of filters as to how you look at something. So we can't generally just take something that they give us and use it. We need to add the brand, (…), the consumer lens, you know, the technology ‘doable bit’ that we have the knowledge on, and then when you actually package those two things together, then you've got something that we can use.

A second aspect of the assimilation effort is the broadcast and transfer of external knowledge to colleagues who may incorporate it in their ongoing innovative efforts. Individuals need to share the external knowledge with colleagues and ensure it is diffused within the wider organization in order to identify those product categories, processes or technologies for which this new knowledge holds the greatest promise for technological advancement (Ancona and Caldwell, 1992; Hansen, 1999). One interviewee, involved with market research, explained how she formally documented and broadcast learnings from an external partner using an internal knowledge management tool:

[These reports are a] formal way of communicating nuggets of ideas in a one-pager format. And the good thing is that it's been centralised, so typically if you want to push information to the R&D world in Neptune that would be a very good route.

A senior process engineer explained informal means of diffusion:

If an [external] technology comes in I'll call up a few friends and go on to some of network I've got and say here's an interesting capability that's being developed by so-and-so, has anybody got an interest in it? And if they have, then I'll try and link them up and find ways of them progressing the idea.

2.4.3. Utilization effort

The third set of external knowledge absorption efforts is when individuals’ push for the utilization of external knowledge. Critical to this effort is championing the application of external knowledge in the organization’s innovative outputs (Howell and Higgins,
1990). This effort involves pointing to its potential to contribute to innovative products or processes, steering external knowledge through internal assessments, and overcoming resistance from risk-averse decision-makers (Andersson and Bateman, 2000). It is often a highly strategic process:

If this idea comes in, part of the skill of selling it is figuring out how to sell it. It's identifying who is a barrier, who is an obstacle and how do I influence them? And if they're going to be that much of a barrier, how else can I ...? Is there somebody I can feed out [in another division] that would bring in the idea?

Although such championing behavior is not specific to externally-generated inventions – since innovations may be generally illegitimate in large established organizations (Dougherty and Heller, 1994) – selling an idea internally is especially necessary when the origins of the invention are outside the firm and Not-Invented-Here-type reactions abound (Katz and Allen, 1982). The utilization of external knowledge requires someone who is passionate about the invention or technology to guide it through internal decision procedures, and mold the views of senior management. Based on the personality profile portrayed in the championing literature, R&D scientists who pursue the utilization of external knowledge usually show commitment to the external knowledge as if it were their own. They take risks to ensure the potential of the external knowledge is realized (Howell and Higgins, 1990; Markham, 1998).

3. Part II: quantitative study of absorption roles

Individuals working in R&D organizations may differ in the level of effort they ascribe to each of the three sets of external knowledge absorption activities described above. Although it is understood that individuals may gain from engaging in each of these efforts, it is not clear whether they should specialize in single types of effort or rather in roles that combine different types of effort. In part II, we analyze how combining these different efforts impacts on individuals’ ability to generate innovations for their organization, proposing two combinatory roles that help them achieve innovative outcomes through more effective external knowledge absorption.

3.1. Theoretical background

3.1.1. The gatekeeper role

Individuals who combine involvement in broad external search with engagement in assimilation effort can be seen as gatekeepers. Although recent work on gatekeepers largely overlooked the assimilation aspects of gatekeeping, the original studies on the topic (Allen, 1977; Macdonald and Williams, 1994; Tushman and Katz, 1980) emphasize gatekeepers’ dual role of external knowledge acquisition and translation. Building on these original ideas, we suggest that there are two main reasons for positive synergies between involvement in broad external search and the assimilation of external knowledge.

First, high levels of assimilation may give a more targeted direction to an individual’s external search efforts, increasing the likelihood that external knowledge can be applied in the organization in a meaningful way. Given the infinite size of the technological search space beyond the organization’s boundaries, individuals who can reduce this search space in their efforts to identify useful external knowledge will be more likely to spot opportunities that are valuable to the firm and that would potentially provide a better fit for recombination with internal knowledge (Kogut and Zander, 1992). The effort to assimilate external knowledge is the ‘glue’ that adds value to individuals’ external search. Even if search and assimilation efforts do not refer to the same piece of external knowledge, individuals who combine both types of effort may achieve combinatorial advantage because experience with the assimilation process deepens knowledge and awareness of the type of external knowledge the organization needs, and helps individuals to develop a more refined filter when scanning the external environment for opportunities. Individuals who do not combine their broad external search with involvement in assimilation will face great difficulty in finding valuable external knowledge in the first place, and subsequently, in handing-over such knowledge for others to assimilate. One interviewee in new product development explained that his experience with one of his colleagues who focused simply on identifying external knowledge was of limited use:

He was always bringing in things like you know what about this, what about that, and the problem with it is that there was no real customer need. And without a customer need they have to really push.

In effect, individuals that are not involved in assimilation may have limited understanding of what type of external knowledge the organization needs, limiting the chances that it will form a useful input for the firms’ innovation efforts.

Second, the synergy between search and assimilation may also work the other way round. High levels of external search breadth may render an individual’s assimilation efforts more effective. Individuals may assimilate external knowledge without being actively involved in its search, a situation that is particularly likely to arise in companies with dedicated knowledge scouts whose task it is to identify valuable external knowledge and then pass it on to colleagues. Yet, we argue that individuals’ direct involvement in external search provides insights into how it can best be assimilated, ensuring that the external knowledge will be better aligned with broader market and technological trends. That is, knowledge about the context of where external knowledge comes from – emanating from the external search efforts – helps individuals to align external knowledge with internal expertise, capabilities, and categories and to explain it to colleagues. As this scientist involved in market research demonstrates, involvement in both search and assimilation also offers an opportunity to coach external parties to communicate or shape external knowledge in a form that makes subsequent assimilation easier:

The biggest [challenge] I have encountered, and that’s true for design firms and trends experts we’re working with, is for them to speak the Neptune language [...]. It’s really important to frame them and to make sure that they understand how it works at Neptune. It’s not sufficient to just simplify their output. It’s critical to get them to learn how to deliver against the expectation of Neptune. If it’s on one occasion, I can play the role of translating into Neptune language. If it’s more recurrent (…), then it’s important to make sure that the connection can happen outside of me massaging the message.

Taken together, we predict that the synergy between search and assimilation as embodied in the gatekeeper role is positively associated with the probability that the individual contributes effectively to generating innovations for their organization.

