Open for Ideation: Individual-Level Openness and Idea Generation in R&D*

Ammon Salter, Anne L. J. Ter Wal, Paola Criscuolo, and Oliver Alexy

Organizations are increasingly encouraging their scientists and engineers to source knowledge externally. However, it is unclear how the openness of individuals to external sources of knowledge affects their ideation performance, that is, their ability to develop new, useful innovative ideas for their organization, and which factors might moderate this process. Drawing on theories of combinatorial search, and using a sample of 329 R&D scientists and engineers working in a large organization, we demonstrate that individuals' openness to external sources of knowledge is curvilinearly related to their ideation performance. Openness provides benefits such as alertness and variety which contribute to ideation up to the point where increasing integration and approval costs cause negative returns to set in. We also examine how the R&D time horizon, ties to senior managers, and the breadth of individual knowledge moderate the costs and benefits of openness to individuals. We explore the implications of these findings for managerial practice.

Introduction

Open innovation offers significant opportunities for large, mature organizations to break away from existing ways of working and to engage in wider and richer search efforts by tapping into the vast potential of ideas and technologies outside the firm (Chesbrough, 2003). External actors, such as users and suppliers, may have critical information that would allow individual research and development (R&D) scientists to create new combinations of knowledge that unlock significant commercial potential for their organizations (Dahlander and Frederiksen, 2012; Franke, Von Hippel, and Schreier, 2006). While external knowledge should not be considered superior to internal knowledge per se, many companies could benefit from allowing their employees to work selectively with knowledge that is beyond the boundaries of the firm (Cohen and Levinthal, 1990; Laursen and Salter, 2006). Individuals in R&D departments are increasingly being encouraged by their employers to seek knowledge from external sources to sustain and stimulate corporate open innovation and strategic renewal programs.

While we know that this trend implies that individuals need to become more open, the consequences of this direction for individual workers have been scarcely investigated. Current debate focuses mainly on the antecedents to and consequences of organizational-level openness (Dahlander and Gann, 2010), and has shifted only recently to the project level (Salge, Farchini, Barrett, and Dopson, 2012). At the same time, we know that individuals working in R&D need to adapt when employers adopt more open models of innovation, but we do not know how individual work needs to change in order for the benefits promised by open innovation to be achieved (Alexy, Henkel, and Wallin, 2013). In particular, very few studies explore how individual-level openness might explain the ability of individuals to generate new and useful ideas for their organizations. A few recent papers investigate how individuals can balance their time between internal and external engagement in order to get the best advantage from external search activities (Dahlander, O’Mahony, and Gann, 2012). However, our understanding of the costs and benefits of openness to individuals remains limited.

To shed more light on the individual-level effects of opening the firm’s boundaries, we focus on the impact of...
individual openness to external sources of knowledge on their ability to develop new and useful ideas for the organization. In line with Amabile’s (1996) definition of creativity as the generation of ideas that are both novel and useful, we define ideation performance as the ability of the individual to develop ideas at the front end of the innovation process which the organization considers sufficiently valuable to justify further development. We address the question of how an individual’s use of diverse external sources of knowledge impacts on their ideation performance.

We follow the literature in arguing that individuals can gain from openness but extend this logic by arguing also that the benefits of openness to individuals will be subject to decreasing and negative returns (Laursen and Salter, 2006). Specifically, we draw on theories of combinatorial search (e.g., Katila and Ahuja, 2002; Nelson and Winter, 1982; Rosenkopf and Nerkar, 2001), and contend that engagement with a range of external partners helps individuals to generate novel and useful ideas by making them more alert to relevant external developments, and by providing access to varied technological knowledge. However, when the number of different external knowledge sources increases beyond a certain threshold, the resulting increased coordination costs cause negative returns to set in. These coordination costs include integration costs resulting from the cognitive challenge of bringing together knowledge from diverse settings and approval costs related to obtaining internal agreement to engagement with different external partners taking account of intellectual property (IP) considerations.

We hypothesize that the curvilinear relationship between openness and individual ideation performance is moderated by individual, network, and organizational factors, which alter the threshold level of openness at which decreasing or negative returns set in. In particular, we argue that individuals may be able to lower their integration and approval costs through the adoption of a long-term horizon for their R&D efforts, direct connections with senior managers, and possession of a broad knowledge base. We test our predictions on a data set of 329 R&D scientists and engineers working for a large, mature organization. Overall, we find support for most of our hypotheses.

Our study makes two contributions to the literature on the management and organization of innovation activity. First, we probe the nature of individual openness to external sources and demonstrate how this openness can enable successful idea generation. We contribute to the ongoing debate on the sources of individual-level ideation (e.g., Bharadwaj and Menon, 2000; Scott and Bruce, 1994), showing that openness to external knowledge is a critical factor in facilitating individual creativity within organizations. Second, we shed light on the contingencies that shape the value of openness for individuals, demonstrating that the nature of their R&D efforts, their network resources, and the diversity of their existing knowledge significantly alter their ability to benefit from openness. We provide new insights into the contextual mechanisms that enable individuals to learn successfully from external sources and to benefit from increasingly “open” environments.

BIOGRAPHICAL SKETCHES

Dr. Amon Salter is a professor of innovation at the School of Management, University of Bath. He received his doctorate from the Science Policy Research Unit at the University of Sussex. His research explores open and distributed models of innovation, social networks and innovation, and university–industry collaboration.

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Dr. Paola Criscuolo is an associate professor of innovation management at Imperial College Business School. She received her Ph.D. in the economics of innovation and technological change from Maastricht University. Her research interests include knowledge transfer and innovation at the firm and individual levels.

Dr. Oliver Alexy is a professor of strategic entrepreneurship at TUM School of Management, Technische Universität München, where he was also awarded his Ph.D. His current research focuses on organizational design; interorganizational collaboration; and open, distributed models of innovation in innovation ecosystems.

Theory and Hypotheses

The Role of Individual-Level Openness in Ideation

Combining insights from theories of combinatorial search and the literature on open innovation, we present a framework that allows us to theorize the relation between individual-level openness and ideation performance, and how this relationship is moderated by individual-level, network-level, and organizational-level factors. We argue that engaging with diverse external sources of ideas endows individuals with the advantages of variety and alertness, but disadvantages in the form of higher costs of integration and approval. These disadvantages can be moderated by individual job characteristics, internal
network resources, and breadth of knowledge. In what follows, we develop these arguments in detail.

In most large organizations, R&D professionals are rewarded for their ability to develop ideas that might lead to successful new products, processes, and services (e.g., Sarin and Mahajan, 2001). Ideation performance—the individual ability to generate novel ideas that are selected for further development by the individual’s organization—is a crucial criterion in this context. In the search for novel and useful ideas, individuals working on R&D will often need to search externally to discover new knowledge and opportunities or to develop their ideas (Allen, 1977). This is because, although large firms may have considerable internal knowledge, this pales in comparison to related knowledge outside the firm. Users, consultants, suppliers, universities, and competitors may all be sources of essential knowledge that will allow the individual to develop a new idea (e.g., Dahlander and Frederiksen, 2012; Kristensson, Gustafsson, and Archer, 2004; von Hippel, 1988).

