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# Fostering creativity and innovation in teams: Findings on climate, leadership, and constraints

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You make me happy every day…

# Abstract

This dissertation contributes to our understanding of team creativity and team innovation in the workplace by shedding light on three of their antecedents: the innovative climate within the team, the distribution of creative tasks between leader and team, and the perceived time pressure as a constraint to team creativity.

The *first empirical chapter* resolves inconsistencies in the current literature on team climate for innovation by applying meta-analytical techniques on the construct of team climate for innovation and its relationship with team performance and team innovation. Besides estimating the true relationships with these criteria, the validity of team climate for innovation is assessed via meta-analytical factor analysis and meta-regressions. Further, the contingencies of these relationships are investigated via various moderator analyses. Finally, the mechanism behind the relationship between team climate for innovation and team performance is examined via meta-analytical mediation analyses. Thereby, the first empirical chapter helps to clarify the construct of team climate for innovation and offers an integration of the inconsistent findings on its relationship with team performance and team innovation.

The *second empirical chapter* focuses on the influence of creative leadership modes on team creativity and team innovation. The chapter builds and tests a theory on three different modes of creative leadership (facilitating, directing, and integrating), which refer to the distribution of creative and supportive tasks between leaders and teams. First, a scale for measuring these creative leadership modes is developed and validated. Second, the differential effects of these different modes on team creativity and team innovation are tested on survey data of scientific teams by using mixed-effect models. The results show that facilitating and integrating creative leadership modes are positively related to the creative behavior of teams, while integrating and directing creative leadership modes are positively related to the innovative productivity of teams. Thereby, the chapter helps to increase our understanding of and to establish measurement for creative leadership.

The *third empirical chapter* analyzes the mechanisms behind the relationship of the constraint of time pressure with individual and team creativity. By drawing on social cognitive theory and social exchange theory, this chapter proposes different mechanisms at different levels of analysis: While it assumes a positive motivational mechanism of self-efficacy at the individual level, it suggests a negative social mechanism of team knowledge sharing at the team level. Multi-source survey data of team members and supervisors from product development programs is examined using mixed-effect models. The initial analyses do not yield significant results, probably due to low statistical power; however, post hoc analyses show that creative self-efficacy mediates the relationship between individual time pressure and individual creativity. Further, team knowledge sharing mediates the relationship between team time pressure and team creativity. Thereby, the chapter advances our knowledge of opposing mechanism explaining the relationship between time constraints and creativity at different levels of analysis.

In sum, the findings of this dissertation highlight the importance of three different interpersonal processes which can foster or hinder the generation and implementation of ideas in teams. Based on these findings, this dissertation derives implications for research and practice and provides recommendations for future research. Thereby, it strengthens our understanding of the complex interpersonal processes that play a role in organizational innovation.

# Deutsche Kurzfassung (German Abstract)

Diese Dissertation trägt zu unserem Verständnis von Teamkreativität und Teaminnovation am Arbeitsplatz bei, indem sie drei Voraussetzungen beleuchtet: das innovative Klima innerhalb des Teams, die Aufteilung von kreativen Aufgaben zwischen Führungskraft und Team und den wahrgenommenen Zeitdruck als Hemmnis für die Teamkreativität.

Das *erste empirische Kapitel* löst Widersprüche in der aktuellen Literatur zum Thema Teamklima für Innovation auf, indem das Konstrukt des Teamklimas für Innovation und seine Beziehung zu Teamleistung und Teaminnovation mithilfe von meta-analytischen Methoden untersucht werden. Neben der Ermittlung der tatsächlichen Beziehung zu diesen Kriterien wird die Validität des Konstrukts Teamklima für Innovation mittels meta-analytischer Faktorenanalysen und Regressionen bewertet. Darüber hinaus werden die Bedingungen dieser Zusammenhänge mit Hilfe verschiedener Moderatorenanalysen untersucht. Schließlich wird der Mechanismus hinter dem Zusammenhang zwischen Teamklima für Innovation und Teamleistung mittels meta-analytischer Mediationsanalyse untersucht. Damit trägt das erste empirische Kapitel zur Klärung des Konstrukts Teamklima für Innovation bei und integriert die inkonsistenten Befunde zu dessen Zusammenhang mit Teamleistung und Teaminnovation.

Das *zweite empirische Kapitel* befasst sich mit dem Einfluss kreativer Führungsmodi auf die Kreativität und Innovation von Teams. In diesem Kapitel wird eine Theorie zu drei verschiedenen Arten der kreativen Führung (fördernd, dirigierend und integrierend) aufgestellt und getestet, die sich auf die Verteilung kreativer und unterstützender Aufgaben zwischen Führungskräften und Teams beziehen. Zunächst wird eine Skala zur Messung dieser kreativen Führungsmodi entwickelt und validiert. Anschließend wird die unterschiedliche Wirkung dieser verschiedenen Modi auf die Kreativität und Innovation von Teams anhand von Umfragedaten wissenschaftlicher Teams mit Hilfe von Mixed-Effect-Modellen getestet. Die Ergebnisse zei-

gen, dass fördernde und integrierende kreative Führungsmodi positiv mit dem kreativen Verhalten von Teams zusammenhängen, während integrierende und dirigierende kreative Führungsmodi positiv mit der innovativen Produktivität von Teams zusammenhängen. Damit trägt das Kapitel dazu bei, das Verständnis und die Messung von kreativer Führung zu verbessern.

Im *dritten empirischen Kapitel* werden die Mechanismen analysiert, die hinter der Beziehung von Zeitdruck mit individueller und Team-Kreativität stehen. Aufbauend auf der sozial-kognitiven Theorie und der Theorie des sozialen Austauschs werden in diesem Kapitel verschiedene Mechanismen auf unterschiedlichen Analyseebenen vorgeschlagen: Während auf der individuellen Ebene ein positiver Motivationsmechanismus der Selbstwirksamkeit angenommen wird, wird auf der Teamebene ein negativer sozialer Mechanismus des Wissensaustauschs im Team vermutet. Umfragedaten von Teammitgliedern und Supervisoren aus Produktentwicklungsprogrammen werden mit Hilfe von Mixed-Effect-Modellen untersucht. Die ursprünglichen Analysen zeigten keine signifikanten Ergebnisse, was wahrscheinlich auf eine geringe statistische Teststärke zurückzuführen ist. Post-hoc-Analysen zeigen jedoch, dass kreative Selbstwirksamkeit die Beziehung zwischen individuellem Zeitdruck und individueller Kreativität mediiert. Außerdem vermittelt der Wissensaustausch im Team den indirekten Effekt zwischen Zeitdruck im Team und Kreativität im Team. Damit erweitert das Kapitel unser Wissen über gegenläufige Mechanismen, die den Zusammenhang zwischen Zeitdruck und Kreativität auf verschiedenen Analyseebenen erklären.

Zusammenfassend zeigen die Ergebnisse dieser Dissertation die Bedeutung von drei verschiedenen zwischenmenschlichen Prozessen, die die Generierung und Implementierung von Ideen in Teams fördern oder behindern können. Aus diesen Erkenntnissen leitet die Dissertation Implikationen für Forschung und Praxis ab und gibt Empfehlungen für die zukünftige Forschung. Damit stärkt sie unser Verständnis für die komplexen zwischenmenschlichen Prozesse, die bei der organisationalen Innovation eine Rolle spielen.

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# List of Abbreviations

| | |
|---|---|
| α | alpha |
| AIC | Akaike information criterion |
| β | beta |
| BIC | Bayesian information criterion |
| b | unstandardized regression coefficent |
| cf. | short for Latin *confer:* ‘compare’ |
| CFA | confirmatory factor analysis |
| CFI | comparative fit index |
| CI | confidence interval |
| CR | creativity requirement |
| CV | credibility interval |
| Δ | delta |
| df | degrees of freedom |
| DV | dependent variable |
| e.g. | short for Latin *exempli gratia:* ‘for example’ |
| et al. | short for Latin *et alii:* ‘and others’ |
| EFA | exploratory factor analysis |
| H | hypothesis |
| i.e. | short for Latin *id est*: ‘in other words’ or ‘that is’ |
| ICC | intraclass correlation |
| IPO | input-process-outcome |
| k | number of independent samples |
| M | mean |
| N | number of entities in sample |
| *p* | p-value |

| | |
|---|---|
| $\rho$ | mean true correlation |
| p. | page |
| $Q_M$ | Q statistic for overall moderator model |
| $Q_R$ | Q statistic for residual heterogeneity |
| PhD | philosophiae doctor |
| r | correlation coefficient |
| $R^2$ | coefficient of determination |
| R&D | Research and Development |
| RMSEA | root mean square error of approximation |
| $r_{wg}$ | interrater agreement index |
| SD | standard deviation |
| SE | standard error |
| SRMR | standardized root mean square residual |
| STEM | science, technology, engineering, and mathematics |
| TCI | Team Climate Inventory |
| TI | team innovation |
| TP | team performance |
| vs. | versus |
| $\gamma$ | fixed-effect regression coefficient |
| $\chi^2$ | chi-squared statistic |

# 1 Introduction[1]

*"For innovation to flourish, organizations must create an environment that fosters creativity; bringing together multi-talented groups of people who work in close collaboration together – exchanging knowledge, ideas and shaping the direction of the future."*

— *Linda Naiman*

This dissertation contributes to the understanding of creativity and innovation in the workplace. In particular, this dissertation advances our knowledge on interpersonal team processes as well as context factors which foster or hinder the creative and innovative performance of teams. To do so, this dissertation focuses on three different conceptual frameworks: team climate for innovation, creative leadership modes, and mechanisms of constraints on creativity. In the following chapter, the overall motivation for the dissertation and the research questions are introduced.