H1. Combining external search breadth and assimilation of external knowledge is positively associated with individuals’ innovation performance.

3.1.2. The shepherd role

Synergies may also be present in the combination of individuals’ efforts to assimilate and utilize external knowledge. Although external knowledge may have become accepted as valid for internal use through successful assimilation, it still requires an advocate...
to point to its potential for achieving innovative products or processes. We propose the role of shepherds to indicate individuals who push for the application of external knowledge by guiding external knowledge through internal selection procedures whilst simultaneously managing its adaptation and integration with internal knowledge and categories. That is, we argue that such shepherds who combine the assimilation of external knowledge with its internal championing benefit from synergies between those efforts, boosting their ability to innovate relative to those who focus on one of these efforts.

First, the assimilation of external knowledge deepens the background knowledge and skills for successful external knowledge championing. That is, efforts to assimilate external knowledge increase shepherds’ awareness of how external knowledge fits with the organization’s existing capabilities and strategies and, in turn, helps them to construct more compelling arguments about why the externally developed knowledge is worth pursuing, and enriches their story about its value to the organization. A product designer explained how restating an external technology in terms of cost advantages paved the way for championing:

You’re going to say who’s going to be the key person, from a managerial side, that’s going to help champion this. And what’s going to stop them from pushing this, what’s their kind of bias? For some people it may be that my external suppliers really don’t think about cost so you’re going to be like how much do you understand your cost? [You have to] understand how to quickly filter through [...] and make a presentation that will be well received.

Second, experience with external knowledge championing may make shepherds better at assimilation. Involvement in championing external knowledge may help them tailor the assimilation process in such a way that the chances of selling the externally generated ideas to senior management at later stages in its development is increased. Indeed, such individuals are likely to develop tactics to mold the views of internal decision-makers, and to build coalitions of support to push ideas through internal stage-gate processes (Howell and Higgins, 1990):

What you have to do is find out who are the decision makers that are going to be the ones that you have to influence and usually it’s somebody you know already. And you know where their bias lies and so what you have to do is create a frame, acknowledge the bias and [think] here are the things that we have to make sure that we ask those questions of the supplier and external connection first.

Taken together, the enhanced ability of shepherds to assimilate knowledge through involvement in championing – and, vice versa, their enhanced ability to champion external knowledge through involvement in assimilation – will be reflected in their superior innovative performance relative to those who focus on either assimilation or utilization. Thus:

H2. Combining the assimilation and championing of external knowledge is positively associated with individuals’ innovation performance.

3.1.3. Gatekeepers versus shepherds

Potential absorptive capacity describes a firm’s capability to value and acquire external knowledge paving the way for its application, whereas realized absorptive capacity captures the firm’s ability to transform and exploit those application opportunities in realized innovation outcomes (Zahra and George, 2002). We argue that gatekeepers help build a firm’s potential absorptive capacity, whereas shepherds help build realized absorptive capacity.

Gatekeepers, by combining broad external search with intensive assimilation efforts, can engage in a more targeted search endeavor and coach external parties to communicate external knowledge in ways that facilitate subsequent internal assimilation. By combining these two types of efforts these individuals help enlarge the pool of internalized external knowledge with promise for application in the organization’s wider internal R&D efforts. In other words, the synergies between external search and assimilation associated with the gatekeeping role allows individuals to contribute to the organization’s potential absorptive capacity (Zahra and George, 2002). By contrast, shepherds, who combine assimilation and utilization effort, can tailor the assimilation process in ways that ease the concerns of potential internal stakeholders in the push for external knowledge utilization, and may benefit from deeper understanding of the knowledge origins obtained during assimilation that may help the utilization effort. By combining both types of effort, individuals become more effective in facilitating the application of internalized external knowledge. In other words, synergies between assimilation and utilization enables shepherds to contribute more strongly to a firm’s realized absorptive capacity.

We expect the role of shepherding to be more strongly associated with innovation outcomes than the role of gatekeepers. In contributing to potential absorptive capacity, gatekeepers create a large pool of potential innovation ideas, many of which may not ultimately lead to successful innovations. Relatively speaking, the odds of achieving innovation outcomes are greater for shepherds whose efforts are directed at facilitating the application of external knowledge that has already been internalized by the organization. As part of this internalization, these external ideas have been subject to rounds of review and evaluation, and partially aligned with the categories of the organization. In contrast, the gatekeepers’ external knowledge may still require further assessment and adjustment. In this respect, shepherds are likely working on relatively ‘ripe’ external knowledge, whereas gatekeepers may still be dealing with ‘seedlings’.

H3. The benefits for individuals’ innovation performance of combining the assimilation and championing of external knowledge are greater than the performance benefits of combining external search and assimilation.

3.1.4. The dual role of gatekeeper-shepherds

Individual R&D scientists may also combine the gatekeeper and shepherd roles, expending high levels of effort in all three types of knowledge absorption activities. In principle, these individuals may benefit simultaneously from the synergies associated with both the gatekeeping and shepherding roles. However, we argue that these combined synergies are unlikely to outweigh the costs of the time and effort associated with undertaking all three types of efforts. Individuals have limited amounts of time and attention available to perform their daily tasks (Ocasio, 1997). If they try to work on too broad a range of efforts related to the development of innovations, they may struggle to allocate their time effectively across these tasks (Dahlander et al., 2016; Koput, 1997). Accordingly, gatekeeper-shepherds risk spreading themselves too thinly. They also may lack the skills and experience required to master the diverse sets of efforts associated to the gatekeeper and shepherd roles. In particular, the search for valuable external knowledge, with its relative outward orientation, may require a very different set of skills to promoting the internal utilization of external knowledge. Therefore, we posit that gatekeeper-shepherds who combine high levels of all three types of effort of knowledge absorption will perform worse than gatekeepers or shepherds who benefit from the synergy associated with combining two types of effort.

