R&D MANAGEMENT

Individual performance in a coopetitive R&D alliance: motivation, opportunity and ability

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This study examines individual knowledge sharing in a coopetitive R&D alliance. R&D is increasingly carried out in an R&D alliance setting, where individuals share highly specialized tacit knowledge crossing firm boundaries. A particular challenging setting is the coopetitive R&D alliance, where partner firms partially compete and individuals may leak competitive knowledge. This setting has been studied on the level of the partner firm. We want to deepen insights by examining the individual level. Drawing on the motivation-opportunity-ability framework, we study the influence of individuals' job experience (ability) on their performance in the alliance. We also examine effects of two- and three-way interactions between job experience, a central position in the social alliance network (opportunity) and intrinsic and extrinsic motivation. We find a positive association of job experience with individual performance, a positive interaction between job experience and extrinsic motivation and a positive three-way interaction between job experience, central network position and intrinsic motivation, and discuss the impact of these findings.

1. Introduction

Breakthrough innovations ask for the creation of new knowledge out of highly specialized tacit knowledge of different people. Increasingly, people collaborate in interorganizational settings, like R&D alliances. Thus, progressively the R&D management has to deal with the management of R&D alliances. Crucial part is the sharing of knowledge crossing firm boundaries (Sampson, 2007; Li et al., 2012; Martinez-Noya and Narula, 2018). A particular challenging setting is the coopetitive R&D alliance, in which cooperating partners are also partially competitors. While in a cooperative R&D alliance setting partners may hesitate to share knowledge with 'strangers' (other partners), in a coopetitive setting it may even be dangerous as a partner can leak competitively damaging knowledge (Li et al., 2012; Martinez-Noya and Narula, 2018).

Knowledge sharing in such coopetitive setting really deviates from the intrafirm setting. It has been studied at the level of the partner firms (Tsai, 2002; Sampson, 2007), but not on the individual level, although knowledge sharing is pre-eminently an action among individuals. The coopetitive setting will likely be of influence of the individual knowledge sharing, but it has not been studied yet (Tasselli et al., 2015). By studying individual knowledge sharing in a coopetitive R&D alliance, we aim to deepen the understanding of knowledge sharing at the alliance level and ultimately the performance of R&D alliances as it often falls short of expectations (Ernst et al., 2011).

Focusing on individual knowledge sharing in a coopetitive R&D alliance and building on the motivation-opportunity-ability (MOA) framework (Blumberg and Pringle, 1982; Siemsen et al., 2008; Reinholt et al., 2011), we examine the influence of job experience (ability), social network position (opportunity) and intrinsic and extrinsic motivation on Individual Alliance-related Work Performance (IAWP), the individual's behaviours or actions that are relevant to the goal of the R&D alliance (Campbell, 1990). We consider IAWP as one of the most important outcomes of individual knowledge sharing. We address the following research questions: (1) What is the influence of ability, opportunity and motivational factors on IAWP in a coopetitive R&D alliance, and, (2) what are the performance effects of the interactions among these factors?

Despite new work challenges in an R&D alliance, we assume that the performance of alliance members is primarily based on their job experience in the respective firms. The effectiveness of this ability depends on the individuals' contextual information about the importance of their actions to the alliance goals. A central position in the alliance social network enables an individual to acquire this contextual information. We further explore the role of intrinsic and extrinsic motivation of the alliance members to share knowledge, as this knowledge sharing is not self-evident in the coopetitive setting due to pressures of each of the partner firms to share some (alliance-related) but not all of the firm's sensitive and valuable knowledge.

In our study, we slightly adapt the MOA framework to ensure that we can relate it to the alliance (Martinez-Noya and Narula, 2018), social network (Tasselli et al., 2015), absorptive capacity (Cohen and Levinthal, 1990) and individual work performance literatures (Foss et al., 2011). We find that the main idea of the MOA framework can be confirmed for the coopetitive R&D alliance setting, but we also have some remarkable outcomes. In particular, we find different roles of intrinsic and extrinsic motivation. The findings from this study lead to a better understanding of knowledge-creating behaviour in coopetitive R&D alliances, ultimately leading to better knowledge creation outcomes on the R&D alliance level as well (Foss et al., 2010).

2. Theoretical background

2.1. Knowledge sharing in R&D alliances

R&D alliances have become a crucial part of R&D management (Cassiman and Veugelers, 2006). R&D alliances are defined as innovation-based relationships formed by two or more partners who pool their resources and coordinate their activities to reach a common goal (Martinez-Noya and Narula, 2018). They may include horizontal collaborations (among competitors), vertical collaborations (with suppliers or customers) and institutional collaborations (with universities and research institutes) (Belderbos et al., 2004). And, as we will see in our empirical setting, collaborations can also be partially horizontal and partially institutional.