## 1.1 Motivation and Research Questions

Creativity and innovation are crucial for the survival and effectiveness of organizations in today's rapidly changing and globalized market environment (Anderson et al., 2014; van Knippenberg, 2017; Zhou & Hoever, 2014). Creativity commonly refers to the generation of novel and useful ideas (Amabile & Pratt, 2016), and is important for organizations because it is a driver of innovation, growth, and development in general, as it helps organizations to cope with unpredicted challenges and dynamic environments (Zhou & Hoever, 2014). Innovation is commonly referred to as the implementation of ideas (West, 2002), for which creativity is an essential antecedent (West & Farr, 1990). Innovation is important for organizations because it allows them to sustain a competitive advantage, which in turn is a key determinant of their success and survival (Leifer et al., 2000; Pirola-Merlo & Mann, 2004; van Knippenberg, 2017).

[1] This introduction is partly based on Strobel and colleagues (2022a), Strobel and colleagues (2022b), and Dreymann & Strobel (2022); the full references can be found in the Appendix.

While the relevance of innovation as a determinant of performance for creative industries or industries invested in research and/or development is immediately clear, the importance of innovation is also given for organizations whose main performance output is not based on innovation (e.g., health care services, public administration; Zhou, 2008): Adapting and improving processes in order to improve team efficiencies or introducing new ways of solving workplace problems can increase performance in organizations across work environments (Eisenhardt & Tabrizi, 1995; Gong et al., 2009; Harari et al., 2016). Despite the described importance for a wide range of practice, senior managers have been found to be unsure how to promote creativity and innovation in their organization (Barsh et al., 2008).

Different streams of research have investigated creativity and innovation in order to identify fostering and hindering factors. Psychological research has mainly focused on individual aspects of creativity – for instance, on antecedents of individual creativity like knowledge, personality, or intelligence (e.g., Barron & Harrington, 1981; Helson, 1996; Sternberg, 1988). This is also due to the long-standing notion of the 'creative genius' (Simonton, 2003), the idea that creativity primarily takes place in the mind of a single gifted individual. In contrast, early organizational creativity research has focused on how the interaction between the individual and different social and organizational factors influence creativity, already shedding first light on the interpersonal processes playing a role in fostering creativity and innovation (e.g., Amabile et al., 1996; Woodman et al., 1993). However, these theoretical advancements still have primarily resulted in research at the individual level (e.g., Zhou & Hoever, 2014; Hammond et al., 2011) or at the organizational level (e.g., Leifer et al., 2000; Sarooghi et al., 2015).

While individual and organizational innovation have been studied thoroughly in prior research, research on creativity and innovation at the team level has received much less attention in comparison and is only recently gaining momentum (cf. Hülsheger et al., 2009; van Knippenberg, 2017). The reason for the hesitance to conduct this research may be due to the increased complexity of team level research: For many variables of interest, especially for psychological constructs, no group level indices are available and therefore they need to be aggregated from individual level data (Chan, 1998). This in turn does not only make the theorizing more complex, but it also makes it necessary to apply new, more advanced statistical methods to map the mixed-level structure of the data (González-Romá & Hernández, 2017). Therefore, investigating teams as the central unit of observation requires careful mixed-level theorizing, modelling, and measurement.

The scarcity of research on the team level is a problem for theory and practice. Theory is incomplete, if only individual and organizational levels are investigated, as findings on these levels of analysis cannot simply be transferred to the team level: Rousseau (1985) stresses the importance of avoiding this so called ‘cross-level fallacy’. Further, theory and empirical findings indicate that antecedents, processes, and mechanisms are at least partially different for individual, team, and organizational level creativity and innovation (e.g., Acar et al., 2019; Anderson et al., 2014; Woodman et al., 1993). In practice, team level research is dearly needed, as organizations are increasingly relying on team-based structure to produce innovation (Ilgen et al., 2005; van Knippenberg, 2017): Already in 2001, 81% of Fortune 500 organizations were at least partially applying team-based structures (Lawler et al., 2001). In a more recent survey, 9 out of 10 business executives stressed that teams are essential to provide effective solutions to the complex problems and to ensure their organization’s effectiveness and competitiveness (Ernst & Young, 2013). Indeed, especially cross-functional and complex challenges are primarily addressed by team-based work designs today (Devine et al., 1999; Fulmer & Gelfand, 2012), which has led some researchers to proclaim an “era of the team” (Delice et al., 2019, p. 2). To enable teams to innovate effectively, it is important to understand what fosters and what hinders creativity and innovation at the team level.

This dissertation aims to address this issue by offering a contribution to the still scant team creativity and team innovation literature by providing three empirical chapters. These chapters share a common focus on interpersonal processes and context factors that foster team creativity and team innovation. While chapter 2 investigates the construct of team climate for innovation and its relationship with team innovation and team performance, chapter 3 examines the relationship of creative leadership modes with team creativity and team innovation. Chapter 4 analyzes the motivational and social mechanisms between time pressure and creativity at the individual and team level. By researching these relationships, the present dissertation intents to answer several important research questions, which are further motivated in the following.

### 1.1.1 Climate for Innovation

In management research, it has been established that organizational climates influence a variety of important outcomes at individual, team, and organizational levels (Kuenzi & Schminke, 2009; Schneider et al., 2013). Due to its rising practical importance, the facet of innovation and creativity has received growing attention in research on organizational climates. In particular, team climate for innovation (Anderson & West, 1998) is one of the most frequently investigated types of climate and the only innovation climate focusing on the proximal workgroup (Mathisen & Einarsen, 2004). It has been defined as consisting of four dimensions: Participative safety, vision, task-orientation, and support for innovation (West, 1990). This construct entails the idea that innovation is improved, if all team members feel that they can openly speak their mind, share a common vision and commitment to quality excellence, and support each other in their innovative pursuit (van Knippenberg, 2017). Empirical evidence supports this notion (e.g., Bain et al., 2001; Pirola-Merlo, 2010) and, unsurprisingly, a meta-analysis by Hülsheger and colleagues (2009) confirmed that team climate for innovation is positively associated with team innovation.

However, despite the growing body of support for the importance of team climate for innovation in the workplace, the current state of research is full of unresolved issues: First, the factorial structure of team climate for innovation has never been conclusively specified. A consolidation of the construct's structure ("what", Whetten, 1989, p. 490) would be important, because only in this way the generalizability of results across studies can be improved (Kuenzi & Schminke, 2009; van Knippenberg, 2017). Second, empirical evidence on the relationship between team climate for innovation or its dimensions and team performance is inconsistent, both concerning direction and strength. As team performance is crucial for organizational success (Mathieu et al., 2008), it would be important to draw clear conclusions on the existence and size ("how", Whetten, 1989, p. 491) of the relationship between team climate for innovation and team performance. Third, the contingencies ("when", Whetten, 1989, p. 492) that influence this relationship have not been investigated thoroughly in prior research (Newman et al., 2020), which would be helpful for explaining and interpreting the mentioned inconsistencies. Fourth, though theoretically indicated (West, 1990), the mechanism of "why" (Whetten, 1989, p. 491) team climate for innovation relates to team performance has not been empirically investigated so far. Doing so would be important to clarify the overall theoretical model of team climate for innovation (cf. Whetten, 1989). Therefore, the first goal of this dissertation is to investigate the following research questions:

*Research Question 1: What is the factorial structure of team climate for innovation?*
*Research Question 2: How, when, and why is team climate for innovation related to team performance and team innovation?*

### 1.1.2 Creative Leadership Modes

Today, leadership and creativity are inevitably intertwined: "[…] while in the past creativity was often perceived as an optional feature of leadership, today it is no longer optional because leaders who lack creativity are unlikely to propel their organizations into the future."

(Mainemelis et al., 2015, p. 395). The discourse on creative leadership in management research has been mainly dominated by two perspectives: First, leadership is considered as an important factor in the organizational environment that fosters creative performance of individuals and teams (Anderson et al., 2014; Zhou & Hoever, 2014). Second, the creativity of leaders themselves has received increasing attention in both research and practice: Creativity is important for leadership because "[i]t is the component whereby one generates the ideas that others will follow." (Sternberg, 2007, p. 34). According to an IBM report (2010), chief executives considered creativity as the most important leadership competency for the future, especially in dynamic environments. However, it remains unclear, whether it is more essential for leaders to support their followers' creativity or rather to be creative themselves in order to lead their teams toward the goal of achieving creative outcomes.

In a large-scale, interdisciplinary review on creative leadership, Mainemelis and colleagues (2015) identified three leadership strategies that vary in the degree to which the leader and the followers are active contributors to the process of creating and innovating: The first is *facilitating*, which corresponds to the traditional view of creative leadership as supporting and offering resources and not actively contributing creatively. The second is *directing*, wherein the leader is the primary generator of creative contributions and the followers primarily undertake supportive tasks. The third is *integrating*, wherein both the leader and the followers generate creative contributions, which the leader then synthesizes to install a creative synergy (Mainemelis et al., 2015). While evidence of the impact of these three strategies exists, their combined and relative efficacy is not known, and a comprehensive measure of all three strategies does not exist yet.

With the increasing importance of creativity as a competitive factor in corporate organizations, organizations might increasingly ask whether their current creative leadership practices are the best for achieving innovative outcomes. Therefore, both research and practice would profit from comparisons of these different modes of creative leadership with regard to their effectiveness in achieving innovative outcomes and successfully leading creative employees. Therefore, the second goal of this dissertation is to investigate the following research question:

*Research Question 3: How are different creative leadership modes related to team creativity and team innovation?*

### 1.1.3 A Constraint on Creativity: Time Pressure

Generating creative ideas is an essential antecedent of innovation and, therefore, crucial for the survival and effectiveness of organizations (Anderson et al., 2014; Zhou & Hoever, 2014). However, driven by digitization, companies' market environments are increasingly complex and volatile, requiring them to respond with ever-faster product and innovation cycles (e.g., Chen et al., 2012; Welpe et al., 2018). Emerging frameworks for product development, such as Scrum or Lean startup, apply time-boxing processes and aim at massively shortening the time to market of products (Ries, 2014; Schwaber & Beedle, 2002). But how does this dramatically time-pressed environment influence the creative processes of individuals and teams working on developing the next innovative product?

