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The Relationship between High Performance and Knowledge about How to Master Cooperation Situations

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SUMMARY

This paper applies the expertise approach to cooperation settings and examines high performers' knowledge about cooperation situations. We argue that high performers know more about how to address cooperation situations than do moderate performers. Specifically, we assume that they know more about problem analysis, about how to address the task, the cooperation partner and the cooperation partners' task approach. We report findings of two empirical studies in which study participants responded to scenario situations. The first study based on a sample of 39 software professionals showed that high performers were superior with respect to overall knowledge and specific knowledge aspects. The second study based on a sample of 62 engineers partially replicated these findings. High performers' better knowledge of cooperation situations could not be explained by years of experience or perspective taking. However, situation specific experiences partially accounted for the relationship between performance level and knowledge.

The question of what distinguishes high from moderate performers is one of the core questions of research on expertise (Ericsson and Lehmann, 1996; Ericsson and Smith, 1991a). Empirical studies within this research area showed that high performers possess exceptional domain-specific knowledge and superior problem-solving skills (Groot, 1978; Koubek and Salvendy, 1991; Vessey, 1986). Most of this research is based on the study of individuals meeting domain-specific, mainly cognitive task requirements in individual task settings. However, in modern organizations, the work situation of many professionals is characterized not only by high cognitive but also by high cooperation requirements (Clegg *et al.*, 1996; Keenan and Newton, 1987). In professional areas such as software design, product development, or engineering, many tasks are not any longer accomplished in individual task settings, but in team-based working environments. Thus, for an individual it is not enough to possess domain-specific knowledge and problem-solving

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skills relevant for accomplishing one's individual tasks. It is necessary to cooperate with others, to share information, and to plan one's work process in a larger context.
Until now, the question is still unanswered whether individuals who perform very well with respect to domain-specific task requirements know how to approach the cooperation requirements associated with the tasks they have to accomplish. An empirically based answer to this question is important both for theoretical and practical reasons. First, to advance a theory on expertise (Ericsson and Smith, 1991b) it is crucial to examine whether high performers differ from moderate performers not only with respect to domain-specific knowledge and problem-solving skills typical for individual task settings but also with respect to characteristics relevant for cooperation situations. Second, because high cooperation requirements are present in many professional domains, it is of great practical interest to ensure that individuals showing high performance with respect to the domain-specific task requirements are at the same time able to meet the high cooperation requirements imposed to them. Traditionally, researchers have been sceptical whether excellent performers possess good cooperation skills (Shanteau, 1988; Stein, 1995). If this scepticism was confirmed empirically, organizations would face a difficult problem: individuals highly needed because of their high domain-specific task performance would threaten the team's or department's overall performance when falling short in meeting cooperation demands. As a consequence, alternative staffing decisions or additional training interventions would be necessary.

In this paper, we argue that high task performance is related to knowledge about how to approach cooperation situations. Many researchers have operationalized expertise by years of experience (e.g. Boshuizen and Schmidt, 1992; Jeffries *et al.*, 1981; Patel and Groen, 1991). Recent studies, however, show that long years of experience do not necessarily correlate with high performance. Therefore, we follow the work of Ericsson and his colleagues (Ericsson and Lehmann, 1996; Ericsson and Smith, 1991a) and adopt a performance-based conceptualization of expertise and define an expert as a person who shows high and exceptional performance in a specific domain. In two empirical studies we test whether high performers know more about how to accomplish cooperation tasks. In the second study, we will additionally examine the role of experience and perspective taking.

HIGH TASK PERFORMANCE AND COOPERATION

We assume that high performers know more about how to approach cooperation situations, i.e. they have a more comprehensive representation of how to work together with others effectively and how to deal with difficult cooperation settings such as conflicts. When faced with problems in a cooperation situation they know more about how to overcome these problems. For example, imagine a situation where professionals from different backgrounds have to work together in a project team. Some team members are reluctant to work together and they do not accomplish their tasks at the previously agreed upon time. We assume that a high performer possesses more knowledge about possible solutions for this situation than a moderate performer.

This superior knowledge is due to two processes. First, Ericsson and Lehmann (1996) have argued that high performers show a high adaptation to task requirements and constraints. This implies that in work situations characterized by high cooperation demands, high performers should be superior in addressing and meeting these cooperation demands. For example, in professional domains such as software design or engineering

where cooperation is essential for successful task accomplishment (Ancona and Caldwell, 1992; Kraut and Streeter, 1995), high performers will adapt to the high cooperation demands and will know how to meet the cooperation requirements and constraints associated with the tasks they have to perform. Second, studies in the area of professional software design showed that high performers participated more in work-related communication and cooperation processes such as informal consultations within the team or participation in review meetings (Curtis *et al.*, 1988; Sonnentag, 1995). Compared with moderate performers, high performers were found to be more involved in specific cooperation-related activities, such as helping co-workers and asking them for feedback (Sonnentag *et al.*, 1998). Because of this greater participation in cooperation activities high performers will know better how to approach situations which ask for cooperative task accomplishment.