Knowledge sharing is one of the key operations in R&D alliances to meet the common alliance goal (Sampson, 2007). In general, innovation-based activities require the exchange of highly specialized tacit knowledge, in case of an R&D alliance this knowledge must be exchanged crossing firm boundaries. We will examine individual knowledge sharing in a coopetitive R&D alliance. While crossing firm boundaries will in any case be a hurdle for knowledge sharing, this holds in particular for the coopetitive alliance setting where partners not only cooperate but also compete. In such setting, it may even be dangerous to share knowledge among partner firms as the value of the firms' knowledge resources may erode due to unintended sharing of highly competitive knowledge (Sampson, 2007, p. 364). Such coopetitive setting has been described by Gulati and Singh (1998) and empirically analysed by Sampson (2007) on competing firm level and by Tsai (2002) on competing unit level. Following calls of Foss et al. (2010) and Tasselli et al. (2015), we conduct an individual-level study as knowledge sharing is particularly an action between individuals and, therefore, mechanisms that are found on the level of the alliance may well be rooted in and better understood by factors on individual level. Moreover, following suggestions of Tasselli et al. (2015), we also examine the role of motivation to share knowledge. In short, we will build on the MOA framework which is explained below.

2.2. Motivation-opportunity-ability (MOA) framework

Already in 1982, Blumberg and Pringle tried to cover all known antecedents of individual work performance in one framework, consisting of three elements: ability, opportunity, and willingness or motivation (Blumberg and Pringle, 1982). They claim that individual work performance can only be realized when all three elements ability, opportunity and willingness/ motivation are present to some degree, in terms of Siemsen et al. (2008) moderate complementarity among the elements is required. The MOA framework has been broadly used by academics to structure antecedents of individual work performance and to explain it. Most recently, the model has been used to explain knowledge sharing (Siemsen et al., 2008; Rheinholt et al., 2011). We will also use it in this way, but examine individual alliance-related performance as the outcome variable. Although the MOA framework is conceptually well established for its intuitively natural explanation of work performance, it also has been criticized for the lack of empirical validation of its multiplicative character (Terborg, 1977; Siemsen et al., 2008). We will come back to this matter in the discussion section.

We define individual alliance-related work performance (IAWP) as the individual's behaviours or actions that are relevant to the goal of the R&D alliance (Campbell, 1990). Ability refers to the psychological and cognitive abilities of an individual to perform a task. In this study, ability is reflected by job experience, or the knowledge and capabilities an individual gained from work in an organization, and in a specific job.

Opportunity concerns the non-controllable forces surrounding a person that enable or constrain the person's work performance. While opportunity may include a lot of situational variables, the common idea is that individuals' direct access to knowledge that others possess is captured by the opportunity concept. Social network literature suggests that this is best reflected in the central position of the individual in the (alliance) social network (Cross and Cummings, 2004; Reinholt et al., 2011, p. 1285). If individuals have such direct contact or access, they have much opportunity to engage in knowledge sharing. Motivation regards the psychological characteristics leading to an individual's inclination to perform a particular task such as knowledge sharing (Reinholt et al., 2011). In this study, we will examine both intrinsic and extrinsic motivation. We will explain these concepts when we develop the hypotheses with support of the MOA framework.

3. Hypotheses

3.1. Ability (job experience) and IAWP

A large number of studies in the individual work performance literature found a positive impact of job experience on work performance in a within-firm setting (e.g. Ree et al., 1995). While (coopetitive) alliance members face a new and more challenging setting, they need the capability or knowledge of their own to engage in knowledge exchange. Having experience in their jobs they have an understanding of important, job-specific knowledge that allows them to not just do their own jobs well, but also have a better understanding of what an alliance member's knowledge contributes to their own. Moreover, people with job experience may be less anxious in the new situation constituted by the (coopetitive) R&D alliance context, drawing upon their previously acquired knowledge and skills (Warr and Bunce, 1995), which in turn positively influence their work performances. We therefore hypothesize:

H1: *An individual's Ability (job experience) is positively associated with their IAWP.*

3.2. Moderator: opportunity (position in formal R&D alliance network) enhancing ability?

Social network literature has extensively studied the interactions and exchange of knowledge between individuals, but mostly in a within-firm setting (Dolfsma and Leenders, 2016). The knowledge exchange in the coopetitive setting will probably be different. In social network literature, a distinction is made between formal and informal social networks. We focus here on the formal network, as we expect it to be more powerful in the coopetitive setting with its appropriability concerns. The formal network is the formally prescribed set of interdependencies between actors (members of the alliance) set forth in job descriptions and reporting relationships (Mehra et al., 2001; Aalbers et al., 2014; McEvily et al., 2017).