Recent findings in creativity research indicate a positive influence of time pressure on individual creativity while taking motivational mechanisms into account (Baer & Oldham, 2006; Khedhaouria et al., 2017; Ohly & Fritz, 2010). However, as team-based structures become more prominent in organizations, it is also important to consider team creativity (Anderson et al., 2014). Initial qualitative research by Rosso (2014) indicates a negative relationship between time pressure and team creativity as the communication of knowledge becomes more difficult. Moreover, emerging mixed-level research indicates that team level mechanisms can affect individual creative processes (Dong et al., 2017; Hirst et al., 2018; Richter et al., 2012). Integrating these findings, Acar and colleagues (2019) propose that time pressure may have a positive effect on individual creativity via motivational mechanisms, but a negative effect on team creativity via social mechanisms.

However, empirical research on individual and team creativity has so far not simultaneously assessed how underlying mechanisms link time pressure and creativity across levels, which makes our understanding of this relationship as a mixed-level phenomenon incomplete (for reviews, see Acar et al., 2019; Razinskas & Hoegl, 2020). As managers strive to lead their employees towards highly creative outcomes (Dong et al., 2017; Gong et al., 2009, 2013), they must know whether exerting time pressure has opposing influences on individuals and teams. Therefore, the third goal of this dissertation is to investigate the following research questions:

*Research Question 4: How and why does time pressure influence individual and team creativity?*

## 1.2 Theoretical Background and Core Concepts

### 1.2.1 A Framework for Team Research

A team is commonly defined as a (semi-)permanent group of people "to which individuals are assigned, whom they identify with, and whom they interact with regularly in order to perform work-related tasks" (Anderson & West, 1998, p. 236). Teams are typically interdependent in the execution of their tasks and share responsibility for the outcomes of their work (Cohen & Bailey, 1997; Kozlowski & Bell, 2003). The individual team members are nested within their teams, which are themselves nested within organizations, which in turn are nested in a specific environment (Kozlowski & Klein, 2000). Thus, investigating team creativity and team innovation requires an overarching framework which acknowledges this inherent mixed-level nature of teams (Mathieu et al., 2008).

As an organizing framework for the relationships investigated in this dissertation, the widely accepted input-process-outcome (I-P-O) model of team effectiveness is used (Cohen &

Bailey, 1997; Ilgen et al., 2005, Mathieu et al., 2008) (cf. Figure 1.1), which has already been adapted to the research on innovation (West & Anderson, 1996; Hülsheger et al., 2009). It assumes that team level factors (e.g., team composition, interdependence, leadership) as well as individual team member characteristics (e.g., personality, abilities) and organizational context factors (e.g., culture, size, resources; Cohen & Bailey, 1997) form input factors which together drive team processes (Mathieu et al., 2008). Team processes refer to the interactions of the team members directed towards the accomplishment of the team's task (e.g., team participation, knowledge sharing; Mathieu et al., 2008). Team processes transform given inputs into outcomes. Team outcomes can refer to a multitude of team effectiveness criteria, such as team performance, team creativity, and team innovation, but also team members' affective reactions and viability (e.g., job satisfaction, organizational commitment), well-being, or customer satisfaction (Cohen & Bailey, 1997; Mathieu et al., 2008). While it is not the aim of this dissertation to test the overall IPO model of innovation, this framework serves to classify the investigated concepts into meaningful categories.

This dissertation focuses on examining the influence of input factors and team processes on two related team outcomes: team creativity and team innovation; chapter 2 additionally examines team performance. More specifically, the investigated antecedents of team creativity and team innovation are the interpersonal processes of team climate for innovation (West, 1990; chapter 2) and creative leadership (Mainemelis et al., 2015; chapter 3) and the input factor of time pressure as a constraint to creativity (Acar et al., 2019; chapter 4). Investigating the latter, chapter 4 particularly focus on motivational and social processes that transform the influence of time pressure on team creativity. Figure 1.1 displays the conceptual research models investigated by the three empirical chapters. In the following, the theoretical background of the core concepts of team creativity and team innovation as well as the concepts of their three antecedents are introduced.

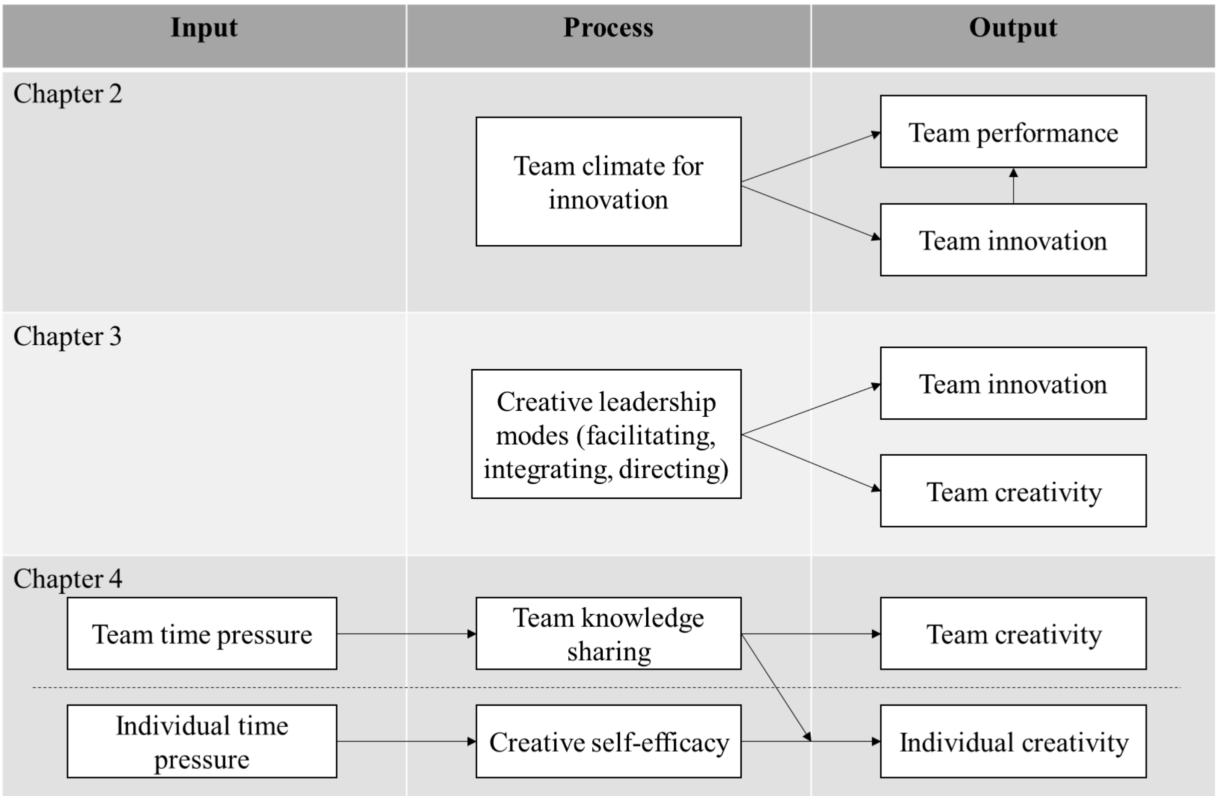


*Figure 1.1.* Overview of the variables and relationships investigated in chapter 2, 3, and 4 of this dissertation.

### 1.2.2 Team Creativity

Workplace creativity is commonly defined as the generation of ideas for products, processes, or services, which are both novel and useful for the organization (Amabile et al., 1996; Montag et al., 2012; Oldham & Cummings, 1996). To be regarded as novel, an idea has to be unique in comparison to other ideas already available in the organization; to be regarded as useful, an idea has to have the potential to be directly or indirectly valuable to the organization (Shalley et al., 2004). The creativity of an idea can range from incremental, implying minor modifications of existing practices, to radical, implying substantial differences to the current practices in the organization (Madjar et al., 2011; Mumford & Gustafson, 1988). In general, creative ideas can be generated and developed by any employee – independent of the hierarchical level and position (Madjar et al., 2011; Shalley et al., 2004).

While initial creativity research conceived creativity as the consequence of individual traits (Barron & Harrington, 1981; McCrae, 1987), more recent behavior research has increasingly focused on the context in which creative performance is embedded. In contrast to the ‘lone genius’ perspective (Simonton, 2003), current organizational behavior research suggests that both the creative process and the creative performance develop in a complex person-situation interaction (e.g., Amabile & Pratt, 2016; Woodman et al., 1993; Zhou & Hoever, 2014). Two of the most widely adopted theories on workplace creativity stress inter-individual processes as relevant antecedents of creativity: In her theory of organizational innovation Amabile (1988, 1997) proposes the social context factors of organizational motivation, resources, and management practices as antecedents of creativity. Similarly, Woodman and colleagues (1993) model creativity as being dependent on the influence of group characteristics (e.g., norms, cohesiveness, diversity) as well as on organizational characteristics (e.g., culture, structure, resources).

While workplace creativity has individual, group, and organizational level antecedents, the construct of creativity itself can be construed at either the individual, group, or organizational level (cf. Woodman et al., 1993). Individual creativity refers to the creative performance of a single actor and is a function of individual characteristics (e.g., personality traits, motivation, self-concepts, cognitive abilities), social influences (e.g., group norms, social rewards), and contextual influences (e.g., task and time constraints) (Woodman et al., 1993; Zhou & Hoever, 2014). In contrast, team creativity refers to the creative performance of a group (Woodman et al., 1993). While team creativity undeniably requires individual creativity (Drazin et al., 1999), it cannot be simply assumed that team creativity is the average of the team member’s individual creativity (Gong et al., 2013). For instance, Taggar (2002) found that team processes explained additional variance in team creativity beyond the effect of individual creativity. This suggests that the team members’ interactions play a vital role in making use of the creative ideas provided by the individual team member and in transforming these into team level creative performance (Taggar, 2002; Pirola-Merlo & Mann, 2004). Thus, team creativity can be understood as a function of the individual creative performance and the interaction between the team members, which is shaped by group characteristics (e.g., group composition, size, norms), group processes (e.g., group climate), and contextual characteristics (e.g., organizational culture, resources) (Drazin et al., 1999; Woodman et al., 1993).