Hypothesis 1: Compared to moderate performers, high performers know more about how to approach a cooperation situation.

If it turns out that high performers know more about how to address cooperation situations, the question arises to which content areas their knowledge refers to, i.e. *what* they know about how to approach cooperation situations. In the remainder of this section we present a framework of individual action in cooperation situations. We use this framework for deriving more specific hypotheses about high performers' knowledge.

A FRAMEWORK ON INDIVIDUAL ACTIONS IN COOPERATION SITUATIONS

In our framework (see Figure 1), we conceptualize a cooperation situation as a triad comprising as crucial components at least two persons (Person A and Person B) and a task to be performed. We will describe the situation from the perspective of Person A. Based on earlier work on problem solving as well as work on group and cooperation processes (Bales and Strodtbeck, 1951; Lipshitz and Bar-Ilan, 1996; McGrath, 1984) we assume that task accomplishment in a cooperation situation requires various types of actions: (a) analysing the problem; (b) addressing the task directly; (c) addressing the cooperation partner (Person B) by focusing on the interpersonal aspects of the relationship; (d) addressing the way the cooperation partner (Person B) approaches the task.

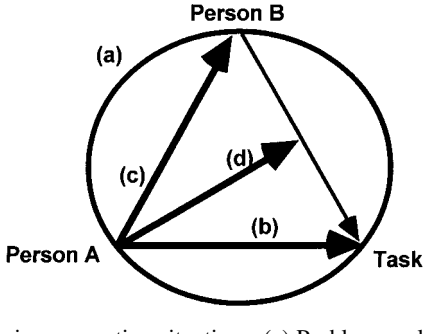

Figure 1. Individual actions in cooperation situations. (a) Problem analysis; (b) addressing the task directly; (c) acting at interpersonal level; (d) addressing cooperation partner's approach to the task

Problem analysis

Problem analysis is a crucial step in problem solving and task accomplishment processes (Frese and Zapf, 1994; Lipshitz and Bar-Ilan, 1996). When confronted with a difficult situation, it is necessary to gather information in order to understand the problem and to develop an adequate problem representation. This representation builds the basis for further actions. In a cooperation situation, problem analysis can refer to various aspects of the situation: the task, the cooperation partner, and the self. For example, an individual can analyse and gather information about the task in order to arrive at a better understanding of the features of the task to be performed. Additionally, the individual might wish to get a better understanding of his or her cooperation partner, his or her idea about the task, motivation or prior experience. Finally, the individual can analyse him- or herself in the given setting by reflecting about own competencies or motivation. Studies suggest that high performers pay more attention to problem analysis than do moderate performers (Klemp and McClelland, 1986; Lesgold *et al.*, 1988). Because problem analysis is essential for deriving further action steps and for initiating successful task accomplishment, we assume that high performers know more about how to analyse the problem.

Hypothesis 2: Compared to moderate performers, high performers know more about problem analysis in cooperation situations.

Addressing the task directly

For achieving a goal and accomplishing a task it is not enough to analyze the problem. It is necessary to approach the task directly. Approaching the task directly corresponds to what Argote and McGrath (1993) called the 'task execution process' and comprises actions of actually generating the work product. Research has shown that high performers have a better knowledge about how to approach tasks and how to make use of successful strategies (Hershey *et al.*, 1990; Isenberg, 1986; Vitalari and Dickson, 1983). This implies that the high performers' way of approaching the task is superior to that of moderate performers. We assume that this is not only the case in situations where tasks are accomplished in an individual setting but also in situations which ask for cooperation.

Hypothesis 3: Compared to moderate performers, high performers know more about how to directly address a task to be accomplished in a cooperation situation.

Addressing the cooperation partner by focusing on the interpersonal aspects of the relationship

In a cooperation situation where a cooperation partner is involved in joined task accomplishment, it is necessary to interact and to address one another at an interpersonal level. These interactions need not be primarily task-related although they might indirectly effect task accomplishment. For example, the individual might start an informal conversation in order to subsequently facilitate exchange of task-related information. Research has shown that high performers participate frequently in cooperation situations (Curtis *et al.*, 1988; Sonnentag, 1995). Because of this frequent participation, they will know that an unfavorable interpersonal situation can impede goal achievement (De Dreu *et al.*, 1999). Moreover, during this frequent participation they have seen ways of how to successfully approach a cooperation partner at an interpersonal level.

Hypothesis 4: Compared to moderate performers, high performers know more about how to address a cooperation partner at an interpersonal level.