Individuals with different network positions in the formal network have different levels of access to other individuals and the knowledge they have. According to social network theory, a more favourable and in particular a more central position, implying more contacts involved in, allows an individual alliance member to access more knowledge and also gather the other individuals' interpretations of the alliance's goals, each of the alliance organizations' interests, as well as time horizons, priorities and core values; the organizational and technical opportunities

and constraints of the current alliance project is thus better understood (Nahapiet and Ghoshal, 1998). As the information and knowledge obtained through the formal network comes from mandated connections, it can be safely used in the coopetitive setting. Having a better view on the 'big picture' (Schönrok, 2010) gives the individuals the opportunity to better deploy their job experience. From an absorptive capacity perspective (Cohen and Levinthal, 1990), it can be argued that people with a central position in the formal network have substantial access to new knowledge that they can assimilate (if they are able to) and apply it to their own benefit. We hypothesize:

H2: *The relation between an individual's Ability (job experience) and their IAWP is positively moderated by the individual's Opportunity to exchange (position in the formal alliance network).*

3.3. Second moderation: motivation enhancing ability?

When individuals in an R&D alliance have the motivation to use their ability to perform, this may be expected to enhance their IAWP. We will consider both intrinsic and extrinsic motivation. Intrinsic motivation indicates the pleasure and inherent satisfaction derived from an activity (i.e. sharing knowledge), the activity is valued for its own sake. Extrinsic motivation focuses on the goal-driven reasons, such as rewards or benefits earned from performing an activity (i.e. sharing knowledge) (Osterloh and Frey, 2000; Lin, 2007; Escobar et al., 2017).

Alliance members with high-level intrinsic motivation for knowledge sharing enjoy the process of knowledge exchange in the R&D alliance: exchanging (complementary) knowledge can be stimulating. So, they will be more involved in learning from others (Vallerand and Bissonnette, 1992; Amabile, 1993), especially the understanding about the context as well as concrete tasks to carry out and goals to realize. This can inspire them to use their capacity in a more effective way.

At the same time, however, it can be quite difficult to establish the trust required to act within the relatively short time frame of an R&D alliance. This particularly holds for the coopetitive setting where appropriability issues are of importance. Then playing into people's extrinsic motivation to share knowledge in the alliance is also important. Individuals from both alliance partners, as sender and recipient, may also, or perhaps even mostly, exchange knowledge when they receive a material reward, such as a promotion or a bonus. They may be concerned with the value of the exchanged knowledge not so much because of how useful it might be for their exchange partner, but because how its exchange will benefit to use their ability in a more effective way. We thus hypothesize:

H3a: *An individual's intrinsic motivation positively moderates the relation between Ability (job experience) and their IAWP.*

H3b: *An individual's extrinsic motivation positively moderates the relation between Ability (job experience) and their IAWP.*

3.4. Double moderation: motivation enhancing opportunity?

Although knowledge sharing is mandated in the alliance formal network, it may be impossible for management to identify and sanction alliance members for holding back from exchanging their tacit or even explicit knowledge (Osterloh and Frey, 2000). In the knowledge-intensive setting of an R&D alliance, much knowledge is tacit. Thus, individuals might exchange the knowledge they are instructed to exchange in such a way that it becomes difficult to be interpreted and used over time because, for instance, it is presented in parts.

Therefore, individuals who are intrinsically motivated might be more likely to be involved in sharing more knowledge in a manner that is beneficial to their exchange partner (Constant et al., 1996; Lin, 2007). They may overcome their reluctance due to appropriability concerns in the coopetitive setting or because alliance partners are not well known, to use the opportunities they have to share (tacit) knowledge (Li et al., 2012).

Alliance members may as well be extrinsically motivated to share some of the (tacit) knowledge in the coopetitive R&D alliance, even when they otherwise may not be inclined to do so. They can be persuaded to overcome their inclination not to share tacit knowledge, to exploit the opportunities they have because of the central position in the formal alliance network to exchange their knowledge, making more effective use of their ability. We hypothesize:

H4a: *An individual's intrinsic motivation positively moderates the moderating effect of Opportunity (central position of the individual in the formal alliance network) on the relation between Ability (job experience) and IAWP.*

H4b: *An individual's extrinsic motivation positively moderates the moderating effect of Opportunity*

(central position of the individual in the formal alliance network on the relation between Ability (job experience) and IAWP.

4. Method

4.1. Organizational settings

We collected data about individuals active in an alliance between a company developing and producing fuel cells in China (the Company) and a research organization focusing on chemical physics and in particular fuel cell research and development (the Institute).

The Company, leading in the development and commercialization of fuel cells, is founded in 2001 and by now employs 150 individuals. It has a unit structure with intensive cooperation between the units. To obtain in-depth research-based knowledge to advance its products, the Company allied with the Institute. The Institute, founded in1961, is famous in China for its research in chemical physics. It is structured in divisions. The fuel cell division employs 50 scientists. In addition to basic research, this division also makes innovative breakthroughs in fuel cells and at the time of collection of data held 25 highly influential patents.