To sufficiently explain this construct at the team level, it is necessary to thoroughly investigate antecedents of team level creativity, besides examining individual creativity. Therefore, this dissertation primarily focuses on team creativity and team innovation and the inter-individual antecedents and processes that shape them.

### 1.2.3 Team Innovation

Innovation is commonly defined as "the intentional introduction and application within a role, group or organization of ideas, processes, products or procedures, new to the relevant unit of adoption, designed to significantly benefit the individual, the group, organization or wider society." (West & Farr', 1990, p. 9). This definition on the one hand indicates that the novel idea not necessarily needs to be developed by the respective group or organization, but that it merely has to be new to the context, in which it is introduced and implemented to be considered as an innovation (van Knippenberg, 2017). On the other hand, it offers broad possibilities concerning consequences and recipients of the benefits of the implemented innovation instead of merely focusing on the singular criterion of economic growth of an organization (Anderson & West, 1996). For instance, alternative criterions could be staff well-being, improved group processes, or even personal growth and work satisfaction; alternate recipients can be the society as a whole, the team, or the individual employee (Anderson & West, 1996).

While technically innovation can happen at the individual level (i.e., an individual actor implementing an idea by herself), organizational innovation tends to happen at the team or organizational level (Ilgen et al., 2005; van Knippenberg, 2017). Team innovation can be understood as an adaption of the more generally defined innovation: It refers to innovation by the team designed to benefit the team, the organization or a broader group of stakeholders (van Knippenberg, 2017). It is important to note that innovation can take place in a wide range of jobs and teams, as innovating does not necessarily has to be the primary or explicitly assigned task of the team producing the team innovation (van Knippenberg, 2017). While innovating is the core task for value creation for R&D or teams in creative industries, traditional service or administration teams can also produce innovation, for instance, aiming to simplify or improve their processes (Gong et al., 2009; Harari et al., 2016; Zhou, 2008).

Even though creativity and innovation are closely related constructs, it is important to distinguish between them: Creativity is defined as the generation of novel and useful ideas (Amabile, 1988; Oldham & Cummings, 1996), whereas innovation refers to the conversion of these ideas into new and improved products, processes or services (West, 2002). While team members may share their ideas with the team, only when they are successfully implemented they are considered as innovation (Mumford & Gustafson, 1988; Shalley et al., 2004). Implementation is vital, as between uttering an idea and implementing it into a product or process there is a wide range of opportunity for failure (e.g., not finding support for the idea in the team, not being able to mobilize necessary resources, loosing motivation, or being distracted by other work tasks). Thus, creativity may be suitably conceptualized as the first necessary step and an important antecedent for subsequent innovation (West & Farr, 1990). Empirical research similarly suggests the two are not perfectly related (as shown in a meta-analysis by Sarooghi et al., 2015) and that they are influenced by partially different inputs and mechanism (Anderson et al., 2014; Hughes et al., 2018). Therefore, researchers have highlighted the importance of a clear distinction between and a separated investigation of creativity and innovation (Hughes et al., 2018; Montag et al., 2012; Perry-Smith & Manucci, 2017).

This dissertation aims to carefully distinguish between the two concepts whenever possible. However, the meta-analysis in chapter 2 is based on secondary data from published studies, thus allowing no influence on the operationalization and measurement of the constructs in the primary studies. As suggested by a review of the most common creativity and innovation scales (Hughes et al., 2019), the measures used in these articles made it impossible to distinguish between the two constructs, as the major share of them consisted both of items measuring creativity and items measuring innovation. For this reason, for chapter 2, this dissertation followed the approach by Hülsheger and colleagues (2009) and applied a boarder concept of innovation: From this point of view, creativity - or the generation of ideas - is one of two stages that innovation encompasses and can be considered as one of its sub-processes (Hülsheger et al., 2009). This broad category of innovation thus subsumes creativity and can be operationalized as both the quantity and quality of developed and implemented ideas (Pirola-Merlo & Mann, 2004; West, 2002).

### 1.2.4 Antecedes of Team Creativity and Team Innovation

This dissertation focuses on three different antecedents of team creativity and team innovation, namely team climate for innovation (West, 1990), creative leadership (Mainemelis et al., 2015) and time pressure as a constraint to creativity (Acar et al., 2019). In the following, the three concepts are introduced and their relevance for team creativity and team innovation is described.

*Team climate for innovation* is conceptualized as an organizational climate, which can be understood as “the shared perceptions of and the meaning attached to the policies, practices, and procedures employees experience and the behaviors they observe getting rewarded and that are supported and expected” (Schneider et al., 2013, p. 362). More specifically, team climate refers to the shared perceptions of employees at the proximal work group level on “the manner of working together that the team has evolved” (Anderson & West, 1994, p. 3). This entails both descriptive ('this is how we do it') and normative ('this is how it should be done') elements (van Knippenberg, 2017). Systemizing and integrating existing innovation research, West (1990) introduced his four-factor theory on team climate for innovation by identifying four team climate factors as crucial antecedents of group level innovation: First, the factor *vision* refers to "…how clearly defined, shared, attainable, and valued [...] the team's objectives and vision" are (Anderson & West, 1996, p. 59). Second, the factor *participative safety* refers to "…how participative the team is in its decision-making procedures and how psychologically safe team members feel it is to propose new and improved ways of doing things" (Anderson & West, 1996, p. 59). Third, the factor *task orientation* refers to "…a shared concern with excellence of quality of task performance in relation to shared vision or outcomes, characterized by evaluations, modifications, control systems and critical appraisals" (West, 1990; p. 313). Fourth, the factor *support for innovation* refers to a shared belief that creativity and innovation is supported in the team (Amabile et al., 1996; Anderson & West, 1996). Team climate for innovation is an inherently mixed-level concept as it emerges through shared perceptions and experiences of the team environment by the individual team members and predicts outcomes on the group level (Pirola-Merlo & Mann, 2004)

Taken together, the construct of team climate for innovation entails the idea that teams may exhibit a facilitating or discouraging combination of processes which influence the ability of the team to produce and implement original ideas (Anderson & West, 1996). Innovation is improved, if all team members feel that they can openly speak their mind, share a vision and commitment to quality excellence, and support each other in their innovative pursuit (van Knippenberg, 2017). Empirical evidence tends to consistently support this notion (e.g., Agrell & Gustafson, 1994; Bain et al., 2001; Pirola-Merlo, 2010) and a meta-analysis confirmed that the dimensions of team climate for innovation are positively associated with the parallel facet-specific outcome of team innovation (Hülsheger et al., 2009). However, research on the factorial structure of the construct, its relationship with team performance, the contingencies and mechanism of this relationship has either resulted in inconsistent findings or is currently missing. To resolve these inconsistencies and fill this gap, this dissertation presents a meta-analytical examination of the construct of team climate for innovation and its relationships.

*Creative leadership modes.* Creative leadership can be understood as “leading others toward the attainment of a creative outcome.” (Mainemelis et al., 2015, p. 399). Based on a large-scale, interdisciplinary review on creative leadership, Mainemelis and colleagues (2015) identified three leadership strategies that vary in the degree to which the leader and the followers are active contributors to creativity and innovation. The first is *facilitating*, which corresponds to the traditional view of creative leadership as supporting and offering resources, but not actively contributing (Mainemelis et al., 2015). This has been a prominent perspective within the organizational creativity literature: Leaders, being a core element of social work context, influence employee creativity (Amabile, 1988; Woodman et al., 1993) by supplying them with the required resources and establishing an environment conducive to creative work (e.g., through encouragement, support, or a good team climate) (e.g., Amabile et al., 1996; Janssen, 2005; Madjar et al., 2002; Mumford et al., 2002; Zhang & Bartol, 2010).

The second is *directing*, wherein the leader is the primary generator of creative contributions and the followers primarily undertake supportive tasks (Mainemelis et al., 2015). While this notion of creative leadership has been less prominent in prior organizational behavior research, research on leaders’ own creative contribution is slowly emerging (e.g., Huang et al., 2016; Koseoglu et al., 2017). For example, creative leaders are considered to be better equipped for effecting positive change by reacting to dynamic environments, by directing followers towards the most promising ideas, and by creating environments conducive to creativity (Mainemelis et al., 2015; Mumford et al., 2002; Sternberg, 2007). Further, leaders displaying their creative behaviors and problem solving skills have been shown to function as a role model for followers, which leads to an increase in their creative performance (Jaussi & Dionne, 2003; Koseoglu et al., 2017; Reiter-Palmon & Illies, 2004; Shalley & Perry-Smith, 2001).

The third is *integrating,* wherein both the leader and the followers generate creative contributions, which the leader then synthesizes to establish a creative synergy (Mainemelis et al., 2015). This concept of creative leadership has not been studied explicitly in organizational behavior research before, however it may still find resonance in prior research: van Knippenberg (2017) highlighted the importance of integrating knowledge, perspectives, ideas, and expertise from diverse members of the innovation team. In the creative interaction between the leader and team members, this integration can result in a creative synergy, where the collective creative outcomes are greater than the sum of the individual inputs (Mainemelis et al., 2015). Further, the integrating creative leadership inherently possesses the notion of participative collaboration between leader and team members inputs (Mainemelis et al., 2015). Participation is considered to enhance innovation (Axtell et al., 2000; Hülsheger et al., 2009), as it increases the experienced ownership and thus commitment for the task and its outcomes (Basadur, 2004; Rouse, 2013; West, 1990),

While evidence of the influence of these three strategies exists, their combined and relative effect on creativity and innovation is not knownj and a comprehensive measure of all three strategies does not exist. Based on this reasoning, this dissertation develops and tests theory and measurement on the three creative leadership strategies as antecedents to team creativity and team innovation.