Accordingly, many organizations are promoting initiatives to make appropriate use of external sources of knowledge, a development that can be understood as an increasing trend toward an open model of innovation (Chesbrough, 2003; Dahlander and Gann, 2010). However, the organizational goals of increased efficiency and greater effectiveness of innovation activity are contingent on the actions of the individual firm employees (Alexy, Henkel, et al., 2013). It is the individual researchers within the firm, not the organization, that identify and develop new innovative ideas in collaboration with sources outside the firm’s boundaries. It is the individual researchers who might (or might not) become more efficient and effective at generating new ideas by working with external actors.1

Yet our understanding of individual-level contributions to organizational open innovation efforts is fairly limited. Henkel (2009) shows how, in the case of open-source software, individuals participating in corporate open innovation efforts usually have the organizations’ best interests in mind. Alexy, Henkel, et al. (2013) describe how variations in job roles and types of corporate open innovation engagement explain differences in the individual predisposition to support organizational open innovation efforts. Similarly, Rollandsson, Bergquist, and Ljungberg (2011) point to individual-level coping mechanisms in the process of the transition from closed to open innovation. Dahlander et al. (2012) explore how differences in individuals’ allocation of attention to open innovation activities are linked to variations in their contribution to the performance of organizational R&D. Building on this emergent strand of research, we focus on the costs and benefits to individuals active in R&D of engagement in external search at the front end of innovation, and how these may be moderated by individual, network, and organizational factors.

Our core theoretical argument draws on theories of combinatorial search and suggests that individuals who invest greater effort in drawing in ideas from outside the firm will be better able to generate useful ideas for their organization than those relying only on internal search. That is, these individuals will exhibit higher ideation performance based on their greater awareness and variety of sources of information.

First, since different sources of knowledge provide unique and divergent sets of knowledge and resources, individuals who exploit a broader range of knowledge sources obtain greater inspiration and inputs for the generation of novel ideas (Maggitti, Smith, and Katila, 2013). The literature on entrepreneurial opportunities suggests that individuals who engage in external search are more alert to new opportunities (Kaish and Gilad, 1991; Kirzner, 1973). In effect, R&D workers who also invest time and energy in external search efforts will be more likely to recognize new market or technological opportunities compared to colleagues who focus exclusively on internal research (Howell and Sheab, 2001). External engagement by R&D professionals is often the source of novel ideas that incorporate potentially valuable insights that might otherwise not have been noticed by the organization.

Second, since external sources of knowledge incorporate more variety than internal sources, external search enlarges the scope for individuals to see opportunities related to new combinations of internal and external ideas (e.g., Maggitti et al., 2013). Exploiting only internal sources reduces the potential for combinatorial novelty required to support high levels of ideation (Fleming and Sorenson, 2001; Stuart and Podolny, 1996). The cumulative and evolutionary nature of intra-firm knowledge can lead to convergence rather than variety in the knowledge available to the firm (Nelson and Winter, 1982). Thus, individuals who rely on only internal sources, or very few external sources, will have fewer opportunities to create combinatorial novelty and new valuable ideas. Exploitation of (more) external ideas opens up opportunities to

1 Of course, at the level of the organization, there are several firm-level and environmental moderators that influence the openness–performance relationship (e.g., Alexy, George, and Salter, 2013; Chesbrough, 2003). However, since empirically we are investigating individuals within the same organization, many of these external contingencies are constant across the sample.
import ideas from external actors, and overcomes the tendency common to many large, mature organizations, to stick with “tried and tested” approaches and solutions (Hargadon and Sutton, 1997; Katz and Allen, 1982). Thus, compared to more inward-looking colleagues, externally engaged individuals will be better placed to combine internal and external knowledge elements into novel ideas that may seed new developments for their organization.

The Potential for Decreasing Returns to Individual-Level Openness

Although the benefits to individuals of drawing ideas from many external sources can be considerable, there is a point where these efforts are subject to diminishing or even negative returns. Using knowledge from different sources creates coordination challenges: in large, mature organizations these take the form of integration and approval costs.

First, since every different source of knowledge may result in knowledge distinct to a particular setting, the individual will need to make considerable efforts to find ways of integrating the ideas (Dougherty, 1992). Use of too wide a range of knowledge sources may result in the individual being unable to effectively combine the acquired knowledge because it is too diverse, and is discordant with what the organization knows and can do (Laursen and Salter, 2006; Nooteboom, 2000). In particular, if the individual explores fields in which the organization lacks routines for translating or recombining the external knowledge (Cohen and Levinthal, 1990), there are integration costs related to making the external knowledge accessible and demonstrating its value to the organization. Establishing links with larger numbers of different sources of external knowledge may increase these integration costs exponentially (Salge et al., 2012).

Second, the individual needs organizational approval for engagement with different sources of external knowledge. Despite the move toward open innovation, large R&D organizations are extremely focused on the creation and protection of IP, which can have a significant impact on how they engage with external sources (Alexy, Criscuolo, and Salter, 2009; Chesbrough, 2006). For example, use of external knowledge may be constrained by the organization’s fear of knowledge leakages, and its keenness to retain control rights, such as the ability to obtain patents. In seeking to exploit knowledge from multiple partners, individuals may experience internal barriers to external collaboration, and may be unable to obtain approval for mutual exchanges of knowledge with external sources, such as universities, suppliers, and competitors. Engagement with a larger number of different types of partners amplifies the complexity of the internal approval process since each distinct source of external knowledge may be operating according to different contracts for and norms of exchange. For example, working with a noncompeting firm will involve a different set of IP terms and conditions for exchange than collaborating with a university. As a result, approval costs can increase nonlinearly with the number of external sources of knowledge.

Taken together, by reaching out to access a broader range of external sources, individuals may increase the coordination costs of external openness, potentially turning the benefits of additional openness into a negative sum gain, in the effort to generate new and useful ideas. While individual-level openness initially should have positive effects on the individual’s ability to propose novel and useful innovative ideas, after a certain threshold, the benefits of individual-level openness, such as increased alertness and knowledge variety, may be outweighed by a nonlinear increase in integration and approval costs. Therefore, we propose:

\[ H1: \text{Individual-level openness is curvilinearly related (takes an inverted U-shape) to individual ideation performance.} \]

R&D Time Horizons and the Effect of Individual-Level Openness

The benefits to individuals of openness to external sources of knowledge may be shaped by the time horizon of their R&D efforts. Some R&D professionals focus on short-term, close-to-market innovations; others work on the development of ideas destined for the market at some future time (de Brentani and Reid, 2012; Reid and de Brentani, 2004). We argue that the latter efforts have a better chance of benefitting from openness to external sources than short-term-focused R&D. A longer time horizon allows more time and resources to identify, evaluate, and harness external sources of knowledge, and to coordinate these inputs from different complementary sources. Given the likely high costs of engaging with a wide variety of partners, the additional time and resources concomitant with a longer R&D time horizon will enable individuals to learn effectively from external sources, and allow the conversion of this knowledge into a form that is usable by the organization. Therefore, a longer time horizon alleviates the coordination problems related to external engagement.