The R&D alliance (the Alliance) focuses on fuel cell technology development and application. It consists of several projects coordinated by project leaders and directors from the Company and the Institute. To monitor the progress of the projects, there are regular meetings between alliance members. Besides the project work, there are personnel trainings, technology consulting, prototype testing and regular seminars about recent developments in the forefront of the relevant technology.

We can classify this R&D alliance in terms of Luo (2007) as 'adapting', having a moderate-to-high need for cooperation and a moderate-to-high need for competition. The need for cooperation is rooted in the Company's desire to advance their products into a more science-based direction, making use of newest scientific ideas in chemical physics that it could not develop itself as a relatively new, resource-constrained firm. But both partners also compete for patents and governmental funding regarding fuel cell technology development. Both partners also are engaged in multiple alliances – knowledge leaking unintentionally from the focal alliance can be used in other alliances on both sides helping either competitors for government research grants or competitors in the market. Although we only face here a moderate level of coopetition, managers from both partners emphasized in their introductory interviews that they see the other partner as a competitor, so they clearly perceive the R&D alliance as coopetitive. It is well known that such perceptions are leading in the respondents' decision-making processes (Song and Parry, 1997).

4.2. Data collection

We conducted survey research. Data on IAWP were collected from the two alliance directors from the Company and the Institute. Data on the formal alliance network, and intrinsic and extrinsic motivation were collected from the alliance members. This study used snowball sampling, which is especially useful if the population is not clear from the beginning, when, for example, the population crosses firm boundaries (Marsden, 1990, 2002; Aalbers et al., 2014). The required sample emerges in several rounds of surveying. Respondents in one round give information whom should be approached in a next round. This process repeats until the key respondents are sampled. We obtained the high response rate, required for this type of network study, in three rounds (97% at the Company, 100% at the Institute). The total respondents within the Alliance participating in the formal alliance network are 66, the formal alliance network consists of 312 knowledge transfer ties. While 66 observations may appear a small number, former studies also analysed networks of such size providing robust outcomes (Albrecht and Hall, 1991; Costenbader and Valente, 2003; Aalbers et al., 2014).

The invitation to participate in the survey was distributed by the two alliance directors with an email to each of the alliance members, accompanied by an introduction of the survey and the hyperlink to the online survey. The online survey included well-validated existing measurement scales that have often been used in the literature. Therefore, we did not pretest the survey. The original survey was developed in English. We translated it to Chinese making use of the parallel translation method of Adler (1983) and Sekaran (1983) to allow all people of the Alliance to complete it. The network data were collected by making use of a validated name generator query. This is a typical and well-validated survey method for gathering social network data (Sparrowe et al., 2001; Aalbers et al., 2014). Via this name generator query, the names of individuals are elicited with whom a particular individual has direct contact (Burt, 1984; Marsden, 1990). In the query, the type of contact is specified.

4.3. Measurements

4.3.1. Dependent variable

Individual alliance-related work performance (IAWP) was measured by means of a 7-point Likert-type scale in ascending order, which means the higher the rating, the better the performance. IAWP includes five dimensions: individual work quality, efficiency, innovativeness, knowledge and interpersonal capability (Cross and Cummings, 2004; Stewart et al., 2012). The five dimensions are significant for indicating one's work performance in general, but also particularly in the R&D alliance. In such a knowledge-intensive setting members cannot develop breakthrough technologies without knowledge, quality and innovativeness. Moreover, for the Alliance time-to-market is very important to be able to compete with rivals, thus work efficiency is an important dimension. Finally, especially in an alliance knowledge must actually be shared which asks for interpersonal capability of the alliance members.

We purified the measurement scale of IAWP by performing an exploratory factor analysis using principle component analysis. Standardized factor loadings are presented in Table 1. Also the wordings of the survey questions for this scale can be found in Table 1.

4.3.2. Independent variable

Job experience has been measured by the number of months of the alliance member working in a specific field in the Company or the Institute.

4.3.3. Moderating variables

The formal alliance network variable was determined by the use of the aforementioned name generator question. We asked each individual who are the key people within the Alliance with whom he or she is supposed to discuss ideas or solutions at work (Mehra et al., 2001; Aalbers et al., 2014). We provided a guideline of naming seven alliance members to make sure that only the most important contacts per member were mentioned. Further contacts could be added, however. To measure the central position of an alliance member in the formal alliance network, we calculated the degree centrality as a centrality index, using Ucinet 6.0 (Freeman, 1979; Borgatti et al., 2002). *Degree centrality*, the number of direct contacts an actor has (Freeman, 1979; Cross and Cummings, 2004; Balkundi and Harrison, 2006) is the most commonly used index to describe an individual's direct contact-based network position.