*Constraints on creativity.* Constraints can be understood as "any externally imposed factor (e.g., rules and regulations, deadlines, requirements, and resource scarcity) that limits creativity and/or innovation." (Acar et al., 2019, p. 3). According to Acar and colleagues' (2019) taxonomy three types of constraints (input, process, and output) and three types of mediating mechanisms (social, motivational, and cognitive) can be distinguished. Traditionally different research streams have primarily assumed a negative influence of constraints on creativity and innovation (e.g., Amabile, 1996; Damanpour, 1991), for example, because slack in resources encourages experimentation (Cyert & March, 1963; Levinthal & March, 1981) and increases R&D spending and new product introductions (Chen & Miller, 2007; Natividad, 2013). However, more recent research has also presented reasoning and evidence for a positive effect of constraints, for example, because slack in resources inhibits exploratory innovation (Voss et al., 2008), potentially due to increased complacency and risk avoidance (Acar et al., 2019), and limited resources increase the generation of novel ideas and their innovative recombination in entrepreneurs (Jones & Jayawarna, 2010; Vanacker et al., 2011). Whether a constraint has a positive or negative effect likely depends on the types of constraints and the combinations of the underlying mechanism (Acar et al., 2019).

The most commonly investigated type of constraints are input factors, of which again time constraints (e.g., deadlines, workload, time pressure) tend to stand out (Acar et al., 2019), as time has become one of the most scarce resources in practice: In a recent survey, 39% of the 2,500 questioned corporate innovation leaders considered the speed of adopting new technologies as crucial, making it the third most important issue in new product development projects for the respondents (Boston Consulting Group, 2019). Similarly, time constraints have gained attention in organizational behavior research, which has argued for and found both negative (e.g., Amabile, 1988; Andrews & Smith, 1996) and positive effects (e.g., Baer & Oldham, 2006; Khedhaouria et al., 2017) on creativity and innovation: On the one hand, some researchers argue that due to a reduced perception of control and intrinsic motivation, time constraints reduce creativity (Amabile, 1996; Shalley et al., 2004). On the other hand, others reason that due to the motivating effect of the perceived challenge, that they impose, time constraints increase creativity (Andrews & Farris, 1972; Ohly & Fritz, 2010). Concerning time constraints and social mechanisms empirical research is currently lacking (Acar et al., 2019). To resolve this inconsistency and to fill this gap, this dissertation investigates the influence of time pressure on creativity and both a motivational and a social mechanism that drive this influence.

### 1.2.5 Investigating Multiple Levels

Investigating teams as the central unit of observation often requires thorough mixed-level theorizing, measurement, and modelling which adds to the complexity of the research (in comparison to one-level individual level or organizational level research). First, as part of the organizational context, teams reside in nested arrangements: Team members are nested in teams, teams are nested in an organization and the organization is nested in the larger environment (Kozlowski & Klein 2000). Therefore, the context of teams is inherently mixed-level and the complexities of most team level phenomena can only be explained when antecedents, processes, moderators, and outcomes can be modelled at different levels (González-Romá & Hernández, 2017; Kozlowski & Klein 2000). Second, assuming that constructs exhibit homologous relationships across different levels of analysis is illegitimate without empirical validation, as Rousseau (1985) warns in her description of the 'cross-level fallacy'. Therefore, findings on the individual or organizational level cannot simply be transferred to the team level. Third, as the team consists of individual team members, the entity of a team can only act and behave through its individual members (Kozlowski & Klein, 2000; Morgeson & Hofmann, 1999). The behavior of individuals meets "in space and time", thereby resulting in interpersonal interaction (Gong et al., 2013, p. 833). In this way, social interactions between individuals induce collective phenomena, like a perceived shared climate (Gong et al., 2013; Morgenson & Hofmann, 1999). Though the team as a collective entity can be assessed concerning team level variables by an external observer (e.g., team performance evaluated by a human resource expert), many psychological variables defining the psyche of the team as a whole can only be assessed by collecting the individual perceptions, opinions or behaviors of the team members and then aggregate them to the team level (cf. Chan, 1998). For the mentioned reasons, team level research in most cases inevitably becomes mixed-level research.

However, investigating mixed-level concepts and theories can refer to different approaches (Klein et al., 1994)[2]. Rosseaus (1965) typology can help to disentangle these different research perspectives on multiple levels. According to it, mixed-level research can be classified as either multilevel, cross-level or compositional. *Multilevel* refers to specific "patterns of relationships replicated across levels of analysis" (Rousseau. 1985, p. 22). Multilevel models address the question of whether the relationship between the independent and dependent variable is functionally equivalent or homologous and thus generalizable across different levels (Klein et al., 1994). *Cross-level* refers to the examination of "the relationship between independent and dependent variables at different levels" (Rousseau, 1985, p. 20). Cross-level models address, for instance, the question of whether group level context factors shape individual behaviors and attitudes (Klein et al., 1994). *Compositional* refers to "functional relations among constructs in the same content domain at different levels of analysis" (Chan, 1998, p. 234). Compositional models address the question of whether data on lower level variables can be aggregated to establish a higher level construct (Chan, 1998). By focusing on the functional similarity of variables at progressively more complex levels, this allows, for instance, the emergence of a collective team action through the individual behavior of the team members (Fisher, 2001; Morgeson & Hofmann, 1999).

[2] Unfortunately, in the organizational literature the terminology for referring to theory and research on multiple levels is inconsistent (Klein et al., 1994). In this dissertation, the terminology by Rousseau (1985) is adopted, while for the overarching approach to investigate multiple levels the umbrella term of 'mixed-level' research is used.

This dissertation takes a compositional perspective primarily focusing on the team as the unit of observation. Chapter 4 additionally encompasses a multilevel and a cross-level perspective focusing on both the level of the individual and the team.

## 1.3 Methodological Approach

The methodology of this dissertation can be described as empirical and quantitative in nature. This approach allows it to develop and systematically test hypotheses on research topics for which prior research has already established theoretical foundations (Döring & Bortz, 2016).

### 1.3.1 Research Designs

In chapter 2, meta-analytical methodology is applied to move research on team climate for innovation forward. Meta-analysis is a type of research synthesis that creates a "statistical synthesis of results from a series of studies" (Borenstein, 2009, p. XXI). Meta-analytical results are commonly considered to be provide the most trustworthy evidence, as meta-analyses aim to statistically integrate all available evidence, thus providing more reliable results than analyses from primary single studies (e.g., Berlin & Golub, 2014; Rynes & Bartunek, 2017; Tranfield et al., 2003). Conducting a comprehensive meta-analysis on team climate for innovation is motivated by the following reasons: First, it is capable of revealing the strength and consistency of the true relationship between team climate for innovation and team level outcome variables (cf. Hunter & Schmidt, 2004), which allows integration and reinterpretation of past empirical studies. Second, it allows the exploration of contextual factors moderating these relationships, which are difficult to investigate in primary studies (Hunter & Schmidt, 2004). Third, a meta-analysis also offers the benefit of a qualitative overview through which concepts can be identified which have not gained enough attention yet, while other may have been studied exhaustively (cf. Hülsheger et al., 2009). By conducting this meta-analysis on team climate for innovation, this dissertation addresses calls for meta-analytical investigation of organizational innovation (e.g., Anderson et al., 2004, 2014; Anderson & King, 1991; Damanpour, 1991).

In chapter 3 and 4, quantitative cross-sectional field survey methodology with a correlational design was employed. Three major reasons motivated this choice: First, this is consistent with the dominant research design applied in organizational behavior research. While other research designs have been applied in this research stream (e.g., laboratory experiments, case studies, qualitative interviews), in the scientific discourse the survey method has been established as the method of choice for investigating the core constructs of this dissertation (e.g., Anderson & West, 1996; Hughes et al., 2018; Mesmer-Magnus & DeChurch, 2009; Tierney et al., 2002). Second, field surveys allow to investigate research settings that provide a sufficient long-term perspective for realistic interpersonal processes, as it gives the team members enough time to develop adequate psychological involvement within the team. In contrast, experimental manipulation of interpersonal process variables is difficult, as experiments often consist of comparatively short-lived simulations with little psychological investment in the team (Hambley et al., 2007; Staples & Zhao, 2006). Third, the field survey design allows to investigate the relevant constructs in research settings with a high external validity. Conducted in real-life organizational contexts, field studies allow the investigation of the hypothesized relationships between context factors and team creativity or innovation in real, pre-existing leader-follower and team member relationships. Thus, the results are more likely to generalize to real organizational settings than results from laboratory studies (Scandura & Williams, 2000).

It should be noted that specific issues could not be addressed by the studies of this dissertation due to the implications of the chosen research designs and therefore remain for further investigation. For instance, being primarily based on survey data[3], none of the three empirical

[3] In the sample of the meta-analysis (chapter 2), all but one studies were based on cross-sectional field survey data.

chapters is able to fully address the question of causality or the issue of endogeneity. Further, the studies in the present dissertation mainly focus on team level relationships, neglecting the organizational level of innovation and, in case of chapter 2 and 3, the individual level of creativity and innovation. Also, chapter 2 and 3 do not address any cross-level or multilevel questions. A more detailed evaluation of the limitations of the studies included in this dissertation can be found in each empirical chapter (chapter 2, 3, and 4) and in the overall discussion (chapter 5).

### 1.3.2 Samples and Data Collection

The studies of this dissertation are based on three different samples. The first sample, which was used in chapter 2, consists of a total of 950 effect sizes ($N$ = 6,078 teams) from 71 primary, quantitative studies, which had been identified as a result of an exhaustive literature search. The literature search included an automated online search via various citation databases and search engines, an extensive backward and forward search on seminal articles on the topics of innovation and organizational climate as well as a manual search in top-rated journals, conference programs, and dissertation databases. The identified 71 studies represent 87 independent samples with an overall of 6,078 teams consisting of over 32,000 individuals. All included primary studies are field surveys, except for one study, which is a laboratory experiment. The studies were coded following the procedures suggested by Lipsey and Wilson (2001) and Hayes and Krippendorff (2007).