H4. Combining the search, assimilation and championing of external knowledge is negatively associated with individuals’ innovation performance.
3.2. Method

3.2.1. Survey data collection

Based on the information from staff interviews and internal firm documentation relating to Neptune’s R&D department, its dual career ladder system, and its external engagement strategy, we designed a survey instrument (see also Criscuolo et al. 2014; Salter et al. 2015). After a pilot with ten scientists and engineers at one of Neptune’s R&D sites, we made significant adaptations to the questionnaire and administered it online to all senior members of the company’s technical career ladder. Survey invitations were sent with a cover letter from the company’s Chief Technology Officer, and at the company’s request, the survey was anonymous because it was believed that this would achieve a higher response rate and alleviate potential confidentiality concerns. After two reminders, we had a total of 408 surveys, corresponding to a response rate of 67%. Our final sample was reduced to 268 individuals due to incomplete responses.1

Since all the variables in our analysis are self-reported and come from the same survey, there is the potential risk of common-method and single–respondent bias. We attempt to circumvent this problem by using the organization’s innovation ratings for individuals as our main dependent variable. Although this information is self-reported, we believe that the anonymity of our survey and the additional choice given to respondents not to disclose this information reduced the tendency of respondents to answer in a biased manner. In the final stage of our study, we reported our analysis of the survey to senior members of the technical career ladder community and to the vice-president of the company’s R&D department. These exchanges provided valuable feedback on the validity of our analysis and its implications for this organization.

3.2.2. Measures

3.2.2.1. Dependent variable. We measured individuals’ innovative performance using the organization’s rating of respondents’ innovativeness (see also Criscuolo et al., 2014). Innovation rating is assigned annually by a committee of line managers from different divisions based on the ability of the individual – relative to peers – to produce creative outputs that have been successfully implemented and have generated significant value for the organization. Ratings are based on R&D scientists and engineers submitting a package of their individual contributions – new initiatives, cost reductions, process improvements, increased sales through product improvements, etc. – to a performance appraisal committee staffed by senior managers. Individuals are held accountable for keeping accurate contribution sheets and having their contributions recognized by the organization, but these claims are then discussed and verified by the committee. Neptune’s rating system operates on a fixed distribution with 20% of the population entitled to a top rating. Supervisory ratings have been shown to be relatively unbiased in terms of gender or race (Arvey and Murphy, 1998), and hence are considered a valid indicator of individual task performance.2 In our context, we consider performance ratings preferable to a patent-based measure (e.g. Dahlander et al., 2016) since many scientists and engineers in Neptune work in roles where patenting is not a target outcome.

3.2.2.2. Independent variables. We measured external search breadth using the frequency with which individuals relied on a range of external search channels to gain external knowledge, technical solutions, or expertise (see also Dahlander et al., 2016; Salter et al., 2015). Breadth is expressed as the number of search channels out of a list of 11 (including universities, suppliers, professional and trade institutions) that the individuals used at least a few times in the previous year.

Although related scales exist in relation to individuals’ ability to connect people inside organizations (Osbild, 2005), we could not find existing scales to measure individual assimilation and championing effort of external knowledge and thus we developed new scales. To generate scale items we first identified and coded in our interview material the distinct activities undertaken by individuals seeking to assimilate and utilize external knowledge. We then categorized the codes into higher-order groups of similar activities and labeled them. We formulated items for each of the activities undertaken, resulting in a total of 14 items. Table 1 displays the different activities related to the assimilation and championing of external knowledge that emerged from the interviews, as well as illustrative interview quotes and a short version of the scale items. Although not shown in Table 1, the survey instrument also contained negatively worded items to attenuate response pattern bias. Our championing scale is heavily based on the work of Howell and Higgins’ (1990) on championing, albeit modified to the context of external knowledge. All items were measured on a 7-point Likert scale ranging from “strongly disagree” to “strongly agree”.3

In the final step, we conducted an exploratory factor analysis, adopting the principal component method. This method retains a maximal amount of variance of the original items – as opposed to the principal-factor method, where factors maximize common variance – and is considered better if the underlying constructs are likely to be correlated. After removing one item that cross-loaded on two factors, the remaining 13 items loaded on two factors accounting for 60% of the variance among the original items. All factor loadings reported in Table 2 were above 0.4 with none of the items loading on multiple factors.

3.2.2.3. Control variables. Our control variables can be grouped into three main categories. First, since individuals’ ability to absorb external knowledge depends on their prior knowledge, we introduce a number of control variables to account for experience (Cohen and Levinthal, 1990) including grade, tenure, years of industry experience before joining Neptune, and number of divisions worked for since joining. We also include individuals’ knowledge percentage of 1-rated (0-rated) in the population. In this way, we attribute additional weight to the 0-rated group that is underrepresented in our sample.

1 We checked for non-response bias by testing whether the distribution of individual characteristics, such as gender, seniority, and location, differed between the samples of respondents and non-respondents. We found no significant differences between these two groups in terms of these variables. We also investigated if there was a significant difference between early and late respondents with respect to other independent variables for which we had no information on the entire population and found no statistically significant differences.

2 We collected information on ratings by asking respondents to indicate their current rating and their rating for the 2 years prior to the survey: 87 respondents decided not to disclose this information. This resulted in individuals with low innovation ratings being under-represented in our sample with respect to the distribution of ratings across the company. Since this response pattern may bias our results, we estimated the models with innovation rating as the dependent variable, using weights equal to the number of 1-rated (0-rated) in our sample over the percentage of 1-rated (0-rated) in the population. In this way, we attribute additional weight to the 0-rated group that is underrepresented in our sample.

3 Before administering the survey, we pre-tested the construct validity of our measures using a scales following a procedure suggested by Moore and Benbasat (1991). To this end, the survey items related to all three constructs – the search, assimilation, and utilization of external knowledge – were printed on cards and shuffled. We used four judges, namely PhD students in management not familiar with the study topic, to sort the items into groups of four to six items, and to label them. We measured the extent to which the four judges grouped individual items into the intended underlying constructs, and assessed the similarity between their labeling and the actual constructs. The exercise provided clues about the extent to which items pertaining to a single construct formed a coherent set (convergent validity) and the extent to which items referring to different constructs discriminated between them (discriminant validity). After substantial rewording of the items, we repeated the exercise using four different judges and found significant improvement in the extent to which items were allocated as intended.
Table 1
An inductive approach to developing a scale for individuals’ external knowledge assimilation and championing efforts