Intrinsic and extrinsic motivation were measured by a 7-point Likert-type scale with four and six items, respectively. They were based on Amabile et al. (1994), and Lin (2007). In particular, we used one item of the 'Enjoyment in helping others' (sub) scale from Lin (2007) to measure intrinsic motivation, as well as one item from the 'Attitude towards knowledge sharing' (sub)scale and two items from the 'Knowledge sharing intentions' (sub)scale. Moreover, we used three items from the 'Expected organizational rewards' (sub)scale and three items from the 'Reciprocal benefits' (sub)scale from Lin (2007) to measure extrinsic motivation. We also performed an exploratory factor analysis on the intrinsic and extrinsic motivation scales. See Table 2 for the results and the wording of the items.

4.4. Control variables

We control for job title and rank. *Job title* was measured by a dummy variable, indicating whether the job concerned administrative or technical support in the Company or the Institute (0) or engineering work in the Company or scientific work in the Institute (1). *Ran*k was measured by a dummy variable indicating whether the individual has a relatively low (1) or high (2) position in the Company or the Institute.

Table 1. Standardized factor loadings and Cronbach's alpha of the dependent variable

Construct item and Cronbach's α	Item wording	Factor loadings
Individual R&D alliance work performance		$\alpha = 0.868$
1	He or she contributed to the alliance with his or her work output quality	0.866
2	He or she contributed to the alliance with his or her work efficiency	0.879
3	He or she contributed to the alliance with his or her innovativeness	0.915
4	He or she contributed to the alliance with his or her job knowledge	0.786
5	He or she contributed to the alliance with interpersonal ability	0.597

Table 2. Standardized factor loadings and Cronbach's alpha of extrinsic and intrinsic motivation

Construct item and Cronbach's α	Item wording	Factor loadings	
Intrinsic motivation		$\alpha = 0.838$	
		F1	F2
1	I enjoy knowledge sharing with colleagues	−0.069	**0.842**
2	Knowledge sharing with other colleagues is (1 = very worthless… 7 = very valuable)	0.079	**0.732**
3	I intend to have knowledge sharing more frequently with colleagues in the future	0.038	**0.874**
4	I will always make an effort to have knowledge sharing with my colleagues	0.061	**0.796**
Extrinsic motivation		$\alpha = 0.901$	
		F1	F2
1	I will receive increased job security from knowledge sharing	**0.704**	0.107
2	I will receive increased promotion opportunities from knowledge sharing	**0.850**	0.046
3	I will attain certain important objectives from knowledge sharing	**0.946**	−0.119
4	I strengthen relations between existing members of the alliance and myself	**0.764**	0.124
5	I expand the scope of my association with other firms' members	0.665	0.137
6	I believe that my future requests for knowledge will be answered	**0.913**	−0.071

Note: Figures in bold exceed 0.7 as a threshold.

4.5. Robustness checks

Before we tested our hypotheses, we checked whether the IAWP scores of the Company director and the Institute director were influenced by the extent of participation of the alliance members. The correlation between IAWP scores and participation appeared to be insignificant ($r = 0.15$, $p = 0.24$). Moreover, we checked whether both directors had the same standard in mind by examining the correlation between IAWP scores and the alliance partner (1 = Company; 2 = Institute). We found a highly significant correlation of 0.49 ($p = 0.00$). So, the Institute director systematically scored its members higher compared to the Company director. Thus, we standardized each member's score within each alliance partner, making the alliance member scores comparable between the partners, assuming that in a fair scoring process the average score of a member in the Company is equal to the average score of a member of the Institute. We used these standardized scores in the regression analysis.

We next examined if the formal alliance network indeed had additional ties compared to the existing partner firm networks. We found a correlation of 0.36 ($P < 0.01$) between degree centralities in the full formal alliance network and the network only based on (new) ties from the other partner. Thus, the full formal alliance network has additional ties.

Finally, we tested if reversed causality between a central position in the formal alliance network and IAWP would influence our outcomes. A Durbin-Wu-Hausman test (Greene, 2012) making use of 2SLS regression with the strength of (new) ties between members of different partners as instrument, showed no inflationary effects ($P < 0.01$).

4.6. Analysis

Descriptive statistics and correlations between variables are presented in Table 3.

Ordinary least squares multiple regression was used to test the hypotheses (Table 4). We took a hierarchical approach involving 66 observations of the formal network. Moreover, we used ridge regression, since despite the mean-centring of the variables in the moderator analysis (Aiken and West, 1991) we still faced multicollinearity in our three-way interaction models. To avoid that we had to use ridge regression and we used it in all models to make them comparable. We first examined the control variables' effects on (standardized) IAWP in model I. Then we added the main factor of job experience to the analysis in model II. Afterwards, in model III the moderating effect of degree centrality in the formal network was examined. In models IV, V and VI, the three-way interactions regarding job experience, degree

Table 3. Descriptive statistics and correlations

	Variable	Mean	Std. dev.	1	2	3	4	5	6
1	Job title	8% (0)	–						
2	Rank	88% (1)	–	0.106					
3	Ability (job experience)	62.940	56.997	0.043	0.508**				
4	Opportunity (degree centrality)	11.748	6.926	0.105	0.415**	0.140			
5	Intrinsic motivation	6.284	0.588	0.066	−0.101	−0.381**	0.066		
6	Extrinsic motivation	5.854	0.966	−0.044	0.008	−0.293*	0.141	0.762**	
7	Individual R&D alliance work performance	5.936	0.692	−0.010	0.481**	0.376**	0.602**	−0.095	−0.052

Note: $N = 66$. */** Significance at 5% and 1%, respectively.