Addressing the cooperation partner's task approach

Additionally to actions which focus on the interpersonal level, an individual can directly address the cooperation partner's approach to the task. In a cooperation situation, each person might have own ideas about how to approach a task and specific sub-tasks may be assigned to each person. This implies that in a cooperation triad Person B has his or her own approach to the task irrespective of the Person A's actions. Nevertheless, Person A can have an influence on how Person B approaches the task, for example, by encouraging a specific approach to the task or by adding own ideas the Person B's approach. In general, highly performing professionals have superior approaches for task accomplishment (Curtis *et al.*, 1988; Hershey *et al.*, 1990). Thus, high performers know what to do in a given situation. This implies that they know more about how their cooperation partners should approach the task.

Hypothesis 5: Compared to moderate performers, high performers know more about how a cooperation partner should approach the task.

RATIONALE OF THE STUDIES

To test the hypotheses, we conducted two empirical studies. In both studies, we confronted our study participants with task scenarios requiring cooperation. To assess knowledge, we asked participants what they regarded as the most appropriate actions in the specific scenario situations. We choose such a scenario approach in order to hold the cooperation requirements to be responded to constant for all participants. We conceptualized performance as the independent variable. Knowledge measures were treated as dependent variables.

Within expertise research, it has been argued that long years of experience are crucial for differences between individuals (e.g. Chase and Simon, 1973). Thus, it might be that it is not primarily an individual's performance level, but this person's length of experience which is responsible for knowing what to do in a cooperation situation. To rule out this interpretation, in Study 1, we additionally tested whether the assumed relationship between high performance and knowledge can be accounted for by length of experience. In Study 2, we looked at the effects of experience in more detail. Additionally, we examined the role of perspective taking.

STUDY 1

Methods

Sample

Data were gathered in the context of a larger research project on software design (Sonnentag, 1998). For the present analysis, data from 39 software professionals working in 16 German software development teams from 13 companies were available. Typical products to be developed by these teams included information and communication systems, software for logistic and process control purposes, and an expert system. Participants had an average professional experience of 6.9 years ($SD = 2.9$). Participants'

average age was 33.7 years ($SD = 5.2$). Sixty-nine per cent of the participants were male. Software professionals received a payment for participation in the research project (for details about the selection procedure cf. Sonnentag, 1998).

Scenario situations
On the basis of critical incidents reported by software professionals in a previous study (Brodbeck and Frese, 1994) we developed five cooperation scenarios which we presented to the participants. Typical examples of the scenarios used in the present study were:[1]

> A system which is developed by your team should be delivered soon. During final testing, in one module a serious problem becomes obvious. One of your co-workers had developed this module. However, at this moment this co-worker is seriously ill and will not be able to work on the module during the next weeks. Thus, the task to complete the system and to guarantee its delivery is assigned to you. What are you going to do?

> There are two co-workers in your 6-person team who obviously do not work towards the project goal. These persons contribute very little to the project and show only little motivation. However, for accomplishing your tasks you have to rely on a close cooperation with them. What are you going to do?

Four industrial/organizational psychologists rated the cooperation requirements of the scenario situations. They were given the five scenarios in a written form with one scenario on one sheet of paper. For each of the five scenarios they responded to the item 'The cooperation requirements in this situation are high' on a 7-point Likert-scale (1 = I fully disagree; 7 = I fully agree). On average, the cooperation requirements were rated reasonably high ($M = 5.35$; $SD = 0.19$; eta = 0.73 for agreement among raters), suggesting that the situations described in the scenarios asked for a high level of cooperation. The four industrial/organizational psychologists additionally provided ratings for cognitive requirements associated with the tasks described in the scenarios. The exact wording of the item was: 'The cognitive requirements in this situation are high'. The 7-point Likert-scale ranged from 1 (= I fully disagree) to 7 (= I fully agree). Cognitive requirements were rated reasonably high ($M = 5.40$; $SD = 0.94$; eta = 0.73 for agreement among raters).

Each scenario was read to the participants during an individual interview session. We presented the scenarios in a fixed order and introduced them as 'difficult situations', but made no specific reference to the cooperation aspect. We asked participants to provide solution ideas for the described scenario situation. Specifically, we instructed them to tell 'what one could do in such a situation'. They were informed that it was not necessary to describe all the possible actions in detail, but to provide as many solution ideas as possible. When participants indicated that they forgot an element of a scenario, the whole scenario was read to them again. When participants indicated that they did not know more about what to do in such a situation they were told: 'Imagine, that all these ideas do not work out. What else can one do in such a situation?' This prompting was repeated once. Participants were given no feedback on their performance during the session. On average, an interview session lasted 30 minutes. No breaks were given during the session.

All verbal responses provided by the particpants were written down verbatim during the session and were later categorized.

[1]The complete sets of scenarios from Study 1 and Study 2 can be obtained from the first author on request.

