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Josette M.P. Gevers

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ter verkrijging van de graad van doctor aan de Technische Universiteit Eindhoven, op gezag van Rector Magnificus, prof.dr. R.A. van Santen, voor een commissie aangewezen door het College van Promoties in het openbaar te verdedigen op donderdag 30 september 2004 om 16.00 uur

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en
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Josette Gevers

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Contents

Chapter 1

Introduction

Meeting deadlines is a problematic issue for many project teams. Despite good will and hard work, deadlines are often exceeded. The present dissertation addresses this problem by examining how teams control and direct their actions toward timely project completion. The dissertation presents four studies in which we investigate a variety of input and process variables relevant to team self-regulation and meeting deadlines. A particular emphasis is put on the role of shared temporal cognitions, or the level of agreement among team members about the temporal aspects of task execution, and how these affect the ability of teams to complete projects on time.

Today more than ever, work is performed in groups and teams. Organizations increasingly rely on team-based arrangements, such as project teams, task forces, quality circles, autonomous work groups, and cross-functional teams as a means to gain competitive advantage and improve the experience of work for their employees (Guzzo & Shea, 1992; Thompson, 2004). This dissertation addresses a particular type of arrangement: the project team or project group (terms which we will use interchangeably). We define a project team as an interdependent collection of individuals whose primary function is to perform a complex task requiring a specific output (in the form of some product, plan, or decision) by some deadline, after which they disband (cf. Janicik & Bartel, 2003). Complex tasks typically involve a high

degree of ambiguity regarding the appropriate strategy for task completion and often require individuals from different organizational units or fields of expertise to work together. Therefore, project teams operate under relatively high levels of autonomy to allow them to develop viable task approaches and effective ways of working together. Members may or may not be assigned specific roles or functions. Moreover, we assume that team members are jointly accountable for the project output.

Much work in organizations is carried out in teams because the division of labor allows greater and faster achievements. Moreover, the complexity of tasks often requires that individuals with different knowledge, skills, and expertise work together to accomplish tasks. Although work in teams has the potential to provide many benefits, such as increased flexibility and creativity, it is also known to be associated with problems of coordination and motivation (Steiner, 1972). Differences in members' knowledge and working routines may lead to conflict about how to perform a task or which procedures to use. In addition, the fact that others are there to do the job may encourage social loafing and cause members to expend less effort. Moreover, taking into consideration that individual team members often work in multiple projects (Waller, 1997), members may abandon plans due to conflicting pulls on their time use, which may lead to delays in the flow of work. Because of these problems, teams may perform below their potential and display deficiencies in performance outcomes.

A rather pervasive and persistent deficiency frequently encountered in project performance is missing deadlines. Time and again, project deadlines are put off or exceeded. Lientz and Rea (2001) indicate that half of all system and technology implementation projects overrun their budget and schedule by two hundred percent or more. Although this may be a somewhat pessimistic estimate, others have identified the problem as well. Tukel and Rom (1998) conducted a survey among 91 project managers of which 56 % indicated that deadlines were often exceeded or missed. Ford and Sterman (2003) refer to it as the "90 % syndrome": a frequently observed phenomenon in product development projects that 90 % of the work is completed according to the original schedule, but due to unplanned rework and slow late-stage progress, projects still take twice the original project duration to be finished. Missing deadlines may have far-reaching negative consequences for employees, organizations, and clients. The first to be affected is the client, who may not be able to bring the

project output into use until it is completely finished. In addition, frequent failure to complete projects on time may damage organizational performance in terms of financial loss or undermine a company's competitive position compared to other players in the field. What is more, frustrations associated with failure of goal attainment may adversely affect team members' psychological well-being or deteriorate their moral. Hence, clients, organizations, and employees all have an interest in meeting deadlines.

Efforts to improve project timeliness have predominantly been aimed at the development of increasingly sophisticated project management tools. Although these tools allow project managers to produce highly efficient workflow plans on paper, their implementation still proves to be a major challenge. From a psychological point of view, this is not surprising: people do not perform work tasks as they are given, but tasks as they are understood and redefined by themselves (Roe, 1999). According to action theory (Hacker, 1982, in Roe, 1999), individual workers redefine an objective task according to their personal wishes and perceived constraints and opportunities. The subjective task that results from this process is the goal that drives and directs the individual's task activity. In teams, the problem of discrepancies between the objective and the subjective task is complicated by the fact that team members may arrive at different subjective tasks, and therefore, may work towards different objectives. In reference to this problem, several authors have argued that successful team performance requires the development of a collective view on the task and the team (Cannon-Bowers, Salas, & Converse, 1993; Klimoski & Mohammed, 1994; Rentsch & Hall, 1994; Wilke & Meertens, 1994). They state that team members have to build a collective representation of their collective task and establish agreement on how the task should be executed. In addition, members have to agree about how the team should be organized in order to be able to complete the task. This suggests that, although formal plans may provide a normative framework for collaborative action, the actual implementation and coordination of the task work is largely to be regulated by the team itself. In other words, the team has to make a plan work. This raises the question how teams manage to do this.

Although relatively little research has been conducted on meeting deadlines in work groups, several studies have identified deadlines as catalysts of project progress. Gersick (1988; 1989) addressed group development processes and established that the

awareness that time is running out motivated groups to radically change their task approach halfway through the allotted time, and to enter into a new qualitatively different phase in which work progressed much faster. Others found that team effort increased exponentially as the deadline approaches and that most of the work was done in a relatively short period just before the deadline (Seers & Woodruff, 1997; Gladstein, 1984; Chang, Bordia, & Duck, 2003). Both findings suggest that missed deadlines may simply be due to low productivity rates in early project stages and that tighter deadlines may promote team effectiveness. Several studies were conducted to test this assumption (e.g. Kelly & McGrath, 1985; Karau & Kelly, 1992). Tight deadlines were shown to decrease the extent to which team members discussed alternative task approaches and engaged in social activities. While this increased performance rates, output quality was negatively affected. Apparently, teams need time to get to know the task and the team to be able to produce high-quality output on time. In this dissertation, we build on this work and examine more closely the regulatory processes involved in meeting deadlines, with a particular focus on the role of shared cognitions. Furthermore, whereas prior empirical work has mainly been conducted in the laboratory, we set out to study natural groups as they function in real-world settings.

1.1 Objectives and Design of the Research

The main objective of this dissertation is to identify relevant input and process variables for project teams to regulate their processes towards timely project completion. Notwithstanding the fact that other factors may also be relevant to meeting deadlines in project teams (e.g., project definitions, team composition, leadership practices, or external dependencies), the emphasis is on team self-regulation, i.e., on how teams control and direct their actions toward the achievement of some goal or goals. Self-regulation implies the use of specific mechanisms to guide goal-directed behavior over time and across changing circumstances (cf. Karoly, 1993). Like individuals, teams may use such mechanisms to regulate their actions toward goal accomplishment.

Table 1.1 presents an overview of the variables that are addressed in this dissertation. Because we are interested in meeting deadlines, we focus on input and process variables that are time relevant. The variables are categorized into six

categories: team composition, team self-regulation, shared cognitions, team motivation, team task execution, and team performance. In the following, we will describe the variables in each of these categories briefly and discuss why they are relevant to meeting deadlines in project teams. We begin with the category of shared cognitions, since much of the research in this dissertation centers on this topic. Then, we address the categories of team composition, team self-regulation, team motivation, team task execution, and team performance.

Shared Cognitions

The concept of shared cognitions refers to the increasingly popular notion that effective teamwork requires that team members hold similar cognitive representations of the situation or phenomenon they are facing (Klimoski & Mohammed, 1994). Prior research has shown that team processes and team performance benefit when team members have shared cognitions about the task and the team, which means that team members have shared knowledge of task procedures, strategies, and actions, and about each other's knowledge, skills, preferences, roles, and responsibilities (Cohen, Mohrman, & Mohrman, 1999; Mathieu, Heffner, Goodwin, Salas, & Cannon-Bowers, 2000; Stout, Cannon-Bowers, Salas, & Milanovich, 1999). However, shared cognitions have not been addressed in relation to meeting deadlines. We suggest that to improve meeting deadlines, it may be important that members also have shared temporal cognitions, which means that they have common or overlapping views regarding the temporal aspects of their collective task, such as the importance of meeting the deadline, (sub) task completion times, and the appropriate timing and pacing of task activities.

Team Composition

Team composition may be relevant to meeting deadlines because the individual characteristics of team members may increase or decrease the likelihood that deadlines are met. Shared temporal cognitions, for instance, may be more easily established when members have similar pacing styles, i.e., when members have similar ways of using their time when performing tasks under deadline conditions. Moreover, whether shared temporal cognitions will actually result in timely project completion may depend upon the pacing styles present in the team. When several

Table 1.1. *Overview of variables in the dissertation*

Team Composition	Team Self-Regulation	Shared Cognitions	Team Motivation	Team Task Execution	Team Performance
Similarity in Pacing Styles (Chapter 3)	Planning (Chapter 2, 4)	Shared Temporal Cognitions (Chapter 3, 4, 5)	Potency (Chapter 2, 5)	Coordinated Action (Chapter 4)	Project Progress (Chapter 2)
Team Pacing Style (Chapter 3)	Reflexivity (Chapter 2, 4)	Shared Team Cognitions (Chapter 4, 5)			Meeting Deadlines (Chapter 2, 3, 4, 5)
	Temporal Reminders (Chapter 3, 4)	Shared Task Cognitions (Chapter 5)			Output Quality (Chapter 5)

members tend to wait until the deadline is very close before they start working, shared temporal cognitions may cause teams to putt off work for too long (e.g., due to risky shift), and timeliness may be jeopardized.

Team Self-Regulation

Whereas team composition effects are likely to take place implicitly (i.e., without conscious effort), the display of self-regulatory behavior constitutes a more explicit or intentional attempt to direct team processes and team performance. We address three regulatory mechanisms that teams may use to control and direct team cognitions and team task execution: planning, reflexivity, and temporal reminders. Planning involves the decomposition of the project into sub-goals for which specific tasks are determined and time schedules are made (Tripoli, 1998). Reflexivity refers to the extent to which team members collectively reflect upon their objectives, strategies, and internal processes, and adapt them to current and anticipated circumstances (West, 1996). Finally, temporal reminders represent team members' deliberate attempts to draw attention to time, for instance by reminding other team members of important temporal milestones. All three mechanisms may be expected to contribute to shared temporal cognitions and meeting deadlines.

Team Motivation

Shared cognitions may affect meeting deadlines, and other project outcomes, through increased team motivation. Team motivation is represented in our research by the concept of group potency, i.e., the collective belief within a group that it can be effective (Guzzo, Yost, Campbell, & Shea, 1993). Potency may contribute to project performance because team members who have confidence in their team are likely to exert greater effort and to be more persistent in their efforts (cf. Bandura, 1982). This may enhance both the timeliness of project performance and the quality of project output. In addition, potency may make teams more effective in dealing with time pressure. At the individual level, at least, people with confidence in their abilities were found to exert more effort to master challenges and overcome difficulties (Bandura, 1982). Therefore, group potency is included in our research.

Team Task Execution

The coordinatedness of team member actions may constitute another link between shared cognitions and meeting deadlines. Coordinated action refers to the situation where optimal working relations are established within the team and members execute task activities in an integrated and timely manner. Coordinated action manifests itself in a smooth flow of work and cooperative behavior among team members. Prior research has shown that shared task cognitions and shared team cognitions both facilitate team coordination. Since shared temporal cognitions concern the agreement about the use of time in task execution, they are particularly likely to contribute to a team's ability to establish coordinated action.

Team Performance

Although our research focuses on meeting deadlines, we also address project progress and the quality of project output. Project progress provides insight into the development of task accomplishments over time. Output quality is relevant because there could be trade-offs between the quality and timeliness of project performance. We examine the effects of shared team, -task, and -temporal cognitions on both meeting deadlines and output quality to see whether they converge or diverge.

Longitudinal Research Design

The emphasis on temporal issues is also expressed in the design of our studies. All studies are longitudinal, but with three different approaches. First, we made a distinction between the orientation phase and the execution phase of a project to see whether effects of team self-regulatory behavior on project progress are contingent upon the project stage in which they take place. Second, we studied teams that perform two consecutive assignments to examine how experiences in one project affect team processes on a subsequent similar project. Finally, we use a design with four measures to see how changes in team cognitions and team processes over the course of a project affect final project outcomes. Hence, these designs allow us to address a) how performance develops over time, b) how experiences on one project affect team performance on a subsequent project, and c) how changes in team cognitions and team processes over time affect project performance.

1.2 Outline of the Dissertation

The chapters of this dissertation describe four studies: a pilot study and three main studies. The first three studies involve student project teams; the forth is a large field study among 37 project teams operating in the Information Technology business. The main studies were conducted in parallel. Although the studies are certainly related, each has a separate focus and the chapters can be read independently.

Chapter 2 describes a pilot study. The study was conducted as a preliminary orientation on the topic of meeting deadlines in project teams. Additionally, the study served to evaluate the adequacy of a longitudinal survey research design for studying team processes in relation to meeting deadlines. Moreover, it allowed us to establish the reliability and validity of some of the measures we were to use in the main studies. The study presents some interesting findings concerning the role of potency in shaping the effect of time pressure on project progress, and addresses the relationship between planning, reflexivity, and project progress in two distinct project phases.

Chapter 3 presents a study that examines the effect of shared temporal cognitions on meeting deadlines in teams working on two subsequent tasks. Furthermore, it explores implicit and explicit mechanisms in the establishment of shared temporal cognitions, namely the similarity in team members' pacing styles and the exchange of temporal reminders among team members.

The study presented in Chapter 4 investigates the role of coordinated action as a mediator between shared temporal cognitions and meeting deadlines. Moreover, it addresses the effect of planning, reflexivity, and temporal reminders on the development of shared temporal cognitions.

The study described in Chapter 5 aims to establish the relevance of shared temporal cognitions over and above shared team cognitions and shared task cognitions for both meeting deadlines and output quality. Moreover, it addresses the motivational impact of shared cognitions by studying potency as a mediator between shared cognitions and team performance.

Finally, Chapter 6 provides an integration of the findings and proposes a model of team self-regulation toward meeting deadline in project teams. We conclude with suggestions for future research and some recommendations for practice.

Chapter 2

Time Pressure, Potency, and Progress in Project Teams*

This chapter presents a pilot study that was conducted as a preliminary orientation on the topic of meeting deadlines in project teams. In this study, we collected longitudinal data from 22 student project teams, thereby distinguishing between two project phases: the orientation phase and the execution phase. The study addresses the role of potency in shaping the effect of time pressure on project progress. Moreover, it provides insight into the relationship between project progress and team self-regulation, in terms of planning and reflexivity.

Meeting deadlines is a problematic issue for many project teams. In a survey conducted by Tukel and Rom (1998), 91 managers of project teams were questioned, and 56 % indicated that deadlines were often exceeded or missed. Nevertheless, little empirical research has been conducted on time-related aspects of project performance. Therefore, additional insights into what factors would facilitate timely project completion could be valuable to theory as well as practice.

* This chapter is based on: Gevers, J. M. P., Van Eerde, W., & Rutte, C. G. (2001). Time pressure, potency, and progress in project groups. *European Journal of Work and Organizational Psychology, 10,* 205-221.

This chapter describes a longitudinal study on the influence of perceived time pressure, group potency, and team self-regulatory behavior such as planning and reflection on progress in project teams. Considering the dynamic nature of the project life cycle, we expect these relations to be contingent upon project stages (cf. Pinto & Prescott, 1988). In other words, the extent to which time pressure, group potency, planning and reflexivity contribute to timely completion of the group project may depend on the project stage in which they take place.

In our research, we distinguish two project stages, based on the project life cycle model suggested by Adams and Barndt (1983) and King and Cleland (1983). Although the original model distinguishes four phases, we omit the first and the last phase that are mainly concerned with acquisition and project initiation, and with client consultancy after project determination. Because our study involves student groups that carry out assigned projects without being involved in acquisition or implementation, we use a simplified version with only two phases. The orientation phase comprises the translation of preliminary goals into a more formalized set of plans and performance strategies. In the second phase (the execution phase), the actual work of the project is performed; materials and resources are procured and transformed into the intended project result.

2.1 Time Pressure and Group Potency

A deadline is an important "time-marker" (McGrath & O'Connor, 1996) that puts a task within a certain time frame and motivates groups to start working on the task. The motivational power intensifies as the deadline approaches and the level of time pressure rises. Time pressure arises when the available time is perceived to be insufficient and the violation of the time limit is known to lead to sanctions (Rastegary & Landy, 1993).

Several studies have demonstrated that work groups increase their activity on a task when they begin to feel time pressure because of an approaching deadline (Gersick, 1988, 1989; Gladstein, 1984; Seers & Woodruff, 1997). Thus, there appears to be a subtle relationship between the awareness that time is running out and making progress. This does not mean that intensifying time limits in order to promote productivity and efficiency will always be effective. In most tasks, the relationship between time pressure and performance is curvilinear: optimal performance is achieved under an intermediate level of time pressure (Rastegary & Landy, 1993).

Too little time pressure leads to boredom, so that attention is drawn to activities outside the project. Very high levels of time pressure produce stress, causing so much arousal that avoidance reactions may occur (Carver, 1996), including procrastination (Van Eerde, 2000).

Perception plays a central role in the experience of time pressure. Whether a group will perceive the time available for performing a task as sufficient will in part depend on the confidence the group has in its abilities. Guzzo, Yost, Campbell, and Shea (1993) call this 'group potency': the collective belief within a group that it can be effective. We argue that groups that lack confidence in their abilities will experience more time pressure. What is more, they will not experience time pressure as stimulating, but rather as a threat. To find a temporary relief from this stressor, these groups might be inclined to procrastinate. Van Eerde (2000) identifies procrastination as the avoidance of the implementation of an intention because a task is perceived as unattractive or threatening. Research on individual projects by Blunt and Pychyl (2000) indicates that procrastination is particularly likely to take place in the orientation phase of a project. Therefore, we expect groups with low potency to procrastinate in the orientation phase to avoid the project tasks.

Thus, depending upon the strength of a group's belief in their potential for effectiveness, time pressure can either motivate or discourage group activity in the orientation phase of the project. Groups with high potency that experience time pressure will start working right away to make sure they make good progress, while groups with low potency that experience time pressure will tend to procrastinate and, as a result of that, make less progress. Hence, we expect that the effect of time pressure on project progress will be moderated by group potency. For the orientation phase of the project, we propose the following.

> *Hypothesis 1: In the orientation phase, high time pressure will have a positive effect on project progress for groups with high potency, and a negative effect on project progress for groups with low potency.*

Groups with low potency are likely to procrastinate to avoid an unpleasant or threatening task. This, however, does not imply that groups with high potency do not procrastinate in the orientation phase. After all, they may give priority to more urgent or pleasurable tasks outside of the project. In general, the rule will apply that

whenever groups procrastinate in the orientation phase, the progress resulting from that stage will be limited. Consequently, the time pressure in the execution phase will rise, because some of the work that could have been done in the orientation phase has been put off till later. We expect that high potency groups will be motivated by the backlog and the growing time pressure to make up for the lost time. For low potency groups, however, a backlog will make their task even more unfeasible. Even though, at this stage, they may be motivated to work hard, we presume they lack the capability to work effectively under high time pressure, so their performance will be adversely affected once again. Thus, the effect of making little progress in the orientation phase on the project progress in the execution phase will be moderated by group potency. For the execution phase of the project, we propose the following.

> *Hypothesis 2: Making little progress in the orientation phase will have a positive effect on project progress in the execution phase for groups with high potency, and a negative effect for groups with low potency.*

2.2 Team Self-Regulation: Planning and Reflexivity

At the individual level, self-regulation is defined as the ways in which people control and direct their own actions in the service of some goal or goals (Fiske & Taylor, 1991). Self-regulation implies the modulation of thought, affect, behavior, or attention by use of specific mechanisms and supportive meta-skills, to guide goal-directed activities (Karoly, 1993). Project teams can also use such meta-skills and mechanisms to regulate their goal-directed behavior over time and across changing circumstances. In this chapter, we pay special attention to two self-regulation mechanisms that teams may use to organize, coordinate, evaluate and adapt their activities: planning and reflexivity.

Planning

Planning refers to a self-regulation mechanism by which groups make a plan of action for goal attainment. In anchored planning, or execution planning the project is decomposed into sub-goals for which specific tasks are determined and time schedules are made (Tripoli, 1998). Based on that, the group decides who will do what, when, and in what order.

Research by Sonnentag (1998) and Tripoli (1998) has shown that detailed execution planning does not improve individual performance. However, coordination requirements will be higher when tasks are performed in groups, due to interdependent working. Hence, execution planning may be an important tool for successfully coordinating members' efforts in project teams (Weingart, 1992).

Weingart (1992) distinguished between preplanning and in-process planning. Whereas preplanning takes place before group members start executing their task, in-process planning occurs during task performance. This means that only the first few actions are planned in the orientation phase of the project, and subsequent more detailed planning is developed in the execution phase, based on feedback derived from actions undertaken (Schippers, Den Hartog, & Koopman, 1999). According to Tripoli (1998), detailed execution planning is useful only when objectives are clear and circumstances are predictable. When groups know which action steps should be taken, and the outcomes of activities are largely predictable, execution planning will contribute to timely task completion. This leads us to posit the following hypothesis.

> *Hypothesis 3: Execution planning relates positively to project progress in the execution phase, but not in the orientation phase.*

Reflexivity

Using feedback to monitor group performance is an essential part of team self-regulation (Carver & Schreier, 1990). By comparing the actual project progress with the project plan, a group receives feedback. This information provides clues to where plans and actions require adjustments. West (1996) denotes a group's communication on this type of self-regulation with the term group reflexivity. He defines reflexivity as "the extent to which group members collectively reflect upon the group's objectives, task strategies, and internal processes, and adapt them to current or anticipated endogenous or environmental circumstances" (West, 1996, p. 559). According to West, reflexive teams will be more adaptive in the execution of their tasks and will therefore be more effective, especially when operating in uncertain and dynamic circumstances. Our last hypothesis therefore reads as follows.

> *Hypothesis 4: Reflexivity relates positively to project progress in both the orientation phase and the execution phase of the project.*

2.3 Method

Participants

Participants were 93 third-year industrial engineering students at the Technische Universiteit Eindhoven, The Netherlands working in 22 project groups of three to six people developing a business solution in a field assignment. The projects involved realistic industrial engineering consultancy projects in which the groups had to make a detailed analysis of a relevant business problem in a host organization (the client) and develop a viable solution for that particular problem, which was to be communicated to the client in a project report.

The project groups were 'leaderless groups' in that all members had equal positions. Most members were already acquainted from earlier group projects. All projects had two milestones: after three weeks the groups had to present a project plan; and after 13 weeks the project had to be completed, resulting in a final report. Students were asked to fill out a questionnaire on teamwork and team performance at three times during the 13 weeks working period. Participation was voluntary and participants were guaranteed confidentiality. In addition, the students were assured that participation would not influence their grade for the assignment in any way. Four participants, chosen randomly, received a reward of fifty guilders (≈ 23 Euro). In total, 93.5 % of the students filled out the questionnaire at least once, 67 % of the participants completed all three questionnaires. All groups were represented at each data collection point.

Procedure

Longitudinal data were collected by administering the same questionnaire at three data points. Time 1 was at the start of the project, just after the students were assigned to a particular project. Time 2 was after 3 weeks, at the first milestone when the project plans were presented. Time 3 was after thirteen weeks, immediately after the project deadline. Time 1 represents the baseline; Time 2 represents the orientation phase; and Time 3 represents the execution phase. Participants were requested to complete the questionnaire (using either a paper version or an electronic version on the Internet), which was in Dutch, without consulting their fellow group members.

Measures

The items in the questionnaire were formulated at the group level and referred to the project phase preceding the specific data collection point, except at Time 1 when the items were related to the students' expectations for the whole of the group project. Respondents were asked to indicate to what extent a particular group characteristic, task characteristic, or work approach was applicable to his or her group. Response formats ranged from 1 = not at all to 5 = to a very high degree, unless indicated differently below. For all constructs measured, a higher score indicates a higher applicability to the group and its functioning. Cronbach's alphas, indicating the internal consistency of the scales, are presented in Table 2.1.

Time Pressure. Time pressure was measured at Time 1 using four items of the subscale "perceived workload" of the 'Vragenlijst Beleving en Beoordeling Arbeid', a Dutch instrument for measuring psychosocial workload and stress (Van Veldhoven, Meijman, Broersen & Fortuin, 1997). Respondents were asked to what extent they thought the group would experience time pressure in this project. Because the original scale referred to the individual level, the formulations of the items were adapted to the group level. An example of the items is: "To what extent, do you expect your group will have to do too much work in the time available" (see appendix A for all questionnaire items).

Group potency. Group potency was measured at Time 1, Time 2, and Time 3. Considering the total length of the questionnaire, we selected five items that were relevant to this sample from an eight-item scale for group potency by Guzzo et al. (1993). Examples of the items are: "This team has confidence in itself" and "This team believes it can become unusually good at producing high-quality work". Because the variable distributions diverged from the normal distribution at Time 2 and Time 3 (skewness resp.: -1.33 and -.91; kurtosis resp.: 3.02 and 1.84), distributions were corrected using log linear transformation (Tabachnick & Fidell, 1996). As a result, scores now ranged from 0 to 1, with higher scores indicating higher group potency.

Planning. Seven items were used to measure execution planning as the formulation of specific goals, tasks, and time frames for project execution. The measure is largely based on Tripoli's (1998) scale for anchored planning. Because that scale referred to the individual level the formulations of the items were adapted to the group level. Furthermore, three additional items were formulated to measure

prioritization and task allocation. Examples of the items used are: "To what extent did your group lay out subgoals to accomplish along the way?" and "To what extent did your group plan who should do what?". Planning was measured at Time 2 and Time 3. At Time 3, the variable distribution diverged from normality (skewness = -1.20; kurtosis = 3.04), which was corrected by means of a log linear transformation (Tabachnick & Fidell, 1996). Scores on this variable now range from .52 to 1.00, with higher scores indicating more planning.

Reflexivity. Reflexivity was measured at Time 2 and Time 3 using the Dutch translation (Schippers et al., 1999) of the reflexivity scale described by Swift and West (1998). Although the scale originally consisted of eight items, we omitted one of these items in our questionnaire because of ambiguity in its formulation. Examples of the items we did use are: "To what extent did your project group discuss whether you were working effectively together?" and "To what extent did your project group discuss how well information is communicated by the group?".

Project progress. Project progress was measured at Time 2 and Time 3 using ten subtasks formulated in the project assignment. Examples of subtasks are "problem definition", "plan for quick scan", "in-depth analysis" and "final report" (see Appendix A for all items). Respondents were asked to indicate the extent to which each of the subtasks was completed, on a scale from 0 to 100 percent. Each subtask accounted for 10 percent of the total work package, and the project was therefore fully completed when all 10 subtasks were 100 percent accomplished. At Time 3, the variable distribution was skewed (skewness = -1.44; kurtosis = 3.48), which was corrected by means of a square root transformation, following the guidelines of Tabachnick and Fidell (1996). Whereas the original scale ranged from zero up to 100, the scale after transformation ranged from 0 to 5, with higher scores indicating a higher level of project completion.