The second sample ($N$ = 259 teams), which is used in chapter 3, consists of 646 junior scholars nested in 259 academic teams from nine research facilities and was collected as part of an online survey of scientific personnel at universities in Germany. The third sample ($N$ = 31 teams), which is used in chapter 4, consists of 138 team members nested within 31 teams. Data was collected from both team members and supervisors participating in two product development programs at a German university.

In chapter 3 and 4, the investigated interpersonal processes were assessed through quantitative self-report scales, which have been either established in the literature or developed for the purpose of the study (creative leadership modes in chapter 3). As psychological states or perceptions of environmental variables (such as motivation or climate) can usually not be measured by evaluation of others or objective criteria, but only through introspection, using self-report scales to assess them is fairly common (Podsakoff & Organ, 1986). Indeed, measuring leadership behavior, context variables, interpersonal and motivational processes through self-report is in line with previous literature from organizational behavior research (e.g., Baer & Oldham, 2006; Dong et al., 2016; Tierney et al., 2002; Rosing et al., 2011). Still, field studies can be prone to systematic bias due to common sources, if all measures are assessed via self-report scale by the same respondents (Podsakoff et al., 2012). To minimize the likelihood of artificial relationships due to common method variance (cf. Podsakoff & Organ, 1986), both chapter 3 and 4 employed strategies to mitigate this risk by measuring predictor and criterion variables through different sources: In chapter 3, self-report field survey data was aggregated to the team level and combined with bibliometric secondary data. In chapter 4, multi-source data from both team members and supervisors was collected.

### 1.3.3 Approaches of Data Analysis

The method of data analysis was determined in accordance with the respective research design and hypotheses to be tested. In chapter 2, the meta-analytical approach by Schmidt and Hunter (2015) was adopted: The true mean correlation estimates as well as their 95% confidence intervals were calculated by correcting the average effect sizes for both sampling and measurement error in both predictor and criterion. To analyze the structure of the construct of team climate for innovation, the true mean correlation estimates were subjected to confirmatory factor analysis and meta-regressions following the approach by LePine and colleagues (2002).

For moderator analyses, the true mean correlation estimates were subjected to subgroup analyses and meta-regression (Schmidt & Hunter, 2015) and, for the mediation analysis, to structural equation modelling following the approach by Viswesvaran and Ones (1995).

In chapter 3 and 4, data on team level constructs collected at the individual level was aggregated to the team level and results were analyzed using (mixed-level) multiple linear regression analysis. In chapter 3, exploratory and confirmatory factor analyses were used for scale development. Further, ordinary least square regression and two-level negative-binomial generalized regression was used to test hypotheses on the direct effects. In chapter 4, the individual level mediation analyses as well as the cross-level moderation analysis was conducted using two-level random effects regression and the mediation hypothesis was tested with Hayes and Rockwood’s (2020) Monte Carlo simulation-based tests. The team level mediation analysis was conducted using ordinary least square regression and the mediation hypothesis was tested with Hayes’ (2018) bootstrapping-based test for mediation. Additionally, exploratory post hoc analyses were conducted.

## 1.4 Main Results and Contributions to the Literature

*Chapter 2* investigates the construct of team climate for innovation and its relationship with team performance and team innovation. Three different meta-analytical analyses show that team climate for innovation should be treated as a unitary, second-order construct. Further, the study finds a medium-sized positive relationship of team climate for innovation with team performance and with team innovation, of which the strength is contingent upon the innovation-specificity, the function of the assessed criteria, and research design characteristics. In addition, the findings reveal that the relationship between team climate for innovation and team performance depends not only on its indirect effect via team innovation, but also its direct effect.

Thereby, chapter 2 contributes to current literature on organizational climate, team innovation, and team processes in three important ways. First, this chapter resolves inconsistent findings on the construct of team climate and, thus, helps to consolidate the construct, as called for by van Knippenberg (2017). Second, this chapter resolves inconsistent findings on the relationship of team climate for innovation with team performance and team innovation by meta-analytically estimating the direction and strength of the true effect size as well as identifying the contextual contingency factors upon which these relationships depend. Thereby, this dissertation updates and extents the findings of a prior meta-analysis (Hülsheger et al., 2009) by applying more advanced meta-analytical techniques. Further, it contributes to a more contextualized understanding of team climate for innovation, as called for by Newman and colleagues (2020). Finally, this chapter provides a more substantive understanding of the mechanism through which team climate for innovation influences team performance by examining the mediating effect of team innovation on the relationship between team climate for innovation and team performance.

*Chapter 3* introduces and explores the construct of creative leadership modes, which describe three strategies that vary in the degree to which the leader, follower, or both are active contributors to creative outcomes. Drawing on the work of Mainemelis and colleagues (2015), this dissertation establishes theory on these three creative leadership modes (facilitating, directing, and integrating) and develops a measure for them to examine the unique contribution of each strategy to creativity and innovation. The results suggest that while the facilitating and integrating creative leadership mode are conductive to the team's creative behavior, the directing and integrating mode are conductive to the team's innovative productivity.

Thereby, chapter 3 contributes to literature on creativity and innovation in teams as well as to literature on team leadership in four important ways. First, by introducing and establishing theory on the construct of creative leadership modes, which incorporates an active role of leadership, the chapter addresses the call for the investigation of leaders' creativity (Epitropaki et al., 2017; Mainemelis et al., 2015). Second, developing and validating a scale for measuring the three creative leadership modes, the chapter enables the examination of the combined and unique influence of each, thereby providing a more comprehensive understanding of the role of leadership in team creativity and team innovation. Thus, this dissertation contributes to resolving the debate on the role of leaders' creativity, as called for by Fischer and colleagues (2017). Third, the chapter addresses calls for careful differentiation between creativity and innovation (Anderson et al., 2014; Hughes et al., 2018; Montag, et al., 2012; Perry-Smith & Mannucci, 2017), which enables us to explore whether creative leadership modes have different consequences depending on the desired outcome of the innovation process. Fourth, this dissertation contributes to the understanding of the organization of research teams (Shibayama et al., 2015) by shedding light on how different leadership modes can foster scientific creativity (cf. Heinze et al., 2009) and the innovative productivity of research teams.

*Chapter 4* sets out to determine whether and why time pressure serves as a positive challenge or a negative hindrance to individual and team creativity. Drawing on social cognitive theory (Bandura, 1997) and social exchange theory (Blau, 1964; Emerson, 1976), it proposes that at the individual level a motivational mechanism (namely creative self-efficacy) leads to a positive influence of time pressure on creativity, while on the team level a social mechanism (namely the lack of knowledge sharing) leads to a negative influence. A mixed-level analysis approach did not yield significant results, potentially due to insufficient statistical power. However, exploratory post hoc analyses revealed promising results: The individuals' creative self-efficacy partially mediated the relationship between individual time pressure and individual creativity. Team time pressure had a negative indirect effect on team creativity via team knowledge sharing.

Thereby, chapter 4 contributes to the literature on creativity of individuals and teams as well as to the literature on creativity constraints in three important ways. First, the chapter contributes to research on creativity constraints by shedding light on inconsistent findings in the previous literature and by offering integrative empirical investigation on motivational and social mechanisms, which has been called for by Acar and colleagues (2019). Second, the chapter untangles the influence of time pressure on individual and team creativity and analyses the mechanisms of how time pressure simultaneously influences creativity at different levels. Third, by investigating the cross-level interaction of an individual state and a situational group process in the generation of ideas, the chapter contributes to prior person-in-situation research focusing on group factors in a shared work context which activate individuals' creative potentials, which has been called for (Razinskas & Hoegl, 2020; van Knippenberg & Hirst, 2020).

*Summary.* Taken together, the three empirical chapters contribute to the understanding of the creative and the innovative performance of teams in the workplace by advancing our knowledge on interpersonal team processes and context factors that foster or hinder a team's performance, innovation, and creativity. The chapters do so by taking different theoretical perspectives, applying different methods, and focusing on three different constructs (team climate for innovation, creative leadership modes, and time pressure). Thereby, this dissertation offers avenues for creating more suitable work environments for teams who aim at generating original ideas and transforming them into innovations which help their organizations to survive and to thrive.

## 1.5 Dissertation Structure and Summary of the Three Empirical Chapters

All things considered, it can be summarized that this dissertation focuses on the core phenomenon of creativity and innovation in the empirical context of teams applying the theoretical lens of mixed-level research on interpersonal processes and chooses the research approach of research synthesis (meta-analysis) as well as primary studies (field surveys).

Following this introduction, chapter 2, 3, and 4 present the three chapters which address the research questions stated above. Chapter 2 focuses on team climate for innovation and its relationship with team innovation and team performance. Chapter 3 examines the relationship between creative leadership modes and team creativity and team innovation. Chapter 4 investigates the relationship of individual and team time pressure with creativity and the mechanism behind these relationships. Finally, chapter 5 provides an overall discussion of the main results of all chapters, contributions, and limitations and presents an agenda for future research. Table 1.1 summarizes the three empirical chapters.