| Activity                                      | Interview quotes                                                                 | Measurement scale                                                                 |
|-----------------------------------------------|---------------------------------------------------------------------------------|---------------------------------------------------------------------------------|
| Assimilate external knowledge                 | “I would try and see if there’s a chance to make it work, playing with it (a supplier’s technology) by myself in one way or another.” | Process external knowledge to get a sense of its value and meaning               |
| Evaluate external knowledge against business needs | “What are the benefits for using it (the external technology) either in terms of ‘it’s able to do something we couldn’t do before’, ‘it’s able to do a new transformation that allows us to maybe combine ingredients in a way that we couldn’t do previously’?” | Appraise the usefulness of external knowledge                                   |
| Recombine external knowledge with internal knowledge | “We have the knowledge of our technologies, our customers. So we have to add a few different levels of filters as to how we look at an external technology.” | Comprehend how external knowledge connects to ongoing internal R&D               |
| Make external knowledge intelligible into a form understandable to colleagues | “It is a question of translating it into a language so that it means something in Neptune” | Translate external knowledge to ensure it is understood by colleagues            |
| Internally communicate, share and transmit external knowledge | “I start to whisper like ‘hey, we got this technology. I’m still working with the supplier to figure it out but if it does this, that would be meaningful to you. What do you think the skepticism is going to be? You’ve got to do a little bit of that legwork before you have the idea right.” | Repackage external knowledge to make sure it gets attention internally          |
| Overcoming internal resistance                | “And, I think my job is to put data on the table, which makes people think again and change the paradigm, that’s one of my key roles.” | Diffuse external knowledge to other parts of organization                       |
| Strong commitment, effort and persistence to utilize external knowledge | “The company’s already got a fairly rigid mindset about what they want to do. Then, you would have a lot of translation work, I guess, to convince people to change tack based on external data.” | Meet up with colleagues to discuss external knowledge                           |
| Take risks to utilize external knowledge       | “People can’t argue with data, so before you go to any managers, before it gets any management exposure, you know, what we always try to do is get some, get some technical testing and some market data.” | Do almost anything to have my external knowledge taken up by the organization    |
| Gain support and buy-in from management       | “So if you really believe in an idea, if this idea comes in, part of the skill of selling it is figuring out how to sell it.” | Make sure external knowledge is implemented even if the idea was not originally mine |

The value of external knowledge, approximated by the number of internal communities of practice they are member of (Dahlander and Frederiksen, 2012; Salter et al., 2015). We include the past innovation rating achieved two years prior to our study to mitigate concerns of potential omitted variable bias.
Table 2
Factor analysis and item scales.

| Factor | Factor 2 | Mean   | St.dev. | Min | Max |
|--------|----------|--------|---------|-----|-----|
| I work hard to critically assess the potential value of external knowledge against our business needs. | 0.820 | −0.012 | 5.50 | 1.36 | 1 | 7 |
| I am deeply involved in appraising the usefulness of external ideas. | 0.804 | 0.016 | 4.97 | 1.60 | 1 | 7 |
| I often analyze the way expertise of external contacts could be related to Neptune’s business needs. | 0.776 | 0.047 | 4.88 | 1.61 | 1 | 7 |
| I spend little time processing external knowledge to get a sense of how it might be meaningful for our business. | 0.819 | −0.156 | 5.34 | 1.40 | 1 | 7 |
| I strive to comprehend how external knowledge connects to Neptune’s ongoing research and development activity. | 0.630 | 0.021 | 5.45 | 1.34 | 1 | 7 |
| I frequently meet up with colleagues to explain and discuss new knowledge I obtained externally. | 0.699 | 0.057 | 5.05 | 1.46 | 1 | 7 |
| I perform a central role in diffusing externally sourced knowledge to other parts of Neptune. | 0.710 | 0.148 | 4.56 | 1.83 | 1 | 7 |
| I take the time to “translate” external knowledge to ensure it is properly understood by my colleagues. | 0.749 | 0.089 | 5.36 | 1.32 | 1 | 7 |
| I make an effort to “repackage” external knowledge to make sure it gets the attention it deserves. | 0.608 | 0.114 | 4.91 | 1.51 | 1 | 7 |

Utilization of external knowledge (α = 0.75)

| When an external idea appeals to me, I work vigorously to make sure it is implemented, even if the idea was not originally mine. | 0.120 | 0.608 | 5.66 | 1.02 | 1 | 7 |
| When new external ideas I believe in meet resistance within Neptune, I put in a great deal of effort to guarantee the idea is brought to fruition. | 0.060 | 0.832 | 4.87 | 1.21 | 1 | 7 |
| I would do almost anything to have my external ideas taken up by Neptune. | −0.096 | 0.757 | 3.76 | 1.47 | 1 | 7 |
| I am willing to take action to make sure that the potential of external ideas I believe in will be realized. | 0.044 | 0.782 | 5.50 | 1.04 | 1 | 7 |

Bold values indicate the highest factor loadings across the two factors.

The second group of control variables captures some factors found to explain individual-level innovativeness, including intrinsic motivation and extrinsic motivation measured on an 8-item scale adapted from Rynes, Gerhart and Minette (2004) that loaded on two factors (α = 0.69 and α = 0.69). We also include an 8-item scale on the climate for innovation adapted from Siegel and Kaemmerer (1978) and Scott and Bruce (1994) (α = 0.86) and a 7-item scale on manageral support adapted from Greenhaus, Parasuraman and Wormley (1990) (α = 0.94) to take account of organizational support for innovation. We control for the number of ties to senior managers, obtained from name generator and interpreter questions adapted from Podolny and Baron (1997), to capture potential championing network effects, and for the time searching externally to control for the time commitment to external search (Dahlander et al., 2016).

Finally, we control for a range of contextual factors including gender, using men as the reference category, and a dummy variable to account for the potentially larger impact of the innovative efforts of those working for established product lines and those at Neptune’s headquarters, and for the higher level of uncertainty for those with a long-term time horizon, i.e. developing innovations expected to reach the market in more than two years. We also introduce controls for division and job function.

3.3. Results

We tested our hypotheses on the relationship between the roles that individuals assume in external knowledge absorption and innovation rating using a logit model. The estimations have been obtained by clustering the errors by grade. The main rationale is that innovation ratings are assigned with a fixed distribution by grade, which suggests that there might be non-independence of observations within grade groups. Table 3 presents the descriptive statistics and the bivariate correlations of the variables included in the models. In our sample, 25% of individuals received a high innovation rating. On average, individuals had 20 years of experience working for Neptune, four years of prior industry experience, and worked in two different divisions.