Data-analysis

The data were analyzed at the group level, testing hypotheses at a one-tailed significance level of .05 (alpha). For each variable, individual scores were aggregated to group mean scores based on high levels of intra-group agreement (see Table 2.1, $\overline{R}_{wg(j)}$; James, Demarée & Wolf, 1984). The $R_{wg(j)}$ (James, Demarée, & Wolf, 1984)

Table 2.1. *Means, standard deviations, distributions, intercorrelations, and internal consistencies of the variables*

	M	*SD*	*S*	*K*	$\overline{R}_{wg(j)}$	1	2	3	4	5	6	7	8	9
Time 1														
1. Time pressure	3.48	0.33	-.41	-.30	.92	**.66**								
2. Group potency	3.51	0.31	.40	-.18	.95	.11	**.75**							
Time 2														
3. Group potency	0.81	0.11	-.41	.79	.94	.09	.56	**.82**						
4. Planning	3.32	0.36	-.39	-.52	.94	-.34	.01	.29	**.76**					
5. Reflexivity	2.83	0.32	.54	-.40	.85	-.17	.39	.43	.27	**.82**				
6. Progress	40.83	9.36	.09	-.60	.93	-.14	-.28	-.01	-.06	-.15	-			
Time 3														
7. Group potency	0.78	0.10	-.03	.72	.95	-.10	.28	.58	.25	.02	.26	**.81**		
8. Planning	0.80	0.11	-.21	.65	.94	-.11	.41	.35	.37	.19	.37	.68	**.75**	
9. Reflexivity	2.76	0.47	-.60	.69	.90	-.12	.43	.28	-.02	.43	-.17	.37	.52	**.78**
10. Progress	3.48	1.29	-.33	-.54	.98	-.26	.15	.06	.15	-.22	.09	.53	.52	.48

Note. N=22. All correlations above .35 are significant at $p < .05$ (one-tailed); Internal consistencies of the scales (α), as measured at the individual level, are presented in bold printing on the diagonal. *M* = means; *SD* = Standard deviation; *S* = Skewness; *K* = Kurtosis; $\overline{R}_{wg(j)}$ = mean interrater reliability.
Raw distributions of transformated data: Group potency T2: *M* = 3.50; *Sd* = 0.43; Group potency T3: *M* = 3.55; *Sd* = 0.44; Planning T3: *M* = 3.49; *Sd* = 0.44; Progress T3: *M* = 93.04; *Sd* = 7.25.

ranges from 0 to 1, indicating complete disagreement versus complete agreement among group members. Values of .70 or above are considered adequate (George, 1990; George & Bettenhausen, 1990). Due to the limited number of groups included in the study, hypotheses 1 and 2 could not be tested in one model, so we performed one hierarchical multiple regression analysis for each hypothesis separately. Moderators were tested following the guidelines of Baron and Kenny (1986). All analyses were performed with and without the data transformations. As this did not reveal any substantial differences, only the results of the analysis on the transformated data are presented in the following section.

2.4 Results

Table 2.1 presents the alphas, distributions, intercorrelations, and internal consistencies of all variables in the study. The overall means of potency, planning, and reflexivity appear fairly stable over the course of the project (the raw means of the transformated data are presented in the subscript of Table 2.1), but the standard deviations seem to increase somewhat, indicating that there may be larger differences between groups in later project stages. The fact that the intercorrelations are generally low suggests that the variables represent different constructs. In consideration of the high correlation between reflexivity and planning at Time 3, we tested the discriminant validity in a confirmatory factor analysis using LISREL 8.30 (Jöreskog & Sörbom, 1996). By means of a Chi-square difference test, we tested whether a one-factor model fitted the data better than a two-factor model (Bollen, 1989). The results of the test, as presented in Table 2.2, indicated that the two-factor is significantly better fit than the one-factor model ($\Delta\ \chi^2 = 64.67$; $df = 1$; $p = .000$), thereby confirming the conceptual difference between planning and reflexivity.

Table 2.2. *LISREL fit measures for the discriminant validity of planning and reflexivity*

	χ^2	*df*	*p*	RMSEA	CFI	AIC
One-factor	146.57	76	.00	.11	.74	204.67
Two-factor	81.90	75	.27	.04	.93	141.90
Difference	64.67***	1				

*** $p < .001$

Hypothesis 1 predicted that group potency is a moderator for the effect of time pressure on the progress groups make in the orientation phase of the project. Table 2.3 presents the results of the hierarchical multiple regression analysis we performed to test the hypothesis. The results show that there were no direct effects of time pressure on project progress in the orientation phase. However, the significant interaction effect indicates that the effect of time pressure on project progress was indeed moderated by group potency (β = .48; ΔR^2 = .18; p < .01). The interaction effect is depicted in Figure 2.1.

Table 2.3. *Hierarchical multiple regression analysis for the effects of time pressure, group potency at T1 and their interaction term on project progress at T2*

Variable	*B*	*SE B*	β	R^2	*adj.*R^2	ΔR^2
Step 1						
Intercept	40.83	2.00				
Time pressure T1	-1.01	2.06	-.11			
Potency T1	-2.49	2.06	-.27	.09	-.01	.09
Step 2						
Intercept	40.36	1.85				
Time pressure T1	-2.51	2.02	-.27			
Potency T1	-3.66	1.97	-.39			
Time pressureT1 x Potency T1	4.51	2.12	.48**	.27	.15	.18**

Note. N = 22. Time pressure and potency have been standardized to z-scores to avoid multicollinearity.
**p < .01 (one-tailed).

Figure 2.1 shows that the progress made by groups with high levels of potency was hardly affected by the amount of time pressure anticipated by these groups. Low potency groups, however, made far more progress when they expected the level of time pressure in the project to be low than when they anticipated having to work under high levels of time pressure. Thus, our first hypothesis is only partially confirmed. In the orientation phase, high time pressure did not have the hypothesized positive effect on project progress for high potency groups, but it did have the expected detrimental effect on the progress made by low potency groups.

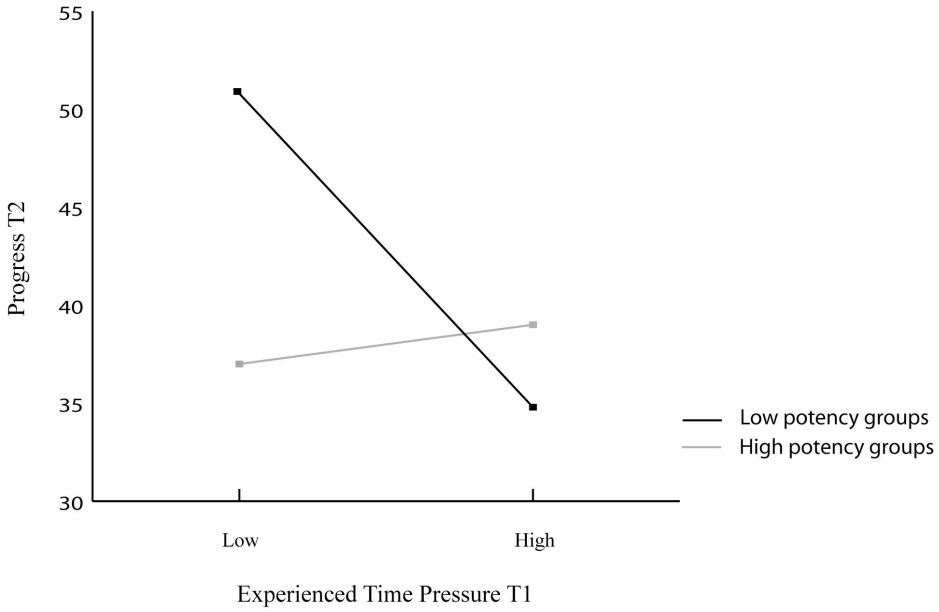

Figure 2.1. The effect of time pressure on progress in the orientation phase for low and high potency groups[1]

Hypothesis 2 assumed that, depending on a group's sense of potency, making little progress in the orientation phase can have either a positive or a negative effect on a group's progress in the execution phase. The lack of progress may motivate high potency groups to catch up and make sure the work is finished on time. For low potency groups the backlog may make the task seem even more difficult, affecting performance in a negative way. This hypothesis was tested in a second hierarchical multiple regression analysis. The results are reported in Table 2.4.

As predicted, the effect of progress in the orientation phase on progress in the execution phase was indeed moderated by group potency (β = -.71; ΔR^2 = .38; p < .001). The interaction effect is depicted in Figure 2.2. The figure shows that, for high potency groups, the smaller the progress in the orientation phase, the more work was actually finished at the deadline. For low potency groups the effect is reversed: the more progress they made in the orientation phase, the more work was finished at the deadline. Herewith, our second hypothesis is confirmed. While making a limited amount of progress in the orientation phase facilitated the performance of high potency groups, it impeded the performance of low potency groups.

[1] Figure 1 and Figure 2 depict the regression lines between one standard deviation below and above the means of the independent variables.

Table 2.4. *Hierarchical multiple regression analysis for the effect of progress and group potency at T2 and their interaction term on project progress at T3*

Variable	*B*	*SE B*	*β*	R^2	*adj.*R^2	ΔR^2
Step 1						
Intercept	3.48	.28				
Progress T2	-.12	.29	-.09			
Potency T2	.08	.29	.06	.01	-.09	.01
Step 2						
Intercept	3.46	.23				
Progress T2	-.55	.27	-.42			
Potency T2	.24	.24	.19			
Progress T2 x Potency T2	-1.38	.41	-.71***	.39	.29	.38***

Note. N = 22. Progress T2 and Potency T2 have been standardized to z-scores to avoid multicollinearity.
***p < .001 (one-tailed).

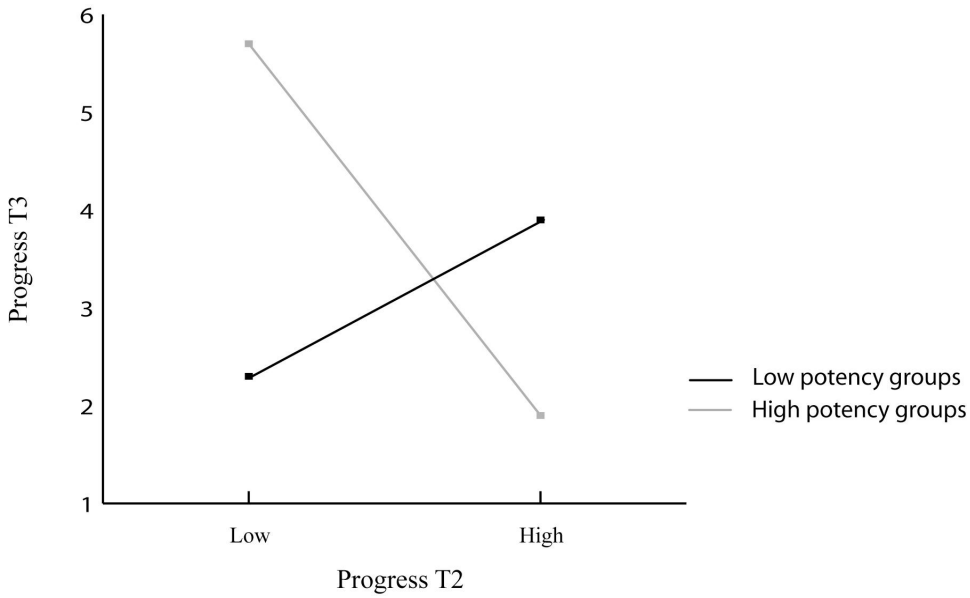

Figure 2.2. The effect of progress in the orientation phase on progress in the execution phase for low and high potency groups

Hypothesis 3 addressed the relationship between planning and performance in project groups. We assumed that planning would relate positively to progress in the execution phase, but not in the orientation phase. This hypothesis was examined using the correlations from Table 2.1. At Time 2, representing the orientation phase,

planning was not associated with progress (r = -.06, ns). At Time 3, the execution phase, there was a positive relationship between planning and progress (r = .52, p < .01). Our hypothesis is thereby confirmed.

According to Hypothesis 4, reflexivity would be associated with more project progress in the orientation phase as well as the execution phase. In contrast to our expectations, reflexivity did not relate to progress in the orientation phase (r = -.15, ns). In the execution phase, however, we do find the expected positive relationship between reflexivity and progress (r = .48, p < .05). Our last hypothesis, therefore, is only partially confirmed.

2.5 Discussion

The objective of this study was to examine the effects of potency and team self-regulatory behavior on progress in project teams. We expected these effects to be contingent upon project stages. Therefore, we studied the effects of time pressure, group potency, planning and reflexivity on progress in the orientation phase and the execution phase of the project. As anticipated, our findings suggest that progress in project groups does not result from simple direct relationships, but originates from a combination of factors influencing project performance. In addition, the study provides evidence for the presumed differential effects for the two project phases.

First, the study shows the importance of group potency in shaping the influence of time pressure on project progress. As predicted, high time pressure hinders effective and timely performance of low potency groups. In the orientation phase, these groups do not make as much progress if they perceive the task to be associated with high levels of time pressure. In the execution phase, their progress is again negatively affected by the backlog from the orientation phase. In contrast with our expectation, high time pressure does not enhance performance for high potency groups in the orientation phase. However, for these groups, a backlog from the orientation phase has a positive effect on their performance in the execution phase.

Evidently, high and low potency groups react differently to high levels of time pressure. Whereas the performance of low potency groups is negatively affected by high levels of time pressure from the orientation phase onward, high potency groups remain unconcerned with it until the execution phase. We explain these effects in presuming that, in the orientation phase, low potency groups are discouraged by high levels of time pressure, which probably leads them to procrastinate, resulting in

limited progress. At this stage, high potency groups seem unconcerned with the time pressure, making equal amounts of progress under low and high levels of perceived time pressure. We argued that both low and high potency group may procrastinate in the orientation phase - be it for different reasons -, which results in a backlog and leads to higher levels of time pressure in the execution phase. As expected, we find different reactions to such a backlog and rising time pressure in the execution phase for low and high potency groups. At this stage, high potency groups are challenged by the rising time pressure, and they manage to make up the arrears. Apparently, they have the capability to give priority to other activities and still make sure that the project is completed on time. This strategy does not work for low potency groups. For them, the backlog makes their task so difficult that they fail to meet the project deadline, presumably because they lack the capability to work quickly under high time pressure.

Second, our findings also indicate that team self-regulatory behavior may contribute to project progress. However, this applies primarily in the execution phase. As predicted, execution planning showed a positive relationship with group performance in the execution phase, but not in the orientation phase. This is in accordance with Weingart's (1992) and Tripoli's (1998) perspective that detailed planning of task execution is useful for coordinating group activities only after clarity about goals and circumstances is established. Nevertheless, other types of planning, like planning goals, prioritizing, and contingency planning, may still be of importance to group performance in the orientation phase of a project.

Finally, as with planning, our findings also demonstrate a positive relationship of reflexivity with project progress. The collective reflection upon group activities, working processes and project progress, and the adequate adaptation of these strategies and processes, relates positively to timely performance, at least in the execution phase. We were unable to justify our assumption that reflexivity would also be related to project performance in the orientation phase. Looking at the overall level of reflexivity at the orientation phase (Table 2.1, $M = 2.83$, $Sd = 0.32$), we think that all groups tend to be highly reflexive at this stage of the project. This may well result from the specific nature and purpose of the orientation phase. Nevertheless, we may conclude that it is the continuation of reflexivity in the execution phase that is truly important for timely group performance. Schippers et al. (1999) address the changes in the focus of reflection in different project stages. In the orientation phase, reflection

is characterized by the joint consideration of the nature of the problem, the goals, and the strategies. In the execution phase, groups review whether they are still on track, whether the problem is being dealt with in a proper way, and how to accomplish task completion within the time available. From this we conclude, that it is not merely reflexivity, but the specific attentiveness to task progression, time limitations and ways to cope with them, that make some groups meet their deadline where others do not.

Based on these findings our knowledge of the factors influencing progress across different stages of group projects has been extended in several ways. First, the study shows that high and low potency groups react differently to high time pressure. Low potency groups are very susceptible to negative effects of high levels of time pressure in both the orientation phase and the execution phase. High potency groups, on the other hand, seem unconcerned with time pressure until it becomes really serious, and at that point they get motivated by it. For practice, these findings imply that putting high time pressure on project groups may promote performance in high potency groups, but low potency groups are likely to perform better under ample time conditions. Whenever working under high time pressure is inevitable, the project manager should pay special attention to stimulating group potency and finding alternative ways of motivating low potency groups than by stressing timeliness.

Second, in contrast with the findings on individual projects, this research suggests that execution planning may contribute to project performance, provided that the members have a clear view of the project goals and circumstances. In addition, we conclude that reflexivity may enhance timely performance, at least if it is continued in the execution phase. Speculating on the presumed causality of these relationships, we would recommend practitioners to make time available for in-process planning and reflexivity in all phases of the project. We expect that, especially under high time pressure conditions, the continuation of reflexivity, with particular attentiveness to time limits and how plans should be adapted to enhance task progression, will facilitate timely project completion.

In generalizing the results from this study to real world project teams, some limitations of the present study should be addressed. First, as the research is based on self-report measures, it is difficult to determine the extent to which, for instance, reports of project progress reflect true characteristics. A respondent could mistakenly assume his group made a lot of progress because they engaged in a lot of planning and

conferencing. We acknowledge that the study would have been stronger if external assessment of progress had been made. However, having multiple raters from the same group providing very detailed reports on project progress, gives some credence to the reliability and validity of the data. In a similar manner, potency equates to perceived ability. Although we expect group potency to be positively associated with actual group abilities, future research should investigate both constructs in order to distinguish between the effects of group confidence and the effects of true competences on project progress.

Second, it should be noted that the number of groups studied was limited and concerned student project groups. Therefore, we should consider the differences between 'educational' projects such as the ones included in this study, and projects in the 'real' world. Although the acquisition and project initiation phase was omitted in this study, we acknowledge that, in real world organizational settings, this phase is often of great importance to project success and timeliness. Poor decisions and agreements made in this phase may confront project groups with unachievable project goals and unrealistic time scales that make successful and timely project completion practically impossible. In addition, the projects in our study took place under reasonably predictable circumstances, whereas many projects in organizational contexts are characterized by turbulence and uncertainty. Even though we have established the relationship between planning and project progress under predictable circumstances, it remains unclear to what extent planning relates to project progress in more dynamic organizational circumstances.

Without a doubt, these findings need to be replicated in a larger sample of project groups in a natural work-related setting in order to establish their validity for daily real world project group practices. However, despite the relatively small sample size, we have been able to demonstrate clear relationships between group processes and the timeliness of project group performance.

Chapter 3

Meeting Deadlines in Project Teams: The Role of Shared Temporal Cognitions*

Chapter 3 presents the results of a longitudinal study involving 31 student project teams working on two consecutive tasks. This study was conducted to examine the effect of shared temporal cognitions on meeting deadlines as it is moderated by the pacing styles of the team members. In addition, we test the assumption that both implicit and explicit mechanisms may contribute to shared temporal cognitions by exploring two antecedents of shared temporal cognitions: the similarity in team members' pacing styles and the exchange of temporal reminders.

Although deadlines are important time markers in organizational life (McGrath & O'Connor, 1996), many project teams appear to have difficulty meeting them. In a survey among 91 managers of project teams (Tukel & Rom, 1998), 56% indicated that deadlines are often exceeded or missed. Meeting deadlines is an important aspect of group performance, but relatively little research has been conducted on this particular aspect, although some studies addressed it explicitly (Gersick, 1988; 1989; Waller, Giambatista, & Zellmer-Bruhn, 1999; Waller, Zellmer-Bruhn, & Giambatista, 2002).

* This chapter is based on: Gevers, J. M. P., Rutte, C. G., & Van Eerde, W. (2004). Meeting deadlines in work groups: The role of shared temporal cognitions. Manuscript submitted for publication.

Meeting deadlines in group projects involves intra-group synchronization and external synchronization (McGrath & O'Connor, 1996), which means that members have to accommodate to each other's actions, as well as to the deadline to make sure that the intended output is delivered on time. In many projects, schedules and deadlines are used to facilitate synchronization. Schedules and deadlines specify who is supposed to do what, when tasks should be completed, and how the combination of individual efforts should ultimately produce the desired end product. As such, they reduce ambiguity and increase the likelihood that team members coordinate their actions effectively. However, it can be argued that a smooth flow of work can only be established when all members acknowledge, accept, and adhere to these schedules and deadlines. Hence, we believe that team members must internalize the meaning of schedules and deadlines to hold shared cognitions regarding the temporal aspects of task execution.

In this chapter, we aim to investigate the role of shared temporal cognitions in regulating team processes toward meeting project deadlines. Although several studies have demonstrated that shared cognitions facilitate team performance (Cohen, Mohrman, & Mohrman, 1999; Mathieu, Heffner, Goodwin, Salas, & Cannon-Bowers, 2000; Rentsch & Klimoski, 2001), questions remain about which cognitions need to be shared to improve particular aspects of team performance (Cannon-Bowers & Salas, 2001). We suggest that to improve meeting deadlines, it will be helpful when members share cognitions about the temporal aspects of task execution, such as deadlines, schedules, and task completion times.

In addition, we explore antecedents of shared temporal cognitions. We suggest that both implicit and explicit mechanisms may contribute to shared temporal cognitions. Blount and Janicik (2002) have produced valuable work studying individual preferences for the use of time in relation to intra-group synchronization. We build on their research to suggest that shared temporal cognitions may arise when team members have similar pacing styles. Because we assume that this process takes place without conscious effort, we refer to it as an implicit mechanism toward shared temporal cognitions. Furthermore, we build on prior research on attention to time in work groups (Gersick, 1988; 1989; Waller et al., 1999) to suggest that group members may also develop shared temporal cognitions when they remind each other of important temporal aspects of a task. We assume that temporal reminders constitute a more intentional attempt to align team members' temporal cognitions, and therefore

refer to it as an explicit mechanism toward shared temporal cognitions. Finally, because we used a longitudinal research design, we were able to determine how these relationships changed over time in groups that continued to collaborate on a follow-up task.

3.1 Shared Temporal Cognitions

We define shared temporal cognitions as the extent to which team members have congruent mental representations of the temporal aspects of their collective task, such as the importance of meeting the deadline, (sub)task completion times, and the appropriate timing and pacing of task activities (Gevers, Rutte, & Van Eerde, 2004). Cognitions are shared when team members have common or overlapping views regarding these temporal aspects of task execution, which does not necessarily mean that they have actively discussed them (Thompson & Fine, 1999). We suggest that shared temporal cognitions help team members to anticipate and understand each other's actions, and to adopt more compatible work patterns. This, in turn, will enhance the coordination of task activities and benefit team performance, meeting deadlines in particular.

We base this reasoning on a large body of work concerning the role of shared cognitions in regulating teamwork. Theory on shared cognitions and related constructs, such as shared mental models (Cannon-Bowers, Salas, & Converse, 1993; Klimoski & Mohammed, 1994), team schema similarity (Rentsch & Hall, 1994), transactive memory (Wegner, 1995), and shared understanding (Cohen et al., 1999) states that cognitive congruence in work groups enhances team performance through a positive effect on team processes. Shared cognitions are assumed to enhance team members' accurate expectations of task execution, and behavioral adaptations to the needs of the task and other team members (Cannon-Bowers et al., 1993).

Empirical research has indeed shown that shared cognitions among team members improve team processes and, consequently, team performance (Cohen et al., 1999; Mathieu et al., 2000; Rentsch & Klimoski, 2001). However, the timeliness of performance has not been studied in this respect. Here, we set out to determine the value of shared temporal cognitions for meeting deadlines. Before we elaborate on the role of shared temporal cognitions in regulating team processes towards meeting a deadline, we discuss antecedents of shared temporal cognitions.

3.2 Antecedents of Shared Temporal Cognitions

We assume that both implicit and explicit mechanisms have the potential to contribute to shared temporal cognitions in project teams, in the sense that shared temporal cognitions may be due to common individual cognitions prior to group interaction, or that these may be generated in group communication. We suggest that shared temporal cognitions emerge without team members consciously making an effort to align cognitions when group members have similar pacing styles. The second mechanism we propose is more intentional, in that group members can develop shared temporal cognitions by reminding each other of important temporal aspects of a task.

Similarity in Pacing Styles

People tend to anticipate a particular rate in the progression of events and activities over time. In work settings, for instance, people have preferences for the speed of their work processes and for the way in which these processes are spaced over time (Blount and Janicik, 2002). These so-called pacing preferences represent a person's preference for the allocation of time in task execution under deadline conditions. While some people prefer a steady work pace and tend to spread out task activities evenly over time, others have a preference for working under the pressure of the deadline and wait until it comes very near before they start working on the task. The latter may be due to the discounting effect, expressed as a preference for short-term outcomes over long-term outcomes (see Koch & Kleinmann, 2001, for a discussion of discounting in relation to time management; Loewenstein & Thaler, 1997; Loewenstein & Prelec, 1993). Still others may want to finish a task as soon as possible and choose to take action as soon as possible, and are less active just before the actual deadline.

Some people claim that they prefer to start working on a task early, but acknowledge that, for whatever reason, they never do. Hence, we prefer to use the term pacing style to refer to the way an individual generally uses his or her time under deadline conditions. Thus, a person with an early action pacing style generally starts task activities early to finish long before the deadline, while a person with a deadline action pacing style does most of the work in a relatively short period of time just before the deadline.

We conceptualize pacing style as a relatively stable and general personal characteristic related to the allocation of time in task performance. Although there is a

fair amount of research on time-related individual characteristics (for an overview, see Francis-Smythe & Robertson, 1999), little is known about how these characteristics affect group performance. Waller and colleagues (Waller, Giambatista, & Zellmer-Bruhn, 1999) demonstrated that the presence of one time-urgent individual increases the group's focus on its primary task activity. Blount and Janicik (2002) found that negotiating partners were more effective in, and more content with, their interactions when they had similar preferences for the pace of their negotiation. These findings suggest that time-related individual differences may influence group processes and group performance.

The interactionist approach to personality-performance relationships suggests that personality traits are expressed in work behavior as responses to trait-relevant situational cues (Tett & Burnett, 2003). When confronted with a trait-relevant situational cue, individuals respond in a manner that reflects their standing on this particular trait. Situational cues may be located at the organizational level, at the group level, or at the task level. We assume that a deadline constitutes a task-level situational cue that is relevant to the expression of pacing styles. When a group is introduced to a group task with a particular deadline, individual members will redefine the objective task according to their personal wishes and opportunities (Hacker, 1982), also with respect to its temporal aspects. Assuming that a deadline evokes the expression of pacing styles, member's interpretations of the task and its temporal aspects are likely to reflect their individual pacing styles. Consequently, members with similar pacing styles are more likely to arrive at similar perspectives on the task and its temporal aspect than members with different pacing styles, even without talking about it. Hence, we hypothesize that similarity in pacing styles will positively affect the level of shared temporal cognitions established within the team.

> *Hypothesis 1. Similarity in individual pacing styles among group members will have a positive effect on the level of shared temporal cognitions in project teams.*

Temporal Reminders

Monitoring group performance is an essential part of group regulation (Carver & Schreier, 1990). West (1996) argues that work groups build a more comprehensive and shared cognitive representation of their work, also with respect to time-use, when team members monitor their task accomplishments and discuss the need for adaptive actions. Several studies have demonstrated that monitoring progress and discussing time-related issues are important mechanisms in regulating group pacing (Chang, Bordia, & Duck, 2003; Gersick, 1988, 1989; Waller, Giambatista, & Zellmer-Bruhn, 1998; Waller, Zellmer-Bruhn, & Giambatista, 2002). Specifically, these studies have identified attention to time as a catalyst of group task activity because groups tend to use the elapse of allotted time as a metric to evaluate task progress and to initiate adaptations in work group processes. One way group members may draw attention to time is by using temporal reminders. For example, group members may remind each other of deadlines and urge one another to stick to task schedules to make sure that subtasks are completed on time.

One could argue that temporal reminders will not benefit shared temporal cognitions because they may increase awareness of the differences in how group members think about time and lead to group conflict. That is, focusing attention on the differences in group members' time perspectives may actually draw group members apart and lead them to form coalitions (Blount & Janicik, 2002), instead of bringing them closer to a shared vision. However, talking about time in task groups has been shown to facilitate the establishment of temporal norms (Janicik & Bartel, 2002) and to focus group task activity (Waller, Giambatista, & Zellmer-Bruhn, 1999), This suggests that temporal reminders may actually stimulate members who tend to underestimate the importance of particular temporal milestones, or who disregard intended work schedules, to align their view on the allocation of time in task performance with that of other group members. Hence, we expect that temporal reminders are more likely to have a positive effect than a negative effect on shared temporal cognitions.

> *Hypothesis 2. The exchange of temporal reminders will have a positive effect on the level of shared temporal cognitions in the project team.*

Longitudinal Effects of Similarity in Pacing Styles and Temporal Reminders

The impact of similarity in pacing styles and temporal reminders on group members' temporal cognitions may change when groups continue to collaborate on a subsequent task. In a second collaboration on a similar task, members will have learned about the task demands and about team members' abilities to deal with these demands. In addition, groups will have experienced success or failure using a particular temporal approach. This makes the second collaboration much clearer and stronger situation than the first collaboration. According to the interactionist approach to personality-performance relationships, strong situations tend to negate individual differences in response tendencies by their clarity (i.e., because everyone construes them in the same way, everyone tends to behave the same way in them) (Tett & Burnett, 2003). Hence, the choice to continue in the same manner or to change the temporal approach on the follow-up task will more likely be based on previous experiences than on general pacing styles. Thus,

> *Hypothesis 3. The effect of similarity in individual pacing styles on the level of shared temporal cognitions will be weaker when groups work together on a second task.*

The role of temporal reminders may also change over time. When group members perform a task for the first time, temporal reminders will draw attention to the temporal aspects of the task and these may help team members to reach shared temporal cognitions. On a follow-up task, this effect may wear off. Because team members are familiar with the task and everyone knows what to do, temporal reminders may lose their value or members may become resistant to each other's comments regarding the use of time in task execution. However, the effect of temporal reminders may also become stronger in a second collaboration. After all, when groups perform a particular task for the first time, members do not know that temporal aspects may be problematic in their group. Temporal reminders in this stage could be regarded as excessive and unnecessary. On a follow-up task, when groups have experienced temporal problems, temporal reminders are more likely to be considered justified and members may become more open to each other's comments. Since there is no literature on the effect of temporal reminders over time, it is hard to say which scenario is more plausible. Therefore, we formulate an open research

question to investigate changes in the relationship between temporal reminders and shared temporal cognitions over time.