**Table 1.1:** Overview of the included empirical studies

| **Title** | **Clarifying Team Climate for Innovation: A meta-analytical construct consolidation, moderator and mediator analysis** | **The Role of Creative Leadership Modes in Team Creativity and Innovation** | **Creative through Time Pressure? - A Cross-Level View on Creative Self-Efficacy & Knowledge Sharing** |
|---|---|---|---|
| **Chapter** | Chapter 2 | Chapter 3 | Chapter 4 |
| **Research Goals** | 1) Clarify the factorial structure of team climate for innovation<br>2) Consolidate the relationship of team climate for innovation with team performance and team innovation<br>3) Investigate contingencies of these relationships<br>4) Investigate the mechanism of the relationship with team performance | 1) Introduce the construct of creative leadership modes<br>2) Develop and validate a measurement tool for creative leadership modes<br>3) Investigate whether creative leadership modes have different consequences depending on the desired outcome of the innovation process | 1) Investigate how time pressure influences individual and team creativity<br>2) Investigate the mechanism of how time pressure simultaneously influences creativity at different levels<br>3) Investigate cross-level interactive effects of individual and team creative processes |
| **Theoretical Background** | Four-factor theory of team climate for innovation | Creative leadership theory | Constraints on creativity, social cognitive & exchange theory |
| **Type of mixed-level Model** | Compositional | Compositional | Compositional, cross-level, multilevel |
| **Level of Analysis** | Team level | Team level, controlled for organizational level | Individual level, team level |
| **Data Collection** | Secondary data from a meta-analytical literature search | Data from a field survey and secondary bibliometric data | Multi-source data from a field survey |
| **Analytical Approach** | Meta-analytical effect size estimation, regression, and structural equation model analyses | Mixed-level regression analyses | Mixed-level regression analyses |
| **Main Findings** | • Team climate for innovation is a unitary second-order construct<br>• Team climate for innovation is related to team innovation and team performance<br>• Innovation-specificity and function of the criterion as well as research design characteristics are moderators of the relationship<br>• Team innovation partially mediates the relationship between team climate for innovation and team performance | • Facilitating and integrating creative leadership modes are related to the creative behavior of teams<br>• Integrating and directing creative leadership modes are related to the innovative productivity of teams | Exploratory post hoc analyses:<br>• Individuals' creative self-efficacy partially mediates the relationship between individual time pressure and creativity<br>• Team time pressure has a negative indirect effect on team creativity via team knowledge sharing |
| **Contributions to Literature** | Innovation literature, team literature, climate literature | Creativity & innovation literature, team literature, leadership literature | Creativity literature, constraint literature, team literature |

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# 2 Clarifying Team Climate for Innovation: A Meta-analytical Construct Consolidation, Moderator and Mediator Analysis

**Abstract**

Team climate for innovation is one of the most frequently investigated types of organizational climate and has stimulated an abundance of research on its consequences. To resolve inconsistencies on the nature of the construct and its relationships, the present study offers a meta-analytical investigation on the results of an exhaustive literature research. Integrating evidence from 87 independent samples with a total of 950 effect sizes ($N$ = 6,078 teams) we address three unresolved issues: First, we demonstrate the validity of team climate for innovation as a unitary second-order construct in a series of analyses. Second, we present its relationship with team performance (ρ = .37) and team innovation (ρ = .44) and identify several contingency factors of these relationships. Thereby, we promote a more accurate and contextualized understanding of this construct and its consequences. Finally, we investigate the mechanism behind the team climate for innovation and team performance relationship: The meta-analytical structural equation model analyses indicate both a direct effect (ρ = .26) and an indirect effect mediated through team innovation (ρ = .12). We discuss the theoretical and practical implications of our findings and offer avenues for future research.

*Keywords*:
team climate for innovation; team performance; team innovation; meta-analysis

*Note: This chapter is based on a working paper co-authored by Lea-Therese Strobel, Maria Strobel, Bart de Jong, Andranik Tumasjan, and Isabell M. Welpe. Therefore, the plural instead of the singular is used throughout this chapter.*

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## 2.1 Introduction

In today's volatile market environments, innovations are crucial for the survival and effectiveness of organizations, as they represent key competitive advantages (Anderson et al., 2014; Zhou & Hoever, 2014). In order to generate and implement innovations, organizations are increasingly relying on teams (Ilgen et al., 2005; van Knippenberg, 2017). To enable these teams to innovate effectively, it is important to understand what fosters team innovation and team performance. One emergent social state that has received growing attention in organizational behavior research as a key factor for fostering the processes of team innovation and team performance is *team climate for innovation* (Anderson & West, 1998). Team climate for innovation is one of the most frequently investigated types of organizational climate and the only innovation climate focusing on the proximal workgroup (Mathisen & Einarsen, 2004). The ongoing importance of this emergent state has been stressed by several literature analyses (e.g., Anderson et al., 2014; Newmann et al., 2020; Hülsheger et al., 2009; van Knippenberg, 2017) and by a rising number of papers published in the last years (Newmann et al., 2020).

However, despite the growing body of support for the importance of team climate for innovation in the workplace, the current state of research is full of inconsistencies: First, according to van Knippenberg (2017) the construct of team climate for innovation has not been thoroughly consolidated. Given the high correlations but also a potential conceptual overlap of the dimensions of team climate for innovation, he questions whether the four-dimensional structure is truly the most parsimonious one. Further, there has been inconsistencies concerning the specification of the construct: While Anderson & West (1998) have explicitly modeled team climate for innovation as a second-order model with four dimensions, some empirical studies have specified it as a single, unidimensional construct (e.g., Nazir et al., 2020; Somech & Drach-Zahavy, 2011; Xu et al., 2019), others have modeled it as four correlated factors (e.g., Bain et al., 2001; Carter & West, 1998) or even examined a single dimensions in isolation (e.g., Chen et al., 2013; Nijstad et al., 2014). These inconsistencies are problematic, as findings may not be comparable across studies or even misguiding. Van Knippenberg (2017) highlights the importance of construct consolidation for team climate for innovation and notes that the lack of clarity concerning its structure is an obstacle hindering future research.

Second, while the relationship of team climate for innovation with the facet-specific outcome team innovation has been meta-analytically investigated (Hülsheger et al., 2009), the findings on its relationship with the global outcome of team performance remain inconsistent, both regarding direction and strength: While several studies find a strong association (e.g., Comber, 2014; Rietzschel, 2008; Seys et al., 2019), others find weak (e.g., Mathisen et al., 2004; Poulton & West, 1999), negligible (e.g., Johnson, 2010; Alipour et al., 2018; van Knippenberg et al., 2011), or even negative (e.g., Goh et al., 2009; Ibrahim, 2012) relationships. Further, the findings regarding the influence of the different facets of climate for innovation (i.e., participative safety, vision, support for innovation, and task orientation) are also inconsistent. Whereas some studies find that all four facets have a similar influence on team performance (e.g., Carter & West, 1998; Pirola-Merlo et al., 2002; West et al., 1998), other studies find differential relationships across the four facets (e.g., Pirola-Merlo, 2010; Poulton, & West, 1999). As a consequence, the present state of the literature does not allow for conclusions on the existence and size of the relationship between team climate for innovation and team performance. As team performance is crucial for organizational success (Mathieu et al., 2008), it is important to investigate whether and how team climate for innovation is related to team performance.

Third, prior research has rarely theorized or empirically tested the contingencies that may influence the relationship of team climate for innovation with team performance and team innovation. These contingencies are often difficult to investigate in single primary studies (Hunter & Schmidt, 2004). However, understanding the boundary conditions of constructs (cf. Fraizer et al., 2017; Seibert et al., 2011) like team climate for innovation would be crucial to support development of meaningful and accurate theory and guide practice (Johns, 2006). For instance, several researchers have highlighted the importance of investigating the context, in which creativity and innovation takes place (e.g., Anderson et al., 2004, 2014; van Knippenberg, 2017; Zhou & Hoever, 2014). Despite its relevance, Newman and colleagues (2020) note that the context in which teams are embedded and in which team climate for innovation emerges has received little attention and therefore call for research in this area.

Fourth, as facet-specific climates, like team climate for innovation, have mainly been investigated regarding their influence on conceptually corresponding facet-specific outcomes, climate researchers consider it increasingly important to investigate more global outcomes of facet-specific climates (Kuenzi & Schminke, 2009). This, however, raises the question of how the facet-specific climate influences global outcomes – directly or mainly through its influence on the facet-specific outcome? In the case of team climate for innovation, an indirect influence on the global outcome team performance through the facet-specific outcome team innovation has been theoretically indicated (cf. West, 1990), but not empirically investigated so far. However, doing so would be important because establishing the underlying mechanism is a vital foundation for clarifying the overall theoretical model (Whetten, 1989).

Finally, the meta-analysis of Hülsheger and colleagues (2009) on the relationships between the team climate for innovation dimensions and team innovation refer to the state of research from over 14 years ago, which calls for an update. While Newman and colleagues (2020) review a more current state of research, they do not provide quantitative integration of the empirical evidence. According to Steel and colleagues (2020), an update of a meta-analysis is warranted, if an expansion in the research base allows improved methodology due to higher power or if novel findings could be generated through analysis of new moderators, meta-regression, or meta-analytic structural equation modeling.

With our study we aim to create consensus by resolving the mentioned inconsistent findings and clarifying the "what" (the construct), the "how" (strength and direction of its influence), the "when" (the contingencies of its influence) and the "why" (the mechanism of its influence). To move research on team climate for innovation forward, we conducted a comprehensive meta-analysis over the last three decades on the construct of team climate for innovation and its four dimensions – as reflected in the team climate inventory (TCI; Anderson & West, 1996) – its relationships with the key outcomes team innovation and team performance and the contingencies and mechanism of these relationships. Thereby, we answer calls for meta-analytical investigation of organizational innovation (e.g., Anderson et al., 2004, 2014; Anderson & King, 1991; Damanpour, 1991). The contributions of our study are threefold:

The first major contribution of this study lies in investigating the validity of team climate for innovation as a unitary construct. We address the "what" of Whetten's (1989) theoretical building blocks by clarifying the construct team climate for innovation. We do so by conducting a meta-analytical confirmatory factor analysis and assessing the predictive strength of team climate for innovation relative to its four subdimensions on our key outcome variables of team innovation and team performance. The second major contribution of our study is resolving inconsistent findings by examining the strength and direction of the relationship between team climate for innovation and team innovation and team performance across all available studies and by identifying the contextual contingency factors upon which these relationships depend. We address the "how" and "who/where/when" of Whetten's (1989) theoretical building blocks by estimating the true effect sizes and examining several potential boundary conditions of the effectiveness of team climate for innovation. Specifically, we investigate the potential moderating effects of work and cultural context, criterion characteristics and research design characteristics. Thereby, our study contributes to a more contextualized understanding of team climate for innovation. The third major contribution of our study is providing a more substantive understanding of the mechanism through which team climate for innovation influences team performance. We address the "why" of Whetten's (1989) theoretical building blocks by examining the potential mediating effect of team innovation on the relationship between team climate for innovation and team performance.