In addition, since R&D staff must conform to the firm’s IP culture and procedures for contractual arrangements with external parties, those working toward a longer time horizon may be better able to cope with the approval costs related to working with numerous partners. This contrasts with individuals involved in short-term R&D who will need to “run fast,” and who will have little opportunity to engage in complex and lengthy procedures to set up collaboration agreements. They will also face more immediate coordination problems arising from the need to ensure that the external ideas are aligned to the immediate objectives of the firm. Thus, they will be disadvantaged compared to colleagues with longer time horizons.

**H2: The time horizon of individuals’ R&D efforts moderates the relation between openness and ideation performance, such that the threshold level of openness at which diminishing or negative returns set in will be higher for those with a long-term focus.**

**Ties to Senior Managers and the Effect of Individual-Level Openness**

In large organizations, senior managers are critical to shaping decisions, since their views cascade down the organizational structure (Hambrick and Mason, 1984). Having a direct link with a senior manager can provide access to critical information and resources (Seidel, Polzer, and Stewart, 2000). In our context, ties to senior managers can enable the individual to win the support of the wider organization for an idea and to influence the stage-gate selection process (Kijkuit and van den Ende, 2010). In addition to the direct effects of a tie to senior management on individual ideation performance, we argue that such ties can help to reduce the integration and approval costs associated with external engagement, and thus moderate the effect of individual openness on ideation performance.

First, since senior managers generally operate across several units, and are involved in corporate-wide decision making, they may have critical insights into the potential applications of the external knowledge in different parts of the organization, and may be able to advise where in the organization it will best fit. Thus, those with direct links to a senior manager should find it easier to identify suitable areas for the application of externally sourced knowledge. In addition, links to senior managers may provide information about where technologists should focus their external search efforts, and which partners are more likely to provide the inputs needed by the organization. For example, senior managers may be able to identify partners whose knowledge has high levels of structural and content compatibility with the firm’s own knowledge base (Lane and Lubatkin, 1998). For all these reasons, we expect that the existence of ties to senior managers should help to lower the cost to the individual of integrating external knowledge.

Second, ties to senior managers can help individuals to obtain approval for external engagement. Senior managers may have the decision rights over external relationships, such as authority to sign off on a confidentiality or partnership agreement. Access to these managers should enable speedier approval for collaboration. Senior managers can also indirectly facilitate and expedite approval for new partnerships from other parts of the organization. By signaling their support for the initiative, senior managers provide the individual with the credibility required to overcome internal resistance, which in turn lowers the approval costs of external engagement (Fichter, 2009).

Therefore, we posit that individuals with ties to senior managers will be better able to take advantage of a higher number of external sources of knowledge than those without such connections. Thus:

**H3: Ties to senior managers moderate the relation between individual openness and ideation performance, such that the threshold level of openness at which diminishing or negative returns set in will be higher for those with ties to senior managers.**

**Individual Knowledge Breadth and the Effect of Individual-Level Openness**

The ability of an individual to benefit from openness to external sources is not determined purely by the direction of their R&D efforts or their networks; it is also a function of their personal ability to bring together and connect different sources of knowledge (Kolb, 1984). Fundamentally, individuals with a broader knowledge base should be able to learn more effectively from external sources, allowing them to minimize the amounts of time and resources expended on external knowledge search. In other words, in general, we would expect knowledge integration costs to be lower for these individuals compared to their peers with a narrower knowledge base.

For example, the literature on absorptive capacity shows that individuals and organizations with a broader knowledge base are better able to learn from external sources (Cohen and Levinthal, 1990). Possessing knowledge related to different domains should give combinatorial advantage compared to more narrowly focused colleagues (Hargadon and Sutton, 1997). Engagement in different knowledge domains allows individuals to
identify opportunities, to learn from different areas, and to create useful and new combinations of knowledge from disparate sources. Breadth of knowledge not only supports the individual’s ability to generate ideas, it also enables more successful exploitation of external sources of knowledge for ideation. By maintaining interest in different knowledge domains, individuals build cognitive capacity to integrate diverse and even potentially conflicting sets of information. They may display greater patience in seeking ways to integrate initially incompatible ideas. As a result, their knowledge allows them more successfully to utilize a broad range of external sources and to profit from openness, and provides the cognitive ability to overcome some of the coordination costs associated with the use of a wide range of external sources. Thus:

\[ H4: \text{Individuals’ knowledge breadth moderates the relation between openness and ideation performance, such that the threshold level of openness at which diminishing or negative returns set in will be higher for those with a broad range of expertise.} \]

Data and Methods

Sample and Data Collection

Our study sample is a group of senior scientists and engineers in a large, technology-intensive, multinational corporation which, for confidentiality reasons, we refer to as Neptune. We started by conducting interviews with 25 senior scientists and engineers, and 10 senior R&D managers to get an understanding of the innovation process in Neptune, and the role of openness in the innovation activities of our interviewees. The information obtained from the interviews helped us to design an anonymous survey, and provided a better understanding of the stage-gate process and the contributions of individual scientists and engineers to the performance of their various projects.

The survey targeted all 600 senior scientists and engineers in Neptune (see also Criscuolo, Salter, and Ter Wal, 2013).\(^2\) It was administered in electronic format in June 2010 after a pilot in a group of 10 individuals to ensure that questions were unambiguous and unlikely to solicit “socially desirable” responses (Podsakoff, MacKenzie, Lee, and Podsakoff, 2003, see more on common method bias below). We achieved 408 responses, a response rate of 67%. However, noncomplete responses reduced our final sample to 329 individuals. Nonresponse bias was assessed by carrying out t-tests on key individual characteristics (seniority, location, gender) between respondents and nonrespondents. There were no significant differences. We also found no significant differences between early and late respondents for our main variables (Armstrong and Overton, 1977).

Organizational Setting

Neptune operates a dual-career structure that allows separate career progression paths for technical professionals and for managers in the R&D department. In this study, we focus on the technical professionals. These individuals are highly skilled, senior members of the R&D organization, whose role is to develop new and useful ideas for the wider organization, i.e., ideas that lead to increased sales or lower the organization’s costs. Thus, rather than being rewarded for technical and scientific achievements such as patents and publications, senior technologists in Neptune are rewarded and promoted on the basis of expected or actual sales of newly developed products, or for cost savings resulting from their innovations. Outcome-based reward systems are not uncommon in organizations which, like Neptune, use cross-functional new product development teams to increase integration among team members from different functions (Sarin and Mahajan, 2001). All Neptune’s R&D researchers are expected to engage in boundary-spanning activities (activities beyond the firm’s boundary) as part of their job function. This activity is discussed annually in the regular appraisal process, along with the individual’s contribution to the development of successful new products, processes, and markets. Note that incentive and promotion schemes, including those aimed at stimulating individuals’ engagement with external ideas, are identical throughout the organization. Finally, although the technical professionals work in various teams, it is their personal contributions that are assessed. Typically, for each project, a cross-functional team is formed, which usually includes only one senior R&D engineer whose contribution is relatively easy to identify. Thus, the Neptune performance management system makes it difficult for individual R&D staff to free ride on others’ efforts.