The results of our regressions are reported in Table 4. Model 1 is our baseline model, including only the control variables. Model 2 includes the variables measuring the three absorption efforts: external search breadth, and the assimilation and championing of external knowledge. Model 3 tests the hypotheses by means of interaction effects, whereas Model 4 tests them with a series of dummy variables indicating on which absorption efforts individuals spent above-median levels of effort: a focus on one type of absorption effort (e.g. only above-median levels of external search) or combining high levels of multiple types of effort (e.g. combining external search and assimilation). Below-median levels on all three types of effort serves as the reference category. As the coefficients of interactions in logit models have limited interpretability due to the non-linearity of these models (Hoetker, 2007; Wiersma and Bowen, 2009), we follow best practice and graph the interaction effects using a simulation procedure proposed by Zelner (2009). This procedure uses statistical simulation to derive the predicted probabilities of receiving a high innovation rating at multiple levels of the interacting variable (i.e. external search breadth or championing of external knowledge) over the entire observed range of the interacted variable (i.e. assimilation of external knowledge), whilst keeping all other continuous explanatory variables at their sample means and significant dichotomous variables equal to one.

Regarding our control variables, we find, not surprisingly, that past innovation rating is a strong predictor of current innovation rating. Industry experience, instead, appears to have a negative impact on individual innovative performance, while individuals’ working for established product lines are more likely to be top rated, those working mostly in projects with a long-term time horizon are less likely to receive a high innovation rating.

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Looking at the main effects of the three different types of absorption effort, the estimates suggest that the assimilation and championing of external knowledge have a positive and significant effect on the likelihood of achieving a top innovation rating. Assimilation has the strongest effect in predicting the innovation rating among all independent variables, with the exception of past innovation rating. We find that a one standard deviation increase in the assimilation of external knowledge increases the probability that an individual will receive a high rating by five percent (keeping all the other continuous independent variables at their means and the dummy variables at their median value). This demonstrates the strong predictive validity of our new scale for assimilation effort. The stand-alone effect of external search breadth is not significant in Model 2. Consistent with the logic of H1, individuals do not stand to gain from external search by itself, rather they may need to engage in assimilation efforts to realize the benefits from external search. Model 4, however, demonstrates that individuals who focus on external search – at below-median levels of assimilation and championing of external knowledge – still have a higher chance of receiving a top innovation rating than individuals with below-median levels on all three types of effort.

H1 predicted that gatekeeping – i.e. combining external search with assimilation of external knowledge – should be positively associated with innovative performance. Model 3 shows that the interaction between both types of effort is indeed significant. The dummy approach in Model 4 further supports this by showing that, relative to having below-median levels of all three types of absorption effort, combining external search and assimilation is positively related to innovation rating. Fig. 2 shows that, as predicted, gatekeepers (D) have a higher chance of receiving a top innovation rating than those who have high external search breadth but little assimilation (B). The contrast between gatekeepers combining search and assimilation (D) and those focusing on assimilation (C) is much less stark, leading to a suggestion that individuals stand to gain least from a focus on search for external knowledge without involvement in assimilation, whereas individuals do benefit when engaging actively in the assimilation of external knowledge without involvement in external search. Note that individuals who do not engage in either external search or assimilation (A) still have moderately high chances of receiving a high rating, suggesting that individuals may still excel in achieving innovative outcomes with little involvement in external knowledge absorption at all. This approach is akin to what Dahlander et al. (2016) call the ‘locals’ approach.
We also find support for H2 in relation to the role of shepherds, i.e. the positive effect of combining the assimilation of external knowledge with high levels of championing on individual innovation rating. The interaction between assimilating and championing in Model 3 and the dummy indicating individuals who combine these efforts in Model 4 are both positive and significant. Fig. 3 shows that shepherds (D) have markedly higher chances of achieving a high innovation rating than those who champion the use of external knowledge with little or no involvement in assimilation (B) or those who assimilate but do not engage in championing (C). This suggests that individuals strongly benefit from synergies between both types of effort in their pursuit of innovation.

In H3, we proposed that the synergies associated with the shepherding role would be more strongly associated with innovation performance than the gatekeeper role. Following the approach suggested by Haans et al. (2016)⁴ and using the estimates obtained using the simulation procedure, we calculated the change in predicted probability of achieving a top rating associated with an increase from the mean of one standard deviation in both external search breadth and assimilation (an increase from Prob(Y) = 0.245 to Prob(Y) = 0.345), and compared that to change in predicted probability due to a one-standard deviation increase in both assimilation and championing (an increase from Prob(Y) = 0.245 to Prob(Y) = 0.440). The values were obtained keeping all variables at their mean value and significant dummies at 1. The results support our prediction that the synergies between assimilation and championing are stronger than those associated with combining external search and assimilation. The stronger synergies associated with the shepherd role are also visible in the steeper sloping surface of Fig. 3 relative to that in Fig. 2.

H4 postulated that gatekeeper-shepherds who invest highly in all three types of effort – i.e. assimilation, identification and utilization – are less likely to achieve a high innovation rating than gatekeepers or shepherds who specialize in two types of effort. To test this hypothesis, we included in Model 3 the three-way interaction between all three types of effort and all the first and second order terms. Our findings do not support this hypothesis. The three-way interaction in Model 3 is not significant and the dummy approach in Model 4 shows no significant effect for combining all three aspects of external knowledge absorption either.

4. Conclusion and discussion

This paper examined how individuals’ efforts to search for, assimilate and champion the utilization of external knowledge shape their contribution to the innovation outputs of their organization, as reflected by their innovation rating. In particular, the objective was to provide insight into whether individuals gain synergistic benefits from combining multiple types of absorption effort or whether they are better able to contribute to innovative outcomes if they specialize in search, assimilation or championing. The organization of external knowledge absorption at the individual level and its impact on innovative outcomes form an important stepping stone for trying to understand the micro-foundations of absorptive capacity. As Cohen and Levinthal (1990) suggested, a firm’s ability to learn from and innovate on the basis of external sources of knowledge in part depends on individuals’ choice as to which elements of the knowledge absorption process to focus their efforts.