> *Research question. Does the relationship between temporal reminders and shared temporal cognitions change from the first to the second collaboration among group members?*

3.3 The Effect of Shared Temporal Cognitions on Meeting Deadlines

We propose that there is no direct relationship between shared temporal cognitions and meeting a deadline. Shared cognitions will only influence group processes in a positive way if the content of the similar cognitions is functional (cf. Rentsch and Hall, 1994). That is, shared temporal cognitions will only facilitate meeting the deadline when these cognitions are in line with the temporal demands of the task. When all group members underestimate the duration of the project or consider the deadline unimportant, sharing these cognitions is more likely to impede their ability to complete the task on time. These groups would probably be better off with one or two members with diverging perceptions on time, who might promote a more appropriate allocation of time in task execution (cf. Waller et al., 1999).

Therefore, we expect that the influence of shared temporal cognitions on meeting a deadline is dependent upon the pacing styles of the members. That is, not only should temporal cognitions be shared to a high degree, but also should the pacing styles of the members be conducive to meeting the deadline. We assume that a group is more likely to miss the deadline when the members generally start task activities late, i.e., have a deadline action pacing style, and agree on how to use time, i.e., have shared temporal cognitions. These shared cognitions will lead to missing deadlines more often, because groups that start late will not have much time left to compensate for overly optimistic estimates of task completion times (Buehler, Griffin, & Ross, 1994), or to correct errors or mismatches between individual parts of the group work. If, however, the group members, on average, start working on the task early, i.e., have an early action pacing style, sharing temporal cognitions will enhance meeting the deadline.

Hypothesis 4. Shared temporal cognitions have a positive effect on meeting deadlines when group members, on average, tend toward an early action pacing style, but they have a negative effect on meeting deadlines when group members, on average, tend toward a deadline action pacing style. Thus, the team pacing style moderates the effect of shared temporal cognitions on meeting deadlines.

3.4 Method

Procedure and Participants

We tested our hypotheses in a longitudinal study of 38 groups of industrial engineering students in the Netherlands. Groups consisted of three to five members who were rather homogeneous with respect to age (between 21 and 25), gender (predominantly male) and educational background (2nd year in industrial engineering). The group work was part of a compulsory course on business modeling techniques. Students were allowed to sign up for group membership, which most of them did. Incomplete groups were assigned additional members by the course instructor.

The groups worked together over the course of eight weeks to complete two assignments that involved applying a particular modeling technique to two cases and writing a report on each case. They worked on one assignment at a time and had to finish each with a report after four weeks. The groups received a grade for each assignment and these were averaged to determine the final course grade. Group members were allowed to re-allocate the total of their grades to reward individual contributions. Grades for the first assignment were known to the group before they started working on the second assignment.

Over the total working period of eight weeks, we administered four questionnaires. Halfway through the working period for each assignment (after week 2 for Assignment 1 and after week 6 for Assignment 2), we asked the respondents about their individual pacing styles, to what extent they had shared temporal cognitions, and to what extent group members used temporal reminders. One day after the deadline for the assignments (after 4 weeks for Assignment 1 and after 8 weeks for Assignment 2), we asked members when they had completed their work on the task. Thus, all variables were measured twice, once for Assignment 1 and once for Assignment 2. In the following, we will denominate all data collected during Assignment 1 as Time 1, and those collected during Assignment 2 as Time 2.

Questionnaires were administered via e-mail. We received at least one completed questionnaire from 80% of the respondents, 27% of the respondents completed all four questionnaires. For the analyses, we selected groups of which at least 50% of the group members provided data on their individual pacing style. As a result, our final sample consisted of 31 groups.

Measures

With the exception of our measure for pacing styles, all questionnaire items were formulated at the group level (all measures are provided in Appendix A). We aggregated individual scores to group mean scores based on high levels of intra-group agreement (see Table 3.1, $\overline{R}_{wg(j)}$; James, Demarée, & Wolf, 1984).

Shared temporal cognitions. Shared temporal cognitions were assessed with four items that asked participants to rate the extent to which group members had shared cognitions regarding the temporal aspects of task execution, such as agreement on how to use their time. Responses were provided on a 5-point response scale (1 = *disagree completely*, 5 = *agree completely*). Because the variable distribution diverged from the normal distribution at both measurement points (skewness: -1.13 and –1.38, respectively; kurtosis: 1.53 and 3.55, respectively), distributions were corrected using logarithmic transformation (Tabachnick & Fidell, 1996). As a result, scores ranged from 0 to 1, with higher scores indicating higher levels of shared temporal cognitions. Analyses were conducted on the transformated scores. Cronbach's alpha, a measure for the internal consistency of the scale was .74 and .73 for T1 and T2 respectively.

Pacing style. We conceptualized the construct of pacing style as a relatively stable individual difference variable relating to the use of time when performing a particular task or project under deadline conditions. We constructed a scale of pacing styles with five graphs, representing different styles of time-use, and asked respondents to choose the graph that represented their personal style.

Each graph represented a particular rate of task activities to progress up to the deadline. We adapted these graphs from Lim and Murnighan (1994) and Blount and Janicik (2002): We selected some of their examples of pacing patterns showing steady or increasing activity over time and complemented them with pacing patterns that show a decrease in task activity over time. The first graph in the scale represented the

early action pacing style, an individual's tendency to start and finish task activities as soon as possible. The third graph was the *constant action pacing style*, indicating a person's tendency to work steadily on a task, spreading it out evenly over time. The fifth graph represented the *deadline action pacing style*, showing the temporal approach of an individual who does most of the work in a relatively short period of time just before the deadline. The intermediate graphs, two and four, showed moderate tendencies toward the early action pacing style or the deadline action pacing style. Together these five graphs represented a range of possible styles regarding the pace, i.e., the acceleration or deceleration of one's task activities over time.

We administered the measure twice to establish test-retest reliability, which was adequate (r = .53; p < .001), averaged the two scores, and calculated the mean pacing style for each group. The lower the *group mean score*, the more group members, on average, tend to use an early action pacing style in task execution; the higher the group mean score, the more group members, on average, tend toward a deadline action pacing style. The standard deviation was used to determine the level of similarity in group members' pacing styles within the group. Finally, we converted these *similarity scores* so that higher scores represented more similarity in group members' pacing styles.

Additionally, we assessed the construct validity of our pacing style scale in a separate validation study. In this study, 121 students completed a questionnaire assessing their pacing style, individual orientation towards time and deadlines, and the Big Five factors of personality (using the Five Factor Personality Inventory, Hendriks, Hofstee, & De Raad, 1999). The study provided support for the concurrent validity of the mean scores of the pacing style scale, as it revealed that individual pacing style related negatively with conscientiousness (r = -.44, p < .001) and individual temporal norms on punctuality and adherence to schedules and deadlines (r = -.25, p < .01), while it correlated positively with the experience of increased challenge and motivation under deadline pressures (r = .25, p < .01). Individual pacing style showed non-significant relationships to the personality factors Extraversion (r = .13), Emotional Stability (r = -.03), and Agreeableness (r = .11), which indicated discriminant validity. We interpreted these results, in combination with the face validity of the scale, as supportive of the construct validity of this pacing style measure.

Temporal reminders. We used three items to measure the extent to which team members provided each other with temporal reminders, on a 5-point response scale (1 = *disagree completely*, 5 = *agree completely*). Cronbach's alpha was .69 and .75 for T1 and T2 respectively.

Meeting the deadline. Meeting the deadline was assessed with one item that asked participants to indicate when the assignment had been finished. Responses were given on a 3-point response scale (1 = *too late*, 2 = *just in time*, 3 = *in ample time*). The scale had high levels of intra-group agreement ($\overline{R}_{wg(j)}$ = .75 and .82 at Time 1 and Time 2, respectively).

Data Analysis

We analyzed the data at the group level. Due to the limited sample size, our hypotheses could not be combined in an overall path analysis. Instead, we performed four separate analyses. First, we performed a multiple regression analysis to examine whether, and how, similarity in pacing styles and temporal reminders were related to shared temporal cognitions at Time 1. Because within-group standard deviations can be confounded with group average scores (Bedeian & Mossholder, 2000), we used the *team pacing style* as a control variable in all analyses involving similarity in pacing styles.

Second, to test whether the relationships of similarity in pacing styles and temporal reminders with shared temporal cognitions changed over time, we performed a hierarchical regression analysis with two steps, thereby controlling for shared cognitions at Time 1.

Finally, the effect of shared temporal cognitions on meeting deadlines, as moderated by the *team pacing style* was tested at Time 1 and Time 2, using two separate hierarchical regression analyses. In testing the moderator-effect, we followed the guidelines of Baron and Kenny (1986).

3.5 Results

Table 3.1 presents the distributions and intercorrelations for all the variables in the study. The results of the multiple regression analysis that we performed to test these hypotheses are reported in Table 3.2. The results support the first hypothesis that similarity in pacing styles will have a positive effect on shared temporal cognitions in

Table 3.1. *Descriptive statistics and intercorrelations*

	M	*SD*	*S*	*K*	$\overline{R}_{wg(J)}$	1	2	3	4	5	6	7
1. Similarity in pacing styles	0.86	0.40	-0.34	-0.24	--							
2. Team pacing style	3.33	0.47	-0.86	1.73	--	.28						
Time 1												
3. Temporal reminders	3.83	0.39	0.04	-0.74	.86	-.03	-.11					
4. Shared temporal cognitions	3.76	0.56	-1.15	0.39	.88	.25	-.25	-.05				
5. Meeting deadline	2.16	0.48	-0.04	0.17	.75	-.20	-.37*	.23	.07			
Time 2												
6. Temporal reminders	3.86	0.54	0.39	-0.06	.87	-.18	-.36	.49**	.15	.14		
7. Shared temporal cognitions	3.68	0.75	-1.45	4.11	.86	-.13	-.39*	.23	.49**	.20	.51**	
8. Meeting deadline	2.39	0.46	0.18	-1.56	.82	-.21	-.30	-.05	-.16	.60***	.11	-.08

Note. N ranges from 26 to 31. S = Skewness; K = Kurtosis; $\overline{R}_{wg(J)}$ = mean interrater reliability. Descriptive statistics and correlations are based on pairwise missings.
*p < .05, **p < .01, ***p < .001; all p-values two-tailed.

Table 3.2. *Multiple regression analysis for variables predicting shared temporal cognitions at T1*

	Shared temporal cognitions (T1)		
Variable	*B*	*SE B*	*β*
Intercept	1.05	.23	
Team pacing style	-.10	.04	-.42*
Similarity in pacing styles	.11	.05	.40*
Temporal reminders (T1)	-.04	.05	-.15

Note. $N = 31$. $R^2 = .25$ ($p < .05$) *$p < .05$, two-tailed.

the groups' first collaboration ($\beta = .40$; $p < .05$). However, we did not find a significant effect of temporal reminders on shared temporal cognitions at the groups' first collaboration ($\beta = -.15$; *n.s.*). Thus, Hypothesis 2 was supported.

Then, we considered the effects of pacing styles and temporal reminders on shared temporal cognitions as the groups collaborated on a second assignment. We conducted a hierarchical regression analysis. The results of the analysis, as summarized in Table 3.3, provided support for Hypothesis 3. In contrast with Time 1, similarity in pacing styles did not have a significant effect on shared temporal cognitions at Time 2 ($\beta = -.11$; *n.s.*). With respect to the research question whether the relationship between temporal reminders and shared temporal cognitions changes over

Table 3.3. *Hierarchical regression analysis for variables predicting shared temporal cognitions At T2*

	Shared temporal cognitions (T2)		
Variable	*B*	*SE B*	*β*
Step 1			
Intercept	.23	.15	
Shared temporal cognitions (T1)	.65	.22	.50**
Step 2			
Intercept	.11	.31	
Shared temporal cognitions (T1)	.52	.21	.40*
Team pacing style	-.06	.05	-.18
Similarity in pacing styles	.04	.06	-.11
Temporal reminders (T2)	.11	.04	.43**

Note. $N = 29$. $R^2 = .25$ for Step 1($p < .01$); $\Delta R^2 = .30$ for Step 2 ($p < .01$).
*$p < .05$, two-tailed; **$p < .01$, two-tailed.

time, the results show that, as opposed to Time 1, temporal reminders were positively related to shared temporal cognitions at Time 2 ($\beta = .43$; $p < .01$).

Finally, Hypotheses 4 predicted that the effect of shared temporal cognitions on meeting the deadlines would be moderated by the mean pacing style of the group. The results of this analysis at Time 1 are presented in Table 3.4. The model is marginally significant (F (3, 25) = 2, 83; $p = .06$). Seeing that both the proportion of variance explained and the beta weight of the interaction term are substantial, we attribute this to lack of power and consider an interpretation of the beta weights permissible. These indicate that the effect of shared temporal cognitions on meeting the deadline is indeed moderated by the mean pacing style of the group ($\beta = -.36$; $p <$ .05, one-tailed). This moderator effect is depicted in Figure 3.1, showing that sharing temporal cognitions was beneficial to meeting a deadline when group members, on average, had an early action pacing style, whereas it was detrimental to meeting the deadline when group members, on average, had a deadline action pacing style. This moderator effect was not significant at Time 2 ($\beta = -.13$; *n.s.*).

Table 3.4. *Hierarchical regression analysis for variables predicting meeting the deadline at T1*

	Meeting the deadline at T1		
Variable	*B*	*SE B*	β
Step 1			
Intercept	2.16	.09	
Team pacing style (T)	-.18	.09	-.39
Shared temporal cognitions at T1 (S)	-.04	.10	-.09
Step 2			
Intercept	2.11	.09	
Team pacing style (T)	-.13	.09	-.28
Shared temporal cognitions at T1 (S)	.01	.09	-.01
T x S	-.21	.11	-.36*

Note. $N = 29$. $R^2 = .14$ for Step 1 (*n.s.*); $\Delta R^2 = .11$ for Step 2 ($p = .06$).
*$p = .05$, one-tailed.

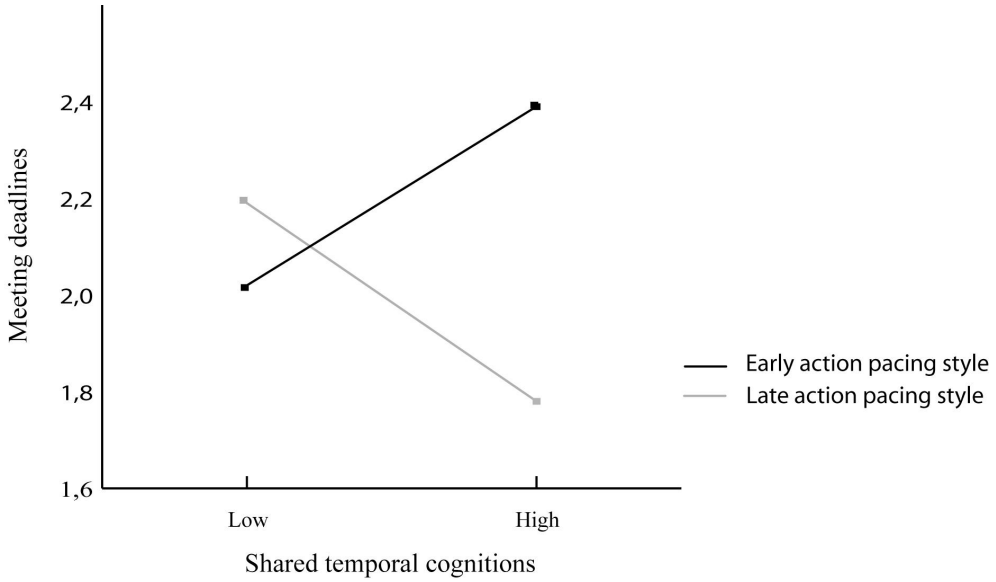

Figure 3.1. Interaction effect of shared temporal cognitions and team pacing style on meeting the deadline at Time 1[2].

Recall that group membership was self-assigned in most groups, but that some groups were put together by the course instructor (this was the case for five groups). Because the method of group assignment could affect the relationships under study, all analyses were also conducted while controlling for self-assignment. The results of these analyses revealed that, although self-assigned groups were more successful in meeting deadlines, this effect was not related to shared temporal cognitions, nor did it affect the relationships between shared temporal cognitions and meeting deadlines.

3.6 Discussion

The purpose of this study was to examine the effect of shared temporal cognitions on meeting deadlines in project teams, and to explore antecedents of shared temporal cognitions. We found that similarity in pacing styles was positively associated with shared temporal cognitions at the group's first collaboration, whereas temporal reminders were not related to shared temporal cognitions at that time. However, temporal reminders showed a positive effect on shared temporal cognitions in the

[2] Figure 1 depicts the regression lines between one standard deviation below and above the means of the independent variables (Aiken & West, 1991).

second collaboration, while, at that time, similarity in pacing preferences was no longer related to shared temporal cognitions.

These findings indicate that both pacing styles and temporal reminders may benefit the emergence of shared temporal cognitions, be it in different stages of group collaboration. Similarity in pacing styles increased the likelihood of a shared view about time allocation when team members worked together on the first task. Moreover, the fact that similarity in pacing styles was irrelevant when groups were more familiar with the task provides support for the interactionists' claim that task conditions may diminish the effect of personal dispositions. Temporal reminders were only related to shared temporal cognitions in the second assignment. A possible explanation for this is that the groups moved from implicit to explicit mechanisms to establish shared temporal cognitions. Possibly, groups needed the first collaboration to realize that shared temporal cognitions would not arise spontaneously, before they started using temporal reminders effectively in the second. However, the overall means of shared temporal cognitions remained stable over time, indicating that there was no overall learning-effect from the first collaboration to the second. Our findings at least show that temporal reminders are not detrimental to shared temporal cognitions.

With respect to the effect of shared temporal cognitions on meeting the deadline, we found that shared temporal cognitions may either facilitate or impede meeting the deadline, depending on the mean pacing style within the group. When group members, on average, tend toward an early action pacing style, sharing temporal cognitions helps them to finish their task on time; when groups tend toward a deadline action pacing style, sharing temporal cognitions impairs meeting the deadline. This effect was only observed in a first collaboration, not when group members worked together on a follow-up task. In fact, meeting the deadline at Time 1 was the only variable that correlated with meeting the deadline at Time 2 (r = .60). This may imply that groups that did not meet the deadline at Time 1 experienced a delay in the second task. Because they still had to complete the first assignment, time scarcity may have overruled the effect of shared temporal cognitions, or in other words, simply not having enough time led to missing the deadline in the follow-up task (this backlog effect was also found Chapter 2, but only for low potency groups). This suggests that there may be a threshold after which shared temporal cognitions are no longer relevant; when there is too much work and too little time to do it, groups

will fail to meet their deadlines irrespective of whether members have shared temporal cognitions or not.

All in all, we conclude that homogeneous project teams composed of individuals who tend to use an early action pacing style in task execution are most likely to meet deadlines, but that in the long run all groups can acquire shared temporal cognitions when they use temporal reminders. For practice, this implies that it may be beneficial to consider individual pacing style when putting people together in project teams. Selecting participants with an early action pacing style will increase the likelihood that deadlines are met. However, we realize that composing the ideal work group is often impossible. Therefore, when deadlines are important, we recommend that members use temporal reminders to promote shared temporal cognitions in their group. When group members fail to use temporal reminders spontaneously, managers may consider providing them for the group. Yet, our study also shows that all groups should be aware that sharing inappropriate temporal cognitions is likely to impede their ability to meet deadlines. This emphasizes the need for reflexivity with respect to temporal issues (Gevers, Van Eerde, & Rutte, 2001, see also Chapter 2). If necessary, managers may encourage team members to engage in reflection, for instance by stimulating discussions about task completion times and the importance of temporal milestones.

Our findings represent a first step in establishing the value of shared temporal cognitions for groups working under deadline conditions. We acknowledge that additional conceptual and empirical work is needed to refine and extend our knowledge of shared temporal cognitions in relation to meeting deadlines. Nevertheless, by showing that shared temporal cognitions affect the timeliness aspect of group performance, we have contributed to clarifying which particular cognitions should be shared to improve which particular aspects of group performance (Cannon-Bowers & Salas, 2001). Moreover, we have provided strong support for the notion that cognitive congruence is only part of the picture, and that the appropriateness of their content is also important, as cognitions may be detrimental to task performance (Rentsch & Hall, 1994). Finally, our findings suggest that both similarity in pacing styles and temporal reminders may contribute to shared temporal cognitions, at least when groups have the opportunity to learn from past performance on similar tasks.

Our pacing style measure may be valuable to future research. We have constructed a measure of how people generally divide their effort over time when

working under deadline conditions. We acknowledge that this scale is not ideal, in that it is a single-item, ordinal measure, and the five graphs may not be exhaustive. For instance, there may be individuals who are inclined to show more effort in task execution at the start as well as the end, providing a U-shape model, or they may do the bulk of the work somewhere halfway through the allotted time, which would constitute an inverted U-shape. Still, despite its limitations, our pacing style scale has the advantage that it is short, and that it can be used to determine both the similarity in pacing styles and the mean pacing style within a group. Our study suggests that both measures are important for meeting deadlines.

The methodological approach we employed has some limitations. First, we should address the nature of our sample, which existed mainly of familiar groups, maybe even friendship groups. Because team member familiarity can facilitate both the rate and quality of group performance (Harrison, Mohammed, McGrath, Florey, & Vanderstoep, 2003), it could serve as an alternative explanation for our findings. Self-assigned groups were indeed more likely to meet their deadlines. However, this was not attributable to the level of shared temporal cognitions in these groups, nor did it affect the relationship between shared temporal cognitions and meeting deadlines. Maybe the self-assigned groups were better able to meet deadlines because their members were more willing to help each other or to step in for each other. What causes familiar groups to be more successful than unfamiliar groups could be explored further in future research.

Then, our findings regarding the antecedents of shared temporal cognitions may suffer from common method variance, because they rely on self-reported cross-sectional data. Ideally, these data would have been obtained at multiple points in time, maybe even before group members started working on the first task. However, in order to answer questions about the level of shared temporal cognitions about the group task, the groups had to have some experience working on that particular task. Our questions could only be answered by the group members themselves, because the groups worked by themselves, without supervision. The high levels of agreement in the group enhance our confidence in the reliability and internal validity of the data.

Another shortcoming of our study is that we focused entirely on meeting the deadline, whereas trade-offs may have taken place in relation to other dimensions of performance, such as quality. This topic definitely deserves attention in future research (see Chapter 5), also because in contrast to what is often assumed, trade-offs

do not necessarily occur (e.g., Atuahene-Gima, 2003) and positive relationships between timeliness and quality may also be found.

With respect to the external validity, we have to keep in mind that the number of groups in our study was limited and that these were leaderless groups with the same education level and area, working under highly structured task conditions. Although this sample allows a fair test of our hypotheses (Driskell & Salas, 1992), it would be helpful to study a broader and larger sampling of project teams to determine the applicability of our findings to the real world. In organizational settings, many projects involve participants from different organizational and functional backgrounds, which implies that team members cannot take over each other's tasks or responsibilities as the students may have done. Consequently, task interdependence could be higher in work settings, which may influence the extent to which group members need more cognitive congruence, making it a more important topic. In addition, organizational dynamics often induce changes in project plans, demanding a higher level of flexibility, or temporal responsiveness, of project teams (Blount & Janicik, 2001). Therefore, it would be interesting to study cognitive congruence in relation to work group flexibility and the ability of teams to collectively adapt their temporal cognitions to changing deadlines (Waller et al., 2002).

Chapter 4

Team Self-Regulation and Meeting Deadlines in Project Teams: A Model of Shared Temporal Cognitions*

This chapter presents a longitudinal study of 48 student project groups in which we investigate the relationship between shared temporal cognitions, coordinated action, and meeting deadlines. In addition, we extent our examination of the effect of self-regulatory behavior on the development of shared temporal cognitions by investigating planning, reflexivity, and temporal reminders as antecedents of shared temporal cognitions. We investigate the effect both initial levels and changes in the levels of regulatory behavior, shared cognitions, and coordinated action on meeting deadlines.

Many project teams have a hard time meeting deadlines. Lientz and Rea (2001) indicate that half of all system and technology implementation projects overrun their budget and schedule by two hundred percent or more. The vast amount of deadlines being missed, despite the fact that meeting them is regarded as vital to project success, urges for a better understanding of the factors that influence timely project performance. The literature shows a growing interest in temporal issues, but only a

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small number of studies have addressed meeting deadlines in work groups (Gersick, 1988; 1989; Waller, Giambatista, & Zellmer-Bruhn, 1999; Waller, Zellmer-Bruhn, & Giambatista, 2002). These studies identify attention to time as an important variable in group pacing behavior and meeting deadlines.

The current study addresses the role of shared temporal cognitions in regulating team interaction toward timely task completion. The concept of shared temporal cognitions refers to the extent to which group members agree about the temporal aspects of their task, such as schedules, deadlines, and task completion times (Gevers, Rutte, & Van Eerde, 2004a, 2004b). The concept is derived from a growing body of literature that argues that effective teamwork is enhanced when team members hold common or overlapping cognitive representations of the situation they are facing (see Klimoski & Mohammed, 1994, for an overview). However, whereas prior research predominantly focused on the overlap in task-related and team-related cognitions, we focus on the similarity in team members' cognitions about the temporal aspects of their collective task. We examine antecedents of shared temporal cognitions thereby focusing on the self-regulatory behavior that teams may display to build shared temporal cognitions. Using a longitudinal approach, we study the effect of planning, reflexivity, and temporal reminders on the level of shared temporal cognitions in early project stages, and also how increases or decreases in team self-regulatory actions relate to increases and decreases in the level of shared temporal cognitions over the course of the project. In addition, we investigate the effects of shared temporal cognitions on coordinated action and meeting deadlines in project teams, suggesting that coordinated action mediates the effects of both the initial level and of changes in the level of shared temporal cognitions.

Before we discuss these constructs in more detail and formulate hypotheses about their relationships, we should outline the boundaries of our research. We presume that our research applies to project teams whose primary function it is to complete a complex task requiring a specific output by some deadline, after which they disband (cf. Janicik & Bartel, 2003). Moreover, we assume that these teams have relatively high levels of autonomy in order to be able to develop viable approaches for task accomplishment, and that members are jointly held accountable for their output.

4.1 Shared Temporal Cognitions

Since the 1990s, various authors have emphasized the importance of shared cognitions for regulating teamwork. Theory on shared cognitions and related constructs, such as shared mental models (Cannon-Bowers, Salas, & Converse, 1993; Klimoski & Mohammed, 1994), team schema similarity (Rentsch & Hall, 1994), transactive memory (Wegner, 1995), and shared understanding (Cohen et al., 1999) suggests that cognitive congruence among team members enhances team performance through a positive effect on team processes. Although empirical research has indeed shown beneficial effects of shared cognitions on team processes and team performance (Cohen, Mohrman, & Mohrman, 1999; Mathieu, Heffner, Goodwin, Salas & Cannon-Bowers, 2000; Rentsch & Klimoski, 2001), shared cognitions have not been studied in relation to meeting deadlines.

We suggest that to improve meeting deadlines it will be helpful when team members share cognitions about the temporal aspects of the task (Gevers et al., 2004a). This proposition is based on the assumption that the timing of completing, exchanging, and integrating individual contributions is important to meeting deadlines. In many projects, schedules and deadlines are used as collective temporal reference points to reduce ambiguity and increase the likelihood that the appropriate person or group executes the intended action in a timely manner. Still, whether actions are implemented as intended probably depends on how schedules and deadlines are interpreted by team members. Action theory (Hacker, 1982, in Roe, 1999) argues that people do not perform tasks as they are given, but that they redefine tasks according to personal wishes and perceived constraints and opportunities. This implies that team members may have different perspectives on the appropriate use of time in a project, despite the fact that they are presented with identical project plans. Moreover, schedules and deadlines have been shown to affect the pace of task activities in work groups (Gersick, 1988; 1989; Gladstein, 1984, Seers & Woodruff, 1997), due to feelings of time pressure associated with them (Rastegary & Landy, 1993). However, individual team members may show very different reactions to an approaching deadline, because of individual differences in time perception (Bartel & Milliken, 2004), pacing styles (Gevers et al., 2004b, see also Chapter 3), and time urgency (Conte, Landy, & Mathieu, 1995), or because they hold different norms concerning punctuality, speed, and adherence to deadlines. Especially when the violation of time

limits does not lead to sanctions, team members may also choose to neglect temporal milestones instead of adjusting their pace to ensure that tasks are completed on time. This may, in turn, lead to delays in the flow of work and endanger the timeliness of task completion. However, before we go into the effects of shared temporal cognitions, we will first discuss how team members may come to share temporal cognitions.