Measures

Performance. To ensure that performance was not confounded with the accomplishment of cooperation tasks we used participants' performance in a software design task as performance measure. Within the larger research project, participants worked in individual sessions on the Lift Control Problem, a complex and ill-structured software design task (for more details about the design task see Guindon, 1990; Sonnentag, 1998). Participants' design solutions were rated along four criteria (algorithm quality, modularity, comprehensibility, and detail) which we subsequently collapsed into one overall measure of design task performance (Cronbach's Alpha = 0.79). For reliability analysis, a second rater assessed 20 design solutions. Interrater reliability for the overall measure was $r = 0.87$.

Knowledge about cooperation situations. We assessed participants' knowledge by analysing the content of the verbal transcripts. We measured overall knowledge and four specific knowledge aspects. *Overall knowledge* was operationalized as the total number of solution ideas reported for the five scenarios. A solution idea constituted a verbalized statement of how do deal with the scenario situation. In most instances, one sentence comprised one statement. A statement which reiterated a content already verbalized or which simply provided details for an earlier statement was not counted as a separate solution idea. Typical examples for solution ideas were statements such as 'Immediately re-evaluate the project plan to find out whether the goal is still feasible' or 'Initiate an emergency project meeting to inform all the other project members'.

For analysing the more specific knowledge aspects, we developed a category system. This was based on the framework presented in the introduction and comprised four categories: *Problem analysis*, i.e. knowledge about how to analyse the situation and how to gather information about the problem (sample answer: 'Read the documentation of the module in order to learn as much as possible about the module's functionality'); *Addressing the task*, i.e. knowledge about how to work directly on the task to be accomplished (sample answer: 'Redesign basic functions of the module'); *Acting at the interpersonal level*, i.e. knowledge about how to address the cooperation partner without direct reference to the specific task to be accomplished (sample answer: 'Meet with co-workers in a relaxed atmosphere in order to discuss openly the cooperation problems'); *Addressing the cooperation partner's approach to the task*, i.e. knowledge about how allocate tasks among co-workers and how the cooperation partner should work on the task (sample answer: 'Reconsider task allocation in a way that unmotivated co-workers work on tasks of minor importance'). Solution ideas which could not be classified as any of these knowledge aspects (including the suggestion to quit the situation) were coded as '*other solution ideas*'. Each solution idea ($n = 1356$) was categorized as an instance of the four knowledge categories or the category 'other solution ideas'. For reliability analysis, a second rater additionally categorized 1146 of the reported solution ideas. Interrater agreement was 91% (Cohen's Kappa = 0.79). For further analyses, we computed the total number of solution ideas for each of the four knowledge aspects (and the category 'other solution ideas') and across all five scenarios.

Statistical analysis

We conceptualized performance as a continuous variable. Therefore, we analysed our data with a correlational approach.

Table 1. Means, standard deviations, and zero order correlations between variables of Study 1

	M	*SD*	1	2	3	4	5	6	7
1 Overall knowledge	34.1	7.9							
2 Problem analysis	8.9	3.5	0.64						
3 Addressing task directly	18.8	5.3	0.87	0.27					
4 Acting at interpersonal level	1.2	1.1	0.26	0.01	0.25				
5 Addressing cooperation partners' task approach	4.2	2.0	0.36	0.11	0.11	0.27			
6 Other solution ideas	0.9	1.1	0.06	0.20	0.05	0.13	0.12		
7 Performance	2.8	0.9	0.34	0.27	0.32	0.27	0.09	0.19	
8 Years of experience	6.9	2.9	0.23	0.02	0.28	0.15	0.04	0.02	0.16

Results and discussion

Table 1 displays the descriptive statistics of Study 1 variables. Hypothesis 1 predicted a positive relationship between performance and knowledge about what to do in a cooperation situation. Analysis showed that performance correlated significantly with overall knowledge ($r = 0.34$; $p < 0.05$).

After having found a positive relationship between performance and overall knowledge, we analysed in more detail with which knowledge aspects performance was positively correlated. Analysis revealed that performance was significantly correlated with knowledge about problem analysis ($r = 0.27$; $p < 0.05$), knowledge about how to address the task directly ($r = 0.32$; $p < 0.05$), and knowledge about how to act at the interpersonal level ($r = 0.27$; $p < 0.05$). The correlation between performance and knowledge about how to address the cooperation partner's task approach was negative and non-significant ($r = -0.09$; *ns*).

One could argue that it is not primarily an individual's performance level but his or her years of professional experience which enable this person to come up with many solution ideas. However, years of professional experience showed no significant positive correlation neither with overall knowledge nor with specific knowledge categories. Similarly, when partialling out years of professional experience from the correlations between performance and knowledge measures, the size of the correlation coefficients did not drop substantially (partial $r = 0.31$ for overall knowlege; partial $r = 0.27$ for problem analysis; partial $r = 0.28$ for addressing task directly; partial $r = 0.25$ for acting at an interpersonal level).