Building on conceptual insights from the literatures on absorptive capacity, and boundary-spanners (Carlile, 2004; Cohen and Levinthal, 1990; Lane et al., 2006; Monteiro and Birkinshaw, 2017; Tushman and Scanlan, 1981), we defined and measured the efforts that individuals make in searching for external knowledge, assimilating it and championing its use, and examined how these efforts jointly shape their ability to generate innovations for their organization. First and foremost, our findings highlight the importance of individual assimilation effort. We found that individuals’ efforts to translate external knowledge, to align it with the firm’s expertise, capabilities, language and culture and to transfer into the wider organization are strongly linked with individual innovativeness. Those individuals who possess this ‘combinative capability’ (Kogut and Zander, 1992) may be better able to realize the opportunities represented by external knowledge. Individuals working in large firms need to be able to transform and reshape external knowledge into a form that can be diffused within the organization (Monteiro and Birkinshaw, 2017). It is through these assimilation efforts that external knowledge is transformed into a hybrid state that includes both internal and external components. Although external sources of knowledge used in the innovation process always tend to be regarded as “external”, it is clear that individuals can modify that knowledge, blending it with internal knowledge and highlighting its relevance and potential for the innovative endeavors of the organization. As one interviewee explained:

"So what we’ll do is we’ll have a marriage of materials, and generally, like, when we’re going to be presenting that to influential people, we’ll invite the [external] people who’ve actually done that work to come and present their part. We will have applied the filters and the learnings that we have within our own [internal] sphere of knowledge."

Assimilation efforts thus ‘domesticate’ external knowledge, creating useful hybrids that combine the novelty of external knowledge with the structure and validity of the firm’s internal knowledge as well as enhancing the visibility of this knowledge within the firm.

Second, our research defined two equifinal paths through which individuals help contribute to the organization’s absorptive capacity by delineating two combinatory roles. That is, we explored whether individuals were able to better exploit their assimilation

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⁴ Since we use non-linear models, we cannot test H3 by comparing the coefficients of the two interaction effects. The marginal effects are a function not only of the coefficient of the interaction, but also of the coefficients of the interacted variables (Hoeptker, 2007).
efforts when they carried these out in conjunction with other types of effort related to the use of external knowledge. We found convincing support for our argument that individuals may benefit from synergies between the search for and the assimilation of external knowledge. In line with the original conceptualization of gatekeepers (Allen, 1977; Macdonald and Williams, 1994; Tushman and Katz, 1980), we portray gatekeepers as individuals who combine high levels of external search breadth with active involvement in assimilation. We demonstrate that by combining these types of efforts gatekeepers may be better aware of what type of exter-

Table 4
Logit Model Estimations (N = 268), DV = Achieving top innovation rating.

|                          | 1     | 2     | 3     | 4     |
|--------------------------|-------|-------|-------|-------|
| Seniority                | −0.192| −0.284| −0.262| −0.088|
|                          | (0.137)| (0.168)* | (0.150)* | (0.135)* |
| Tenure                   | 0.033 | 0.041 | 0.042 | 0.037 |
|                          | (0.006)* | (0.005)* | (0.005)* | (0.007)* |
| Industry experience      | −0.054| −0.060| −0.062 | −0.066 |
|                          | (0.014)* | (0.016)* | (0.018)* | (0.015)* |
| Number of divisions worked for | −0.134| −0.120| −0.124 | −0.154 |
|                          | (0.139)* | (0.102)* | (0.106)* | (0.085)* |
| Knowledge breadth        | 0.128 | 0.119 | 0.126 | 0.156 |
|                          | (0.048)* | (0.057)* | (0.058)* | (0.073)* |
| Past innovation rating   | 1.845 | 1.750 | 1.766 | 1.844 |
|                          | (0.251)* | (0.245)* | (0.262)* | (0.354)* |
| Intrinsic motivation     | 0.292 | 0.167 | 0.161 | 0.240 |
|                          | (0.126)* | (0.171) | (0.186) | (0.177) |
| Extrinsic motivation     | −0.332| −0.353| −0.344 | −0.321 |
|                          | (0.223)* | (0.245) | (0.244) | (0.271) |
| Innovation climate       | 0.064 | 0.083 | 0.095 | 0.078 |
|                          | (0.032)* | (0.032) | (0.010) | (0.062) |
| Managerial support       | 0.264 | 0.225 | 0.221 | 0.222 |
|                          | (0.088)* | (0.115)* | (0.113)* | (0.080)* |
| Ties to senior managers  | 0.192 | 0.208 | 0.178 | 0.292 |
|                          | (0.058)* | (0.064)* | (0.068)* | (0.074)* |
| Time searched externally | 0.006 | −0.004| −0.004 | −0.006 |
|                          | (0.005)* | (0.002)* | (0.002)* | (0.001)* |
| Gender                   | −0.751| −0.494| −0.455 | −0.604 |
|                          | (0.111)* | (0.099)* | (0.108)* | (0.126)* |
| Working for established product lines | 0.359 | 0.396 | 0.399 | 0.393 |
|                          | (0.051)* | (0.064)* | (0.089)* | (0.062)* |
| Headquarters             | 0.008 | 0.050 | 0.040 | 0.049 |
|                          | (0.305)* | (0.275)* | (0.264) | (0.171) |
| Time horizon             | −0.726| −0.755| −0.800 | −0.812 |
|                          | (0.047)* | (0.084)* | (0.046) | (0.079)* |
| External search breadth (1) | 0.015 | −0.009 |           |       |
| Assimilating external knowledge (2) | 0.378 | 0.403 |           |       |
|                          | (0.083)* | (0.068)* |           |       |
| Championing external knowledge (3) | 0.294 | 0.294 |           |       |
|                          | (0.146)* | (0.154)* |           |       |
| External search (1) * Assimilating (2) – gatekeeping | 0.144 |           |       |       |
|                          | (0.070)* | (0.137)* |           |       |
| Assimilating (2) * Championing (3) – shepherding | 0.286 |           |       |       |
|                          | (0.054)* | (0.054)* |           |       |
| External search (1) * Championing (3) | −0.194 |           |       |       |
| External search (1) * Assimilating (2) * Championing (3) – Gatekeeping-shepherding | 0.064 |           |       |       |
|                          | (0.051) |           |       |       |
| Focus on external search (1) |           |           |       |       |
|                          |       |           |       |       |
| Focus on assimilating external knowledge (2) |           |           |       |       |
|                          |       |           |       |       |
| Focus on championing external knowledge (3) |           |           |       |       |
|                          |       |           |       |       |
| Combining external search (1) and assimilating (2) – gatekeeping |           |           |       |       |
|                          |       |           |       |       |
| Combining assimilating (2) and championing (3) – shepherding |           |           |       |       |
|                          |       |           |       |       |
| Combining external search (1) and championing (3) |           |           |       |       |
|                          |       |           |       |       |
| Combining (1), (2) and (3) – gatekeeping-shepherding |           |           |       |       |
|                          |       |           |       |       |
| Constant                 | −1.994| −1.988| −2.095 | −2.521 |
|                          | (0.074)* | (0.101)* | (0.044)* | (0.462)* |
| McKelvey & Zavoina Pseudo R² | 0.320  | 0.362 | 0.371 | 0.388 |
| Log-likelihood           | −238.64| −232.43| −230.68| −228.28 |
| Log-likelihood ratio test | 13.191(3)* | 6.048(3)* |           |           |

* Significant at 10%.
<sup>a</sup> Significant at 5%.
<sup>b</sup> Significant at 1%.