Although the organization strongly encourages its R&D staff to be open to external sources of knowledge and to engage with external parties, whether academics, suppliers, or start-up companies, it is keen also to capture
and protect IP. Therefore, it organizes external engagement carefully to ensure it is able to secure the downstream IP rights from external collaborations. It also operates in a highly competitive environment, with skilled competitors that closely monitor its innovative efforts. Thus, individual choices about engaging with external parties are constrained by the organization. All individuals—including senior R&D staff—are expected to abide by the organization’s rules and procedures, which state that any form of knowledge exchange with an external party requires prior approval from senior management. Our interviewees were clear that these rules were always adhered to, and referred also to the negative effect of this strict adherence to corporate regulations:

Often, setting up all the confidentiality agreements, determining the ownership of any IP, can be fairly lengthy, time consuming and, you know, often can lead to us going down to a point where we don’t actually then move forward because we’ve found sufficient reasons why wouldn’t want to or the vendor wouldn’t want to because Neptune usually has a fairly explicit requirement when we’re doing things like that.4

In Neptune, all R&D projects have to pass through a “stage-gate” system which operates in the idea generation and the idea implementation phases of the project (Cooper, 1985, 2008; for a more recent overview, see Martinsuo and Poskela, 2011). The company works with clear guidelines and criteria for passing through these stage gates. The first objective in the generation phase is to define the idea and assess its potential to create a business opportunity for Neptune. The next objective is to create a solution that addresses the business opportunity. The final objective is to show proof-of-concept for the idea. Once the new product, process, or technology has reached a fairly well-developed and concrete form, it has to pass the “implementation gate.” In the implementation phase, Neptune allocates human and financial resources to the project. Senior R&D managers in the organizational hierarchy typically are involved in decision-making about project continuation.

Dependent Variable

Ideation performance. Our measure of the ability of individuals to generate new ideas is based on the number of projects that demonstrated proof-of-concept and passed the corresponding “implementation gate” in Neptune’s stage-gate system (Cooper, 1985, 2008). This measure responds to a call for more research into the front end of innovation (Kijkuit and van den Ende, 2010). We asked respondents how many times in the previous three years had their engagement in R&D resulted in projects that had been approved to progress to the idea implementation stage.

The number of projects that pass the “implementation gate” is a relevant criterion for successful ideation among the R&D scientists in our sample for several reasons. First, all new product and process ideas proposed by members of Neptune must pass the stage-gate process; thus, achieving implementation is a prerequisite for the development of an idea into an innovation.5 Second, as mentioned above, senior R&D staff in Neptune play a leading role in progressing ideas to this stage; successful entry of a project into the implementation phase is mostly attributable to their innovation efforts. Third, the R&D scientists and engineers in our sample are focused primarily on the front end of the innovation process, and may have little creative input or further involvement in the implementation of ideas. Also, the number of ideas entering later phases of the stage-gate process is constrained by the number of potential innovative options and the heavy downstream investment cost to Neptune. Thus, ideas selected for downstream development have achieved significant success in passing the several early selection gates and demonstrating value and merit deserving of further investment. Although our variable might suffer from self-reporting bias, it represents the outcome of an objective evaluation process conducted by managers from several functions, and should be unaffected by individual evaluation bias common to investigations of the value of innovation projects (Blindenbach-Driessen, Van Dalen, and Van Den Ende, 2010). Moreover, although our variable is a single-item measure, in line with Rossiter (2002) and Bergkvist and Rossiter (2007), a single-item scale is recommended to

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3 In relation to H3, it is important to distinguish “receiving approval” from “having ties to senior managers.” Notably, only the latter implies a social connection between the individual and a senior manager (in this case through the receiving and giving of advice and support; see also the Independent Variables section). This type of connection may help but certainly is not a prerequisite for approval for building new partnerships.

4 This strong IP focus also has an impact on informal knowledge exchanges between R&D personnel and external researchers, as noted by one R&D employee: “we can approach somebody like at conferences even without having a confidentiality agreement in place, but you just have to keep the conversations quite general.” In turn, meaningful conversations that produce new ideas or lead to collaborations will only start once an IP agreement is in place. While this restriction may seem extreme, past research illustrates that Neptune is typical of other large R&D intensive organizations (e.g., Alexy et al., 2009).

5 Although the researchers in our sample have different job roles within the R&D department, from product researchers to process engineers, we detected no significant differences in the ideation variable across job functions.
capture phenomena represented by concrete and singular objects. The number of projects passing the implementation gate fulfills these criteria.

**Independent Variables**

**Openness.** Degree of openness of individuals’ search efforts is measured by a survey question that asked respondents to indicate the frequency of their interactions with a range of external parties, for ideas, technical solutions, or expertise, in the previous year. The list of external parties was developed on the basis of existing research (e.g., Laursen and Salter, 2006) and refined through interviews and the survey pilot. It was intended to be comprehensive and mutually exclusive, and covers the most important sources of external knowledge on which individuals working in Neptune rely for their R&D efforts. Table 1 reports the descriptive statistics of the 11 external sources listed, which includes suppliers, customers, and universities, as well as noncompeting firms and innovation brokers. In general, it appears that working with external sources is common among our population of respondents.

Our measure of openness is similar to Allen’s (1977) measure of scientists’ and engineers’ information sources. The responses to a similar survey question have been used to measure organizational-level openness (e.g., Laursen and Salter, 2006; Leiponen and Helfat, 2010) and to measure project and team-level search efforts (Gruber, MacMillan, and Thompson, 2013; Li, Maggitti, Smith, Tesluk, and Katila, 2012; Salge et al., 2012). Our measure is consistent with Dahlander et al. (2012). The internal reliability of our individual-level variable is relatively high (Cronbach’s alpha = .71). To ease interpretation of the coefficient estimates in our models, we standardized this variable by subtracting the mean and dividing by the standard deviation.

**Time horizon of R&D efforts.** To construct this variable, we asked the survey respondents to indicate when their R&D work could be expected to reach or to have an impact on the market: within two years, or in more than two years. We constructed a dummy variable that equals 1 if the results of an individual’s R&D efforts will reach the market in more than two years. We chose this cut-off point in the time horizon on the basis of informants’ views about the nature of R&D development in Neptune.