4.2 Antecedents of Shared Temporal Cognitions

Although shared temporal cognitions may sometimes exist prior to group interaction or come about unintentionally, for instance when team members have similar pacing styles (Gevers et al., 2004b, see also Chapter 3), other situations may require that members make explicit efforts to align their views on the temporal aspects of the task. In this study, we are particularly interested in the self-regulatory mechanisms teams may use to build shared temporal cognitions. We address three self-regulatory mechanisms: planning, reflexivity, and temporal reminders. In the following, we will describe our expectations regarding the role of planning, reflexivity, and temporal reminders in the development of shared temporal cognitions.

Planning

In the context of teamwork, planning refers to a regulatory mechanism by which groups decide on a principal course of action for goal accomplishment (Marks, Mathieu, & Zaccaro, 2001). It includes discussing expectations and task-related information, and assigning roles and responsibilities to team members, while taking into account the situational and time constraints, team resources, member expertise, and changing nature of the environment. Several types of planning may be distinguished, but the one most commonly referred to in the literature is execution planning, or anchored planning (Tripoli, 1998). In execution planning, a project is decomposed into subgoals for which specific tasks are determined, time schedules are made, and it is decided who is supposed to do what, when it should be done, and with whom it should be done.

Planning facilitates team performance, particularly during periods of high-workload (Gevers, Van Eerde & Rutte, 2001), because it explicates how task activities are spread over time and increases the degree to which team members share an

understanding of each other's needs and information requirements (Stout, Cannon-Bowers, Salas & Milanovich, 1999). Moreover, research by Janicik and Bartel (2002) suggested that a review of temporal issues in planning stimulates the formation of time norms and facilitates team coordination and general performance. Based on these findings, we suggest that project teams may build shared temporal cognitions by addressing issues of subtask duration, task allocation and sequential interdependence. Hence, we hypothesize that execution planning will contribute to shared temporal cognitions.

> *Hypothesis 1: Project teams that engage more in planning will have higher levels of shared temporal cognitions*

Reflexivity

Teams should monitor task progress when team members actually conduct activities directly aimed at goal accomplishment (Marks et al., 2001). The extent to which team members collectively reflect upon the team's objectives, strategies, and internal processes, and to which they adapt to current and anticipated endogenous or environmental circumstances is called reflexivity (West, 1996). According to West, reflexive teams have a more comprehensive and shared cognitive representation of their work, which enables them to be more adaptive to and more effective in the execution of their tasks, especially when operating in uncertain and dynamic circumstances. We suggest that discussing team objectives, strategies, and processes may not only contribute to a shared understanding of the team's task, but also to a collective understanding of its temporal aspects. Moreover, reflexivity may help teams to identify and resolve conflicts regarding the content and pacing of group activities, and contribute to a shared view on the adaptive actions required in response to performance gaps or unexpected events. Collective shifts in the timing and pacing of members' activities (e.g., speeding up) will probably be more easily accomplished when team members think they are necessary and worth putting effort into, a condition that we expect can be established through reflexivity. Of course, differences in temporal cognitions may also surface and members may be drawn apart instead of being brought closer to a shared vision. However, when disparate views remain

unspoken, they are all the more likely to continue. Hence, we suggest that reflexivity will have a positive effect on shared temporal cognitions.

Hypothesis 2: Project teams that are more reflexive will have higher levels of shared temporal cognitions.

Temporal Reminders

Team members may exchange temporal reminders to build shared temporal cognitions among themselves. That is, members may remind each other of deadlines and urge one another to stick to schedules and to make sure that subtasks are completed on time. Gersick (1988, 1989) showed that groups tend to use the elapse of allotted time as a signal to start talking about time. The attention to time facilitates the establishment of temporal norms (Janicik & Bartel, 2002) and helps to focus group task activity (Waller, Giambatista, & Zellmer-Bruhn, 1999). Similar to reflexivity, temporal reminders may also lead to conflict by emphasizing the differences in team members' views on time. However, Gevers et al. (2004b, see also Chapter 3) found that temporal reminders were associated with the alignment of temporal cognitions in project groups. Therefore, we expect that the exchange of temporal reminders will positively affect the level of shared temporal cognitions in project teams.

Hypothesis 3: Project teams that engage more in the exchange of temporal reminders will have higher levels of shared temporal cognitions.

Longitudinal Effects on Shared Temporal Cognitions

Because cognitive congruence is not a matter of all or nothing, the degree to which temporal cognitions are shared may change over the course of team interaction, and planning, reflexivity, and temporal reminders may play a role in this. After the initial planning of task execution and having worked together for some time, members may reflect upon their work processes to decide whether their plans and actions need adjustments. During a project, members may decide that additional planning or a different type of planning is needed to enhance the coordination between team member's actions or to speed up the work processes, based on progress feedback and experiences with the task and the team. Groups often choose to plan only a few

essential steps that are necessary to start working on a task and leave more detailed schedules to be developed during the actual task execution (Weingart, 1992). Also, members may learn that the level of shared temporal cognitions is not high enough to ensure effective collaboration, and may increase the amount of temporal reminders in an attempt to coerce those who are perceived to deviate from the norm to align with the team. We expect that increases in the extent to which project teams engage in planning, reflection, and temporal reminders will contribute to an increase in shared temporal cognitions. This leads to the following hypothesis.

Hypothesis 4: Over time, an increase in planning, reflection, and temporal reminders will be associated with an increase in shared temporal cognitions.

4.3 Coordinated Action as a Mediator

We suggest that coordinated action may act as a mediator for the effects of shared temporal cognitions on meeting deadlines in project teams. Coordinated action refers to the situation where optimal working relations are established within the team and members execute intended actions in an integrated and timely manner. As such, coordinated action represents an emergent state (Marks et al., 2001) in the sense that it is a proximal outcome of team coordination efforts that influences subsequent team processes and more distal outcomes. Coordinated action manifests itself in a smooth flow of work and effective collaboration. This means that it goes beyond the mere synchronization of action patterns and implies a willingness to cooperate and help each other, which has been identified as an essential aspect of effective teamwork (McIntyre & Salas, 1995).

Coordinated action was associated with higher output quality in a business consultancy project (Janicik & Bartel, 2002). We expect that coordinated action will also benefit the timeliness of project performance. In order to meet deadlines, team members must coordinate both the content and the timing of their task activities (McGrath & O'Connor, 1996). Especially when task interdependence is high, team effectiveness depends on the ability of members to mutually adapt and modify their activities in order to achieve the team's objectives (Fleishman & Zaccaro, 1996; Tesluk, Mathieu, Zaccaro, & Marks, 1997). Cannon-Bowers et al. (1993) argued that shared cognitions enhance team performance because they allow team members to

form accurate explanations of and expectations about task execution, which helps them to coordinate their actions and adapt their behavior to the demands of the task and to other team members. Research by Mathieu et al. (2001) indeed showed that shared cognitions affect task performance through improved team coordination. Although this research involved dyads collaborating in a laboratory flight simulation task, we suggest that its findings will also apply to project teams and meeting deadlines. When members have shared temporal cognitions they are more likely to execute intended actions in a timely and integrated manner. Consequently, process losses (Steiner, 1972) are smaller and teams are more likely to reach an optimal production level and complete their work on time. Moreover, Klimoski and Mohammed (1994) suggested that the perception of shared cognitions in a team may produce positive affect among team members and a greater propensity to trust one another. This, in turn, may increase team members' willingness to step in and help one another in high-workload or time-pressured situations, at least when the content of the task allows workload sharing. According to McIntyre and Salas (1995) such back-up behavior and workload balancing makes a team truly operate as a team.

We propose that high levels of shared temporal cognitions early in the project enhance coordinated action, and thereby facilitate a timely project completion. Moreover, increases in the level of shared temporal cognitions over the course of the project will also benefit coordinated action and increase the likelihood that the project is finished on time, while decreases in the level of shared temporal cognitions will impede coordinated action and decrease the likelihood of a timely project completion. Thus, we hypothesize that both the effect of initial shared temporal cognitions and of changes in the level of shared temporal cognitions on meeting deadlines is mediated by coordinated action.

Hypothesis 5: Project teams with higher levels of shared temporal cognitions at the beginning of the project are more effective in meeting deadlines; This relationship is mediated by coordinated action.

Hypothesis 6: Project teams that experience an increase in shared temporal cognitions over the course of the project will be more effective in meeting deadlines, while project teams that experience a decrease in shared temporal

cognitions over time will be less effective in meeting deadlines; This relationship is mediated by coordinated action.

4.4 Method

Sample and procedure

We tested our hypotheses on 48 project teams of third-year industrial engineering students, who worked together to complete a business consulting project. We collected data in two successive years, 2002 and 2003. The sample consisted of 194 male and 47 female students in groups of three to seven members (19 all-male and 29 mixed groups). Group membership was self-assigned and no specific team roles or positions were appointed. The projects lasted for 13 weeks and had two predetermined stages: The first three weeks comprised an orientation phase and involved setting up a project plan, which was subsequently worked on in the execution phase. After 13 weeks, projects had to be completed, resulting in a final report and a presentation.

Longitudinal data were collected by asking team members to complete a questionnaire about their work at two points during their project. Questionnaires were administered in Dutch. Time 1 was after 3 weeks, at the end of the orientation phase; Time 2 was in week 11, near the end of the execution phase. After the teams had presented their reports, we administered another questionnaire to inquire about the timeliness of their performance. This we refer to as Time 3. Participation was voluntary and anonymous. In addition, the students were assured that participation would not influence their grade for the assignment in any way. We awarded eight participants, randomly chosen, a reward of 25 Euro to encourage participation. The response rate was 94 % at Time 1, 95 % at Time 2, and again 95 % at Time 3.

Measures

Planning. We used six items to measure planning, operationalized as formulating goals, activities, and time frames for task accomplishment. The measure was adapted from Tripoli's (1998) scale for anchored planning and proven to be adequate in previous research (Gevers et al., 2001). All questionnaire items are presented in Appendix A. Examples of the planning items are "To what extent did your group set time limits for working on a particular task?" and "To what extent did your group plan who should do what?". Responses were given on 5-point scales (1 =

hardly ever to 5 = to a high degree). Cronbach's alphas for all measures are presented in Table 4.1.

Reflexivity. We used seven items from the Dutch translation (Schippers et al., 1999) of the reflexivity measure described by Swift and West (1998), assessing the extent to which teams reflected upon its work processes. Prior research has established the adequacy of the selected items (Gevers et al., 2001). Examples of items are "To what extent did your group review its approach to getting the work done?" and "To what extent did your group adapt task strategies?". All items were rated on 5-point scales (1 = hardly ever to 5 = to a high degree).

Temporal reminders. The extent to which group members provided each other with temporal reminders was measured with three items, a sample item being "In my group, we have reminded each other of important temporal milestones". Items were answered on 5-point scales (1 = disagree completely to 5 = agree completely).

Shared temporal cognitions. Shared temporal cognitions were assessed with four items that asked participants to rate the extent to which group members agreed on the temporal aspects of task execution. For example, participants were asked to what extent they agreed with the statements that, in their group, team members "had the same opinions about meeting deadlines", and "agreed on how to allocate the time available". All items were answered on 5-point scales, with 1 = disagree completely to 5 = agree completely.

Coordinated action. Coordinated action was measured with a newly developed scale of five items that measured the extent to which synchronization and cooperation among group members resulted in a smooth flow of work and effective collaboration. One item was derived from Janicik and Bartel's (2002) scale of coordination difficulties. Respondents were asked to what extent they agreed with the statements presented. Answers were given on 5-point scales, with 1 = disagree completely to 5 = agree completely. Sample items are "My group experiences delays in the flow of work between members (reversely coded)" and "Our task activities are well coordinated".

Meeting deadlines. Meeting deadlines was assessed with one item that asked participants to indicate when they had finished their project report. Responses were given on a 4-point response scale (1 = much too late; 2 = a bit too late; 3 = just in time; 4 = in ample time). We used the answer of the majority as the team score.

Perceptions of timeliness are rather subjective and the majority score provides a more objective view of the timeliness of performance. When the answers of the group members were distributed evenly over the response categories (responses never deviated more than one category), we gave the group the benefit of the doubt and used the higher score.

Control Variables

The ability of project teams to meet deadlines may be affected by particular team characteristics, such as team size and the extent to which members are familiar with one another or have experience working together. Increasing team size, for instance, is known to be associated with coordination problems (Steiner, 1972). Shared knowledge of team members' characteristics such as their roles, knowledge, skills, preferences, strengths and weaknesses, on the other hand, has been shown to benefit team coordination (Mathieu et al., 2000). Therefore, we included team size and shared team cognitions in our analyses to control for their effects on coordinated action and meeting deadlines, assessed with three items at T1: "In my group, we know which role each of us plays in the project", "In my group, we are familiar with each other's knowledge and skills", and "In my group, we are acquainted with each other's way of working". All items were answered on 5-point scales, with 1 = disagree completely, to 5 = agree completely.

Discriminant Validity

To see whether we could empirically distinguish between the variables in the model, we performed principal component analyses to assess the discriminant validity of our measures. We used an oblimin rotation to allow for some association between the factors. Due to a limited sample size we could not include all items in one analysis. Therefore, we first analyzed the items of the measures for coordinated action and shared temporal cognitions. At T1 as well as T2, two factors emerged; these explained 46 % and 12 % of the variance at T1, and 43 % and 13 % of the variance at T2. Factor loadings are reported in Appendix B. At T1, one item from the shared temporal cognitions scale did not reach the criterion of loading higher than .40 (Nunnally, 1967). However, because the loading of this item at T2 well exceeded this criterion, we decided to keep the item in the scale. In a similar procedure, we analyzed the

items of the three antecedent variables to distinguish between planning, reflexivity, and temporal reminders. This analysis yielded three factors that explained 27 %, 14 %, and 9 % of the variance at T1, and 27 %, 15 %, and 9 % at T2. Two items of the reflexivity scale had cross-loadings that were smaller than .20 at T1 (see Appendix B for factor loadings). However, we decided to keep the items in the scale, because they showed adequate cross-loadings at T2. We feel this procedure is justified, because the phenomena underlying the constructs need time to fully develop.

Analyses

The data were analyzed at the group level. Individual scores were aggregated to the group mean score based on high levels of intra-group agreement (see Table 4.1, $\overline{R}_{wg(j)}$; James, Demarée & Wolf, 1984), for all variables except meeting deadlines, for which we used a majority score. Due to the limited sample size, the complete model could not be tested in a single analysis. Hence, we performed multiple analyses to test the model. All tests were performed using a one-tailed significance level of .05 (alpha) and controlled for effects of team size and shared team cognitions.

Hypotheses 1 to 3 address the relationship between self-regulatory behavior and shared temporal cognitions early in the project. We regressed shared temporal cognitions at T1 on planning, reflexivity, and temporal reminders at T1 to test these hypotheses, using a stepwise procedure to select significant predictors.

We used difference scores (X_2-X_1) to test hypothesis 4, which stated that an increase in self-regulatory behavior would lead to an increase in shared temporal cognitions, while a decrease in self-regulatory behavior would result in a decrease in shared temporal cognitions. We regressed the change in shared temporal cognitions on the initial levels and the changes in self-regulatory behavior, while controlling for the level of shared temporal cognitions at T1[3]. Again, we used a stepwise procedure to select significant predictors.

Hypotheses 5 and 6 suggest that the effects of the initial level of shared temporal cognitions and of changes in the level of shared temporal cognitions on meeting deadlines will be mediated by coordinated action. Hence, we tested the dependent variables of the previous analyses as predictors of coordinated action and

[3] We would like to thank Toon Taris and Marcel Croon for their advice on the use of the difference score in multiple regression analyses.

Table 4.1. *Distributions, intercorrelations, interrater reliabilities, and internal consistencies of the variables in the research*

		M	*SD*	$\overline{R}_{wg(j)}$	1	2	3	4	5	6	7	8	9	10	11	12
1	Team size	5.02	1.26													
2	Shared team cognitions	3.48	.53	.82	.04	**.66**										
Time 1																
3	Planning	3.22	.53	.84	.20	.33	**.85**									
4	Reflexivity	2.79	.42	.94	.36	.16	.18	**.74**								
5	Temporal reminders	3.81	.35	.91	.27	.46	.31	.33	**.69**							
6	Shared temporal cognitions	3.47	.43	.89	-.31	.14	.24	-.30	.18	**.74**						
7	Coordinated action	3.74	.53	.93	-.19	.15	.13	-.24	.18	.77	**.81**					
Time 2																
8	Planning	3.32	.45	.94	.22	-.07	.46	.16	.11	.01	.18	**.84**				
9	Reflexivity	2.95	.32	.94	.49	.08	-.01	.58	.25	-.44	-.32	.12	**.71**			
10	Temporal reminders	3.80	.41	.90	.19	.08	.26	.08	.25	-.16	.04	.70	.33	**.75**		
11	Shared temporal cognitions	3.41	.38	.88	.03	.06	.12	-.11	.04	.62	.56	.13	-.16	.06	**.73**	
12	Coordinated action	3.59	.45	.92	-.02	.16	.38	-.01	.20	.61	.58	.33	-.25	.21	.66	**.80**
Time 3																
13	Meeting deadlines	3.10	.69	.90	.09	.36	.59	.25	.40	.26	.14	.03	.08	.13	.37	.47

Note. $N = 44$; all correlations above .25 are significant at $p < .05$, one-sided; Internal consistencies of the scales (α), as measured at the individual level, are presented in bold printing on the diagonal; *M* = mean; *SD* = standard deviation; $\overline{R}_{wg(j)}$ = mean interrater reliability.

meeting deadlines. Establishing mediation involves demonstrating that three conditions are satisfied: (1) the independent variables significantly predict the mediator, (2) the mediator significantly predicts the dependent variable, and (3) a previously significant effect of the independent variables on the dependent variable decreases substantially when the mediator is entered into the model (Baron & Kenny, 1986). The latter condition is merely required to establish complete mediation (Kenny, Kashy, & Bolger, 1998).

4.5 Results

Descriptive statistics

Table 4.1 presents the distributions, intercorrelations, reliabilities, and internal consistencies for all variables in the study. Looking at the mean scores, an increase in planning and reflexivity took place over time, while there appeared to be a decrease in shared temporal cognitions and coordinated action at T2. This could mean that initial optimism about group functioning was tempered. However, it may also indicate that individual groups show different patterns over time. That is, some groups might show an improvement over time, and others a deterioration. A visual inspection of the development patterns over time indicates that the levels of shared temporal cognitions and coordinated action remained stable in the teams that finished on time (i.e., just in time or in ample time) and decreased in the teams that failed to meet the deadline (i.e., much too late or a bit too late). However, because most teams managed to meet the deadline and merely seven teams exceeded the deadline, we did not empirically test these differences over time.

With respect to the intercorrelations, it can be noted that meeting deadlines was positively related to shared team cognitions, planning, and temporal reminders early in group collaboration, while shared temporal cognitions and coordinated action only seemed to be important for meeting deadlines near the project's end. Shared team cognitions, planning, and temporal reminders show positive associations among themselves, as do shared temporal cognitions and coordinated action. Actually, shared temporal cognitions and coordinated action show such high intercorrelations (r = .77 and r = .66 at T1 and T2, respectively) that we considered it necessary to substantiate the discriminant validity by means of a confirmatory factor analysis (LISREL 8.54, Jöreskog & Sörbom, 1996). At both T1 and T2, we compared the goodness-of-fit of a

model with one factor against a model with two factors with a Chi-square difference test (Bollen, 1989). The fit measures for the one- and two-factor models are presented in Table 4.2. The results of these tests indicated that a two-factor model yielded a significantly better fit than the one-factor model ($\Delta \chi^2_{T1}$= 100.99; *df* = 1; $p < .001$; $\Delta \chi^2_{T2}$= 69.94; *df* = 1; $p < .001$). Although the two-factor models did not yield a perfect fit, the superior fit compared to the one-factor models demonstrates the conceptual difference between shared temporal cognitions and coordinated action.

Table 4.2. *LISREL fit measures for the discriminant validity of shared temporal cognitions and coordinated action*

		χ^2	*df*	*p*	RMSEA	CFI	st. RMR
Time 1	One-factor	216.05	27	.000	.18	.89	.08
	Two-factor	115.06	26	.000	.11	.95	.06
	Difference	100.99*	1				
Time 2	One-factor	177.62	27	.000	.16	.90	.08
	Two-factor	107.68	26	.000	.12	.94	.06
	Difference	69.94*	1				

$p < .001$; N_{T1}= 234 ; N_{T2}= 237

Testing hypotheses

To test hypotheses 1 and 2, we regressed shared temporal cognitions at T1 on planning, reflexivity, and temporal reminders at T1. The results in Table 4.3 show that team size was negatively related to shared temporal cognitions, meaning that smaller groups are more likely to agree on the use of time in a project (β = -.38; p = .01). Shared team cognitions was not related to shared temporal cognitions. With respect to the antecedents, planning was the only predictor that significantly contributed to shared temporal cognitions at T1 (β = .28; p = .05). Together these variables accounted for 13 % of the variance.

Over time, increases in the extent to which group members engage in planning, reflection, and temporal reminders were expected to be associated with an increase in shared temporal cognitions, while decreases in group regulatory behavior were expected to be associated with a decrease in shared temporal cognitions (Hypothesis 4). To test this hypothesis, we regressed the change in shared temporal cognitions over the interval T1-T2 on changes in the amount of planning, reflexivity,

Table 4.3. *Regression analyses for predicting the level of shared temporal cognitions at T1*

	Shared temporal cognitions T1		
	F	$R^2_{adj.}$	*β*
Step 1	3.16*	.13	
Team size			-.38**
Shared team cognitions			.07
Planning T1			.28*

Note. $N = 46$.
*$p < .05$, **$p < .01$, ***$p < .001$, one-tailed.

and temporal reminders over T1-T2, while controlling for shared temporal cognitions at T1. The results are presented in Table 4.4. They show positive effects of team size ($\beta = .27$; $p = .05$) and shared temporal cognitions at T1 ($\beta = .76$; $p = .001$) on the change in shared temporal cognitions, which means that large groups and groups with initial lower levels of shared temporal cognitions show a stronger increase in shared temporal cognitions over time. With respect to team self-regulatory behavior, we found that an increase in shared temporal cognition is significantly predicted by an increase in temporal reminders ($\beta = .23$; $p = .05$). We did not find longitudinal effects of changes in the amount of planning or reflexivity on changes in shared temporal cognitions.

Table 4.4. *Hierarchical regression analysis for predicting changes in the level of shared temporal cognitions over the interval T1-T2*

	Δ Shared temporal cognitions T1-T2		
	F	$R^2_{adj.}$	*β*
Model	6.93***	.36	
Team size			.29*
Shared team cognitions			.01
Shared temporal cognitions T1			-.39**
Δ Temporal reminders T1 – T2			.25*

Note. $N = 44$.
*$p < .05$, **$p < .01$, ***$p < .001$, one-tailed.

To test hypotheses 5 and 6, which suggested that coordinated action would mediate between shared temporal cognitions and meeting deadlines, firstly, we regressed coordinated action at T2 on shared temporal cognitions at T1, and on

changes in the level of shared temporal cognitions over the interval T1-T2. The results of the analysis are summarized in Table 4.5, column 1. As can be seen, the initial level of shared temporal cognitions (β = .84; p = .001) and the change in the level of shared temporal cognitions (β = .39; p = .01) both significantly predicted coordinated action. Together with the control variables, they explained 45 % of the variance in coordinated action. Secondly, we conducted a hierarchical regression analysis with two steps to determine the combined effect of shared temporal cognitions at T1, the change in shared temporal cognitions over T1-T2, and the level of coordinated action at T2 on meeting deadlines. The results are presented in the second column of Table 4.5. Step 1 shows that shared team cognitions (β = .29; p = .05), shared temporal cognitions at T1 (β = .40; p = .05), and an increase in shared temporal cognitions over T1-T2 (β = .31; p = .05) all contribute to the prediction of meeting deadlines, explaining 16 % of the variance. Entering coordinated action into the model in Step 2 increased the amount of variance accounted for to 23 %. At the same time, the effects of shared temporal cognitions at T1 on meeting deadlines, and of the changes in shared temporal cognitions over T1-T2 on meeting deadlines dropped substantially, even to the extent that they were no longer significant, indicating full mediation. In addition, the results show that there is was a direct positive effect of shared team cognitions on meeting deadlines.

Table 4.5. *Hierarchical regression analyses for mediation of shared temporal cognition, coordinated action, and meeting deadlines*

	Coordinated action T2			Meeting deadlines T3			
	F	$R^2_{adj.}$	β	F	$R^2_{adj.}$	ΔR^2	β
Step 1	9.84***	.45		3.09*	.16		
Team size			.06				.07
Shared team cognitions			.02				.29*
Shared temporal cognitions T1			.84***				.40*
Δ Shared temporal cognitions T1 – T2			.39**				.31*
Step 2				3.61**	.23	.08*	
Team size							.04
Shared team cognitions							.29*
Shared temporal cognitions T1							.07
Δ Shared temporal cognitions T1 – T2							.15
Coordinated action T2							.40*

Note. N = 45.
*p < .05, **p < .01, ***p < .001, one-tailed.

4.6 Discussion

The aim of this study was to examine shared temporal cognitions as they relate to coordinated action and meeting deadlines, and to investigate the role of planning, reflexivity, and temporal reminders in the development of shared temporal cognitions. In line with our hypotheses, we found that project teams are more likely to meet deadlines when team members have high levels of shared temporal cognitions in the early stages of the project and when they develop shared temporal cognitions over the course of the project. Both effects were mediated by the level of coordinated action established in the teams. Additionally, we found that initial planning contributes to high levels of shared temporal cognitions early in the project. An increase in the use of temporal reminders over time was associated with a further alignment in temporal cognitions over the course of the project.

Contrary to our expectations, reflexivity did not contribute to the development of shared temporal cognitions. An inspection of the correlations revealed that both shared temporal cognitions and coordinated action at T1 related negatively to reflexivity at T2 (r = -.44, p = .05; r = -.32; p = .05). This may suggest that the level of shared temporal cognitions affects the amount of reflexivity a group displays, rather than the other way around. Probably, a lack of shared temporal cognitions inhibits coordinated action and forces project groups to engage in reflection to find out why things are not running smoothly. Although West (1996) indicated that the experience of coordination difficulties provides an important opportunity for reflection on team functioning, little research has considered why or when groups engage in reflection. This topic deserves additional research.

Our research contributes to the existing literature on shared cognitions in project teams in two ways. First, our findings establish the relevance of shared temporal cognitions to meeting deadlines in project teams. Prior research evidenced beneficial effects of shared team cognitions and shared task cognitions on team coordination and general performance (Mathieu et al., 2000). Our results add to this research by showing that coordinated action also profits from shared temporal cognitions, and that this category of shared cognitions is beneficial to the ability of teams to complete projects on time. However, this main effect of shared temporal cognitions on meeting deadlines contrasts with argumentations that shared cognitions are only beneficial to team performance when they are appropriate (Rentsch & Hall,

1994) and with earlier findings that inappropriate shared temporal cognitions lead project teams to exceed the deadline (Gevers et al., 2004b, see also Chapter 3). We suggest that this inconsistency may stem from differences in project duration in the studies. In comparison to the present study, the projects studied by Gevers et al. (2004b) had relatively short lead-times. The shorter the project duration, the less time teams have to learn that their shared temporal cognitions are inappropriate and that adaptations in task activities are required to meet the deadline. In the present study, teams may have had enough time to realize that their shared cognitions were inappropriate, and to alter their perspective on the use of time, make up arrears, and finish the project on time. Also, the present project teams may have had more or better supervision and guidance with respect to the rate of progress in task accomplishments. This suggests that detrimental effects of sharing inappropriate cognitions may be undone when teams have the opportunity to learn from progress feedback and to adapt task activities accordingly.

A second contribution of our research to existing literature is that it not only confirms prior evidence that planning in early project stages promotes a shared view on the temporal aspects of task execution (cf. Janicik & Bartel, 2002), but also demonstrates that temporal reminders play a role in consolidating and expanding shared temporal cognitions in later project stages. We suggest that initial planning activities help groups to establish a common perspective on the use of time in a project, while the exchange of temporal reminders increases the likelihood that members actually live up to these plans when the deadline approaches. Thereby, our results are in line with earlier findings that successful groups show increased time awareness in the second half of their allotted time, as indicated by the number of references to time in group communication (Chang, Bordia, & Duck, 2003; Gersick, 1988; 1989).