Taken together, Study 1 supported four of the five hypotheses. The relationships between performance and knowledge could not be explained by years of experience. This finding suggests that long years of experience do not necessarily help in knowing how to address cooperation situations. However, there are alternative explanations. For example, one might argue that high performers were better in imagining the described scenario situations and putting themselves cognitively into the situations what in turn helped them in providing solution ideas. On a more theoretical level, this argument would imply that perspective taking, i.e. assessing and adopting other persons' viewpoints (Davis, 1983) plays an important role in answering the scenario questions. Therefore, in Study 2, we tested whether the relationship between performance and the knowledge measures is due to this third variable, perspective taking.

STUDY 2

Our first aim for Study 2 was to test the generalizability of Study 1 findings by using a different sample, different scenario tasks, and a different performance measure. To rule out alternative explanations, we controlled for years of experience and perspective taking. The hypotheses to be tested were the same as in Study 1.

Hypothesis 1a: Compared to moderate performers, high performers know more about how to approach a cooperation situation.

Hypothesis 2a: Compared to moderate performers, high performers know more about problem analysis in cooperation situations.

Hypothesis 3a: Compared to moderate performers, high performers know more about how to directly address a task to be accomplished in a cooperation situation.

Hypothesis 4a: Compared to moderate performers, high performers know more about how to address a cooperation partner at an interpersonal level.

Hypothesis 5a: Compared to moderate performers, high performers know more about how a cooperation partner should approach the task.

Our second aim for Study 2 was to examine the role of experience in greater detail. More specifically, we analysed whether other aspects of experience than years were responsible for the relationship between performance and knowledge what to do in cooperation situations. In the past, many studies have focused on years of experience as the crucial experience variable (Boshuizen and Schmidt, 1992; Patel and Groen, 1991; Simpson and Gilhooly, 1997). However, several authors have pointed out that other aspects of experience, particularly task-specific experiences might be more relevant for performance (Quiñones *et al.*, 1995; Tesluk and Jacobs, 1998). In line with this argumentation we assume that it is high performers' specific experience which is responsible for their knowledge about what to do in cooperation situations. When having experience with specific situations, it is more likely that one has already gathered more information and has received feedback about one's degree of goal attainment within these situations. Therefore, one knows more about the situations' critical features and the most successful approaches to master these situations. This knowledge helps in coming up with solution ideas for difficult cooperation situations. Thus, we expect that the relationship between performance and knowledge about cooperation situations breaks down when controlling for specific experiences.

Hypothesis 6: The relationship between high performance and knowledge becomes non-significant after controlling for specific experiences with cooperation situations.

Methods

Sample

Sixty-two engineers participated in the study. The engineers were employed by nine small and medium-sized companies located in the western part of Germany. They worked mainly in the areas of research and development, construction, planning, and project management. Participants' average professional experience was 10.0 years ($SD = 8.5$). Ninety-two per cent of the participants were male. Average age was 36.3 years ($SD = 8.3$).

Scenario situations

Eight cooperation scenarios were presented to the participants. These scenarios were derived from critical incidents reported in an earlier study (Brodbeck and Frese, 1994) and from additional pilot interviews with managers working in the field of engineering. In these pilot interviews, managers had reported cooperation incidents which had been experienced as difficult. Typical examples of the scenarios presented in Study 2 were:

> You have to work on a task which is unfamiliar to you. Some of your co-workers possess more knowledge and are more experienced in this task. However, these co-workers do not initiate any exchange of information with respect to your problem. You yourself have to mention the difficulties you face again and again. When you approach these co-workers, their answers are restrained and monosyllabic. What are you going to do?

> While working on a project, you have to cooperate with members from another project or department. The other department has already finished its planning before all the information from your department was available. A consequence of this procedure is that errors might occur and that the work of your department does not fit very well into the other department's plans. What are you going to do?

Four industrial/organizational psychologists rated the cooperation and cognitive requirements of the eight scenarios following the same procedure as described in Study 1. Again, cooperation requirements were rated reasonably high ($M = 5.28$; $SD = 0.66$; eta $= 0.78$ for agreement among raters). Ratings for cognitive requirements were moderately high ($M = 4.19$; $SD = 1.54$; eta $= 0.64$ for agreement among raters) and were significantly lower than cognitive requirements ratings provided for Study 1 scenarios ($t = 3.35$; $df = 3$; $p < 0.05$).

In genereal, the procedure was the same as in Study 1: each scenario was read to the participants and participants were asked to give solution ideas for the described scenario situations. All solution ideas were written down verbatim during the session and were later categorized. However, in this study the order of presenting the scenarios was counterbalanced. Additionally, participants were asked whether they knew situations similar to the presented scenarios from their everyday work situation. On average, 53.2% of the participants reported that they had already experienced a situation similar to the described scenario (range between 27.4% and 79.7%), indicating that the scenarios captured essential aspects of real world cooperation situations.