**Ties to senior managers.** This variable was constructed using the responses to four name generator questions in the survey (i.e., “Over the last six months, are there any work-related contacts from whom you regularly sought information and advice as input for your research and development work?”) adapted from Podolny and Baron (1997). For each question, respondents could nominate a maximum of three contacts, either internal or external to the organization. Therefore, the maximum number of possible different contacts was 12. We asked respondents to indicate whether they worked in the same business unit, and if so, what their position in the hierarchy was. On this basis, we derived the number of the respondent’s ties to senior management.

**Knowledge breadth.** We measured breadth of individual expertise by asking respondents to indicate to which communities of practice (CoPs) within Neptune they belonged. Neptune has an internal knowledge management system that includes best practice repositories, expert yellow pages, and internal CoPs. Members of CoPs provide advice and support to colleagues working on similar topics. Membership in these communities is voluntary, but active contributions from community members are expected and are assessed during the annual appraisal process. It is expected that senior technologists will act as leaders of these communities, shaping and orchestrating the knowledge sharing. Respondents belonged to an average of three internal knowledge communities. Engagement in different communities signals their expertise and involvement in different areas of

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**Table 1. The Use of External Source of Knowledge**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Number of Individuals</th>
<th>Percentage</th>
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</thead>
<tbody>
<tr>
<td>Suppliers</td>
<td>309</td>
<td>.87</td>
</tr>
<tr>
<td>Universities</td>
<td>247</td>
<td>.69</td>
</tr>
<tr>
<td>Customers and end users</td>
<td>242</td>
<td>.68</td>
</tr>
<tr>
<td>Consultancy firms</td>
<td>222</td>
<td>.63</td>
</tr>
<tr>
<td>Noncompeting firms</td>
<td>210</td>
<td>.60</td>
</tr>
<tr>
<td>Professional and trade institutions</td>
<td>198</td>
<td>.56</td>
</tr>
<tr>
<td>Individual external inventors</td>
<td>167</td>
<td>.46</td>
</tr>
<tr>
<td>Private research institutes</td>
<td>161</td>
<td>.46</td>
</tr>
<tr>
<td>Innovation brokers</td>
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<td>.33</td>
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<tr>
<td>Standard setting organizations</td>
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<td>.25</td>
</tr>
<tr>
<td>Competitors</td>
<td>83</td>
<td>.24</td>
</tr>
</tbody>
</table>

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6 In this study, we measured the frequency of engagement with different external sources, in contrast to prior work on the openness of organizations, which examined the importance of different sources. These differences in question format made it difficult to develop a measure of “external search depth.”

7 We conducted sensitivity analysis on the cut-off point where we dichotomized the R&D time horizon variable: earlier and later cut-off points yielded very similar results to those reported.
knowledge development within the firm, which allows them to keep abreast of the range of technical problems that emerge in different areas of the firm’s practices (Wenger, McDermott, and Snyder, 2001). Other studies (e.g., Dahlander and Frederiksen, 2012) use memberships in CoPs to capture individual cognitive ability to access diverse domains of knowledge and find a positive association with individual innovative activity. To ease interpretation of our results for the interaction with the openness variable, we standardized this variable by subtracting the mean and dividing by the standard deviation.

**Control Variables**

We include a number of other variables that have been shown to influence individual ability to generate useful and novel ideas, in other organizational settings. Several studies (e.g., Amabile, 1996) show that intrinsic and extrinsic motivation can influence creativity. We derived measures of intrinsic motivation (Cronbach’s alpha = .69) and extrinsic motivation (Cronbach’s alpha = .69) based on an 8-item scale adapted from Rynes, Gerhart, and Minette (2004). Following factor analysis, the items referring to the importance of salary, job security, and benefits loaded into the extrinsic motivation factor, while items related to the importance of intellectual challenge, level of responsibility, degree of independence, and contribution to society loaded into the intrinsic motivation factor. Another variable related to the generation of new ideas is the extent to which the individual perceives the work environment as supportive of creative efforts (Scott and Bruce, 1994). We derived a measure of climate for innovation (Cronbach’s alpha = .86) based on eight items from an original 22-item scale developed by Scott and Bruce (1994). Since the time spent interacting with people outside the organization to search for and develop new ideas might affect individuals’ ideation performance (Dahlander et al., 2012; Li et al., 2012), we included a variable for percentage of time a senior technologist invests in searching externally (time searching externally). We also take account of a number of individual level characteristics including gender (dummy variable equal to 1 for women), organizational tenure (number of years working in Neptune), and seniority (3-point scale capturing Neptune’s official seniority levels). We control for the individual’s location with a dummy variable that equals 1 if the researcher is based at the company’s headquarters, which we assume means they are closer to strategic decision-makers which may increase the chances of a project progressing to the implementation phase. We control also for amount of revenue generated by the product category to which the individual’s R&D efforts are directed: more resources should positively affect the ability of R&D technologists to develop new and useful ideas. We measured this through a dummy variable (product line significance) that equals 1 if the innovative efforts of the individual are focused on a product line that generated revenue above a certain threshold (not disclosed for reasons of confidentiality) at the time of our survey. Finally, we included dummy variables to control for differences in ideation among Neptune’s different business units and various job functions. These controls should account also for other sources of heterogeneity at the business unit and job function levels which might affect individuals’ external engagement such as informal policies and unwritten practices.

**Common Method Bias and Validity of Measures**

Because our dependent and independent variables are based on responses to the same survey instrument, this introduces the possibility of common method bias in our results (Podsakoff et al., 2003). To minimize this risk, we adopted best practice in the design, administration, and statistical analysis of our survey. First, we ensured that the questions related to our dependent and independent variables were in different sections of the survey. Second, we pointed out to participants that their responses would remain anonymous to minimize issues of evaluation apprehension. Third, we used an inductive approach to developing our scale items, based on the interviews, to ensure that the items in the survey corresponded to Neptune’s local terms and jargon. Fourth, the theoretical model underlying our survey includes a curvilinear relationship between ideation performance and openness, and interaction terms with both the main term and the squared term of openness. Since this model specification is relatively complex, it is unlikely to have been predicted by respondents and is unlikely to be part of their theory-in-use (Chang, van Witteloostuijn, and Eden, 2010) when responding to the survey instrument. Thus, biases arising from respondents “guessing” relationships are unlikely. Finally, we sought to measure our dependent and independent variables on the basis of individuals’ behaviors

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8 We acknowledge that there may be other reasons for joining one or several CoPs, such as a building a personal network, which are not directly related to individual expertise. Therefore, we conducted additional analyses to test our assumption that internal CoPs reflect the individual’s knowledge breadth. Correlations between our CoPs-based knowledge breadth and typical social capital variables, such as network size and network diversity, are below .2, suggesting that CoPs measure something other than internal networking.
Table 2. Descriptive Statistics and Bivariate Correlations \((n = 329)\)