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nal knowledge the organization needs and thus target their search for external knowledge more effectively. Combining both types of effort also allows gatekeepers also to coach external parties on how to communicate external knowledge to internal audiences. It is often a deep understanding of one’s own, internal technologies in combination with a curious, open mindset when searching for new, external knowledge that increases the likelihood of identifying external knowledge that creates opportunities for the organization, and thus helps to build its potential absorptive capacity. One senior scientist talked about when, at a conference, he stumbled on a medical technology that he believed may also have a totally different, non-medical application in Neptune:

*It was our idea, their technology, and we talked to them then about the application. So that, to me, is because we were aware of the opportunity and the solution requirements. ... They had the technology and had never thought about the potential application to [our type of] products.*

By contrast, individuals who focus on the search for external knowledge and then hand it over to others to assimilate may identify knowledge that is unlikely to fit the organization and find suitable application. Their lack of involvement in assimilation may imply they have too limited a depth of understanding of their organization’s needs, or do not appreciate the extent of assimilation required for external knowledge to be readied for internal application. Although this result is consistent with Dahlander et al. (2016), who found that individuals who benefit from external search also invest time internally, our study helps to unpack why this may be so, suggesting that individuals need to invest not only time but also need to make an effort to help assimilate this knowledge for their colleagues and the wider organization. Our findings are also consistent with Monteiro and Birkinshaw (2017) who actually found that dedicated knowledge scouts, unlike their name suggests, often not only engage in channeling knowledge in, but also make an effort to translate it to ease internal understanding and actively seek to optimize the fit between external knowledge and internal needs. Our results suggest that individuals will not benefit from external search alone. Deep engagement in assimilation is required to ‘repackage’ external knowledge to give it a local feel and articulate its value in categories and language that are meaningful to insiders, and to allow it to be internally broadcasted to maximize the chances of finding a suitable application in the organization’s innovation outputs.

We also found that individuals who focus on the assimilation of external knowledge but have low levels of external search – implying they help assimilate external knowledge identified by others – did not appear to have lower chances of achieving innovative success than those who combined it with external search. In other words, this suggests that the quality of individuals’ assimilation effort is not undermined if these individuals are not actively engaged in search efforts themselves. Unlike external search, assimilation can have value for innovation as a stand-alone effort, provided that others supply external knowledge to be assimilated and remain themselves involved in assimilation efforts as well. We believe that this finding is an important extension of prior research, which has only focused on the identification of external knowledge, giving modest attention to how this knowledge is ‘repackaged’ for use within the organization.

The second path through which individuals’ absorption efforts may help them achieve innovation is through combining high levels of assimilation with high levels of external knowledge utilization. We introduce the label of shepherds to indicate individuals who can reshape external knowledge or ideas to meet internal requirements and logics and thus may be better able to shepherd ideas based on external knowledge through internal selection procedures and overcome internal resistance to the utilization of external knowledge. Their experience with assimilation of external knowledge may deepen their understanding of how external knowledge can be incorporated in the development of innovations, helping them to gain traction for these ideas against hostile or indifferent internal groups. At the same time, involvement in both utilization and assimilation allows shepherds to tailor the assimilation process in such a way as to maximize its chances of successful utilization. This suggests that shepherds’ involvement in assimilation and utilization helps organizations to pave the way for external knowledge to be incorporated into their internal innovation efforts and thus contribute to its realized absorptive capacity. We also find that the performance benefits of shepherding are stronger than those of gatekeeping. Since the performance premium from realized absorptive capacity is higher than that from potential absorptive capacity, these findings are in line with the expectation that gatekeeping helps to create options for external knowledge to feed into the firm’s internal innovation endeavors, whereas shepherding helps with the realization of some of those options.

The final stage of our analysis investigated the implications of engaging in all three types of effort involved in the use of external knowledge considered in this study – i.e. search, assimilation, and championing. Contrary to our predictions, we did not find that the combination of all three types of effort had a dampening effect on the probability of an individual achieving a top innovation rating relative to individuals who only focused on two types of effort. This may suggest that opportunities to simultaneously benefit from synergies associated with both the gatekeeper and shepherd roles – i.e. between external search and assimilation, and between assimilation and championing of external knowledge – may counterbalance the attentional costs related to being involved in too many different types of effort, leading to no significant overall effect of combining all three types of absorption effort.

4.1. Limitations

This study relied on the responses of R&D scientists to a survey about their efforts to find, adapt, and apply external knowledge and, as such, has several limitations. First, although we have information about objective performance measures, we rely on the statements of individuals about their own performance, and there was reluctance among lower performers to declare their innovation rating. Although we weighted the data to account for this bias in response patterns, more objective measures of performance from secondary sources would have been beneficial. Nevertheless, our measures have strong contextual and predictive validity and are consistent with the extant literature on the sources of individual-level innovativeness. Furthermore, using a cross-sectional survey we were not able to relate individual absorption efforts to specific instances of knowledge transfer and absorption, which limits our study in its ability to observe how external absorption unfolds over time as a process. Another limitation related to our performance variable is that assessing individual innovative output during a single year may be insufficient, particularly for assessing the relation between absorption effort and individual contributions to radical innovation. Efforts to innovate on the basis of external knowledge may take many years to come to fruition with the consequence that our analysis may underestimate the importance of search in the absorption process. In this respect, our study was somewhat constrained by the short-term outlook of the industry partner’s performance measurement system. Future research using longer temporal time windows – perhaps tracking instances of external engagement over time – may help to further assess the impact of individual assimilation efforts on radical innovation outcomes. Moreover, it may also be the case that individuals are better able to obtain credit for their achievements through higher supervisory ratings if they are shep-
herds as a result of their higher involvement in the more visible aspects of the later stages of the absorption process. Although we control for ties to senior managers and the time horizon of individual’s work in our estimates, it would be useful to further explore how the profile of different absorption efforts inside the organization affects assignment of credit among the individuals involved in the process.