As is the case with any study, our research has some limitations. Our research is entirely based on team members' self-reported data. Although we recognize that these may be subject to bias, we feel that team members' own perspective on the project is most relevant, because that is what group activities are based upon (Amabile, Conti, Coon, Lazenby, & Herron, 1996). Plus, outsiders may not be in the position to know exactly what is going on inside the group. Actually, research indicates that self-report measures may not limit internal validity as much as is often

expected (Spector, 1992; Wall, Michie, Patterson, Wood, Sheehan, Clegg, & West, 2004). Moreover, the fact that we obtained data from multiple group members (actually, most groups were fully represented) and members showed high levels of intra-group agreement enhances our confidence in the validity of the data.

Furthermore, we feel that we should address the fact that we used difference scores to predict changes in shared temporal cognitions from changes in team self-regulatory behavior. Previously, the use of difference scores has been discouraged because of their presumed unreliability (Cronbach & Furby, 1970) and for their sensitivity to regression toward the mean effects (Cohen & Cohen, 1975). However, much of this criticism has been shown to be founded on misconception (Taris, 2000). Rogosa (1988) argued that the difference score has decent reliability when individual differences in true change exist. The differences in standard deviations over time indicate that this was the case in our study. Moreover, we dealt with ceiling and/or floor effects by controlling for the initial levels of shared temporal cognitions when predicting the change in shared temporal cognitions, i.e. we combined the use of the difference score with the regressor variable approach suggested by Allison (1990). To be on the safe side, we also conducted the analysis using the regressor variable approach thereby regressing shared temporal cognitions at T2 on the independent variables while controlling for shared temporal cognitions at T1. This yielded exactly the same results, which suggests that we may have confidence in our findings.

Another limitation concerns the fact that we did not account for effects of shared task cognitions on coordinated action and meeting deadlines. Agreement about shared temporal cognitions may not be as effective when team members disagree about the content of the task (i.e., about what has to be done, how it has to be done, and why it has to be done). This suggests that, if shared task cognitions and shared temporal cognitions both affect group processes and outcomes, their combined effect may even be stronger. We did control for the extent to which group members had shared team cognitions, but it was not related to shared temporal cognitions. Shared team cognitions facilitated meeting deadlines, but did not affect coordinated action, which we would have expected based on earlier findings (Mathieu et al., 2000). Possibly, this inconsistency stems from differences in operationalizations, because Mathieu et al.'s measure of shared team cognitions also tapped into the extent to which team members shared cognitions about team interactions, while our measure

only included team member characteristics. Nevertheless, additional research should establish the impact of shared temporal cognitions on meeting deadlines over and above the effects of both shared team cognitions and shared task cognitions (see Chapter 5).

With respect to the external validity, we have to take into account that our sample consisted of leaderless groups that performed their task under reasonably predictable circumstances because the projects were part of a learning situation. However, the groups operated in real business settings, solving problems that were highly relevant to the organizations involved. Organizational settings are often characterized by turbulence and uncertainty, which may limit the extent to which groups can engage in initial planning to establish shared temporal cognitions. Instead, groups may have to rely on "in-process planning" (Weingart, 1992), which means that only the first few actions are planned, while the remainder of the plan for future actions is developed and adapted based on performance feedback. In this situation, reflexivity may be more important as a means for groups to be able to quickly adapt to changing circumstances. Moreover, because project leaders or team managers are often held responsible for planning, coordinating, and monitoring project progress, they are likely to play an important role in building shared temporal cognitions and guiding a team toward a timely project completion. In future research, we hope to take our model to work-related settings to establish its viability for natural group projects while taking into account organizational dynamics and project management practices.

Although caution should be exercised in drawing causal inferences from non-experimental data, our findings suggest that shared temporal cognitions deserve attention in project practices, at least when timeliness is a valued outcome. To promote the development of shared temporal cognitions, it appears to be helpful when team members do not only engage in initial planning, but also remind each other of important temporal milestones and urge one another to stick to the planning and finish subtasks on time. Although our study involved leaderless groups, it seems plausible that temporal reminders could also be provided by a project manager or team leader when members themselves fail to engage in such regulatory behavior.

Chapter 5

Where Timeliness and Quality meet: Effects of Shared Cognitions and Potency on Project Performance*

This chapter presents a longitudinal study of 37 professional project teams operating in the Information Technology business. This research investigates the relevance of shared team, task, and temporal cognitions for both meeting deadlines and output quality. Thereby a distinction is made between initial levels of shared cognitions in early project stages and changes in the level of shared cognitions over the course of the project. In addition, we address the motivational impact of shared cognitions by examining potency as a mediator between shared cognitions and project performance.

Over the last decades, we have seen a tremendous increase in the popularity of groups and teams as a means for organizations to gain competitive advantage (Guzzo & Shea, 1992). Teams have the potential to provide many benefits, such as increased flexibility and creativity, and are useful in situations in which individuals with different skills or perspectives are required to work together to achieve a common goal (Langan-Fox, Wirth, Code, Langfield-Smith, Wirth, 2001). On the other hand,

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work in groups is also known to be associated with problems of coordination and motivation, which sometimes makes them less effective than they could be (Steiner, 1972). Especially in cross-functional project teams, differences in team members' knowledge and working procedures sometimes cause group conflict or impede a group's ability to coordinate individual actions effectively (Lientz & Rea, 2001). This may cause groups to perform below their potential and may lead to all sorts of deficiencies in work group outcomes, such as quality deficiency or deadlines missed. This suggests that, in order to profit from their project teams, organizations will have to ensure that the factors that promote effective teamwork are optimal.

One of the factors that have been postulated to contribute to effective teamwork is shared cognition. The general idea behind the construct of shared cognition is that members of effective teams have similar or compatible knowledge, which allows them to adapt their behavior more effectively to the demands of the task and the team (Cannon-Bowers, Salas, & Converse, 1993). Although empirical research has shown that shared cognitions facilitate team processes and team performance (Cohen, Mohrman, & Mohrman, 1999; Mathieu, Heffner, Goodwin, Salas, & Cannon-Bowers, 2000; Mohammed & Ringseis, 2001; Stout, Cannon-Bowers, Salas, & Milanovich, 1999), this research has been limited in a number of ways.

First, the vast majority of studies on shared cognitions have used rather broad categories, such as task-related and team-related cognitions (Mathieu et al., 2000; Stout et al., 1999). In addition, these categories (of shared cognitions) were examined in relation to rather general outcome measures, like general team effectiveness. Hence, there is no empirical ground to draw inferences about which cognitions need to be shared to improve specific aspects of group task performance, such as meeting deadlines or the quality of output. In the current study, we aimed to determine the relevance of specific categories of shared cognitions for various types of performance outcomes to see whether they converge or diverge.

Secondly, mediating variables have received relatively little attention. A number of studies have shown that shared cognitions enhance team performance through improved team communication, coordination, and cooperation (Mathieu et al., 2000; Stout et al., 1999). Recently, Pearce and Ensley (2004) have demonstrated that the extent to which innovation teams have a shared vision of their future state is

strongly related to their sense of potency and their innovation effectiveness. To our knowledge, this is the only empirical study that has investigated shared cognitions in relation to motivational aspects of teamwork. However, actual mediation was not established. Therefore, we addressed the role of motivational processes in shaping the effect of shared cognitions on team performance.

Lastly, studies on shared cognitions have typically been conducted in the laboratory with teams or dyads performing simulated tasks over a short period of time. The short duration of the experimental sessions limited the possibilities for analyzing the development of shared cognitions over time. Mathieu et al. (2000), for instance, failed to demonstrate any significant changes in cognitive convergence, but the team collaboration in their experiment lasted for only three hours. Our field research involved larger time spans to determine how shared cognitions evolve over time.

So, in this study, we diverged from prior research on shared cognitions in a number of ways. First, we used less broad categories for both independent and dependent variables. In addition to the traditional distinction between shared team cognitions and shared task cognitions, we introduced a third, more specific, category of cognitions that has to do with the temporal aspects of the group task, namely shared temporal cognitions. Moreover, we examined two specific outcome measures, namely the timeliness of performance and the quality of output. Secondly, whereas prior research concentrated on the direct impact of shared cognitions on team performance or studied improved team coordination as a mediating variable, we focused on the motivational impact of shared cognitions by studying group potency as the mediating variable between shared cognition and team performance. Finally, our study involved natural project groups and project teams (terms that we will use interchangeably) whose primary function it was to complete a complex project requiring the deliverance of a custom-made IT system by a certain deadline. Project lead-times varied from two months up to more than a year, which allowed us to examine the development of shared cognitions over a longer period and to determine their longitudinal effects on group potency and group performance. More specifically, we examined the effect of the initial level of shared cognitions in the teams, and of changes in the level of shared cognitions in the course of the project.

5.1 Shared Cognitions

For some time now, there has been a resurgence of interest in the notion of shared cognitions. Various related concepts have been introduced to argue that effective team performance requires team members to hold common or overlapping cognitive representations of the situation or phenomenon they are facing (see Klimoski & Mohammed, 1994, for an overview). Despite the proliferation of terms, scholars appear to agree that team members need to share task cognitions as well as team cognitions to accomplish complex group tasks (Cannon-Bowers et al., 1993; Klimoski & Mohammed, 1994; Rentsch & Hall, 1994). While task cognitions involve knowledge of the specific procedures, strategies, and actions necessary to perform a task, team cognitions involve information about teammates' knowledge, skills, preferences, roles and responsibilities. Sharing both types of knowledge allows groups to perform task-related functions well and to work well together as a team. Mathieu et al. (2000) empirically demonstrated the distinction between shared task cognitions and shared team cognitions, and the relation between both types of cognition and improved team performance.

Gevers, Rutte, and Van Eerde (2004a) suggested that agreement about the allocation of time may also be important to group functioning. They introduced the concept of shared temporal cognitions and argued that team members will have to agree on the temporal aspects of their collective task in order to establish coordinated action and deliver high-quality output on time. These temporal aspects include perceptions regarding the time it takes to complete (sub)tasks, the importance of meeting deadlines, and the appropriate timing and pacing of actions. Until now, temporal issues received remarkably little attention in the shared cognitions literature, although some authors referred to issues of task sequence and pacing when discussing task cognitions (Cannon-Bowers, Tannenbaum, Salas & Volpe, 1995; Rentsch & Hall, 1994). In this study, we distinguished between shared team cognitions, shared task cognitions, and shared temporal cognitions to examine their unique contributions to meeting deadlines and output quality. In the following section, we will explicate our expectations regarding these effects.

Shared Team Cognitions

Shared team cognitions are beneficial to task performance because they enable team members to adapt their behaviors to mutual expectations (Cannon-Bowers & Salas,

2001), and allow teams to take advantage of team members' strengths, such as the specific expertise available within the team (Hackman, 1987). Moreover, knowledge of each others' roles and responsibilities ensures that team members understand how to interact, how to support each other by exchanging information, and how to help each other (Cannon-Bowers & Salas, 2001). Thus, shared team cognitions make it easier for team members to adapt to the needs of the task and the team so that they can collaborate more effectively and efficiently.

Several studies have shown beneficial effects of shared team cognitions on team performance. Mathieu et al. (2000) found that dyads performed better on a flight simulation task when they shared information about team attributes. Recently, Harrison, Mohammed, McGrath, Florey, and Vanderstoep (2003) compared the speed and quality of performance for familiar teams, unfamiliar but continuing teams, and one-shot teams in an experimental study. Studying three-member student teams that worked together on a variety of tasks, they found that familiar teams initially outperformed unfamiliar teams with respect to speed as well as quality. However, as continued work on follow-up tasks allowed familiarity to develop, unfamiliar but continuing teams managed to catch up with the a priori familiar teams. One-shot teams (with unfamiliar members on all tasks), on the other hand, failed to improve their performance. The authors suggested that familiar teams experienced a head start because they had more shared team cognitions, which allowed them to concentrate more effectively on task performance and avoid the process losses inherent in acquiring information about other team members. Based on these findings, we expect that the quality and timeliness of performance will benefit from shared team cognitions at the beginning of a group project, or when developed during the course of group interaction. Vice versa, when the level of shared team cognitions decreases, for instance because membership changes or roles and responsibilities are re-allocated, this will have negative effects on the timeliness and quality of group performance.

Hypothesis 1: Groups with higher initial levels of shared team cognitions perform better with respect to meeting deadlines and output quality.

Hypothesis 2: Increases in the level of shared team cognitions over the course of the group project will have a positive effect on meeting deadlines and

output quality; decreases in the level of shared team cognitions over time will have a negative effect on meeting deadlines and output quality.

Shared Task Cognitions

Several authors have argued that team effectiveness is strongly influenced by the degree to which team members share representations of the task. According to Cannon-Bowers et al. (1993), shared cognitions of task procedures, scenarios and contingencies, strategies, and actions lead to shared expectations among group members, which allow them to coordinate individual contributions effectively, even without overt communication. In a similar vein, Rentsch and Hall (1994) asserted that shared task cognitions help groups to quickly reach agreement on how to define the task and how to handle it, without wasting time, labor, and resources.

Mathieu et al. (2000) found that shared task cognitions affected team performance indirectly, through improved communication, coordination, and cooperation in dyads. Cohen et al. (1999) demonstrated a direct effect of shared task cognitions on team performance. Studying knowledge work teams, they found that successful teams reported higher levels of shared understanding about what they were trying to accomplish and how they approached the work. These results indicate that we may expect positive effects of shared task knowledge on group performance.

On the other hand, various authors have argued that high-quality performance requires that members do not reach agreement on their task too quickly (e.g., Mohammed & Ringseis, 2001; Tjosvold, 1998; Walsh, Henderson, Deighton, 1988). That is, particular aspects of group work may benefit from cognitive diversity. Research on group decision-making has repeatedly shown that multiple member perspectives lead task groups to consider less obvious alternatives, which contributes to creative solutions and team effectiveness (Jackson, 1992; Kilduff, Angelmar, & Mehra, 2000; Tjosvold, 1998). High-performing teams tend to start out with a certain amount of task ambiguity that is gradually being resolved, while low-performing groups tend to show the opposite pattern (Kilduff et al., 2000). Thus, disagreements about the task early in group collaboration may actually contribute to the quality of output and may even enhance the ability of project groups to deliver the output on time, because taking time to consider alternative strategies may prevent groups from having to do rework.

However, a successful and timely project implementation requires that debate does not continue for too long. According to Gersick's punctuated equilibrium model (1988; 1989), high-performing groups are characterized by a midpoint transition that terminates an initial period of inertial task work and causes groups to adopt new perspectives and make dramatic progress. Although this transition may be associated with increased task conflict (Jehn & Mannix, 2001), it is essentially "a moment when successful groups agreed on some concrete plan or goal that formed the basis for moving forward with their projects. In doing so, they eliminated competing possibilities and gave themselves a platform from which to construct further work" (Gersick, 1989: 290). Research by Lim and Murnighan (1994) and Chang, Bordia, and Duck (2003) supported the punctuated equilibrium model, although they found that the transition often took place before the midpoint. In all, these findings suggest that the ability of groups to meet deadlines and produce high-quality output is best predicted from low levels of shared task cognitions early in group collaboration and a convergence of task cognitions in the course of the project.

> *Hypothesis 3: Groups with lower initial levels of shared task cognitions perform better with respect to meeting deadlines and output quality.*

> *Hypothesis 4: Increases in the level of shared task cognitions over the course of the group project will have a positive effect on meeting deadlines and output quality; decreases in the level of shared task cognitions over time will have a negative effect on meeting deadlines and output quality.*

Shared Temporal Cognitions

Temporal issues are important to effective team functioning, especially in relation to meeting deadlines. Meeting deadlines requires that team members coordinate the timing and pacing of their individual contributions, finish subtasks on time, and avoid delays in the flow of work. However, group members may have very different ideas about time allocation in a group project, which may cause group conflict and impede the group's ability to establish a smooth flow of work. Even when schedules and deadlines are established in project plans, team coordination probably depends on how the individual members of the team interpret these schedules and deadlines. That

is, individual differences in time perceptions (Bartel & Milliken, 2004), pacing styles (Gevers, Rutte, & Van Eerde, 2004b), and time urgency (Conte, Landy, & Mathieu, 1995) may lead to differences in deadline salience and responses to progress feedback (Waller, Conti, Gibson, & Carpenter, 2001). Moreover, team members may hold different norms and values about schedules, deadlines, and other time-related issues. Team members who do not value punctuality and adherence to deadlines may be inclined to exceed time limits instead of adjusting their pace to make sure that tasks are completed on time. Janicik and Bartel (2002) showed that project groups are better able to establish compatible work patterns when members collectively acknowledge that temporal issues are important. Therefore, we suggest that shared temporal cognitions will contribute to effective teamwork and thereby enhance the ability of groups to finish work on time.

However, Gevers et al. (2004b) have shown that groups may share temporal cognitions that actually impede their ability to meet deadlines (see Chapter 3). That is, group members may erroneously think there is ample time and that they can take it easy, or may simply agree that meeting deadlines is not important. However, given that these results were obtained in rather short-termed student projects, we presume that the chances of sharing inappropriate temporal cognitions in professional projects are probably smaller, because these teams are subject to much stronger external control, which increases the likelihood that inappropriate cognitions are adapted on the basis of performance feedback. We expect that when temporal cognitions are shared in professional project teams, they are also likely to be appropriate, and thus beneficial to meeting deadlines.

We propose that early agreement about temporal issues will positively affect project outcomes because it allows group members to set up efficient work patterns and focus attention on the content of their (sub) tasks without delay. However, sometimes groups will have to reach agreement about the task content before they can establish shared cognitions about its temporal aspects. Hence, shared temporal cognitions may also be developed during group interaction. Group pacing studies indicate that work groups tend to use the elapse of allotted time as a signal to start talking about time. Research by Chang, Duck, and Bordia, (2000) showed that, although attention to time increased gradually in all groups, successful groups showed particularly high levels of attention to time just before the deadline. We assume that

the attention to time helps team members to align their ideas about the pace and effort required for successful task completion, which, in turn, will help them to finish the project on time. Vice versa, when temporal cognitions diverge in the course of the project, for instance because members fail to establish shared task cognitions or react differently to an approaching deadline (Waller et al., 2001), groups are more likely to experience coordination difficulties that may impede their project performance.

Hypothesis 5: Groups with higher initial levels of shared temporal cognitions perform better with respect to meeting deadlines.

Hypothesis 6: Increases in the level of shared temporal cognitions in the course of the group project will have a positive effect on meeting deadlines; decreases in the level of shared temporal cognitions over time will have a negative effect on meeting deadlines.

5.2 Group Potency as a Mediator

Shared cognitions may lead to better task performance because they enhance the predictability of team behaviors and help groups to better coordinate members' efforts. However, as noted before, several authors have argued that shared cognitions may also enhance motivation in groups (Cannon-Bowers & Salas, 2001; Klimoski & Mohammed, 1994). Klimoski and Mohammed referred to "the wealth of evidence that our cognitions vis-à-vis the cognitions of other individuals (especially close team members) potentially can set up important forces affecting such things as our self concept, our willingness to take risks, and our confidence" (1994: 425). They suggested that the perception of shared cognitions might serve to energize and motivate team relevant behavior. Van Ginkel and Van Knippenberg (2003) provided evidence for the facilitating effects of the awareness of shared cognitions, or meta-level sharedness (Klimoski & Mohammed, 1994; Rentsch & Hall, 1994). They found that groups in which task cognitions were shared outperformed groups that did not share task cognitions, but that groups that were aware of the fact that they shared cognitions performed even better than those groups in which individuals had shared cognitions of the task but were unaware of it. The researchers did not examine the underlying mechanisms responsible for this effect. We suggest that group potency may play a role and that the perception of cognitive congruence leads group members

to have more confidence in their group's abilities, which enhances group performance.

Group potency is defined as the collective belief within a group that it can be effective (Guzzo, Yost, Campbell, & Shea, 1993). A considerable amount of research on group potency and related constructs, such as collective efficacy (Bandura, 1982), established that groups with higher levels of potency perform more effectively (Campion, Medsker, & Higgs, 1993; Campion, Papper, & Medsker, 1996; Lester, Meglino, & Korsgaard, 2002; Sivasubramaniam, Murry, Avolio, & Jung, 2002). In fact, group potency has been shown to contribute to group performance over and above the actual ability of group members (Hecht, Allen, Klammer, & Kelly, 2002). According to Bandura's theory of self-efficacy (1982), people who have confidence in their abilities tend to exert greater effort and are more persistent in their efforts. In addition, when faced with difficulties, those who have a strong belief in their capabilities exert greater effort to master the challenge, which usually pays off in performance accomplishments (Bandura, 1982). Group potency may play a similar role in group performance. Gevers, Van Eerde, and Rutte (2001), for instance, demonstrated that high potency groups were more effective in dealing with time pressure (see Chapter 2).

Although little is known about the factors that promote the development of potency in work groups, Guzzo et al. (1993) suggested that the perceived adequacy of the qualities and attributes represented in the group is one factor that is likely to influence a group's sense of confidence. We expect that the degree to which members perceive their cognitions to be shared is likely to be another. The perception of shared cognitions produces positive affect and trust among team members (Klimoski & Mohammed, 1994). Moreover, when team members recognize that they have shared ideas about the task and how to handle it, this will promote their confidence that they can work well together without much conflict about task allocation or task strategies. Also, knowing that other team members take schedules and deadlines just as seriously and that teammates will have their work ready when the time comes, will enlarge members' faith in the potential of the group, lift team spirit, and induce greater team effort. Ultimately, team performance will benefit from all this. Hence, we propose that high levels of shared cognitions, whether established early in the project or developed

over the course of group interaction, will have a positive effect on the level of group potency, which in turn will benefit group performance.

Hypothesis 7: Group potency will mediate the relationship between the initial levels of shared cognitions and the outcomes of the group project in terms of meeting deadlines and output quality.

Hypothesis 8: Group potency will mediate the relationship between increases and decreases in the levels of shared cognitions and the outcomes of the group project in terms of meeting deadlines and output quality.

5.3 Method

Sample and Procedures

Over a period of two years (May 2001 – May 2003), we collected data from nine medium-sized and large companies in the Information Technology business, and from an IT department of a large banking corporation in the Netherlands. With the help of an internal representative, we selected projects with a lead-time of at least two months and a team of at least three members, including the project leader. Work on the project should not have progressed more than halfway through the lead-time. Initially, 45 projects were selected for participation, but eight projects were eventually eliminated from the sample, because they were terminated prematurely or because of poor response. Thus, our analyses were based on a final sample of 37 projects. Project lead-time ranged from 8 to 70 weeks (as agreed upon with the client and written down in the project planning at the start of the project), with an average of 32 weeks. Team size ranged from 3 to over 50 members, with an average of 15 members. Team members were predominantly males. Most projects involved the development and implementation of an integrated information system from standard software modules and client-specific applications and were classified by the project manager as rather complex.

Longitudinal data on shared cognitions, group potency and other variables were collected by administering questionnaires at four data points. Time 1 was approximately three weeks after the team had started working on the project. Time 2 was halfway through the project lead-time as indicated by the project leader. Time 3

was approximately three weeks before the project deadline. One week after the project was completed we administered a questionnaire to collect performance data (Time 4). If, for whatever reason, the project deadline was shifted, we adjusted the timing of the remaining measurements accordingly to preserve the early-middle-late-end data collection structure. Questionnaires were administered to the project leader and a sample of at least two team members (including all team members in the research would have been too costly and too time-consuming). Respondents were 90 % male, 10 % female. Most respondents (62 %) spent at least 90 % of their working hours on the project. Longitudinal data were typically obtained from the same sample of team members, although respondents were sometimes replaced by fellow team members, for instance when they were on holiday or when they were taken from the project. For 12 projects, the Time 1 data collection was omitted, because these projects had already progressed past this point when they were selected for participation in our study. In 23 projects, an additional team performance rating was collected from a unit manager or project manager at the next hierarchical level. Project leader, team member, and project manager performance measures were identical and were administered mostly electronically. Participants were guaranteed confidentiality. In addition to the questionnaires, we conducted interviews with project managers, project leaders and team members to obtain more detailed information about the projects.

Measures

The questionnaire items were formulated at the group level and referred to the state of affairs in the project at the time of measurement. Unless indicated otherwise below, the response format ranged from 1 = disagree completely to 5 = agree completely and item scores were averaged to obtain a single score for each variable. Cronbach's alphas, indicating the internal consistency of the scales, are presented in Table 5.1. All questionnaire items are presented in Appendix A.

Shared team cognitions. Shared team cognitions were measured with three items. Respondents were asked to what extent they agreed or disagreed that group members (1) knew each others' roles and responsibilities, (2) were familiar with each others' knowledge and skills, and (3) were familiar with each others' style of working.

Shared task cognitions. Shared task cognitions was also measured with three items asking respondents to what extent group members agreed on (1) what had to be done in the project, (2) how these tasks had to be done, and (3) why they had to be done. The response format ranged from 0 %, indicating total disagreement, to 100 %, indicating total agreement, with 10 % intervals.

Shared temporal cognitions. We used four items to assess the extent to which team members shared temporal cognitions. We asked participants to indicate to what extent they agreed that group members (1) had similar opinions about meeting deadlines, (2) had similar thoughts about the best way to use the time available, (3) agreed on how to allocate the time, and (4) had similar ideas about the time it takes to perform subtasks.

Group potency. Group potency was measured with five items that we selected from Guzzo et al.'s eight-item scale (1993). The items we used were: (1) this team has confidence in itself; (2) this team believes it can become unusually good at producing high-quality work; (3) this team expects to be known as a high-performing team; (4) this team feels it can solve any problem it encounters; (5) this team believes it can be very productive. The same selection of items was used by Gevers et al. (2001) and was shown to be adequate (see Chapter 2). In our analyses we used the group potency scores at T3 as an indicator of the level of group potency established during the project. The distribution of the variable at T3 diverged from normality toward a high degree of potency (skewness = -1.50; kurtosis = 4.63), which we corrected with a square root transformation (Tabachnick & Fidell, 1996). After transformation, the scores ranged from 1.95 to 3. The scale-orientation remained the same: higher scores are indicative of higher group potency.

Meeting deadlines. After project completion, team members, project leaders, and project managers were asked what percentage of the total work package had been completed at the deadline defined as the planned ending of the project. The response scale ranged from 0 % to 100 %, with 10 % intervals. The overall mean was 85.85, with a standard deviation of 16.04. In 40 % of the projects at least 90 % of the work had been done at the deadline; 90 % of the projects had finished at least 70 % of their work. A skewness in the variable distribution (skewness = -2.38; kurtosis = 7.51) was corrected by means of a square root transformation. After the transformation, the

scores ranged from 1 to 9, with a higher score indicating a higher level of project completion at the deadline.

Output quality. After project completion, we obtained ratings of the output quality from team members, project leaders, and project managers. We asked them to evaluate how the quality of the project output compared to the quality of output from other projects they were familiar with. Responses were given on a seven-point scale that ranged from 1 = much worse to 7 = much better.

Discriminant validity. We performed a principal component analysis to assess whether we could empirically distinguish between the independent variables. We used oblimin rotation to allow for some association between factors. To be able to analyze all items simultaneously, we pooled the data of T1, T2, and T3 and performed one analysis across all data points (we made sure that only one set of scores per respondent was used). The analysis yielded four factors (see Appendix B). All items loaded highest on their own factor, with loadings of .53 or above. One cross-loading, between potency and shared team cognitions, exceeded .40, and although the difference between the loadings was .11, we decided to keep the item to maintain the three-item scale for shared team cognitions. The four factors explained 69 % of the total variance.

Response and Treatment of the Data

Of the 136 intended measurements (37 teams * 4 times – 12 omitted T1), 133 resulted in a response. In 97 cases, there were at least three respondents per team. In 22 cases, there were two respondents; in 14 other cases, there was one respondent, typically the project leader.

Data were analyzed at the group level, using a one-tailed alpha level of .05 for testing hypotheses. Before aggregating the individual-level scores to the group level, we assessed the average intra-group agreement index $R_{wg(j)}$ for all variables (James, Demarée, & Wolf, 1984). All average values of $R_{wg(j)}$ exceeded .83 (see Table 5.1), which allowed us to aggregate scores and analyze the data at the group level (George, 1990; George & Bettenhausen, 1990).