Measures

Performance. The performance measure was based on supervisory ratings (Schuler *et al.*, 1995). Supervisors provided ratings of four aspects of participants' technical performance shown in their real-life work context (scientific-technical knowledge, innovation, problem solving, theory-based working). For these ratings, a 9-point scale was used (Cronbach's Alpha $= 0.88$).

Knowledge about cooperation situations. Participants' knowledge about how to approach the cooperation situations was assessed by the measures developed in Study 1: *overall knowledge*; *problem analysis*; *addressing the task*; *acting at the interpersonal level*; *addressing the cooperation partner's approach to the task*; *other solution ideas* (including

the suggestion to quit the situation). All solution ideas ($n = 3102$) reported by the participants were categorized. For reliability analysis, a second rater additionally categorized 630 solution ideas. Interrater agreement was 78.3% (Cohen's Kappa = 0.72).

Perspective taking. Perspective taking was measured with the 7-item questionnaire scale from the Interpersonal Reactivity Index (Davis, 1983). The scale was slightly adapted to work contexts (e.g. 'friends' were replaced by 'co-workers'). A sample item was: 'I sometimes try to understand my co-workers better by imagining how things look from their perspective' (Cronbach's Alpha = 0.74).

Professional experience. In addition to *years of professional experience*, we assessed *experience with specific cooperation situations*. This measure was based on the number of situations described in the scenarios participants have already experienced in their everyday work situation.

Statistical analysis
Again, we conceptualized performance as a continuous variable. We tested the hypotheses with a multiple regression approach (Cohen and Cohen, 1983).

Results and discussion

Table 2 shows the descriptive statistics between Study 2 variables. In Hypothesis 1a, we assumed a positive relationship between performance and overall knowledge and that this relationship holds when controlling for years of experience and perspective taking. We tested this hypothesis with hierarchical regression analysis and entered the control variables (years of professional experience and perspective taking) in Step 1, and performance in Step 2.

Table 3 shows that for overall knowledge as dependent variable, perspective taking was a significant predictor in Step 1. Performance entered in Step 2, improved the amount of explained variance significantly. Individuals with a high performance level provided more solution ideas, also when controlling for years of experience and perspective taking.

In Hypotheses 2a to 5a we predicted positive relationships between performance and specific knowledge aspects also when controlling for years of experience and perspective taking. Hierarchical regression analysis showed a significant finding for knowledge about how to act at the interpersonal level. The two control variables entered in Step 1 explained a marginally significant percentage of variance of this knowledge aspect. Performance entered in Step 2 contributed significantly to the prediction of knowledge about how to act at the interpersonal level. Performance was no significant predictor for the other knowledge measures. Taken together, Hypotheses 1a and 4a were supported.

In Hypothesis 6, we assumed that specific experiences are responsible for the relationship between performance and knowledge about cooperation situations. We tested this hypothesis in hierarchical regression analyses with overall knowledge and knowledge about how to act at the interpersonal level respectively as dependent variables. Again, we entered years of professional experience and perspective taking into the regression equation in Step 1 as control variables. In Step 2, we entered the specific experience measure. In Step 3, we entered performance. In line with Hypothesis 6, we expected that performance entered in Step 3 will no longer contribute significantly to the prediction of the dependent variables.

Table 2. Means, standard deviations, and zero-order correlations between variables of Study 2

	M	*SD*	1	2	3	4	5	6	7	8	9	10
1 Overall knowledge	50.0	9.2										
2 Problem analysis	5.6	3.8	0.61									
3 Addressing task directly	10.7	4.7	0.42	0.11								
4 Acting at interpersonal level	11.0	4.5	0.53	0.29	− 0.26							
5 Addressing cooperation partners' task approach	14.5	4.0	0.44	0.14	0.20	0.00						
6 Other solution ideas	8.2	4.1	0.19	− 0.13	− 0.22	0.12	− 0.35					
7 Performance	6.5	1.2	0.25	0.13	− 0.02	0.30	0.19	− 0.05				
8 Years of experience	10.0	8.5	0.04	− 0.12	0.06	− 0.03	0.11	0.05	0.14			
9 Experience with specific cooperation situations	0.5	0.2	0.27	0.10	0.24	0.11	0.09	0.02	0.33	0.22		
10 Perspective taking	3.6	0.5	0.35	0.23	0.12	0.29	0.03	0.07	0.03	− 0.01	0.19	

Table 3. Hierarchical regression analysis: predicting knowledge from years of experience, perspective taking, and performance (Study 2)