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<tr>
<th></th>
<th>Mean</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
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<td></td>
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<td></td>
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<td>4. Ties to senior managers</td>
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<td>.13</td>
<td>.06</td>
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<td>.16</td>
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</tr>
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<td>.03</td>
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<td>7. Intrinsic motivation*</td>
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</tr>
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<td>8. Innovation climate*</td>
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<td>.04</td>
<td>.11</td>
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<td>9. Time searching externally</td>
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<td>.04</td>
<td></td>
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<td>12. Seniority</td>
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<td>.51</td>
<td>1</td>
<td>3</td>
<td>.01</td>
<td>.08</td>
<td>.14</td>
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<td>.16</td>
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<td>.03</td>
<td>.03</td>
<td>.02</td>
<td>.33</td>
<td></td>
</tr>
<tr>
<td>13. Headquarters</td>
<td>.64</td>
<td>.48</td>
<td>0</td>
<td>1</td>
<td>.10</td>
<td>.04</td>
<td>.02</td>
<td>.21</td>
<td>.03</td>
<td>.14</td>
<td>.06</td>
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<td>.03</td>
<td>.01</td>
<td>.31</td>
<td>.21</td>
<td></td>
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<tr>
<td>14. Product line significance</td>
<td>.57</td>
<td>.50</td>
<td>0</td>
<td>1</td>
<td>.02</td>
<td>.11</td>
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<td>.14</td>
<td>.11</td>
<td>.08</td>
<td>.01</td>
<td>.02</td>
</tr>
</tbody>
</table>

*a* Mean, SD, Min and Max shown are averages across all items included. Regressions were performed with factor scores with mean 0 and SD 1. Correlations greater than |.097| are significant at 5%.

rather than their attitudes, to capture information on concrete and context-specific outcome variables.

Following implementation of the survey, we formally tested for the presence of common method bias in our data. First, the Harman’s single factor test, including all 55 items in our survey, resulted in 11 factors, the first of which accounted for 18% of the variance. This suggests that common method bias should not be a major concern. Second, using the marker variable technique proposed by Lindell and Whitney (2001), we included in the survey a question about environmental concern at work. According to the theory, this variable should not be correlated with ideation performance or openness, and any correlation detected would be caused by the marker variable and other variables suffering from the same bias. In our case the most likely bias is social desirability. Since the partial correlations among our variables of interest were unchanged when we controlled for the marker variable, we can assume that common method bias is unlikely to be a serious concern in our case.

**Analytical Procedure**

We tested our hypotheses using negative binomial models, which are appropriate if the dependent variable takes the form of an event count—here, the number of ideas generated by an individual. Over dispersion in our data means that negative binomial models fit the data better than Poisson models.\(^9\) However, the nonlinearity of the negative binomial model makes it difficult to interpret the interaction terms, especially since we are interested in assessing the effect of a moderating variable on the curvilinear relationship between the independent variable (openness) and the dependent variable (ideation performance). We therefore follow Zelner (2009) to derive via simulation, the predicted number of new ideas, for different values of each moderator variable, keeping all other variables at their means. We graph the predicted count against the entire range of the openness variable to assess whether the effect of the moderator variable significantly shifts the threshold level for number of external sources in the direction hypothesized.

Finally, we assess the possibility of multicollinearity, which could arise in our model as a result of inclusion of a quadratic term and the interaction terms. We found no significant unexpected shifts in the thresholds caused by backward or forward inclusion of the variables (see Maddala and Lahiri, 2009, in particular Chapter 7). Finally, we tested improvements to the model fit using likelihood ratio tests when adding the interaction effects (with the linear and quadratic terms) to our model.

**Results**

The summary statistics and bivariate correlations of all of our variables are presented in Table 2. On average, the presence of over dispersion in the data, given that the mean of the dependent variable is 2.01 and the variance is 5.42. This can be formally tested by estimating a negative binomial model and then testing for the significance of a parameter α which reflects unobserved heterogeneity among observations. The log-likelihood ratio test for α = 0 in the model provides strong evidence of over dispersion (χ² = 165.92, p = .000).

\(^9\) A goodness-of-fit test comparing the Poisson predictions for a model equivalent to model 1 in Table 3 indicated that the Poisson model fits very poorly (χ² = 827.57, p = .000). The poor fit of the Poisson might be due to...
individuals in our sample had experienced two ideas progressing to the implementation stage, engaged with six different external sources of knowledge, and spent 22% of their time searching externally, indicating that external search is common in our sample. Finally, for 65% of senior R&D staff, the outcomes of their R&D efforts are expected to reach the market in more than two years.

Table 3 reports the results of the negative binomial regression analysis. Model 1 is the baseline model and includes only the control variables. Model 2 introduces

### Table 3. Negative Binomial Models for Ideation Performance (n = 329)

<table>
<thead>
<tr>
<th></th>
<th>1</th>
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<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
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<tbody>
<tr>
<td>Extrinsic motivation</td>
<td>.066</td>
<td>.076</td>
<td>.078</td>
<td>.076</td>
<td>.075</td>
<td>.077</td>
</tr>
<tr>
<td>Intrinsic motivation</td>
<td>−.089</td>
<td>−.082</td>
<td>−.079</td>
<td>−.084</td>
<td>−.082</td>
<td>−.08</td>
</tr>
<tr>
<td>Time searching externally</td>
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<td>.001</td>
<td>.001</td>
<td>.000</td>
<td>.001</td>
<td>.001</td>
</tr>
<tr>
<td>Innovation climate</td>
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<td>.073</td>
<td>.072</td>
<td>.070</td>
<td>.069</td>
<td>.066</td>
</tr>
<tr>
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<td>.119</td>
<td>.136</td>
<td>.124</td>
<td>.111</td>
<td>.132</td>
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<td>.011</td>
<td>.022</td>
<td>.008</td>
<td>.041</td>
<td>.042</td>
</tr>
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<td>−.006</td>
<td>−.006</td>
<td>−.006</td>
<td>−.006</td>
<td>−.006</td>
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<td>−.016</td>
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<td>−.147</td>
<td>−.129</td>
<td>−.158</td>
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<td>Time horizon</td>
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<td>−.208</td>
<td>−.112</td>
<td>−.131</td>
<td>−.193</td>
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<tr>
<td>Ties to senior managers</td>
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<td>.117</td>
<td>.101</td>
<td>.115</td>
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<td>.038</td>
</tr>
<tr>
<td>Knowledge breadth</td>
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<td>.117</td>
<td>.114</td>
<td>.079</td>
<td>.115</td>
<td>.075</td>
</tr>
<tr>
<td>Openness</td>
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<td>.216</td>
<td>.022</td>
<td>0</td>
<td>.161</td>
<td>.074</td>
</tr>
<tr>
<td>Openness squared</td>
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<td>−.218</td>
<td>−.12</td>
<td>−.115</td>
<td>−.189</td>
<td>−.056</td>
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<tr>
<td>Openness x time horizon</td>
<td>−.259</td>
<td>.058</td>
<td>.056</td>
<td>.058</td>
<td>.058</td>
<td>.071</td>
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<td>Openness squared x time horizon</td>
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<td>Openness x ties to senior managers</td>
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<td>Openness x knowledge breadth</td>
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<td>−.018</td>
<td>−.018</td>
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<tr>
<td>Openness squared x knowledge breadth</td>
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<td>1.162</td>
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<td>−617.46</td>
<td>−615.57</td>
<td>−617.17</td>
<td>−615.78</td>
<td>−614.27</td>
</tr>
</tbody>
</table>

* significant at 10%; ** significant at 5%; *** significant at 1%.