Then, we used all information available in the aggregated data set to account for missing values at the group level, calculating estimates with an EM algorithm (expectation-maximization). The EM algorithm is a general method of finding the

maximum-likelihood estimate of the parameters of an underlying distribution from a given data set when the set is incomplete or has missing data due to problems with or limitations of the observation process (Dempster, Laird, & Rubin, 1977). This technique has been shown to be superior to other missing data strategies such as mean substitution, single regression imputation, pairwise deletion, or listwise deletion (Dormann & Zapf, 2002). Hence, all analyses were performed on $N = 37$.

Data Analyses

The first six hypotheses addressed how the levels of shared cognitions at the project's start and changes in the levels of shared cognitions during the project are expected to affect performance outcomes. In order to test these hypotheses, we calculated difference scores for the changes in the level of shared cognition between T1 and T2 (X_2-X_1) and for the changes between T2 and T3 (X_3-X_2). We performed two hierarchical regression analyses in which we regressed meeting deadlines and output quality on the levels of shared team, -task, and -temporal cognitions at T1, and the difference scores of these variables over the intervals T1-T2 and T2-T3. We used a stepwise procedure to select significant predictors. Although we hypothesize that shared temporal cognitions would affect meeting deadlines and not output quality, we did include shared temporal cognitions in the analyses on output quality as a control variable.

Hypothesis 7 and Hypothesis 8 predicted that group potency would mediate the relationship between shared cognitions and project outcomes. To establish mediation, three conditions need to be satisfied (Baron & Kenny, 1986). First, the independent variable should significantly predict the mediator. Secondly, the mediator should significantly predict the dependent variable. Thirdly, a previously significant effect of the independent variables on the dependent variable should disappear or decrease substantially when the mediator is entered into the model. The last condition is merely required to establish complete mediation. We used hierarchical regression analyses to test whether these conditions were satisfied for the relationships established in the first set of analyses.

Table 5.1. *Descriptive statistics, interrater reliability, internal validity, and intercorrelations of the variables in the study*

	M	*SD*	$\overline{R}_{wg(j)}$	1	2	3	4	5	6	7	8	9	10	11
Time 1														
1. Shared team cognitions	3.95	.33	.92	**.73**										
2. Shared task cognitions	81.06	8.76	.96	.48	**.75**									
3. Shared temporal cognitions	3.50	.38	.92	.40	.19	**.83**								
Time 2														
4. Shared team cognitions	4.02	.31	.93	.25	-.03	.14	**.65**							
5. Shared task cognitions	79.60	12.04	.95	.26	.23	.07	.38	**.85**						
6. Shared temporal cognitions	3.42	.55	.97	.36	.20	.31	.63	.65	**.84**					
Time 3														
7. Shared team cognitions	4.00	.50	.94	.03	-.04	-.09	.30	.27	.07	**.89**				
8. Shared task cognitions	78.80	9.09	.88	.19	.11	-.05	.04	.45	.06	.59	**.87**			
9. Shared temporal cognitions	3.46	.50	.92	.22	-.09	.21	.19	.48	.36	.41	.44	**.83**		
10. Group potency	2.59	.20	.93	.33	-.04	.21	.23	.51	.48	.43	.49	.64	**.90**	
Time 4														
11. Meeting deadlines	6.56	1.85	.93[4]	.08	-.16	.31	.13	.43	.38	.26	.49	.60	.71	
12. Output quality	4.79	.74	.83	.27	-.15	-.14	.31	.49	.32	.36	.42	.46	.47	.43

Note. $N = 37$; all correlations above .21 are significant at $p < .05$, one-tailed; internal consistencies of the scales (α), as measured at the individual level, are presented in bold printing on the diagonal; *M* = means; *SD* = standard deviations; $\overline{R}_{wg(j)}$ = mean interrater reliability.

[4] $\overline{R}_{wg(j)}$ is based on an expected variance (*EV*) for a negatively skewed null distribution (see James, Demarée, & Wolf, 1984)

5.4 Results

Preliminary Analyses

As our sample varied considerably with respect to team size, project lead-time, task complexity, and the level of routine in the job, we tested for systematic differences in the dependent variables due to these characteristics. The results revealed that none of these characteristics significantly predicted project outcomes (see Appendix B for a summary of the results). In addition, we performed a MANOVA to test for differences in scores between the project teams that participated on all of the data-collection points and those that entered the research at T2. We also did not find any significant differences there (for meeting deadlines: F (1,35) = 1.50, p = .23, *n.s.*; for output quality: F (1,35) = 0.16; p = .09, *n.s.*). Hence, we did not include these variables in our analyses.

Descriptive Statistics

Table 5.1 presents the distributions, interrater reliability, internal consistency, and intercorrelations for the variables in the study. Looking at the distributions, we noticed that the mean scores of our measures did not change much over time. We performed a repeated measures multivariate analysis of variance (MANOVA) to test for longitudinal changes. Results showed no significant changes in the mean scores for any of the variables (F (6, 31) = .864; p = 53, *ns*.).

Hypothesis testing

The results of the hierarchical regression analyses that were performed to test the first six hypotheses are summarized in Table 5.2, model 1. Hypothesis 1 suggested that high levels of shared team cognitions at the project's start would have a positive effect on meeting deadlines and output quality. Moreover, increases in the level of shared team cognitions in the course of the project would also contribute to project outcomes, and vice versa (Hypothesis 2). Consistent with our predictions, we found that groups with higher initial levels of shared team cognitions performed better with respect to output quality (β = .32; p = .05). However, shared team cognitions at T1 had no effect on meeting deadlines. We also did not observe that changes in the level of shared team cognitions contributed significantly to the prediction of meeting

Table 5.2

Results of the Hierarchical Regression Analyses on group potency, meeting deadlines, and output quality

	Group potency T3			Meeting deadlines T4				Output quality T4			
	F	*adj. R^2*	*β*	F	*adj. R^2*	*ΔR^2*	*β*	F	*adj. R^2*	*ΔR^2*	*β*
Model 1	6.84***	.49		7.85***	.49			11.24***	.36		
Shared team cognitions T1			.20				---				.32*
Shared temporal cognitions T1			.52**				.64***				---
Δ Shared task cognitions T1-T2			.37*				.50**				.57***
Δ Shared temporal cognitions T1-T2			.72**				.56**				---
Δ Shared task cognitions T2-T3			.35*				.44**				---
Δ Shared temporal cognitions T2-T3			.40*				.32*				---
Model 2				8.59***	.56	.07*.		7.60***	.36	.00	
Shared team cognitions T1							---				.27*
Shared temporal cognitions T1							.38*				---
Δ Shared task cognitions T1-T2							.38*				.51**
Δ Shared temporal cognitions T1-T2							.22				---
Δ Shared task cognitions T2-T3							.30*				---
Δ Shared temporal cognitions T2-T3							.14				---
Group potency T3							.40**				.13

Note. N = 37; *$p < .05$, **$p < .01$, *** $p < .001$, one-tailed; --- not selected as a significant predictor.

deadlines or output quality. Hence, Hypothesis 1 was only confirmed with respect to output quality and no support was found for Hypothesis 2.

Hypothesis 3 and Hypothesis 4 suggested that meeting deadlines and output quality would benefit from a level of shared task cognitions that was initially low, but that would increase over the course of the group project. Contrary to our expectations, the initial level of shared task cognitions did not affect group performance. Hence, Hypothesis 3 was not supported. However, we did find support for Hypothesis 4. Increases in shared task cognitions over the interval T1-T2 promoted both meeting deadlines and output quality (β = .50; p = .01 and β = .57; p = .001, respectively). Moreover, an additional increase in shared task cognitions over the interval T2-T3 further increased the likelihood that the deadline was met (β = .44; p = .01).

Hypothesis 5 suggested that meeting deadlines would benefit from high initial levels of shared temporal cognitions. Moreover, Hypothesis 6 predicted that an increase in the level of shared temporal cognitions in the course of the project would have a positive effect on meeting deadlines, while a decrease in the level of shared temporal cognitions would affect meeting deadlines negatively. In line with these expectations, we found a positive effect of shared temporal cognitions at T1 on meeting deadlines (β = .64; p = 001). Moreover, increases in the level of shared temporal cognitions over the intervals T1-T2 (β = .56; p = .01) and T2-T3 (β = .32; p = .05) both contributed to meeting deadlines. Shared temporal cognitions did not show significant effects on output quality. This means that Hypothesis 5 and Hypothesis 6 were confirmed.

To summarize, meeting deadlines was promoted by high levels of shared temporal cognitions at T1, and by increases in shared task cognitions and shared temporal cognitions over the intervals T1-T2 and T2-T3. Together, these variables accounted for 49 % of the variance in meeting deadlines. Output quality was promoted by high levels of shared team cognitions at T1 and by increases in shared task cognitions over the interval T1-T2. In total, the variance in output quality accounted for by these variables was 36 %.

Testing Mediation

Table 5.2 also reports the results of the analyses performed to test whether group potency mediated between shared cognitions and group performance in terms of

meeting deadlines and output quality (Hypothesis 7 and Hypothesis 8). To establish the first condition for mediation, i.e., that the independent variables significantly predict the mediator, we regressed group potency at T3 on the relevant independent variables (shared team cognitions at T1, shared temporal cognitions at T1, and the change scores for shared task cognitions and shared temporal cognitions over the intervals T1-T2 and T2-T3). The results of the analysis are presented in the first column of Table 5.2. The model shows that the level of group potency established at T3 was significantly predicted by the level of shared temporal cognitions at T1 (β = .52; p = .01), by increases in shared task cognitions over the intervals T1-T2 and T2-T3 (β = .37; p = .05, and β = .35; p = .05, respectively), and by increases in shared temporal cognitions over the intervals T1-T2 and T2-T3 (β = .72; p = .01, and β = .40; p = .05, respectively). The level of shared team cognitions at T1 did not contribute to the prediction of group potency (β = .20; p = .18, *ns*.).

Table 5.2, model 2, shows the tests of the other conditions for mediation (i.e., that the mediator significantly predicts the dependent variable and that previously significant effects of independent variables on the dependent variable decrease substantially when the mediator is entered into the model). With respect to meeting deadlines, adding group potency to the existing model increased the amount of variance accounted for with 7 %. At the same time, the effects of shared task cognitions and shared temporal cognitions dropped substantially. In fact, the beta-weight of the changes in the level of shared temporal cognitions became non-significant, meaning that these effects were fully mediated by group potency. The fact that the beta-weights of the level of shared temporal cognitions at T1 and the changes in shared task cognitions over the interval T1-T2 decreases but remained significant indicates that these effects were partially mediated by group potency.

With respect to output quality, group potency did not show a significant effect. So, although initial shared team cognitions and the increase in shared task cognitions over T1-T2 contributed to the quality of project output, these relationships were not mediated by group potency. Hence, Hypothesis 7 and Hypothesis 8 were confirmed for meeting deadlines. Whereas the level of group potency established at T3 mediated between shared cognitions and meeting deadlines, it did not play a role in mediating the effect of shared cognitions on output quality.

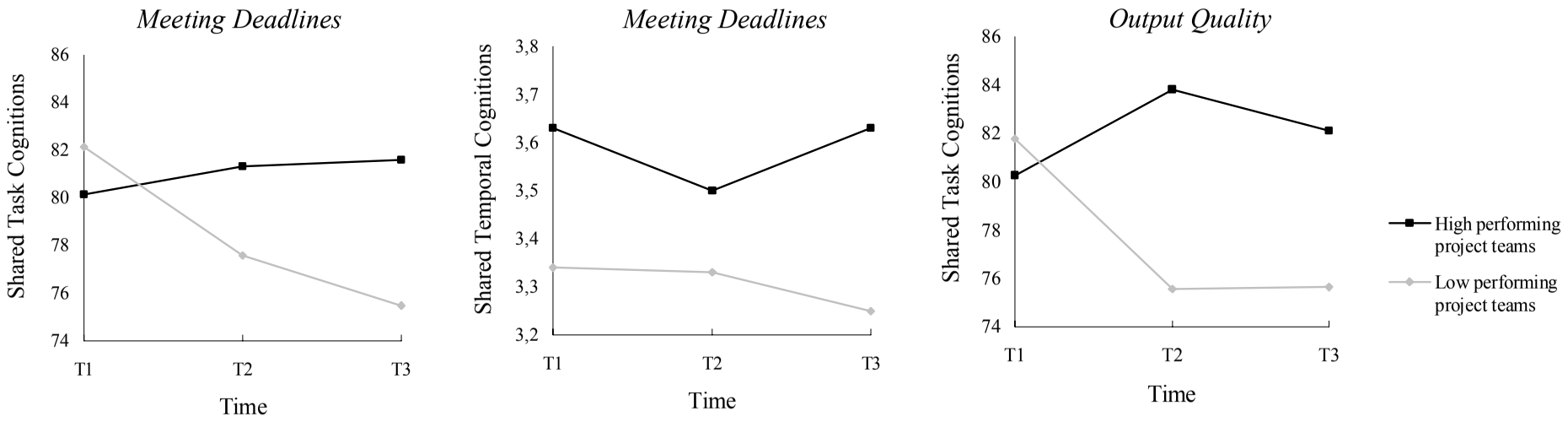

Figure 5.1 Development of shared task cognitions and shared temporal cognitions for high performing and low performing groups on meeting deadlines and output quality

Additional results

Although there were no significant changes in the overall means of the shared cognition variables over time, output quality was significantly predicted by changes in shared task cognitions, and meeting deadlines was significantly predicted by changes in both shared task cognitions and shared temporal cognitions. This suggests that both convergence and divergence in these cognitions must have taken place. The fact that Table 5.1 shows larger standard deviations at later measurements of these variables supports this conclusion. Moreover, while convergence was associated with higher performance on meeting deadlines and output quality, divergence was associated with lower performance on these outcomes. Figure 5.1 shows the development of shared task cognitions for low-performing and high-performing groups with respect to meeting deadlines and output quality (both based on a median split), and also the development of shared temporal cognitions for low-performing and high-performing groups on meeting deadlines. These graphs suggest that low-performing groups have decreasing levels of shared task- and shared temporal cognitions, while high-performance groups display fairly constant or increasing levels of shared task and temporal cognitions. Notably, high-performing groups with respect to meeting deadlines seem to have higher levels of shared temporal cognitions throughout the project.

5.5 Discussion

The aim of this study was to examine how shared team cognitions, shared task cognitions and shared temporal cognitions affect group performance in terms of meeting deadlines and output quality. Additionally, we sought to examine the extent to which the relationships between shared cognitions and group performance were mediated by group potency. Our study contributes to the existing literature on shared cognitions and group performance in several ways. Firstly, it establishes the value of shared temporal cognitions over and above shared team cognitions and shared task cognitions in predicting project outcomes, and demonstrates that meeting deadlines and output quality are affected by different categories of shared cognition. Secondly, it suggests that group potency acts as a mediator for meeting deadlines, but not for output quality. Finally, it advocates a dynamic approach to studying shared cognitions

in demonstrating that the levels of shared cognitions change over time and that these changes affect both group potency and group performance.

As predicted, we found that high levels of shared team cognitions at the projects' start increases the ability of groups to produce high-quality output. However, shared team cognitions did not affect meeting deadlines, nor did we find any significant effects of changes in shared team cognition on project outcomes. The latter may have to do with the fact that most groups in our study started out with quite high levels of shared team cognitions and showed little change during the project, although the standard deviation increased somewhat at T3 (see Table 5.1: M_{T1} = 3.95, *SD* = 0.33 ;M_{T2} = 4.02, *SD* = 0.31; M_{T3} = 4.00, *SD* = 0.50). The outcome that shared team cognitions did not facilitate meeting deadlines is inconsistent with Harrison et al.'s findings that familiar groups, which may be expected to have more shared team cognitions, did not only create better output, but also worked faster (2003). We derive a possible explanation for this inconsistency from the interviews we held with the project managers, in which several of them indicated that they often take into account the extent to which group members are familiar with each others' characteristics and with their roles in the project when planning projects and setting deadlines. This may indicate that groups that were known to have high levels of shared team cognitions may have had tighter schedules than the groups that were known to have little shared information about the team. Consequently, teams with high levels of shared team cognitions may have worked faster, but were thereby not more likely to meet their deadlines than teams with lower levels of shared team cognitions.

Contrary to our expectations, we did not find beneficial effects of initial diversity in shared task cognitions on meeting deadlines or output quality. We suggest that there may not have been enough differentiation in the level of shared task cognitions in our sample to demonstrate such an effect. However, we did find that meeting deadlines and output quality both benefited from increases in shared task cognitions over the first half of the project lead-time, while a decrease in shared task cognitions during that period hampered performance on both aspects. Moreover, a further decrease in shared task cognitions in the second half of the project made it even more difficult for groups to meet a deadline. This suggests that the increase in shared task cognitions is more important to project performance than the initial level of agreement about the task. Thereby, our findings correspond with a growing body of

research that shows that successful groups tend to consider task-related issues early in their collaboration to arrive at a synthesis of task perspectives, whereas unsuccessful groups show a decline in agreement about the task in the course of group interaction (Jackson, 1992; Kilduff et al., 2000; Tjosvold, 1998).

Furthermore, we found that groups with high initial levels of shared temporal cognitions were more likely to complete the project on time. Moreover, meeting deadlines also benefited from a convergence of temporal cognitions in the course of the project. Prior research established that increased attention to time over the course of a project, as indicated by the number of references to time in group conversation, facilitated meeting deadlines (Chang et al., 2003; Gersick, 1988; 1989). Our findings show a similar effect of convergence in group members views on the temporal aspects of task execution. This suggests that these processes may be linked in the sense that groups build shared temporal cognitions by talking about time, as was found in research on self-generated temporal reminders in project teams (Gevers et al., 2004b; see Chapter 3). Apparently, high quality performance is contingent upon a shared representation of the task work and how each individual member contributes to task accomplishment, whereas a timely performance depends upon a shared representation of the task and how time should be allocated in task accomplishment.

Finally, our results show that the effects of shared task cognitions and shared temporal cognitions on meeting deadlines are mediated by group potency. The effects of initial shared temporal cognitions and changes in shared task cognitions were partially mediated; the effects of changes in shared temporal cognitions were fully mediated. The effects of shared team cognitions and shared task cognitions on output quality were not mediated by group potency. Since most of the projects in our sample involved complex, non-routine jobs in which customer-specific applications had to be integrated with standard modules, we suggest that the production of high-quality output may not so much have been a matter of motivation, but a question of knowing how to handle the task or finding creative solutions to the problems encountered during the project.

Strengths, Limitations, and Directions for Future Research

One major strength of our study is its longitudinal design, which allowed us to investigate how shared cognitions developed over time and how changes in shared

cognitions affect group performance. Although the overall means of the shared cognitions variables did not show significant changes over time, we found that the level of shared task cognitions and shared temporal cognitions actually did change, but that there were opposite effects for high- and low-performing groups. While low-performing groups showed decreases in the level of agreement about the task and its temporal aspects, high-performing groups displayed increasing or rather constant high levels of shared task- and temporal cognitions.

Another merit of our research is the fact that, in contrast to much group research that focuses on general team effectiveness, we studied group performance in terms of meeting deadlines and output quality separately. In contrast to the popular assumption that there is often a trade-off between the timeliness of project completion and the quality of project output, we found that the ability of groups to meet deadlines converged with their ability to produce high-quality output, similar to some previous research (Atuehene-Gima, 2003; Harrison et al, 2003).

Next to strengths, there are also some limitations to our study. First, the measurements were based on project members' self-reports, which are subject to biases. However, self-report measures may not limit internal validity as much as is commonly expected (see, Spector, 1992; Wall, Michie, Patterson, Wood, Sheehan, Clegg & West, 2004). In addition, we recognize that the reliance on one-item measures for project outcomes violates reliability rules. We partly compensated for these limitations by obtaining data from various team members who held different functional and hierarchical positions within the team and by collecting additional performance ratings from a project manager or unit manager who did not have an extensive role in the project. Moreover, we derive confidence in the reliability and validity of our data from high levels of intra-group agreement and the fact that our performance measures show different relationships with the independent variables while they were positively correlated.

Then, we should address the use of the difference score as a means to measure change over time. Difference scores have been criticized for their presumed unreliability (Cronbach & Furby, 1970) and sensitivity to regression to the mean effects (Cohen & Cohen, 1975). In more recent literature, however, these imputations have been disputed (Rogosa, 1988) and difference scores have been shown to perform equally well or better than alternative approaches, such as the use of regressor

variable approach, in research on natural groups (Allison, 1990). Moreover, the regressor variable approach has the disadvantage that the residual change scores on which it is based measure predicted change rather than actual change, and that they may be unreliable as well. Weighing the pros and cons of both approaches, we chose in favor of the more transparent difference score, also because they yielded similar results

Another difficulties of longitudinal research is that the investigator has to make assumptions about the appropriate time interval between measures to ensure that true change has take place. We employed an early-midpoint-late approach in which measurement intervals were contingent upon the total project lead-time. We acknowledge that the differences in measurement intervals between groups may have affected our findings since shorter intervals offer groups less time to build shared cognitions. However, prior research suggested that work group development processes do not evolve according to the elapse of actual time, but according to the elapse of time relative to the deadline (Gersick, 1988; 1989). Tight deadlines, for example, were shown to increase team members' focus on the task (Karau & Kelly, 1992). Hence, we anticipated that the development of shared cognitions would be contingent upon the time available and that it would be more appropriate to collect data at particular points in the course of the project than at fixed points in time.

With respect to the external validity, we need to take into consideration that our sample was drawn entirely from the Information Technology business. Consequently, our sample suffers from an overrepresentation of male team members. In addition, it also may have caused projects to be relatively homogeneous with respect to task content to the extent that most projects involved building a customer-specific information system by integrating standard software modules with custom-made applications. However, given that the projects came from multiple companies and showed considerable variation in team size, project lead-time, task complexity, and job routine lends some credence to the generalizability of our findings to a large variety of projects.

Given the rather small sample size (37 groups), statistical power may have played a role in testing our hypotheses, which implies that we need to practice caution in interpreting null results. On the other hand, it also suggests that the relationships that we found had considerable strength. Unfortunately, the limited sample size also

forced us to test hypotheses with respect to meeting deadlines and output quality separately. Future studies could gain considerable strength by testing all relevant variables in an integrated structural equation model.

Another promising avenue for future research concerns the role of the project leader in establishing shared cognitions and guiding a team towards a timely project completion with satisfactory output quality. Although leadership is a much-visited topic in the project management literature, to our knowledge, it has escaped the attention of those involved in research on shared cognitions. Combining these topics would constitute an additional step towards bringing research on shared cognitions into real-world settings.

Practical Implications

Strictly speaking, the reported findings do not allow causal inferences, despite the fact that they are based on a longitudinal research design. However, speculating on their causal direction, we would suggest that practitioners who are interested in improving the quality and timeliness of group project performance should devote time and energy to help develop cognitive congruence about the team, the task, and its temporal aspects among work group members, for instance in project-launch meetings in which management and team members come together to discuss the feasibility of the project and to reach an agreement about the project targets and the project approach. Output quality seems to depend particularly on shared knowledge of what each member contributes to the group, and on the ability of the group to establish a shared view of the task early in group collaboration. Moreover, the chances that high-quality output is delivered on time are highest when group members also have shared temporal cognitions.

Chapter 6

General Discussion

In this concluding chapter, we summarize, integrate, and discuss the main findings of the research presented in the preceding chapters and propose a model of team self-regulation toward meeting deadlines based on this integration. In addition, we address some strengths and limitations of our research. We conclude with some suggestions for future research and some recommendations for project team practice.

This dissertation addressed the question how project teams control and direct their actions toward timely project completion. The foregoing chapters presented four studies that were conducted to help us answer this question. This research adds to the little research that has directly focused on team self-regulation in relation to meeting deadlines. Previous research demonstrated that deadlines are important pacers of task activities in work group collaboration. However, the processes involved in meeting deadlines deserve additional attention. We examined a variety of input and process variables relevant to team self-regulation and meeting deadlines. In the introductory chapter, we categorized these variables into six categories: team composition, team self-regulation, shared cognitions, team motivation, team task execution, and team performance. In the next section, we will use this classification to discuss the main findings of the four empirical studies and draw conclusions regarding their relationships. Based on our conclusions we will propose a model of group self-

regulation toward meeting deadlines. Next, we will evaluate our work and give directions for future research. Finally, the practical implications of our work will be discussed.

6.1 Main Findings and Conclusions

Shared Cognitions: Temporal, Team, Task

Given its central position in our research, we begin this section with a discussion of the main findings regarding the effect of shared cognitions on project performance. Inspired by the finding that team effectiveness is enhanced when team members have shared cognitions about the task and the team (Cohen, Mohrman, & Mohrman, 1999; Mathieu, Heffner, Goodwin, Salas, & Cannon-Bowers, 2000; Stout, Cannon-Bowers, Salas, & Milanovich, 1999), we proposed that in order to meet deadlines it may be important that team members also share cognitions about the temporal aspects of task execution, such as the importance of meeting deadlines, (sub) task completion times, and the appropriate timing and pacing of task activities. In this dissertation, we differentiated, both conceptually and empirically, between shared team cognitions, shared task cognitions, and shared temporal cognitions, and found support for the assumption that shared temporal cognitions affect meeting deadlines over and above the effect of shared team cognitions and shared task cognitions. In addition, we found that shared team cognitions and shared task cognitions also contribute to the quality of project output, while shared temporal cognitions do not. We will first discuss the effects of shared cognitions on meeting deadlines and then address their effects on output quality.

Shared cognitions and meeting deadlines. Shared temporal cognitions facilitated meeting deadlines in both student project groups (Chapter 4) and professional project teams (Chapter 5). We found that teams were more likely to complete projects on time when members started out with high levels of shared temporal cognitions, and when they developed shared temporal cognitions over the course of the project. However, there is a caveat. The study reported in Chapter 3 showed that the relationship between shared temporal cognitions and meeting deadlines was affected by the team's pacing style. That is, shared temporal cognitions improve meeting deadlines when group members, on average, tend toward an early action pacing style, but impede meeting deadlines when group members, on average,

tend toward a deadline action style, i.e., when they tend to put off work until the deadline is very close. This finding endorses the claim made by Rentsch and Hall (1994) that cognitive congruence is only part of the picture, and that the adequacy of their content is vital, because shared cognitions may also be detrimental to performance. Hence, we conclude that shared temporal cognitions are beneficial to meeting deadlines as long as they are appropriate.

Prior research demonstrated that familiar teams, that may be expected to have higher levels of shared team cognitions, worked faster than unfamiliar teams. (Harrison, Mohammed, McGrath, Florey, & Vanderstoep, 2003). We found mixed support for the assumption that shared team cognitions contribute to meeting deadlines. While shared team cognitions improved the timeliness of performance in student project groups (Chapter 4), they did not enhance meeting deadlines in professional project teams (Chapter 5). We explained in Chapter 5 that this inconsistency may stem from the fact that team familiarity is often taken into account when planning project lead-times and setting deadlines in professional projects. As a result, teams with high levels of shared team cognitions may be presented with tighter schedules, and consequently lose their advantage over teams with low levels of shared temporal cognitions. Still, we may tentatively conclude that as long as project plans are not adapted to team characteristics, shared team cognitions will enhance the ability of project teams to meet deadlines.

Shared task cognitions were addressed in Chapter 5. We suggested that initial diversity in task cognitions would facilitate meeting deadlines as long as team members managed to establish agreement about the task approach during their collaboration on the project. Although we failed to demonstrate a positive effect of initial diversity in task cognitions, we found strong support for the presumed positive effect of increases in shared task cognitions during group interaction. Hence, we may conclude that a growing convergence in task cognitions over the course of a project increases the likelihood that deadlines are met.

Shared cognitions and output quality. The research in Chapter 5 provides insight into the effects of shared team, task, and temporal cognitions on the quality of project output. We found that output quality was enhanced by shared team cognitions and shared task cognitions. Consistent with recent findings of Harrison et al., (2003), teams were better able to produce high-quality output when they were already familiar

with each others' knowledge, skills, preference, roles, and responsibilities at the start of the project. A convergence of task cognitions in the first half of the project also benefited output quality. As expected, shared temporal cognitions did not affect output quality. Apparently, the quality of project performance is a matter of having a clear and shared representation the task approach and each members' role and contribution in this process, whereas the timeliness of project performance depends on a shared representation of the task work and how time should be used to finish it on time.

To summarize: we conclude that shared team cognitions, shared task cognitions, and shared temporal cognitions each contribute uniquely to meeting deadlines. Shared team cognitions and shared task cognitions also contribute to output quality, whereas shared temporal cognitions do not. Moreover, while shared team cognitions are more likely to enhance group performance when they are present at the project's start, shared task cognitions and shared temporal cognitions may also be developed during the course of the project. However, inappropriate shared temporal cognitions were found to impede meeting deadlines. Although we did not investigate this, it seems reasonable to suspect that inappropriate cognitions about the team and the task will also impede meeting deadlines and output quality. Therefore, we conclude that sharing inappropriate cognitions will adversely affect project performance.