	β	T	R^2	F	ΔR^2	ΔF
Overall knowledge						
Step 1			0.12	4.16*	0.12	4.16*
Years of experience	0.04	0.36				
Perspective taking	0.35	2.86**				
Step 2			0.18	4.25**	0.06	4.01*
Performance	0.25	2.00*				
Problem analysis						
Step 1			0.06	2.11	0.06	2.11
Years of experience	0.11	0.91				
Perspective taking	0.23	1.83				
Step 2			0.09	1.81	0.02	1.23
Performance	0.14	1.10				
Adressing the task						
Step 1			0.02	0.58	0.02	0.58
Years of experience	0.06	0.48				
Perspective taking	0.13	0.97				
Step 2			0.02	0.40	0.00	0.05
Performance	0.03	0.22				
Acting at interpersonal level						
Step 1			0.09	2.77[a]	0.09	2.77[a]
Years of experience	0.03	0.21				
Perspective taking	0.29	2.34*				
Step 2			0.18	4.16**	0.09	6.42*
Performance	0.30	2.54*				
Addressing cooperation partners' task approach						
Step 1			0.01	0.42	0.01	0.42
Years of experience	0.11	0.89				
Perspective taking	0.03	0.25				
Step 2			0.04	0.88	0.03	1.79
Performance	0.17	1.34				

Note: *$p < 0.05$, **$p < 0.01$, [a]p 0.0708.

Table 4 shows that for overall knowledge as dependent variable, performance did not explain an additional proportion of the variance after controlling for years of experience, perspective taking, and specific experiences. This finding suggests that high performers' overall greater knowledge about how to address cooperation situations is due to their experience with the specific cooperation situations.

For the knowledge aspect 'acting at the interpersonal level' as dependent variable the finding was different. After controlling for years of experience, perspective taking, and specific experiences, performance was still a significant predictor.

To sum up, Study 2 showed that performance was positively related to overall knowledge and knowledge about how to act at the interpersonal level, also when controlling for years of experience and perspective taking. Thus, with respect to overall knowledge and acting at the interpersonal level, Study 2 confirmed the findings of Study 1.

We found support for the hypothesis that the relationship between performance and overall knowledge is due to specific experiences. However, the relationship between performance and knowledge about how to act at the interpersonal level could not be

Table 4. Hierarchical regression analysis: predicting knowledge from years of experience, perspective taking, specific experiences and performance

	β	t	R^2	F	ΔR^2	ΔF
Overall knowledge						
Step 1			0.12	4.16*	0.12	4.16*
Years of experience	0.04	0.36				
Perspective taking	0.35	2.86**				
Step 2			0.17	3.88*	0.04	3.05[a]
Experience with specific cooperation situations	0.22	1.75[a]				
Step 3			0.20	3.57*	0.03	2.37
Performance	0.19	1.54				
Acting at interpersonal level						
Step 1			0.09	2.77[b]	0.09	2.77[b]
Years of experience	0.03	0.21				
Perspective taking	0.29	2.34*				
Step 2			0.09	1.94	0.01	0.35
Experience with specific cooperation situations	0.08	0.59				
Step 3			0.18	3.07*	0.09	5.97*
Performance	0.31	2.44*				

Note: $*p < 0.05$, $**p < 0.01$. [a]p 0.0861, [b]p 0.0708.

accounted for by specific experiences. This finding implies that high performers know more about how to approach interaction partners at the interpersonal level, irrespective of having already experienced many situations similar to the scenario situations.

No relationship was found between performance and the other knowledge aspects, i.e. problem analysis, addressing directly the task, and addressing cooperation partner's task approach, neither in the correlational analysis nor in the hierarchical regression analyses. Thus, with respect to problem analysis and addressing directly the task these findings of Study 2 did not confirm findings of Study 1.

GENERAL DISCUSSION

Our studies showed that high performance was positively related to knowledge about how to address cooperation situations. This relationship could not be explained by years of experience or perspective taking and was only partially due to specific experiences. High performers showed a greater overall knowledge about what to do in cooperation situations. In both studies, performance was positively related with knowledge about how to address the cooperation partner at the interpersonal level. Performance showed no positive relationship with knowledge about how to address the cooperation partner's task approach in any of the studies.

Despite the overall consistent picture, some differences emerged between the findings of Study 1 and Study 2: In Study 1, high performance was positively related to knowledge about problem analysis and knowledge about how to address the task directly, while there was no such significant relationship in Study 2. One might argue that these differences are due to the more rigorous hypothesis testing with more control variables in Study 2. However, Table 2 shows that in Study 2 also the respective zero-order correlations were relatively small in size and did not confirm the findings of Study 1.

It is possible that task aspects were less stressed within the Study 2 scenarios than in Study 1 scenarios. This interpretation is supported by the finding that cognitive requirements associated with the scenarios in Study 2 were lower than in Study 1. This difference might have implied that in Study 2 high performers paid less attention to task aspects, i.e. to the less central aspects of the scenario situations. Moreover, it might be that the design task performance measured in Study 1 captured more narrow aspects of task performance that were more strongly related to knowledge referring to task aspects and to problem analysis. Supervisory ratings used in Study 2 however, as broader performance measures are less tied to a narrowly defined task performance and therefore might be less closely related to knowledge about task and problem analysis aspects.