Table 4. Standardized regression coefficient estimates with the dependent variable individual alliance-related work performance

D.V.	I	II	III	IV	V	VI
CVs						
Job title	0.010	0.009	0.016	0.013	0.016	0.015
Rank	0.204***	0.161***	0.124***	0.112**	0.117***	0.111**
IVs						
Ability (Job experience)		0.200***	0.205***	0.196***	0.183***	0.183***
MVs						
Opportunity (Degree centrality)			0.144**	0.135**	0.145**	0.137**
Ability * Opportunity			0.062	0.070†	0.053	0.062
Intrinsic motivation				−0.096*		−0.068*
Extrinsic motivation					−0.101*	−0.069
Opportunity * Intrinsic motivation				−0.041		−0.038
Opportunity * Extrinsic motivation					−0.020	−0.005
Ability * Intrinsic motivation				0.114**		0.073
Ability * Extrinsic motivation					0.135**	0.105**
Ability * Opportunity * Intrinsic motivation				0.087*		0.068*
Ability * Opportunity * Extrinsic motivation					0.059	0.035
N	66	66	66	66	66	66
F-value	4.480*	6.003**	4.827**	3.730**	3.734**	2.667**
R^2	0.176	0.272	0.342	0.443	0.439	0.453
Adjusted R^2	0.140	0.236	0.287	0.354	0.349	0.316
F-test for ΔR^2		6.531*	3.760*	2.658*	2.606*	2.394*

*$P < 0.05$, **$P < 0.01$, ***$P < 0.001$, $^{\dagger}P < 0.1$

centrality and intrinsic or extrinsic motivation were considered. To see whether there exists a crowding out effect of extrinsic motivation, in model IV or V only intrinsic motivation or extrinsic motivation was treated, while in model VI both intrinsic and extrinsic motivation were examined.

5. Results

The multiple regression analyses in Table 4 present the findings with regard to hypotheses. As hypothesis 1 suggests, an individual's job experience significantly enhances their (standardized) IAWP: hypothesis 1 is supported in models II–VI (we found β-values between 0.183, $P < 0.001$ and 0.205, $P < 0.001$). Hypothesis 2 suggests that a central position in the formal network enhances the job experience's effect on (standardized) IAWP: hypothesis 2, however, is not supported in models III–VI: β-values are insignificant. Moreover, intrinsic motivation does not always play a contingent role in exploiting the individual's job experience: hypothesis 3a cannot be unilaterally supported. In model IV (without the additional influence of extrinsic motivation), we find a positive and significant effect for intrinsic motivation moderating job experience of 0.114 ($P < 0.01$), but the β-value of 0.073 in model VI is insignificant again. However, we do find a stable, moderating role of extrinsic motivation on job experience, confirming hypothesis 3b. In models V and VI, the β-values concerning the interaction between job experience and extrinsic motivation are 0.135 ($P < 0.01$) and 0.105 ($P < 0.01$), respectively. The three-way interaction between intrinsic motivation, central position in the formal network and job experience is significant in both models IV and VI (β-values 0.087 ($P < 0.05$) and 0.068 ($P < 0.05$)), while the three-way interaction in case of extrinsic motivation is insignificant in both models V and VI. Thus, there is a moderating role for intrinsic motivation in fully exploiting the central formal network position, but not for extrinsic motivation. A visual representation of the significant interaction effects can be found in Figures 1 and 2 below.

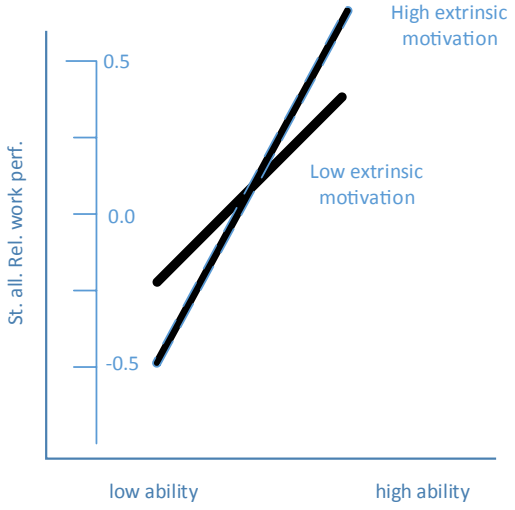

Figure 1. Interaction graph of ability and extrinsic motivation. [Colour figure can be viewed at wileyonlinelibrary.com]