Team Composition: Pacing Styles

In the introductory chapter, we suggested that the likelihood that project teams meet deadlines may be influenced by the personal characteristics of the members in the team. In the foregoing, we discussed that the pacing styles present in a team affect the relationship between shared temporal cognitions and meeting deadlines. However, we also suggested that the similarity in pacing styles might affect the likelihood that team members have shared temporal cognitions in the first place. The research presented in Chapter 2 provides support for this notion: similarity in pacing styles was indeed associated with higher levels of shared temporal cognitions when group members worked together on the first assignment. This relationship disappeared in members' collaboration on a second task. We argued that this implies that team experiences in the first collaboration influenced team members' views on the use of time in the

second collaboration more strongly than their personal pacing styles. In all, we may conclude that the composition of the team in terms of pacing styles may initially influence the extent to which team members have shared temporal cognitions, but that this effect will wear off as team members have the opportunity to learn from previous experiences.

Team Self-Regulation: Planning, Reflexivity, Temporal Reminders

We proposed that planning, reflexivity, and the exchange of temporal reminders represent more explicit or deliberate mechanisms that team members may use to guide team processes and team performance.

Planning. We examined the relationship between planning and meeting deadlines in Chapter 2 and Chapter 4, making a distinction between preplanning (i.e., the planning that takes place before teams start executing tasks) and in-process planning (i.e., the planning that takes place during task execution) by collecting data in the orientation phase and the execution phase of the projects. In Chapter 2, we found that preplanning was not associated with meeting deadlines. In-process planning, on the other hand, related positively to meeting deadlines. In Chapter 4, we observed a positive relationship between preplanning and meeting deadlines, however. Preplanning also contributed to shared temporal cognitions in the team which was shown to facilitate meeting deadlines. However, we did not find support for a positive effect of in-process planning on meeting deadlines. The apparent contradiction between the results presented in these chapters may stem from an inconsistency in our research designs. In Chapter 2, questionnaire items referred to the period preceding the moment of data collection. This approach generates continuous-time data (Taris, 2000), which means that the data provide insight into what happened in the teams between data collections. In Chapter 4, questionnaire items referred to the state of affairs in the team at the moment of data collection itself, thereby generating discrete-time data. The latter approach, in combination with the timing of the data collections (preplanning data was measured at the end of the orientation phase, in-process planning was measured at the end of the execution phase), made it difficult to distinguish correctly between preplanning and in-process planning. This could account for contradiction in the findings of Chapter 2 and Chapter 4. However, the findings of both chapters suggest that planning is most beneficial when it takes place

at the end of the orientation phase, or short after. This is consistent with Tripoli's (1998) assumption that teams need to established clarity about project goals and project conditions for planning to be of any use.

Reflexivity. Mixed support was found for the presumed positive relationship between reflexivity and meeting deadlines. In Chapter 2, we found a positive association between reflexivity and meeting deadlines, at least in the project execution phase. The research in Chapter 4, which involved similar groups and similar projects, did not show any association between reflexivity and meeting deadlines. Neither did we find any support for the presumed positive effects of reflexivity on the level of shared temporal cognitions established within the groups. However, the findings in Chapter 4 showed that lower levels of shared temporal cognitions in the orientation phase were associated with higher levels of reflexivity in the execution phase. This suggests that there is a reciprocal relationship between shared temporal cognitions and reflexivity in the sense that a lack of shared temporal cognitions leads groups to engage in more reflection to solve differences in temporal cognitions and take corrective action, which in turn, may positively affect meeting deadlines. This resembles Edmondson's (1999) consideration of team learning which she defines as 'an ongoing process of reflection and action, characterized by asking questions, seeking feedback, experimenting, reflecting on results, and discussing errors'(p. 353). Through reflection upon task and time progression members may alter their perspective on the use of time in the project, make up arrears, and still finish the project on time. However, our support for this interpretation may only be preliminary and not sufficient to allow us to draw any strong conclusions regarding the role of reflexivity in meeting deadlines.

Temporal reminders. Temporal reminders were examined as antecedents of shared temporal cognitions in Chapter 3 and Chapter 4. Strong support was found for the presumed positive effect of temporal reminders on the development of shared temporal cognitions in project teams. Notably, both studies showed that the exchange of temporal reminders affected the level of shared temporal cognitions only in later stages of group collaboration. In Chapter 3, temporal reminders were only effective when team members collaborated on a second assignment. In Chapter 4, we found no effect of temporal reminders in early project stages, but in the second half of the project an increase in the use of temporal reminders were associated with an increase

in shared temporal cognitions. Hence, both studies indicate that team members need some time in collaboration before temporal reminders have an effect on the level of shared temporal cognition. Maybe, members need this time to realize that temporal aspects may be problematic for their team and that the level of shared temporal cognitions is not high enough to ensure effective collaboration. Only once team members realize that this is the case, temporal reminders may help them to build and consolidate the level of shared temporal cognitions within the team.

In sum, with respect to team self-regulation, we conclude that planning after a first orientation on the project goals and circumstances facilitates the formation of shared temporal cognitions, and thereby, contributes to meeting deadlines. Moreover, the use of temporal reminders in later stages of group collaboration also adds to the development and consolidation of shared temporal cognitions within the team. Our findings do not provide a solid basis for conclusions regarding the effects of reflexivity on meeting deadlines. Hence, this remains a topic to be addressed in future research.

Team Motivation: Group Potency

Team motivation was represented in our research by the concept of group potency, i.e., the collective belief within a group that it can be effective (Guzzo, Yost, Campbell, & Shea, 1993). Potency was studied as a moderator for the effects of perceived time pressure on project progress in Chapter 2, and as a mediator between shared cognitions and project performance in Chapter 5. From these studies, two conclusions may be drawn regarding the role of potency in meeting deadlines. First, potency contributes to meeting deadlines because it makes teams more effective in dealing with time pressure. High and low potency groups showed very different reactions to time pressure. Low potency groups were discouraged by high levels of perceived time pressure and made little progress, which impeded their ability to meet the deadline still further. High potency groups, on the other hand, showed less progress irrespective of the amount of perceived time pressure, but they were challenged by the backlog and managed to make up their arrears.

Second, potency acts as a mediator for the relationships between shared cognitions and meeting deadlines. We found that initial shared temporal cognitions and increases in shared temporal cognitions over the course of the project had a

positive effect on group potency. In addition, increases in shared task cognitions over time also promoted group potency. Potency, in turn, had a positive effect on meeting deadlines. We found no support for the assumption that potency would also mediate between shared cognitions and output quality.

Team Task Execution: Coordinated Action

Coordinated action was examined as another possible link between shared temporal cognitions and meeting deadlines. Coordinated action is defined as the situation where group interaction is characterized by a smooth flow of work and by cooperative behavior among team members. In parallel to earlier findings that shared team cognitions and shared task cognitions facilitated team performance through improved coordination (Mathieu et al., 2000), we found that coordinated action mediated between shared temporal cognitions and meeting deadlines. Chapter 4 showed that initial shared temporal cognition and increases in the level of shared temporal cognitions over the course of the project both led to higher levels of coordinated action in later project stages. This, in turn, facilitated a timely project completion.

Team Performance: Meeting Deadlines and Output Quality

Although our research predominantly addressed the timeliness of project performance, Chapter 5 also examined the quality of project output. This made it possible to determine the unique effects of shared cognitions on both aspects of team performance. As mentioned earlier, both outcome measures benefited from shared task cognitions. However, whereas meeting deadlines was facilitated when team members also had shared temporal cognitions, output quality was enhanced when team members also had shared team cognitions.

Moreover, we were able to test the ever so popular notion that timeliness and quality present trade-off problems. Several studies in the laboratory indicated that output quality was negatively affected when project teams worked faster (Kelly & McGrath, 1985; Kelly & Karau, 1992). However, our field research suggests the contrary; we found that teams that met the deadline where also more likely to produce high-quality output ($r = .43$), consistent with other research in the field (Atuahene-Gima, 2003).

6.2 Theoretical Contributions

The conclusions drawn in the previous section provide the building blocks for a model regarding how project teams control and direct their actions toward a timely project completion. Figure 6.1 presents a proposed model of team self-regulation toward meeting deadlines. The model is based on the assumption that the team is established and that the task and the deadline are specified. There may even be a plan for task execution. With these conditions given, the model depicts meeting deadlines in project teams as a dynamic process in which team members establish shared cognitions about the team, the task, and it temporal aspects either implicitly, when individual cognitions are congruent prior to group interaction, or explicitly through team self-regulation. Shared cognitions, in turn, enhance team motivation and facilitate team task execution, which allows teams to make progress in the direction of project completion. The progression of time and project accomplishments provides input for additional self-regulation in terms of reflection and corrective action. Eventually, the outcome of the process is a timely project completion, i.e., meeting deadlines.

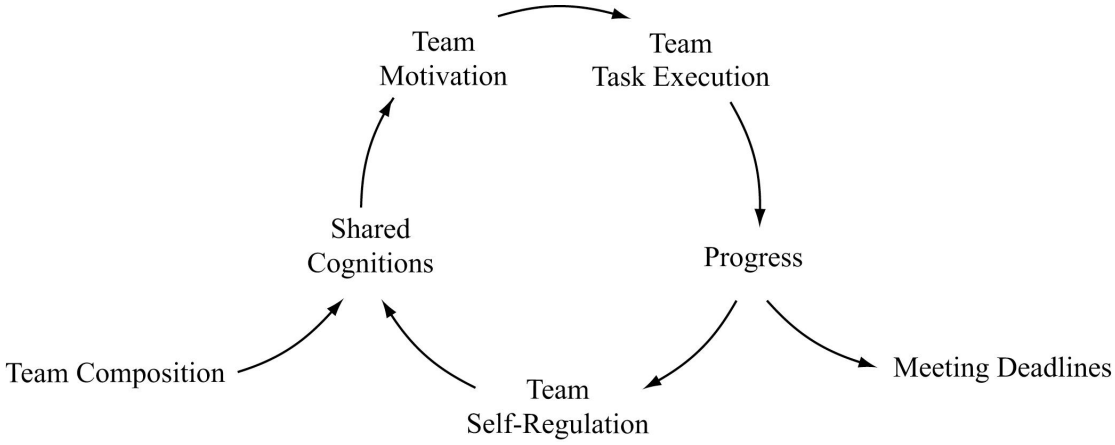

Figure 6.1. Model of team self-regulation toward meeting deadlines

It should be noted that we have simplified the model, leaving out potential direct relationships or feedback-loops among the variables in the model. Team motivation is depicted as an antecedent of team task execution because prior research has shown that the degree to which team members attempt to compensate for each other's behavior depends on their confidence in the team (Fiore, Salas, & Cannon-

Bowers, 2001). However, the experience of coordinated action in team task execution will probably also promote potency. In fact, shared cognitions, potency, and coordinated action may be viewed as emergent states (Marks, Mathieu, & Zaccaro, 2001) that describe the cognitive, motivational, and behavioral states of teams that are the proximal outcomes of team processes, but at the same time act as new input for subsequent team processes and outcomes. We will now discuss the theoretical contributions of the proposed model.

Contributions to Team Self-Regulation Literature

Over the years, many models of team performance have been proposed (see Yeatts & Hyten for an overview and synthesis), including those of Gladstein (1984), Hackman,(1988), and Salas and colleagues (1992). Most of these models present the factors influencing group performance in an input-process-output framework, describing how the design of the team, the task, and the organizational environment affects team performance through their effect on team processes such as communication, coordination, cooperation, potency, cohesion, conflict resolution, and decision-making. However, little insight is provided by these models into the activities that team members themselves may undertake to regulate team processes toward goal attainment. Based on action regulation theory, we identified planning (including task division) and reflexivity as important mechanisms in the regulation of work group activity (Roe, 1999). Although planning and reflexivity have been studied in relation to other performance outcomes, neither has received much attention in research on meeting deadlines, which has focused mainly on group communication about the passage of time, a variable included in our research as temporal reminders.

Our research contributes to the team self-regulation literature in showing that these three self-regulatory mechanisms each have a unique role in guiding team processes toward a timely task completion, also because they help team members to establish a common perspective on the allocation of time in task execution. Moreover, the longitudinal research design allowed us to demonstrate differential effects of team self-regulation in different stages of group collaboration, thereby providing additional insights into the dynamics involved in team self-regulation processes.

Contributions to Shared Cognitions Literature

In the shared cognitions literature it is generally assumed that team members need congruent representations of the task and the team in order to be able to successfully accomplish complex tasks. In line with this assumption, most of the research on shared cognitions has studied rather broad categories of shared cognitions in relation to rather general performance outcomes. Our research demonstrates that when specific performance outcomes are concerned, like timeliness, team effectiveness requires that members also have shared cognitions about these specific aspects of team performance, over and above shared team cognitions and shared task cognitions.

Moreover, the studies of shared cognitions have typically focused on enhanced team coordination as the mediating variable between shared cognitions and team performance. As far as we know, we are the first to empirically demonstrate that beneficial effects of shared cognitions on team performance are not only due to enhanced ability of team members to adapt their actions to demands of the task and the team, but also to enhanced team motivation. Team motivation was represented in our research by the concept of group potency. Previously, group potency has been recognized as an important factor in getting groups and teams to set and remain committed to difficult performance goals which, in turn, are instrumental for improving group performance (Gully, Incalcaterra, Joshi, & Beaubien, 2002). Our research identifies group potency as a valuable contributor to meeting deadlines, both as a mediator of the effects of shared cognitions on meeting deadlines, and as a moderator that influences team effectiveness in dealing with time pressure.

Contributions to Team Composition Literature

There is a wealth of research that considers how team performance is affected by team composition, in particular by the similarity or diversity in team members' characteristics. The conventional focus of diversity research has been on so-called surface-level variables, such as race, sex, and age. However, more recently, several authors have argued that differences and similarities in deep-level or less readily visible characteristics among team members, such as personality traits, preference, attitudes, values, and beliefs are likely to be more important for team functioning, especially over time (Harrison, Price, & Bell, 1998; Harrison, Price, Gavin, & Florey, 2002; Milliken & Martins, 1996). This literature suggests that, as team members

interact and get to know each other better, stereotypes based on surface-level characteristics are replaced with more accurate knowledge of each other as individuals. When members find that they have similar deep-level characteristics this will promote mutual liking, social integration, and collaboration within the team. Our research contributes to this line of work by showing that similarity in pacing styles contribute to meeting deadlines because team members with similar pacing styles are more likely to agree on the use of time in a project. However, since we found that team members that share a deadline action pacing style may arrive at shared temporal cognitions that impede rather than foster meeting deadlines, our research also points to potential contribution of diversity in pacing styles to a more appropriate perspective on the use of time in team task execution.

6.3 Strengths and Limitations

This dissertation extends our knowledge of the processes involved in timely project completion and why some groups meet deadlines while other do not. Moreover, due to its longitudinal design we have gained a better understanding of the role of time in these processes. Another strength of our work is that it not only involved student project groups, but also drew a sample of professional projects from the field of Information Technology. In contrast to student teams in which members typically shared educational backgrounds, members in professional teams tend to hold different functional and hierarchical positions, which intensify the level of interdependency among team members. This probably makes shared cognitions even more relevant to project performance. However, projects in the field are also subject to external influences over which they may have little or no control. Clients, suppliers, subcontractors, or related projects that are preceding or running in parallel to the project may keep a team from performing on time despite cognitive congruence among its members. Despite these potential external influences on project performance, we found support for the presumed effect of shared cognitions on meeting deadlines in samples of student teams and in professional teams.

As always, though, there are also some limitations to our research. In the preceding chapters, we already addressed some specific limitations of research presented, such as the reliance of self-report data and the problems associated with a limited sample size. These limitations will be revisited briefly. However, there are

also some methodological issues that still need to be addressed in more detail, such as the measurement of shared cognitions, the use of difference scores, and the use of data transformations.

Reliance on Self-Report Data

To a large part, the studies in this dissertation relied on self-report data. Self-reports are subject to biases. However, research indicates that self-report measures may not limit internal consistency as much as is often assumed (Spector, 1992; Wall, Michie, Patterson, Wood, Sheehan, Clegg, & West, 2004). Moreover, the team's perspective on the processes operating within the team is most relevant, since that is what team behavior is based upon (cf. Amabile, Conti, Coon, Lazenby, & Herron, 1996), and others may not know exactly what is going on inside the group. Moreover, the fact that all studies showed high levels of agreement among group members regarding their performance encourages our confidence in the reliability of the data. The problem with measuring meeting deadlines is that timeliness is subject to interpretation. Of course, in most cases, temporal norms are explicated in contractual obligations; still, there is always the possibility that specifications have not been exhaustive and that their meaning is not interpreted in the same way by contracting parties. Consequently, team members may collectively believe that they have done a wonderful job by delivering a product on time, while other stakeholders considers the same job to be late or incomplete. Hence, for the measurement of timeliness, its evaluation by multiple parties would lead to more valid conclusions than when only the team evaluates it. We collected performance ratings from other sources, a project manager or unit manager at a higher hierarchical level, in the study reported in Chapter 5. Nevertheless, we acknowledge that our research would have profited when all studies had included ratings of project performance from multiple stakeholders.

Limited Sample Size

Another shortcoming of our research is that, due to limited sample sizes, we could not test all relevant variables in a single model. In contrast, we tested hypotheses using selections of variables, and used multiple analyses to test, for example, mediations. However, this is common practice in many research studies. Moreover, the fact that we found support for many of our hypotheses, despite the small sample size, indicates

that the relationships we established had considerable strength. Nevertheless, future research could profit from large samples that allow for the test for the entire set of variables in a structural equation model.

Measuring Shared Cognitions

Three of the four studies presented in this dissertation have used measures of shared cognitions. However, there is much confusion over how to define and measure cognitive constructs at the team level (Mohammed & Dumville, 2001). Firstly, there are many different categories of cognitive content that may be relevant to team functioning, including task knowledge, teammate knowledge, contextual knowledge, attitudes, beliefs, expectations, and predictions. Cognitions may be declarative in that they represent how things are, or normative in that they represents how things should be. Secondly, there is also lack of conceptual clarity about the meaning of the notion of "shared". Whether cognitions are assumed similar, complementary and/or distributed has consequences for the method of assessment (Cannon-Bowers & Salas, 2001). The majority of techniques to measure shared cognitions have been developed in the context of shared mental model research, which distinguishes between knowledge content and knowledge structure.

A large variety of techniques has been used to determine and analyze knowledge content, including observations, interviews, questionnaires, protocol and content analysis, cart sorting (Mohammed & Dumville, 2001). In most cases, knowledge content is assessed at the individual level, after which similarity at the team level is statistically determined via measures of within-group agreement (e.g., ICC, Rwg). An obvious drawback of this procedure is that data are required from all team members to establish the level of shared cognitions in the team. Moreover, it is unclear how to establish whether the levels of shared cognitions between teams are significantly different (Langan-Fox et al., 2001).

Techniques to capture the knowledge structure (i.e., the relationships between elements in a person's mind) include Pathfinder, UCINET, and cognitive mapping (Mohammed & Dumville, 2001). In general, these techniques require team members to individually rate the relatedness of particular elements or attributes of the concepts of interest, after which patterns of relationships of different team members are compared. Unfortunately, these techniques are rather complex and they do not always

allow the assessment of cognitive congruence between more than two team members (Langan-Fox et al., 2001). These limitations make it practically impossible to apply these techniques to a large number of teams operating in the field.

In this dissertation, we did not measure the structure or content of individual team members' cognitions to determine the level to which they overlapped, but measured the similarity in team members' cognitions directly. That is, we asked team members to rate the similarity in team members' cognitions about the team, the task, and its temporal aspects. Because questionnaire items were formulated at the team level, a simple mean score could then be used to assess the level of shared cognitions. The advantage of this procedure is that it is easy to administer and that it yields data that may be analyzed with the standard statistical software commonly used in social science. A disadvantage may be that the data do not provide insight into the actual content or structure of shared cognitions. Consequently, it remains unclear whether, or to what extent, shared cognitions are accurate or appropriate. Another limitation is that team members have to be aware of the level of cognitive congruence in the team, and that we cannot distinguish between the level of shared cognitions and the level of awareness of shared cognitions, or meta-level sharedness (see also, Klimoski & Mohammed, 1994; Rentsch & Hall, 1994; Van Ginkel & Van Knippenberg, 2003). Moreover, it should be noted that our measures of shared team, task, and temporal cognitions represent a combination of declarative and normative cognitions. With respect to shared temporal cognitions, for instance, we asked team members about the time it would take to perform tasks as well as about how time should be use in task execution. Nevertheless, we managed to develop three reliable operationalizations that adequately distinguish between shared team cognitions, shared task cognitions, and shared temporal cognitions.

The Use of Difference Scores in Measuring Change

Although change is a well-known and common phenomenon in everyday life, its measurement is a complicated matter. The most basic approach to measuring and testing change over time is to assess the simple difference between multiple measures of the same variable. However, the use of the difference score has been discouraged because of its presumed unreliability (Cronbach & Furby, 1970) and its sensitivity to regression to the mean effects (Cohen & Cohen, 1975). These concerns have

motivated the use of residual change scores, also called the regressor variable method (Allison, 1990), which accounts for the effect of X1 on Y2 while holding Y1 constant. Although this solves the problem of the correlation between the change and the initial score, residual change scores have the disadvantage that they represent predicted change rather than actual change. In addition, they may be unreliable as well. Another alternative combines the two approaches in that it uses the difference score while holding the initial score constant to control ceiling and floor effects. Werts and Linn (1970) have shown that this is a slightly more complicated variation on the regressor variable method that yields exactly the same results as the original regressor variable method (Taris, 2000).

In this dissertation, we predicted changes in dependent variables from changes in independent variables using difference scores for both. We feel that the use of difference scores is permissible since they have been shown to have decent reliability when individual differences in true change exist (Rogosa, 1988). Since we employed relatively large intervals between measures over time this is likely to be the case in our data, as is also indicated by changes in the standard deviations over time. Moreover, we dealt with ceiling and floor effects in predicting the change in dependent variables by controlling for significant effects of initial scores on the amount of change. Finally, we compared the results of the difference score approach with the results of the residual score approach. Since these approaches yielded similar results, we chose in favor of the more transparent difference score approach.

The Use of Data Transformations

In all of our studies, we applied transformations when variable distributions diverged from normal. Although normality of the variables is not always required for analysis, the solution is often quite a bit better when all variables are normally distributed (Tabachnick & Fidell, 1996). A potential disadvantage of transformations is that they may hinder the interpretation of the results, particularly when the measurement scale is meaningful and widely used. However, we feel that the transformations were justified since most of our measures were new or adapted, and their scales were rather arbitrary, except maybe for one of our measures of meeting deadlines. This measure assessed the degree to which work on the project was completed at the deadline; the response scale ranged from 0 % to 100 %, with 10 % intervals. Meeting deadlines

refers to behavior to which norms apply. This type of behavior is generally characterized by a peaked distribution (Zubin, 1943), since most people will tend to adhere to the norm. In addition, the distribution may be skewed when there is a larger probability of exceeding the norm to one side. In the case of meeting deadlines, it may not be abnormal to encounter a J-shaped distribution with a long tail to the left because the majority of projects will be nearly of completely finished at the deadline and only few projects will have made very little progress. This raises concerns about the legitimacy of the data transformation, since the skewed distribution actually reflects a natural phenomenon. Although these concerns are acknowledged, we felt is was justified to normalize the distribution of the meeting deadlines measure to reduce outlier effects, since there were some cases that strongly diverged from the other projects in terms of the percentage of work completed at the deadline.

6.5 Directions for Future Research

No research is without loose ends. Many questions that we were unable to address or resolve remain to be addressed in future research. First of all, there is a need to examine the replicability of the proposed model and its generalizibility to other team-arrangements. All the teams studied in this dissertation were project teams. We suggest that the model will apply to a whole range of teams, including work groups, task forces, product development teams, as long as they have to deal with deadlines and rely on self-regulation. However, the particular conditions under which teams operate may call for an extension of the model as to include other types of self-regulatory behaviors. For example, when teams perform ambiguous tasks under highly dynamic circumstances, task accomplishment may require that team members engage in contingency planning, i.e., the consideration of alternative plans in anticipation of potential events (Tripoli, 1998). Hence, we suggest that our model is put to the test with other team-arrangements, taking into account additional potentially relevant input and process variables. In addition, the model may be examined in relation to other outcome variables. We have undertaken a first step in this direction by relating shared cognitions and potency to output quality, but we feel that it would be particularly interesting to relate team self-regulation and cognitive, motivational, and behavioral states to outcome measures that are often very important for

organizational performance important but rarely examined, like team innovation and team viability.

Then, we have to acknowledge that we employed a differential approach in which we made comparisons between teams to investigate processes that are supposedly happening within groups. Although this type of research is customary and valuable, it will certain have to be supplemented by research that examines processes taking place within groups, preferably experimental research.

Furthermore, we have to acknowledge that we were unable to fully explain the role of reflexivity in meeting deadlines in project teams. Contrary to our expectations, we found that reflexivity did not contribute to shared temporal cognitions. In fact, our data indicated that team members were actually more likely to engage in reflection when they experienced a lack of shared temporal cognitions and coordinated action within the team. This is in line with Edmondson's (1999) idea that reflexivity is part of a group learning process. Still, additional research is needed to establish why and when teams engage in reflection and how this influences team processes over time. Moreover, future research could provide insight into the role of reflexivity in correcting dysfunctional cognitions and inappropriate task approaches.

In addition, our findings in Chapter 5 hint at a differential development over time for more and less successful teams (with respect to both meeting deadlines and output quality). That is, while more successful teams showed stable or slightly improving levels of shared cognitions and coordinated action over time, the less successful teams showed a clear deterioration in these variables. Although we confined ourselves to a visual inspection of these development patterns, they provide food for thought about what happened in these teams and whether it is possible to predict from the variables in our model whether a team will show a positive or negative pattern in the development of shared cognitions and coordinated action over time.

Our research has not taken into account the role of the project manager in team self-regulation toward meeting deadlines, other than as a regular member of the team. However, good or bad management may affect the likelihood that teams establish shared cognitions, build potency, achieve coordinated action, and finish a project ont time. Moreover, the project manager often has an important role in monitoring project progress and initiating adaptations in plans and actions when situations change or

when progress is behind schedule. Leadership has been considered in relation to group potency (e.g., Lester, Meglino, & Korsgaard, 2002), but it would be interesting to examine the role of the project leader or project manager in establishing shared cognitions and guiding the team toward a timely project completion.

Finally, there is a need to study contextual variables such as the nature of the tasks or projects carried out by groups, their degree of autonomy, their dependency on informational and other resources, and the way in which they are controlled. Research into these factors would make clear to what degree team processes depend on organizational factors and how far they can be influenced by interventions.

6.6 Practical Implications

This dissertation originated from the observation that many project teams fail to meet their deadlines. We found that, although the majority of student project groups managed to meet their deadlines, about 60 % of the professional project teams still had a considerable amount of work to be done at the project deadline. This suggests that our insights into the factors that influence the timeliness of project performance may be particularly meaningful for project teams in organizational contexts. However, we should exercise caution in drawing inferences from this research for project practice. Strictly speaking, non-experimental data do not allow for causal inferences. After all, we may have overlooked essential variables that could offer alternative explanations for the relationships we found. Experimental research is needed to substantiate the causal relationships implied in our reasoning. Moreover, as is the case with all empirical research, our research is limited by the fact that it is based on a simplified representation of reality. Project teams do not operate in isolation; they face external demands over which they may have little or no control. Clients, suppliers, subcontractors, or related projects that are preceding or running in parallel to the project team may keep a team from performing on time despite cognitive congruence, potency, and coordinated action among its members. Nevertheless, keeping this in mind, we would like to suggest some potential practical implications of our findings for project practice.

A piece of advice for project teams and their managers would be to devote time and energy to the development of shared cognitions within teams, not only about how to approach the task at hand and how each individual member contributes to task

accomplishment, but also about the use of time in task execution. Our research indicates that shared cognitions about the team, the task, and its temporal aspects enhance the ability of project teams to deal with problems of coordination and motivation that are often regarded as the downsides of teamwork (Steiner, 1972). More specifically, shared cognitions contribute to team members' confidence in the abilities of the team, a team attribute that seems particularly important when teams face high time-pressured situations.