* Variable is standardized by subtracting the mean from the value and dividing by the standard deviation.

Robust standard errors for two-tailed tests clustered by seniority. Business units and job function dummies included.
the number of external sources as linear and quadratic terms. Models 3 to 5 include each of the hypothesized moderators separately, to identify their respective contributions to improving the model fit. Model 6 is the full model. Estimates of the baseline model reported in model 1 suggest that individuals who are more extrinsically motivated and perceive their work environment as supportive of their innovative efforts, have greater access to senior managers and broader knowledge, and produce a higher number of ideas that ultimately are selected for further development by the organization. Individuals who are highly intrinsically motivated, and have worked for longer in Neptune, produced fewer ideas that reached the implementation phase. These results for intrinsic and extrinsic motivation are consistent with research that suggests that the effect of motivation on creativity is highly contextual (Eisenberger and Cameron, 1996).

H1 posits an inverted U-shaped relationship between openness and the number of ideas passing through the implementation gate. This is supported by our results: estimates of model 2 show that the linear term is positive and significant ($p < .01$) and the squared term is negative and significant ($p < .01$). Relative to model 1, we observe an increase in the goodness-of-fit of the model as suggested by the log-likelihood ratio test. Using the coefficient estimates of model 2, we plot the number of sources against the predicted rate of ideas generated (see Figure 1) and compute the maximum of the inverted U-curve. We find that negative returns to openness set in if the individual uses more than six different sources. Since almost half of the observations in our sample have values for openness greater than the flexing point at six sources, it is reasonable to assume that our model predicts the presence of negative not just decreasing returns. To test formally for the presence of negative returns, we follow Laursen and Salter (2006) and estimate a model replacing openness with a set of dummies that equal 1 for different cut-off values of the number of external sources used. More precisely, dum0 is equal to 1 if the openness variable ranges between 5 and 9 (the range around the maximum of the curve), and 0 otherwise. The other dummy variables were derived similarly for the following range of values: 0 sources (dum1); 1–4 sources (dum2); and 10–11 sources (dum3). We then estimated a model using all the control and all the dummy variables except dum0 (the reference category). All the dummy variables are negative and significant ($p < .01$), which indicates that—compared to having 5–9 external sources—there is a negative impact for fewer than 5 or more than 9 external sources. This further supports the presence of negative returns predicted in H1.

Our second hypothesis refers to the moderation effect of the time horizon of the individual’s R&D efforts. Consistent with H2, both the interaction terms with the linear term for the openness variable and its squared term are highly significant ($p < .01$), and the inclusion of these two variables improves the model fit significantly. To show the effect of this moderating variable on the openness threshold at which negative returns set in, we graph it using the procedure explained above (Zelner, 2009). Figure 2 shows that—in line with H2—the maximum of the curve describing the relations between openness on ideation, shifts to the right if individuals work mostly on long-term R&D projects (compared to those with a short-term R&D focus). We find also that if individuals’ R&D efforts have a long-term focus, the positive slope of this curve is steeper, and the negative slope is flatter. This suggests that a longer R&D time horizon might amplify the benefits of using a bigger number of external sources...
for ideation, and might dampen the costs of coordinating a large number of different external sources.

Regarding the potential moderation effect of the variable for ties to senior managers, we find that the interaction with the squared term of openness introduced in model 4 is positive and highly significant, but the log-likelihood test indicates there is no improvement in the model fit relative to model 2. Graphical representation of the effect (Figure 3) suggests that H3 is not supported. Access to senior managers increases the marginal effect of openness on ideation performance (i.e., curve shifts upward) without changing the level at which the marginal impact of openness on ideation becomes negative (curve does not shift to left or right). In other words, ties to senior managers increase individuals’ ideation performance but do not enable them to take advantage of a higher number of external sources of knowledge.\(^\text{10}\)

H4 concerns the interaction between openness and knowledge breadth. Consistent with this hypothesis, we find that knowledge breadth significantly moderates the relation between openness and ideation; both interaction terms are significant in the full model and the goodness-of-fit of model 4 is improved relative to model 2. However, Figure 4 indicates that, contrary to our predictions, the moderation effect of knowledge breadth does not shift the openness threshold when negative returns set in but only affects its slope. Increased breadth of individual knowledge flattens both the upward and downward parts of the inverted U-shaped curve describing the relation between individual-level openness and ideation performance. This suggests that, relative to individuals specialized in a limited number of knowledge fields, individuals with broad expertise are able to more easily benefit from a low number of external sources while also experiencing a dampened negative impact of having a large number of different external sources.

**Implications and Conclusion**

**Discussion of Results**

The shift toward open innovation in many large organizations is creating opportunities as well as challenges for professionals working in R&D. This paper contributes to our understanding of the costs and benefits of openness, and its implications for ideation. Allen (1977) suggests that individuals working in R&D operate in an “open system,” drawing ideas from a range of external sources. Accessing external knowledge from numerous different types of sources may provide individuals with access to richer and more diverse knowledge, allowing them to create new combinations of internal and external knowledge elements. However, external search incurs costs. It requires effort and time to engage effectively with external ideas and turn their latent potential into something of use and value to the organization (Cohen and Levinthal, 1990). Although external search has long been recognized as beneficial for both individuals and organizations, few studies explore the costs and benefits to individuals of openness, or examine the critical factors moderating this relationship.

We analyzed 329 R&D scientists and engineers working for a major international organization and found

\(^{10}\) To further explore this result, we experimented with alternative measures of ties to senior managers. First, we derived a measure that weights the ties with managers by their communication frequencies. Second, we derived a measure of the number of strong ties to managers using different cut-off points for the frequency of interaction. Neither of these approaches yielded a significant result for the interaction term, although the main effect of openness and openness squared remained.
strong evidence that openness to external sources can have significant benefits for the ability of individuals to generate new and valuable ideas for their organization. By being open, individuals benefit from variety and alertness, making them better prepared to develop new, valuable ideas for their organization. However, we found also that the integration and approval costs associated with coordinating inputs from a large number and type of external sources produces negative returns to openness. We provide evidence of organizational and individual-level moderators of the effect of individual-level openness on ideation.