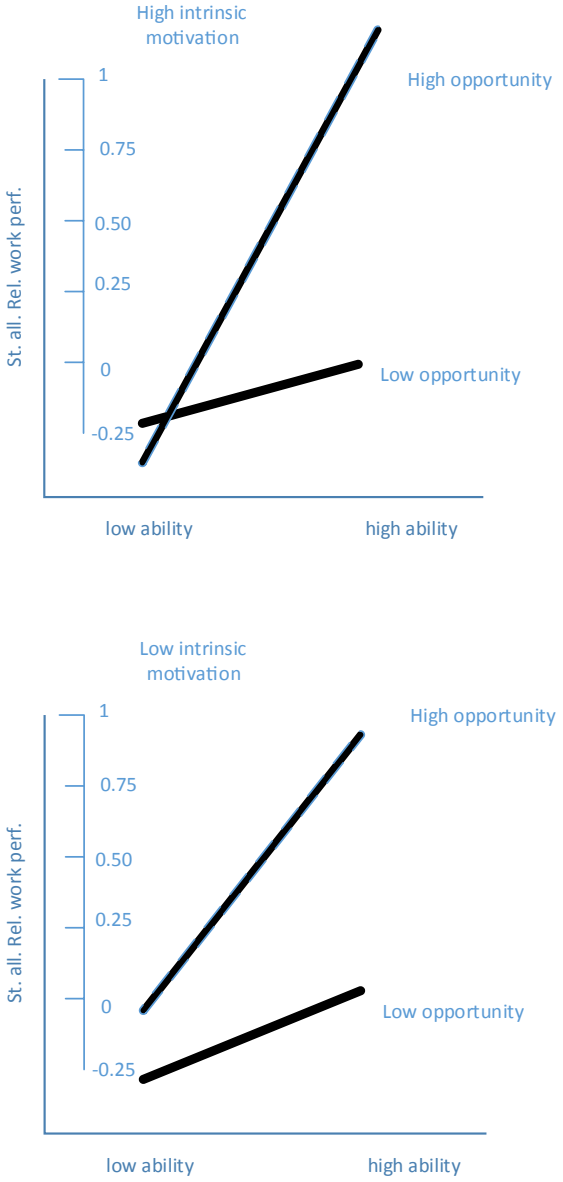

Figure 2. Interaction graphs of ability and opportunity under high vs. low intrinsic motivation. [Colour figure can be viewed at wileyonlinelibrary.com]

With respect to the control variables, our findings show a significantly positive association of rank (hierarchy) with (standardized) IAWP in all models.

6. Discussion

6.1. Theoretical implications

Our study variables and their interactions explain 32% of the work performance of the members of the coopetitive R&D alliance. Our findings show that position in the firm, job experience (ability), and a central position in the formal alliance network (opportunity) positively influence IAWP. Intrinsic

and extrinsic motivation have negative and insignificant impact, respectively. Moreover, interplay between job experience and extrinsic motivation (two-way interaction) has a positive influence on IAWP, as well as the interplay between job experience, a central network position and intrinsic motivation (three-way interaction). These findings largely confirm the (adapted) MOA framework for the coopetitive R&D alliance setting. In line with Rheinholt et al. (2011), but contrary to Siemsen et al. (2008) we do find some evidence for a multiplicative model.

In sum, we find three different paths (positively) impacting IAWP.[1] First, we have a direct path from job experience (ability) and central position in the formal network (opportunity) to IAWP. Moreover, we have the two interplay paths concerning the two-way interaction between job experience and extrinsic motivation and the three-way interaction between job experience, a central network position and intrinsic motivation.

With respect to the direct relationships with IAWP, an individual's knowledge base gives alliance members the ability to cope with the challenges of the coopetitive R&D alliance setting. A central position in the formal alliance network gives particularly knowledge receivers the opportunity to use the knowledge from others at the benefit of their own work performance in the alliance. Note that from a social network perspective, this direct impact of the central position in the formal network is worth mentioning. It is mostly not found in within-firm studies (e.g. Hinds and Kiesler, 1995; Tsai, 2002; Allen et al., 2007). Sharing knowledge requires a climate of trust which needs time and effort in a long-term relationship to establish and is generally not realized in a formal network with mandated contacts (Foss, 2007). But in our coopetitive setting, we found a positive impact probably due to the fact that it is a mandated 'safe' way of dealing with information and knowledge of others. We also find different roles of intrinsic and extrinsic motivation. In former studies, it was generally found that extrinsic motivations play a negative role in knowledge sharing and creation (e.g. Lin, 2007). Here we find a negative influence of intrinsic motivation. This may be due to the coopetitive setting which does not give you much confidence when you are intrinsically motivated to share knowledge that it is allowed and safe to share.