What, then, may project teams and their managers do to establish shared cognitions? Firstly, our research suggests that it would be helpful when teams engage in planning after they have established clarity about project goals and circumstances. It may seem trivial to suggest that planning helps teams to establish shared cognitions about their project, since it is often assumed to be common practice in projects. However, research indicates that not all project teams automatically engage in planning, and that when they do, they do not always consider the temporal aspects of the task (e.g. Janicik & Bartel, 2002). This pertains particularly to student project teams. In professional projects, planning and scheduling is often the responsibility of the team leader or manager. The manager may present team members with a cut-and-dried working schedule, but this may not be sufficient to establish shared cognitions. We assume that team members are more likely to build a common perspective on task execution when they get the chance to participate in planning, for instance by providing their personal estimates for work package duration and by discussing the most efficient flow of work between team members. Although it may take up valuable time, this approach may enhance team members' commitment to the schedule, which will increase the likelihood that subtasks are completed on time. In addition, challenging group members to think about an effective flow of work will emphasize team members' interdependence and reduce the likelihood that individuals fail to pass on outputs that are accomplished earlier than scheduled, just because it is not in their personal interest (Leach, 1999). Alternatively, when participation in planning is too time-consuming, we would advise managers to at least discuss the project planning in the team to make sure that schedules and deadlines are accepted and committed to by all members. Similar meetings can be held during the execution of the project to evaluate task progression, team functioning, and required adaptive actions.

In addition to planning, team members may build and consolidate shared temporal cognitions through the exchange of temporal reminders. Especially when the deadline draws near, it seems beneficial when team members remind each other of important temporal milestones and urge one another to stick to the planning and finish subtasks on time. Although we did not investigate the role of the project manager or project leader in these processes, we expect that temporal reminders could also be provided by the project manager when members themselves fail to engage in such activities. However, it may be better when managers encourage the exchange of temporal reminders in their teams, so that it becomes a common and accepted way of coordinating team activities and dealing with interdependencies among team member. Thereby, potential unpleasantness associated with the use of temporal reminders may also be reduced. As a third possibility, managers may consider the use of technical tools for the provision of temporal reminders. For example, a critical path analysis could provide the basis for project management software to generate messages for (groups of) team members to remind them of an upcoming milestone.

Finally, we feel that the findings presented in this dissertation justify a warning against inappropriate or dysfunctional shared temporal cognitions that may impede rather than foster meeting deadlines. Teams are particularly likely to share dysfunctional cognitions when members share a deadline action pacing style. Although this pacing style need not necessarily be ineffective for individual task performance, it may pose a threat to meeting deadlines in project teams. It is well known that groups and teams are susceptible to risky shifts (Stoner, 1961, reported in Wilke & Meertens, 1994); i.e., when members as individuals are inclined to take risks, group discussion tends to enhance this tendency. With respect to pacing behavior this could result in teams putting off task work for too long and failing to finish projects on time. This suggests that, although team members with similar pacing styles are more likely to arrive at shared temporal cognitions quickly, diversity in pacing styles may enhance the adequacy of shared cognitions when team members share a deadline action pacing style. Hence, we suggest that it could be helpful when pacing styles are taken into consideration in decisions about team composition for time-critical projects. It may not be possible to put together a team of individuals who all share an early action pacing style (and such homogeneity may not be beneficial to

other outcome measures), but it may be beneficial to make sure that team members do not all share a deadline action pacing style.

In relation to this, we would like to emphasize the importance of reflexivity. When teams closely monitor the progression of time and project accomplishment, they may be able to recognize dysfunctional use of time and adapt plans and actions in the service of timely project completion. Unfortunately, little is known about how reflexivity could be stimulated in project teams, although it has been shown that trust and psychological safety are important conditions for teams to engage in reflexivity (Edmondson, 1999).

6.7 Closing Comments

In this dissertation, we have studied meeting deadlines in project teams from a team self-regulation perspective, with a particular focus on shared cognitions. We have demonstrated that project teams are more likely to meet deadlines when they not only share a common perspective on the team and the task, but also on the temporal aspects of task performance as this promotes both team motivation and coordinated task execution. For those interested in improving the timeliness of project performance our research suggests that it may be beneficial to have regard for team members' pacing styles when putting people together in project teams and to stimulate team self-regulatory behavior, such as collective planning, the exchange of temporal reminders, and team reflexivity, as a means to control and direct team processes toward meeting deadlines.

Although this dissertation contributes to a better understanding of the processes involved in meeting deadlines in project teams many questions have remained unanswered. Therefore, we invite fellow researchers to join us in future research on timely team performance and encourage practitioners to address the role of self-regulatory behavior in time-critical projects, and to examine whether shared cognitions are indeed the answer to this rather urgent matter.

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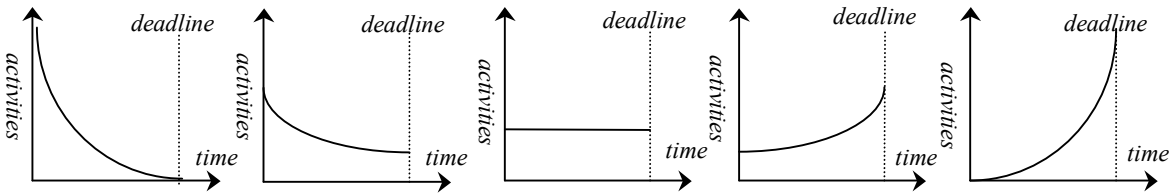
Appendix A

Measures

Pacing Style

Which of the following models represents best the way you generally organize your time when performing a task or project?



a. I start right away and finish the work long before the deadline

b. I do quite a bit of work at the start, so I can relax a little towards the end

c. I work steadily on the task, spreading it out evenly over time

d. I gradually increase my activities on the task as the deadline approaches

e. I do most of the work in a relatively short time before the deadline

Planning

To what extent did your group...

(1 =hardly ever to 5 = to a high degree)

- formulate specific goals to accomplish in this project?
- plan out which activities should be carried out each week?
- plan who should do what?
- set time limits for working on tasks?
- set a deadline for accomplishing a goal?
- develop a timetable for the different steps in the project?
-

Appendix A

Reflexivity

To what extent did your group...

(1 =hardly ever to 5 = to a high degree)

- review its objectives?
- discuss the methods used by the team to get the work done?
- discuss whether the team is working effectively?
- discuss how well information is communicated?
- review its approach to getting the work done?
- alter the way decisions are made in the team?
- adapt task strategies?

Temporal Reminders

To what extent do you agree or disagree with the following statements?

(1 = disagree completely to 5 = agree completely)

- In my group, we have urged one another to finish subtasks on time.
- In my group, we have reminded each other of important milestones.
- In my group, we have prompted each other to stick to agreements.
- In my group, we have made inquiries about task progress

Time Pressure

To what extent do you expect that...

(1 = not at all to 5 = to a very great extent)

- your group will have to do too much work in the time available?
- your group will have to work extra hard in order to finish the work on time?
- your group will have to hurry to finish tasks on time?
- your group will experience time pressure?

Shared Task Cognitions

To what extent do you agree or disagree with the following statements?

(1 = disagree completely to 5 = agree completely)

- Group members agree on what has to be done in the project.
- Group members agree on how these tasks have to be done.
- Group members agree on why these tasks have to be done.

Shared Team Cognitions

To what extent do you agree or disagree with the following statements?

(1 = disagree completely to 5 = agree completely)

- In my group, we know each others' role in the project.
- In my group, we are familiar with each others' knowledge and skills.
- In my group, we are acquainted with each others' way of working.

Shared Temporal Cognitions

To what extent do you agree or disagree with the following statements?

(1 = disagree completely to 5 = agree completely)

- In my group, we have the same opinions about meeting deadlines.
- In my group, we have similar thoughts about the best way to use our time.
- In my group, we agree on how to allocate the time available.
- In my group, we agree on how much time it takes to perform tasks.

Coordinated Action

To what extent do you agree or disagree with the following statements?

(1 = disagree completely to 5 = agree completely)

- The members of my group step in for each other when necessary.
- The members of my group collaborate effectively.
- My group experienced delays in the flow of work between members (reverse coded).
- Our task activities are well coordinated.
- Our project is running smoothly.

Potency

To what extent do you agree or disagree with the following statements?

(1 = disagree completely to 5 = agree completely)

- This team has confidence in itself.
- This team believes it can become unusually good at producing high-quality work.
- This team expects to be known as a high-performing team.
- This team feels it can solve any problem it encounters.
- This team believes it can be very productive.

Progress

To what extent has your group completed the following tasks

(0 % to 100 %, with 10 % intervals)

- Problem definition
- Plan for a quick-scan
- Interviews
- Preliminary report
- Presentation of preliminary report
- Plan for in-depth analysis
- In-depth analysis
- Design
- Plan for implementation
- Final report

Meeting Deadlines

(Chapter 3: 1 = too late, 2 = just in time, 3 = in ample time)

(Chapter 4: 1 = much too late; 2 = a bit too late; 3 = just in time; 4 = in ample time)

- When did your group finish its project report?

Meeting Deadlines

(Chapter 5: 0 % to 100 %, with 10 % intervals)

- What percentage of the work for this project was completed by the deadline?

Output Quality

(1 = much worse to 7 = much better)

- How do you rate the quality of the project output, compared to the work of other project teams?

Appendix B

Additional Tables

Chapter 4:

Results of the principal component analyses for coordinated action and shared temporal cognitions at T1 and T2

	Factor loadings T1 (N=193)		Factor loadings T2 (N=204)	
	Coordinated action	Shared temporal cogntions	Coordinated action	Shared temporal cognitions
Coordinated action				
The members of my group step in for each other when necessary.	**.75**	-.16	**.50**	.20
The members of my group collaborate effectively.	**.93**	-.09	**.67**	.26
My group experienced delays in the flow of work between members (r)*.	**-.60**	-.13	**-.86**	.21
Our task activities are well coordinated.	**.73**	.12	**.76**	.01
Our project is running smoothly.	**.63**	.24	**.73**	.09
Shared temporal cognitions				
In my group, we have the same opinions about meeting deadlines.	.36	.23	-.09	**.67**
In my group, we have similar thoughts about the best way to use our time.	.14	**.73**	.21	**.67**
In my group, we agree on how to allocate the time available.	.05	**.83**	-.14	**.80**
In my group, we agree on how much time it takes to perform tasks.	.02	**.85**	.21	**.66**
Eigenvalue	4.18	1.08	3.91	1.15
% variance explained	46%	12%	43%	13%

Note. Factor loadings above .40 are presented in bold printing;
(r) Reverse coded.* Item derived from Janicik and Bartel's (2002) scale of coordination difficulties.

Appendix B

Results of the principal component analyses for planning, reflexivity, and temporal reminders at T1 and T2

	Factor loadings T1 (N=193)			Factor loadings T2 (N=204)		
	Planning	Reflexivity	Temporal reminders	Planning	Reflexivity	Temporal reminders
Planning						
To what extent did your group...						
formulate specific goals to accomplish in this project.	**.66**	.06	.04	**.64**	.07	.09
plan out which activities should be carried out each week.	**.73**	.09	.02	**.74**	-.04	.11
plan who should do what.	**.63**	.17	.06	**.76**	.06	-.04
set time limits for working on tasks.	**.84**	-.07	.01	**.78**	-.07	.02
set a deadline for accomplishing a goal.	**.78**	-.04	.08	**.80**	.03	-.03
develop a timetable for the different steps in the project.	**.77**	-.14	-.08	**.72**	.01	.01
Reflexivity						
To what extent did your group...						
review its objectives.	-.01	**.66**	-.19	.04	**.53**	-.27
discuss the methods used by the team to get the work done.	.01	**.59**	.14	.17	**.55**	-.01
discuss whether the team is working effectively.	-.01	.33	**.57**	-.10	**.56**	.34
discuss how well information is communicated.	.10	**.41**	**.43**	-.01	**.56**	.31
review its approach to getting the work done.	-.10	**.56**	.25	-.11	**.57**	.27
alter the way decisions are made in the team.	.16	**.70**	-.21	.07	**.72**	-.16
adapt task strategies.	-.06	**.71**	-.01	-.03	**.69**	-.14
Temporal reminders						
In my group, we have urged one another to finish subtasks on time.	.24	.03	**.56**	.26	.02	**.65**
In my group, we have reminded each other of important milestones.	.24	.01	**.49**	.28	-.03	**.57**
In my group, we have prompted each other to stick to agreements.	.06	-.28	**.72**	-.03	.04	**.82**
In my group, we have made inquiries about task progress	-.06	-.04	**.73**	.07	-.09	**.63**
Eigenvalue	4.64	2.31	1.55	4.50	2.47	1.59
% variance explained	27%	14%	9%	27%	15%	9%

Note. Factor loadings above .40 are presented in bold printing.

Chapter 5:

Results of the principal component analysis for shared cognitions and group potency

	Factor loadings			
	Group potency	Shared task cognitions	Shared temporal cognitions	Shared team cognitions
Group potency				
This team has confidence in itself.	**.72**	.24	.03	.04
This team believes it can become unusually good at producing high-quality work.	**.88**	.04	-.03	.00
This team expects to be known as a high-performing team.	**.62**	-.07	.15	.05
This team feels it can solve any problem it encounters.	**.81**	.04	-.12	.02
This team believes it can be very productive.	**.73**	.08	.22	-.08
Shared task cognitions				
Group members agree on what has to be done in the project.	-.02	**.79**	.04	.21
Group members agree on how these tasks have to be done.	.16	**.81**	.05	-.07
Group members agree on why these tasks have to be done.	.20	**.58**	.19	.04
Shared temporal cognitions				
In my group, we have the same opinions about meeting deadlines.	.08	-.03	**.73**	.08
In my group, we have similar thoughts about the best way to use the time available.	.09	-.00	**.77**	.11
In my group, we agree on how to allocate the time.	-.07	.08	**.87**	-.08
In my group, we agree on how much time it takes to perform tasks.	-.05	.02	**.91**	-.01
Shared team cognitions				
In my group, we know each others' role in the project.	-.14	.32	.01	**.79**
In my group, we are familiar with each others' knowledge and skills.	.11	-.05	.07	**.82**
In my group, we are acquainted with each others' way of working.	**.42**	-.26	.11	**.53**
Eigenvalue	6.67	1.55	1.20	1.12
% variance explained	44 %	10 %	8 %	7 %

Note. N=153; Factor loadings above .40 are presented in bold printing.

Appendix B

Results of the regression analyses for predicting meeting deadlines and output quality from project characteristics

	Meeting deadlines			Output quality		
	F	R^2	β	*F*	R^2	β
Model	.70	.10		.32	.05	
Team size			.20			.19
Project lead-time			-.22			-.07
Product complexity*			.12			.09
Routine**			.20			.07

Note. N = 30.

* Compared to the products of other projects in this company, the product of this project is 1) less complex to 5) more complex.

** To a large extent, this project is a matter of routine for this team 1) disagree completely to 5) agree completely.

Summary

This dissertation addresses the topic of meeting deadlines in project teams. Many organisations make use of project teams, especially in situations where individuals have to work together to produce a certain product by some deadline. Although work in teams can provide many benefits, such as shorter lead-times, increased flexibility, and enhanced creativity, it is also known to be associated with problems of coordination and motivation, which may cause teams to perform below their potential and display deficiencies in performance outputs. Many project teams, for example, have difficulties meeting deadlines. Despite good will and hard work, deadlines are often exceeded. This may have negative consequences for clients, organizations, and employees themselves.

There has not been much research on meeting deadlines in project teams. Prior research has shown that deadlines and the awareness that time is running out motivates teams to start working, but little is known about how teams actually manage to finish their work on time. Therefore, we decided to study the issue of meeting deadlines in project teams from a team self-regulation perspective. This dissertation presents four longitudinal studies, three of which were conducted among student teams. The fourth study involved a large field study among 37 professional project teams operating in the Information Technology business. In all studies, project execution was longitudinally examined by means of repeated questionnaires about team- and task processes that may be considered relevant to meeting deadlines in project teams. The variables under study can be divided into six categories: team

composition, team self-regulation, shared cognitions, team motivation, team task execution, and team performance.

Much of the research in this dissertation centers on shared cognitions. Earlier studies showed that team effectiveness is enhanced when team members have shared cognitions about the task and the team, i.e., when team members have congruent mental representations of the procedures, strategies and action involved in task execution, and of each other's knowledge, skills, preferences, roles, and responsibilities. However, these earlier studies focused solely on general team performance. We suggested that in order to meet deadlines, it might be important that team members also share cognitions about the temporal aspects of task execution, such as the importance of meeting deadlines, (sub) task completion times, and the appropriate timing and pacing of task activities. Our findings provide support for this assumption. We found that project teams are more likely to meet deadlines when team members have shared temporal cognitions, in addition to shared team cognitions and shared task cognitions. Unlike shared team cognitions and shared task cognitions, shared temporal cognitions do not affect the quality of project output. However, our results also indicate that cognitive congruence is only part of the picture, and that shared temporal cognitions also need to be adequate to contribute to timely project completion. That is, we found that sharing temporal cognitions only facilitates meeting deadlines when team members tend to start working on their tasks early, not when members tend to put off work until the deadline is very close. Hence, we conclude that shared temporal cognitions are beneficial to meeting deadlines, when they are adequate.

Furthermore, our research indicates that there are at least two ways in which shared temporal cognitions may come about. Firstly, team composition may contribute to shared temporal cognitions. One of our studies showed that team members are more likely to have shared temporal cognitions when they have similar pacing styles, which means that they have similar ways of using their time under deadline conditions. We assume that individual team members rely on their general pacing style when they have to decide how time should be allocated in team task execution and that team members with similar pacing styles are therefore more likely to agree on the allocation of time in project execution. Thus, team composition in terms of pacing styles does not only moderate the relationship between shared

temporal cognitions and meeting deadlines, it also affects the likelihood that team members have shared temporal cognition in the first place. However, our results also show that this effect diminishes as team members spend more time working together and become acquainted with each other and the task.

Shared temporal cognition may also be established through team self-regulation. In our research, we distinguished between planning, the exchange of temporal reminders, and reflexivity as three mechanisms that team members may use to guide their cognitions and actions toward timely project completion. Our findings indicate that each of these self-regulatory mechanisms have a unique role in meeting deadlines in project teams, also because they contribute to the development of shared temporal cognitions in teams. However, their effects are dependent upon the project stage in which they take place. Planning is effective when it takes place in the early project stages, shortly after clarity about project goals and circumstances has been established. The exchange of temporal reminders is beneficial near the project's end, as the deadline draws near. Although we were unable to draw strong conclusions regarding the role of reflexivity, our findings seem to suggest that a lack of shared temporal cognitions gives rise to reflexivity, which is an important prerequisite for improving team and task processes to enable timely project completion.

Finally, our research shows that shared temporal cognitions have a positive effect on meeting deadlines in project teams because they facilitate both team task execution and team motivation. Previous research showed that the positive effects of shared team cognitions and shared task cognitions on general team performance are due to improved team coordination. We established a similar relationship between shared temporal cognitions, coordinated action, and meeting deadlines. However, we also found that shared temporal cognitions add to the teams' sense of potency, which in turn has a positive effect on meeting deadlines. One of our studies also showed that high potency teams are more effective in dealing with time pressure. Therefore, we conclude that both improved coordinated action and enhanced potency make an important contribution to meeting deadlines in project teams.

Based on these findings, we propose a model of team self-regulation toward meeting deadlines in the final chapter of this dissertation. This model depicts meeting deadlines in project teams as a dynamic process in which team members establish shared cognitions about the team, the task, and its temporal aspects either implicitly or

explicitly. These shared cognitions enhance the motivation and coordination within the team, which allows the team to make progress in project accomplishments. The amount of progress being made may act as input for additional self-regulation in terms of reflection and corrective action to ensure that the project is finished on time and the deadline is met. Although additional research is required to validate the model, it already provides some implications for improving the timeliness of project completion in practice.

Samenvatting

(Summary in Dutch)

Deze dissertatie gaat over het halen van deadlines in project teams. Veel organisaties maken gebruik van project teams, met name in situaties waarin individuen moeten samenwerken om voor een bepaalde deadline een zeker product op te leveren. Hoewel het werken in teams vele voordelen kan hebben, zoals een snellere doorlooptijd, meer flexibiliteit en een verhoogde creativiteit, kan het ook problemen opleveren met betrekking tot de motivatie en coördinatie in het team welke ertoe kunnen leiden dat het team niet optimaal presteert. Veel projectteams hebben bijvoorbeeld problemen met het halen van deadlines. Ondanks goede wil en grote inspanning slagen veel teams er niet in hun werk op tijd af te ronden. Dit kan negatieve consequenties hebben voor zowel de opdrachtgever, de organisatie, als de werknemer zelf.

Er is slechts weinig onderzoek verricht naar het halen van deadlines in projectteams. Voorgaande studies hebben aangetoond dat deadlines en het besef dat de tijd verstrijkt teams aanzet tot actie, maar er is weinig bekend over hoe teams er voor zorgen dat het werk ook werkelijk op tijd af is. Vandaar dat wij de problematiek van het halen van deadlines in projectteams hebben onderzocht vanuit het oogpunt van zelfregulatie in teams. In deze dissertatie worden vier longitudinale studies beschreven. Drie daarvan zijn uitgevoerd onder studententeams. De vierde studie betreft een veldonderzoek onder 37 professionele projectteams in de Informatie Technologie sector. In alle studies werd de projectuitvoering gevolgd met behulp van herhaald afgenomen vragenlijsten over aspecten van de samenwerking en

taakuitvoering die relevant geacht kunnen worden voor het halen van deadlines in projectteams. De onderzochte variabelen zijn ingedeeld in zes categorieën: teamsamenstelling, teamzelfregulatie, gedeelde cognities, teammotivatie, teamtaakuitvoering, en teamprestaties.

Gedeelde cognities zijn een centraal thema in het huidige onderzoek. Eerder onderzoek toonde aan dat teams beter presteren als teamleden gedeelde cognities hebben van de taak en het team, d.w.z., als teamleden overeenstemmen over taakprocedures, -strategieën en -activiteiten en bekend zijn met elkanders kennis, vaardigheden, voorkeuren, rollen en verantwoordelijkheden. De studies waarin dit werd aangetoond richtte zich echter alleen op algemene teamprestaties. Wij veronderstelden dat het voor meer specifieke uitkomsten, zoals het halen van deadlines, van belang is dat teamleden niet alleen overeenstemming hebben over de taak en het team, maar daarnaast ook overeenstemming hebben over de tijdsaspecten van de taakuitvoering. De resultaten van ons onderzoek tonen inderdaad aan dat het halen van deadlines in projectteams bevorderd wordt als teamleden naast gedeelde cognities over de taak en het team ook gedeelde cognities hebben over de tijdsaspecten rondom de taakuitvoering, zoals het belang van het halen van deadlines, de tijd die het kost om bepaalde (deel)taken uit te voeren en de beste manier om de beschikbare tijd te besteden. Gedeelde cognities van tijd hadden, in tegenstelling tot gedeelde cognities van de taak en het team, geen invloed op de kwaliteit van het werk. Echter, onze resultaten wijzen er ook op dat overeenstemming slechts een deel van het verhaal is en dat de gedeelde cognities van tijd ook adequaat moeten zijn om bij te dragen aan een tijdige projectafronding. Zo blijkt uit de resultaten dat gedeelde cognities van tijd alleen ten goed komen aan een tijdige projectafronding als teamleden over het algemeen geneigd zijn om vroeg te beginnen aan projecten, niet als men geneigd is het werk uit te stellen tot de deadline heel dichtbij is. We concluderen dan ook dat het halen van deadlines in project teams wordt bevorderd door gedeelde cognities van tijd, op voorwaarde dat die gedeelde cognities adequaat zijn.

Het onderzoek toont verder aan dat gedeelde cognities van tijd op ten minste twee manieren tot stand kunnen komen. Allereerst kan de teamsamenstelling een bijdrage leveren. Uit een van de studies blijkt namelijk dat de kans dat teamleden gedeelde cognities van tijd hebben groter is als ze ongeveer dezelfde '*pacing style*'

hebben, wat betekent dat ze hun tijd gewoonlijk op dezelfde manier indelen bij het werken aan een taak of project. Wij veronderstellen dat individuen uitgaan van hun '*pacing style*' als ze moeten beslissen hoe de tijd het beste besteed kan worden in de uitvoering van een specifieke teamtaak en dat teamleden daarom eerder overeenstemming bereiken over de tijdsindeling als ze er gewoonlijk dezelfde '*pacing style*' op nahouden. De teamsamenstelling wat '*pacing styles*' betreft is dus niet alleen van invloed op de relatie tussen gedeelde cognities van tijd en het halen van deadlines, maar ook op de kans dat teamleden überhaupt tot overeenstemming komen over de tijdbesteding in een project. Dit effect neemt echter af naarmate teamleden langer samenwerken en meer bekend raken met elkaar en met de taak.

Gedeelde cognities van tijd kunnen ook tot stand komen via zelfregulatie. In het onderzoek onderscheiden we drie mechanismen die teams kunnen gebruiken om de cognities en acties van teamleden te sturen ten behoeve van een tijdige projectafronding: het maken van een planning voor de taakuitvoering, het uitwisselen van aanmaningen, en het bewaken en bijsturen van team- en taakprocessen, hetgeen wordt aangeduid als reflexiviteit. Onze resultaten duiden erop dat elk van deze mechanismen een unieke bijdrage levert aan het halen van deadlines in projectteams, mede omdat ze bijdragen aan de vorming van gedeelde cognities van tijd in teams. Het effect van deze zelfregulatie-activiteiten is echter afhankelijk van het stadium waarin ze plaatsvinden. Het plannen van de taakuitvoering is alleen effectief als dit vroeg in het project gebeurt, kort na de eerste oriëntatie op projectdoelen en omstandigheden. Het uitwisselen van aanmaningen is juist effectief tegen het einde van het project, als de deadline in zicht komt. Hoewel we geen harde conclusies hebben kunnen trekken over de rol van reflexiviteit, lijken onze resultaten erop te wijzen dat een gebrek aan overeenstemming over de tijdsbesteding aanleiding geeft tot reflexiviteit, hetgeen een belangrijke voorwaarde vormt voor het verbeteren van team- en taakprocessen ten behoeve van een tijdige projectafronding.

Het onderzoek wijst tenslotte uit dat gedeelde cognities van tijd het halen van deadlines in projectteams bevorderen omdat ze bijdragen aan een betere onderlinge coördinatie in de taakuitvoering, alsook aan een verhoogde motivatie in het team. Eerder onderzoek liet zien dat het positieve effect van gedeelde cognities van de taak en het team op de algemene teamprestaties te danken was aan een verbeterde onderlinge coördinatie in het team. Wij vonden een zelfde relatie tussen gedeelde

cognities van tijd, de onderlinge coördinatie in het team en het halen van deadlines. We vonden echter ook dat teams meer vertrouwen hebben in hun kunnen als teamleden het eens zijn over de tijdsbesteding en dat dit een positieve uitwerking heeft op het halen van deadlines. Bovendien wordt in een van de studies aangetoond dat teams die vertrouwen hebben in hun kunnen ook beter presteren onder tijdsdruk. We komen dan ook tot de conclusie dat zowel de verbeterde coördinatie als het verhoogde vertrouwen in het teamvermogen een belangrijke bijdrage leveren aan het halen van deadlines in projectteams.

Op basis van deze bevindingen opperen we in het laatste hoofdstuk van deze dissertatie een model over teamzelfregulatie en het halen van deadlines. In dit model wordt het halen van deadlines in projectteams weergegeven als een dynamisch proces waarin teamleden op impliciete of expliciete wijze overeenstemming bereiken over het team, de taak, en de tijdsaspecten van taakuitvoering, hetgeen leidt tot een verhoogde motivatie in het team en een verbeterde onderlinge coördinatie van individuele inspanningen welke het team in staat stelt voortgang te boeken in het project. De mate waarin voortgang wordt geboekt kan vervolgens aanleiding geven tot additionele zelfregulatie om te reflecteren op team- en taakprocessen en deze bij te sturen zodat het project uiteindelijk op tijd kan worden afgerond en de deadline wordt gehaald. Hoewel additioneel onderzoek nodig is om de houdbaarheid van het model te toetsen, biedt het reeds enkele aanknopingspunten ter verbetering van de tijdigheid van teamprojecten in de praktijk.

About the author

Josette Gevers was born on September 10, 1970 in Nuenen, the Netherlands. After a short career as a psychiatric nurse, she decided to study psychology at the Universiteit van Tilburg, obtaining her Master's degree in Social Psychology in 1997 with the qualification 'cum laude'. She then worked as a junior researcher at that same university, doing several research projects, including a project on popular support for public health care in the European Union. In November 1999, she started her PhD-research at the department of Technology Management at the Technische Universiteit Eindhoven. This dissertation is the result of her work on meeting deadlines in project teams, the topic of her PhD-research. Josette currently holds a position of assistant professor at the department's Human Performance Management Group.