Contributions to Theory

Our study makes two contributions to the literature on the management and organization of innovative efforts. First, we have provided evidence of a link between individual-level openness and idea generation, and shown that the relationship is curvilinear. That is, since openness to external sources can increase individual alertness to market or technological opportunities and gives access to a larger variety of knowledge on which to draw to build new ideas, higher levels of openness increase performance in developing innovative ideas for the organization. However, we also found evidence of a threshold to openness after which individual-level returns become negative due to (nonlinearly) increasing coordination costs associated with the use of diverse sets of external knowledge. We found that individuals with large numbers of different types of external sources of knowledge experience disproportionate integration costs arising from the cognitive efforts associated with coordinating knowledge from disparate sources, and the approval costs related to external engagement.

These mechanisms add to our understanding of the costs and benefits of openness, for individuals and for their organizations. In particular, our study reveals some of the coordination challenges posed by high levels of openness, discussed in Koput (1997) and Laursen and Salter (2006). It highlights the internal problems related to coordinating external collaboration within IP constraints, which may shape the nature of individual and organizational search efforts. It suggests that as well as having to find a balance between time spent on internal and external search (Dahlander et al., 2012), individuals “open to ideation” face the challenge of coordinating disparate knowledge inputs and managing various types of partnerships in a way that benefits the firm. These insights extend the literature on open innovation by explicating the effects of individual-level coordination costs of openness and the effect on performance outcomes. Our results are consistent with firm-level and project-level studies on the decreasing returns from openness (Laursen and Salter, 2006; Leiponen and Helfat, 2010; Salge et al., 2012). In our sample, a significant proportion of individuals would appear to be “too open,” resulting in an inability to generate as many useful or valuable ideas as generated by colleagues with a more balanced approach to openness. While we cannot say for certain whether it is the individuals’ conscious choice to be overly open, or whether this outcome has been triggered by their job function, this finding suggests that organizational attempts to encourage, support, and train R&D staff to be more open need careful management. Too broad a range of external sources of knowledge may lower the potential for ideation. Openness can be considered a useful tool if contained and managed.

Our second contribution lies in showing that the individual’s organizational context, network resources, and knowledge breadth shape the value of openness. Individuals who work on short-term, near-to-market products, processes, and technologies gain less from openness than those who focus on long-term efforts, and experience more rapidly occurring negative effects of openness. In turn, this suggests that openness to a broad range of external sources in fast-paced environments may be more costly for individuals than narrow, more directed external search. This result is consistent with Laursen’s (2006) suggestion that the organizational benefits of narrow or directed use of external sources are greater for more radical innovations, which are often longer term in nature, than for more incremental near-to-market innovative efforts. We found no support for our prediction that ties to senior managers alleviate integration and approval costs. Although we would argue that connections with senior managers may give individual R&D scientists and engineers privileged access to advice on where in the organization to apply the external knowledge, and may increase the chances of approval for establishing new partnerships, our results show little support for the idea that individuals with ties to senior managers are better able to manage a higher number of external knowledge sources than those without such connections.

Finally, we found that knowledge breadth is associated with more benefits and lower costs of openness. Knowledge breadth appears to allow individuals with greater cognitive capacity to take advantage of openness, which suggests that being active in different areas of technology or knowledge may provide gains from engagement with external sources. It suggests that a broader knowledge base allows the individual to cope better with the prob-
lems associated with partnering with a large number of knowledge sources, and in particular decreases the coordination costs associated with integration. Knowledge breadth is an essential component of individual-level absorptive capacity required to benefit from open innovation activities (Lewin, Massini, and Peeters, 2011; Volberda, Foss, and Lyles, 2010). However, breadth of knowledge does not appear to change the threshold level at which openness turns negative, suggesting that the integration capability based on knowledge breadth is conceptually distinct from other dimensions of the coordination costs. Thus, also individuals with broad expertise may lose from being too open due to the integration and approval costs incurred.

**Limitations, Suggestions for Future Research, and Conclusions**

This research has several important limitations which point to directions for future research. First, our sample is comprised of individuals working in a single organization, which limits the generalizability of our results to other organizational settings. Although Neptune is a large company composed of many, fairly autonomous units, all are subject to the same human resources and IP policies. Thus, we cannot show whether different knowledge governance mechanisms might enable or reduce organizations’ abilities to gain from openness (Foss, Laursen, and Pedersen, 2011). Study of a larger number of organizations and their employees would add to our understanding of whether the costs and benefits of openness found in this study apply more widely. In a different research setting, Dahlander et al. (2012) find positive returns to individual-level openness. More empirical research in different industrial contexts and organizations of different sizes is needed to confirm these findings.

Second, although our list of external sources was fairly comprehensive, we captured only information on the frequency of individual engagement with a broad range of different types of knowledge sources, not their interaction with the multiple actors associated with each type of source. Indeed, it is likely that engaging with multiple partners in each search channel may reduce the benefits of openness by increasing coordination costs even more. We also lack information on the depth of individual interaction with each of these sources. Future research should develop more refined scales of individual-level openness that capture richer information on the individual’s number of relationships within each search channel and the depth of their engagement with each of these external actors.

Third, since we sought to capture new and valuable ideas, our measure of ideation is based on ideas that progressed to an advanced stage in the organization’s stage-gate process. It may be that ideas based on external sources are discontinued before this stage; we were not able to observe the full range of ideas based on an individual’s search efforts. It might be that internal actors “spike” these ideas earlier because they go against established ways of working (Katz and Allen, 1982). We also were unable to test whether ideas that reached the implementation gate ultimately were developed into innovations, because our cross-sectional research design did not allow us to follow ideas through to the end of their life. A study that focused on ideas at different stages in the innovation development process would help to enrich our understanding of the impact of openness on the innovation process.

Fourth, although we explored the effects of ties to senior managers on the value of openness to individuals, this account only partially for the social capital advantages that individuals may reap from different network activities within the wider organization. Future research could look in more depth at networks and openness, and explore how internal and external networks together shape the ability of individuals to gain from openness. We acknowledge that our measure of networks is partial and incomplete and further work is required on how networks shape the benefits of openness. Research that combines measures of individual openness with data on individuals’ structural positions in intra- and interorganizational networks might provide deeper insights into how social capital enables individuals to profit (or lose) from openness.

Finally, it is difficult in a cross-sectional study to establish the definite and directional causal structure between the dependent and independent variables. Research based on panel data and a lagged variable model, repeatedly measuring openness and ideation, might help to reveal the underlying causal structure of this relationship. Such future research might further eliminate remaining concerns related to common method bias inherent in our single-source study. Future research should try to rely on a dependent variable based on objective performance data.

Despite these limitations, our study contributes to a richer understanding of the nature of openness and how openness shapes individual and organizational outcomes. By capturing individual-level openness and theorizing about its costs and benefits to individuals, we shed light on how external knowledge can be harnessed by individuals and organizations to support ideation and innovation.
In explaining the costs and benefits of openness for ideation, and the organizational and individual moderators of this relationship, this paper provides further insights into the complexity, intangibility, and salience of openness.

References