The other two paths to IAWP are interplay paths. We think that the reason that particularly these two paths have significant impact on IAWP can again be explained by the coopetitive setting. In such setting, probably individuals need a kind of formal trigger to share their own knowledge with others. So, these interplay paths are of particular importance to knowledge providers. Without any formal trigger, there is a risk of leaking competitive knowledge when shared. Such formal trigger may include a prospective reward by management, which shows the individual that management formally favours the sharing of knowledge. In that case, the individual may freely use its high ability and its moderate position in the formal network to share knowledge. Another trigger can be the central position in the formal network. That position reflects confidence of management that you do the right things. In combination with a high ability and being intrinsically motivated that knowledge exchange is important, the individual is able to and can safely provide knowledge to other alliance members. In all cases, knowledge providers will also receive knowledge during exchange from people with which they share, while the latter knowledge can be used in the provider's own benefit. Why extrinsic motivation does not stimulate more effective use of the favourable position in the formal network is a subject for future research. Possibly, having the opportunities that many connections offer may make extrinsically motivated individuals who have much knowledge to share perceive they are less unique and less able to leverage their own position.

The reason why other (two-way) interactions are insignificant is of course highly speculative. For the insignificant two-way interactions in which motivation is involved, we look from the perspective of the knowledge provider and suggest that you must be able to provide useful knowledge (ability) and have a kind of formal trigger that you safely can share. That might be the reason of insignificant impacts of opportunity and intrinsic and extrinsic motivation and ability and intrinsic motivation. For the two-way interaction between ability and opportunity, we consider the perspective of the knowledge receiver and suggest that either a central position (combined with moderate ability) or a high ability (combined with a moderate network position) will be enough to advance your own IAWP, so that there is not an increased effect of high ability and a strong network position.

Studying unique and rare data about the internal working of a coopetitive R&D alliance, we are thus able to contribute to the literature on alliances, to the social network literature as well as to the IAWP literature more broadly.

6.2. Managerial implications

This study has important implications for people involved in, or managing an R&D alliance. The main

messages for managers are: first, select the employees from the alliance partners based on their specific job experience that is related to and relevant for the alliance work.

Second, put effort in the development of a formal network with required, mandated interactions between the members of the alliance (also and particularly, between members of different partner firms). Successful R&D collaboration asks for considerable time and effort to organize the work. It is necessary to build comprehensive formal communication channels, involving different ranks of alliance members with divergent specialties, to organize things and solve relevant and specific problems. Knowledge sharing in the formal network can bring in new perspectives or clues for the alliance members solving the alliance-related problems, and it can also help them restructure their own knowledge and increase their creativity. Furthermore, the knowledge sharing with experienced alliance members can be inspirational for noting potential problems more timely, and can enhance forward thinking about technological trends and better solutions based on existing knowledge.

Third, establish appropriate forms, routines and rewarding systems to promote members to exchange knowledge. Inevitably, sharing knowledge to alliance partner refers to the tensions between required knowledge sharing and control over knowledge. Thus, protocols must be established detailing which knowledge can freely be shared and which knowledge is that competitive that it can only be shared within the firm. The rewarding system may strengthen the compliance with these protocols.

Last but not least, for members of the alliance the main message is that for their own sake they should try to get a central position in the formal alliance network, which gives the opportunity to get access to alliance-based contextual knowledge and to be inspired to find solutions for current and potential problems.

6.3. Limitations and (other) future research

We highlight four limitations of our research, and suggest future research directions to address some of these. First, as is the nature of social network analysis, despite the insights generated, this study does not allow for cross-sectional analysis across cases (see Dolfsma and Leenders, 2016; Marsden, 1990, 2002); our findings are based on data from one moderately coopetitive R&D alliance in the field of chemical physics in China. The external validity of the findings in our study can be provided by future research in alliances with higher levels of coopetition, other types of alliances, other industries and other countries. Second, in this study two sources of data collection have been used, alliance managers and alliance members. The advantage is a low likelihood of common method bias (Podsakoff et al., 2003), but it also has disadvantages, as it cannot be ruled out that managers perceive people in their neighbourhood as more important and better at IAWP than people more on a distance. Third, this study makes use of the motivation-opportunity-ability (MOA) framework to explain IAWP. However, there also exist other frameworks. For instance, Siemsen et al. (2008) introduced an interesting constraining factor framework based on the MOA variables. Future research may reveal whether this framework gives better explanations of IAWP than the MOA framework. Moreover, more in-depth qualitative research is required to further clarify the relationships between alliance-internal dynamics found on the individual level and more firm-level dynamics and outcomes. Fourth, our study does not study the alliance-internal social dynamics longitudinally – future research could focus on possible changes in alliance-internal dynamics over time.

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Note

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