Second, since our study relies on data from a single organization, it is unclear whether our results are due to particular features of this organization. However, the survey included respondents from all the firm’s divisions and we controlled for differences in the sizes of the markets of the division and the particular divisions themselves. The firm’s units operate in different markets and largely autonomously. Moreover, we have sought to embed our study in an emerging research stream on individual level openness, trying to use overlapping scales and questions to enable comparability. Nevertheless, given this single firm setting, we cannot confirm whether the results for other large organizations would be similar.

Third, with its focus on individual’s absorption efforts, this study has given only limited attention to the process and the networks through which these efforts may be enacted within the organization. Future research could explore how external ideas travel through organizations over time, examining the contribution of different individuals in this unfolding process. Alternatively, experimental research designs, such as that employed by Singh et al.’s (2010) work on search chains, could provide insights into the nature of the process itself. In addition, future research could explore how an individual’s network resources enable them to better mobilize different absorption efforts. For example, individuals with the ability to introduce people to each other that might benefit from being in touch – which Obstfeld (2005) refers to as tertius iungens orientation – may be better able to gatekeep and shepherd external knowledge through the organization. We would encourage future research on the role of networks within and outside the organization, and how they lead individuals to take up different roles in the absorption of external knowledge and shape the effects of absorption efforts on performance.

Finally, in a cross-sectional study of this type, it is difficult to rule out problems related to endogeneity and reverse causality. To reduce these, we included a wide range of variables that could explain our measures of absorption effort and also individual performance, but we cannot exclude the possibility of some further unobserved heterogeneity. Given our extensive controls and tests – including a lagged value of the innovation rating – we believe that our results are unlikely to be driven by unobserved heterogeneity, but in the absence of panel data and effective instruments, it is impossible to rule out potential sources of endogeneity entirely.

4.2. Implications for theory

Our study has enriched the literature on the individual-level sources of innovation in general and the role of open innovation in particular. We established that it is not merely the broad external search for valuable knowledge and ideas that drives individual success of innovating on the basis of external knowledge. Rather, we suggest that it gatekeepers’ combined external search and assimilation efforts and shepherds’ combined assimilation and utilization efforts that enable effective absorption of external knowledge and are among the most powerful predictors of individual innovative- ness. Although prior research has suggested that the study of how external knowledge is processed internally is critical (Monteiro and Birkinshaw, 2017), it has not delved directly into the effects of individuals’ roles in this process on their performance. In taking up this question, this study has provided insights into how different types of absorption effort map onto productive roles in external knowledge absorption. Efforts to assimilate external knowledge appear to function as the glue that renders gatekeepers’ efforts to search for external knowledge and shepherds’ effort to champion its utilization more effective. These findings highlight the need for a renewed focus on the knowledge assimilation process within organizations, and the conditions under which individuals may be most effective in incorporating external knowledge in the development of innovations internally.

Our study also carries implications for the literature on absorptive capacity. Although the notion of absorptive capacity is an organizational one, Cohen and Levinthal (1990) have suggested that it operates at multiple levels, including the individual, team, division and wider organization. Despite Cohen and Levinthal’s portrayal of individuals on the frontlines of enabling organizations to learn from external sources of knowledge, the number of studies that have examined the role of individuals in external knowledge absorption is very limited (Foss et al., 2011; Monteiro and Birkinshaw, 2017; Volberda et al., 2010). This study has demonstrated that gatekeeping and shepherding are key roles driving individual innovation performance. Although organizational absorptive capacity is certainly more than the sum of individual abilities to absorb external knowledge, our approach constitutes an important step towards building a multi-level understanding of how individuals and organizations learn from external knowledge. In particular, by establishing that individuals’ ability to apply external knowledge meaningfully for the generation of innovations depends on which other types of effort related to external knowledge absorption they are involved with, we explicate the mechanisms of successful external knowledge absorption that operate at the level of the individual. Moreover, most existing work on absorptive capacity emphasizes the importance of prior knowledge and experience as the main predictors of absorptive capacity, leaving little space for individual agency for explaining the successful use of external knowledge in the innovation process (Lewin et al., 2011; Volberda et al., 2010). Offering a detailed look into how individuals tackle the task of bringing together external knowledge and internal knowledge, we have helped to reappraise the role of individual agency in the successful absorption of external knowledge.

4.3. Implications for managerial practice

The increasing importance organizations are placing on their ability to be open to external sources of knowledge is putting new pressures on individual employees. Notably, R&D staff are being asked to act as carriers of external knowledge into and across the firm, which clearly represents a new set of challenges for them (Mowery, 2009; Salter et al., 2014, 2015). In this context, our study offers insights into how organizations prepare and reward R&D staff for this expanded role. First, we highlighted the role of external knowledge assimilation in the successful absorption of external knowledge. As Salter et al. (2014) suggest, in many cases, organizations focus on the search for external knowledge in their own innovation initiatives, but overlook the effort required for its assimilation within the organization. External knowledge will not necessarily find a suitable home unless it is aligned with the organization’s existing expertise and capabilities and drafted onto their business needs. Once introduced into the firm, the utilization of external knowledge needs to be aggressively and persuasively promoted internally. We found that the individuals who received the highest innovation ratings were often heavily involved in both the search for external knowledge and assimilation (i.e. gatekeepers), or in assimilation and championing of external knowledge (i.e. shepherds), whereas mere external search breadth had little effect. By taking this perspective, we have highlighted the roles of both gatekeepers and shepherds in open innovation, helping to widen scope of efforts associated with the absorption of external knowledge. We
can see potential for organizations to develop incentive and training systems that reward and encourage individuals to successfully take up these roles, enabling them to exploit productive combinations of efforts that enable effective external knowledge absorption.

Second, although identifying useful external knowledge will continue to be an important part of organizations’ open innovation efforts, our study suggests these efforts should be broadened to include time, resources, and effort for the successful assimilation and utilization of that external knowledge. This suggests that internal faces of openness – the processes and routines firms have developed to assimilate and utilize external knowledge – require greater attention both from managers and researchers (Dahlander et al., 2016). Critically, perhaps, organizations need to adopt a view of open innovation that incorporates the entire knowledge absorption process. Central to this effort will be to ensure that staff are adequately trained and supported to help them learn to make a ‘marriage of materials’, transforming external knowledge into attractive hybrids that combine the novelty of the external knowledge with the categories and requirements of the internal innovation processes.

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