The role of experience and perspective taking

The studies shed light on the role of experience for high performance. In both studies, there was neither evidence for a strong positive relationship between years of experience and performance nor for such a relationship between years of experience and knowledge about how to approach cooperation situations. Moreover, high performers' superior knowledge could not be accounted for by years of experience. Thus, years of experience seem to be of minor importance for high performance and knowledge about cooperation situations. However, as Study 2 showed, the case is more complicated for specific experiences. Overall knowledge was found to be due to specific experiences. Knowledge about how to address the cooperation partner at the interpersonal level was not accounted for by specific experiences. These findings suggest that specific experiences are not uniformly related to all knowledge aspects. It seems that for overall knowledge, i.e. a broad coverage of cooperation requirements, high performers benefit from their specific experiences. However, other knowledge aspects such as addressing the cooperation partner at an interpersonal level exist beyond the effects of specific experiences.

Study 2 showed that perspective taking was significantly related to a number of knowledge variables. This finding indicates that answering scenario questions is related to an individual's ability to put oneself cognitively into such an imagined situation. However, performance was related to knowledge about how to address cooperation situations, also when controlling for perspective taking. This implies that high performers' superior knowledge is not only due to their higher level of perspective taking.

The scenario approach

We used a scenario approach for measuring professionals' knowledge about cooperation situations. These scenarios represented realistic situations within professional work contexts. In Study 2, we measured whether study participants had already encountered situations similar to the scenarios tasks. For each of scenarios presented, between 27.4% and 79.7% of the participants indicated having already experienced a situation similar to the situation described in the scenario. Moreover, the ratings provided by the industrial/organizational psychologists revealed that the situations described in the scenarios were associated with high cooperation requirements.

Practical implications

Our studies showed that high task performance and knowledge about cooperation situations co-occur in engineers and software professionals. Thus, when staffing projects

one should look for professionals who reconcile in one person high technical competence and knowledge about how to address cooperation requirements. If it turned out that knowledge about cooperation situations has at least partially a causal effect on task performance, implications for training are obvious: At the university and in practical settings, individuals should participate in trainings in which they can acquire knowledge about how to deal with cooperation situations.

Implications for future research

We conducted our studies within the fields of software design and engineering. Within these domains, both cognitive and cooperation requirements are relatively high (Clegg *et al.*, 1996; Keenan and Newton, 1987), but employees are often not sufficiently trained for meeting these requirements (Riedl *et al.*, 1991). It might be that the relationship between high performance and knowledge becomes most evident under these circumstances. Therefore, studies are needed which examine whether the relationship between high performance and knowledge about cooperation situations holds also for other domains than those studied here.

In our studies, we implemented a cross-sectional study design. Strictly speaking, from the present studies we only know that performance and knowledge are positively related. Future research has to test possible causal effects. First, it should be tested whether high performance leads to superior knowledge about cooperation situations. There are good reasons to assume that high performers are more often invited to participate in cooperation situations because co-workers expect help and advice from them (Sonnentag *et al.*, 1998; Turley and Bieman, 1995). High performers' frequent participation in cooperation situations (Curtis *et al.*, 1988; Sonnentag, 1995) might support knowledge acquisition in these areas. Second, it could also be that knowledge about cooperation situations has a positive effect on performance. Professionals who know how to address difficult cooperation situations, how to obtain necessary information under unfavourable circumstances, and how to ask for feedback might face less problems when accomplishing their tasks. Therefore, their performance might benefit from their knowledge about how to address the cooperation setting. Third, future research should test whether the relationship between performance and knowledge is due to other third variables than those tested in the present studies, for example motivational factors.

Our knowledge measures referred to the quantity of solution ideas. Future research should examine whether high and moderate performers differ also with respect to the quality of solution ideas and the organization of knowledge. Additionally, future expertise research should address the question how high performers implement their knowledge in the task-accomplishment process.

Taken together, our studies add to research on expertise by showing that high performers possess more knowledge about how to approach a cooperation situation. Thus, high performers are not only superior in meeting domain-specific task requirements but also in addressing cooperation demands. Moreover, high performers' superior knowledge could not be explained by longer years of experience or better perspective taking. Based on our study two possible contributions to future theory building on expertise can be derived: First, expertise in a specific task domain is accompanied with more general knowledge which goes beyond this specific task domain. This more general knowledge (e.g. about cooperation situations) might be a prerequisite or a consequence for developing task specific expertise. Second, long years of experience play only a minor role in

developing expertise, i.e. high performance, in a specific domain. Situation-specific experiences seem to be more relevant.

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