We add to the meta-analysis by Hülsheger and colleagues (2009) by updating the state of research on team climate for innovation (our study includes over 50 additional studies published after the end of data collection by Hülsheger et al., 2009), applying more advanced meta-analytical techniques (e.g., meta-analytical structural equation modelling, meta-regression), and further differentiating the analyzed relationships through a more fine-grained moderator analysis (e.g., performance vs. innovation, context moderators). We hope that our contributions will free researchers up to pursue innovative and complex research questions instead of repeatedly investigating inconsistent relationships (cf. Anderson et al., 2014) and guide future theoretical and empirical work on team climate for innovation.

## 2.2 Theory

Organizational climate can be understood as "the shared perceptions of and the meaning attached to the policies, practices, and procedures employees experience and the behaviors they observe getting rewarded and that are supported and expected" (Schneider et al., 2013, p. 362). More specifically, team climate refers to the shared perceptions of employees at the proximal work group level on "the manner of working together that the team has evolved" (Anderson & West, 1994, p. 3). This entails both descriptive ("this is how we do it") and normative ("this is how it should be done") elements (van Knippenberg, 2017).

The four-factor theory of team climate for innovation has been introduced by West (1990), in order to systemize the numerous antecedents of innovation on the group level. This theoretical framework proposes that the following four factors of shared perception within the team resemble the essential antecedents of innovation on the group level: Vision, participative safety, task orientation (formerly named climate for excellence), and support for innovation (formerly norms of and support for innovation) (West, 1990; Anderson & West, 1996). Innovation is improved, if all team members feel that they can openly speak their mind, share a common vision and commitment to quality excellence, and support each other in their innovative pursuit (van Knippenberg, 2017). Empirical evidence supports this notion (e.g., Bain et al., 2001; Pirola-Merlo, 2010) and, unsurprisingly, a meta-analysis by Hülsheger and colleagues (2009) confirmed that the dimensions of team climate for innovation are positively associated with team innovation.

Team climate for innovation and its four dimensions can be measured with the Team Climate Inventory (TCI), developed by Anderson and West (1994). The original 38-item version that demonstrated an acceptable factor structure and reliability scores (Mathisen et al., 2004). Other versions of the TCI comprise 44 (Anderson & West, 1998) or 61 items (Anderson & West, 1999) and Kivimäki and Elovainio (1999) established a short version based on only 14 items of the original TCI, which also yielded acceptable reliability and validity. Some researchers have further adapted and shortened the TCI, used sub-dimensions or an eclectic choice of items, which has not been validated (Newman et al., 2020).

### 2.2.1 Construct Validity of Team Climate for Innovation

A first goal of our study is to assess whether team climate for innovation represents four distinct constructs or rather a unitary second-order construct. Anderson & West (1998) explicitly modeled team climate for innovation as a second-order factor, with the four sub-factors vision, participative safety, task orientation, and support for innovation. Accordingly, several studies have similarly specified team climate for innovation as a single, unidimensional construct (e.g., Somech & Drach-Zahavy, 2011; Xu et al., 2019). Empirically, a number of studies has found that all four facets have a similar influence on team performance (e.g., Carter & West, 1998; Pirola-Merlo et al., 2002; West et al., 1998). Accordingly, team climate for innovation could be understood as a latent construct (cf. LePine, Erez, & Johnson, 2002).

However, in his four-factor theory of team climate for innovation, West (1990) assumed that the dimensions have different effects on different aspects of innovation (namely, that vision and task orientation primarily influence the quality of innovation, while participative safety and support for innovation are proposed to primarily influence the quantity of innovation). Further, some of the dimensions are much more innovation-oriented (i.e., support for innovation) than others, which may raise the thought that the strength of the relationship with team innovation may differ across the dimensions. Similarly, other authors have claimed that some dimensions of team climate for innovation are more conductive to performance than others. For instance, Pirola-Merlo (2010) argued that the factors of vision and task orientation are predictors of performance rather than of innovation. Empirically, several studies found differences in the strength of the influence of the different dimensions on innovation and performance (e.g., Pirola-Merlo, 2010; Poulton, & West, 1999). If the dimension-criterion relationships differ between the subdimensions, this would call into question the idea of a unitary construct of team climate for innovation and rather suggest the idea of an aggregated construct (cf. LePine, et al., 2002), supporting the approach of treating the subdimension as separate constructs.

Following the approach by LePine and colleagues (2002) and Seibert and colleagues (2011), we conduct the three analyses to examine and consolidate the construct of team climate for innovation: First, to investigate whether the different dimensions come together into a meaningful second-order construct of team climate for innovation, we use a confirmatory factor analysis based on the meta-analyzed correlation between the four subdimensions. Second, to investigate the discriminant validity of the dimensions, we analyze the relationship of each subdimension with our key outcome variables. If we find no statistically significant differences between the dimensions in their relationship with the outcomes, this supports the application of team climate for innovation as a unitary construct; if we do find statistically different relationships with the outcomes, this would show the discriminant validity among the subdimensions (cf. Seibert et al., 2011). Third, to investigate whether the separate dimensions predict anything above and beyond the second-order construct, we compare the relative predictive strength of the overall team climate for innovation construct to the strength of the subdimensions. If the subdimensions do not have predictive value beyond the overall construct, the global unitary construct is justified; if they do, the global unitary construct is questionable (cf. Seibert et al., 2011). In this way, we seek to answer the following research question:

*Research Question 1: Should team climate for innovation be treated as a unitary construct?*

### 2.2.2 Team Climate for Innovation and Team Performance

As a second goal of this study, we seek to examine how team climate for innovation is related to team performance. According to the team effectiveness framework (Cohen & Bailey, 1997) team performance is one of the most commonly examined criteria in team research and can be understood as part of the overall construct of team effectiveness. Team performance commonly refers to the degree to which teams accomplish their goals (Bell, 2007; Devine & Philips, 2001). Anderson and West (1998) point out that teams who have clear objectives, emphasize task performance, and experience participative safety and support are likely to deliver higher performance than teams that have a poor team climate. All four dimensions of team climate for innovation have been theoretically and empirically linked to team performance.

*Vision* is described as “an idea of a valued outcome which represents a higher order goal and motivating force at work” (West, 1990, p. 310). The climate dimension mainly measures to what extent team members have a common understanding of team objectives and how committed they are to those goals (West & Anderson, 1996). According to West (1990), if the objectives of a team are clear, attainable, and shared, the team members feel committed to them and thus the team performs better and more effectively than teams in which this is not the case. The specificity of objectives has been found to be crucial to team performance in meta-analytical studies (Kleingeld et al., 2011; O'Leary-Kelly et al., 1994). Also, unattainable goals that exceed the team's abilities cause frustration and therefore decrease performance (Locke & Latham, 2006). Further, sharing of common goals within the team can result in greater commitment, which was found to lead to higher performance (Erez et al., 1985; Klein et al., 1999). We therefore propose:

*Hypothesis 1: Vision is positively related to team performance.*

*Participative safety* is characterized by "how participative the team is in its decision-making procedures and how psychologically safe team members feel it is to propose new and improved ways of doing things" (Anderson & West, 1996, p. 59). Both components of these dimensions – participation in decision making and intra-group psychological safety – have been frequently related to team performance. Participation is characterized by shared influence among all group members notwithstanding of hierarchical positions and meta-analytical evidence shows a positive relationship between overall participation and team performance (Wagner, 1994). Furthermore, information sharing – a central attribute of participation (West, 1990) – has been meta-analytically shown to be positively related to team performance (Mesmer-Magnus & DeChurch, 2009). Intra-group safety is characterized by a supportive, trustful, and nonthreatening climate, in which for example divergent perspectives and new ideas can be openly discussed (Anderson & West, 1998). Meta-analytical evidence shows a positive relationship between psychological safety and team task performance (Frazier et al., 2017). We therefore propose:

*Hypothesis 2: Participative safety is positively related to team performance.*

*Task orientation* describes "a shared concern with excellence of quality of task performance in relation to shared visions or outcomes, characterized by evaluations, modifications, control systems and critical appraisals" (West, 1990, p. 313). Anderson and West (1998) suggested that teams who score high on task orientation might also show an overall higher team productivity, mainly due to their constant evaluation of team performance. On an individual level, feedback has been found to improve task performance and learning (Locke & Latham, 1990). Individuals who receive feedback are found to self-set goals, commit to these goals, and show efficiency in goal achieving (Bandura & Jourden, 1991; Klein et al., 1999). Further, research has demonstrated that teams who were provided with team feedback spontaneously set goals (Locke & Latham, 1990) and feedback influenced the teams' collective efficacy and performance (Prussia & Kinicki, 1996; DeShon et al., 2004). We therefore propose:

*Hypothesis 3: Task orientation is positively related to team performance.*

*Support for innovation* is characterized by an atmosphere of expectation, approval, and support for new ideas (West, 1990). This includes rewarding systems for innovative behavior and cooperation, verbal support, and practical support such as the provision of time and resources by group members. As described by several authors (e.g., Amabile et al., 1996; Anderson & West, 1996), a shared belief that creativity and innovation is supported in the team may enhance team effectiveness. This positive association can be explained by the organizational support theory (Eisenberger et al., 2001), which posits that if members perceive a high level of organizational support, they feel obliged to work harder to accomplish organizational goals. Indeed, meta-analytical evidence shows that organizational and team support is related to performance (Chiaburu & Harrison, 2008; Kurtessis et al., 2015). We therefore propose:

*Hypothesis 4: Support for innovation is positively related to team performance.*

The *overall team climate for innovation construct* has been related to team performance in various studies. Some studies have found a negative relationship: For example, Goh and colleagues (2009) examined a negative relationship ($r$ = -.15) between the overall TCI score and the quality of care in 14 English general practice teams. Similarly, in his dissertation Ibrahim (2012) discovered a negative relationship (*r* = -.13) between the overall TCI score and the overall product evaluation of 12 engineering student project teams. In addition, some studies could not find a relationship between the overall TCI score and team performance: For example, in his dissertation Johnson (2010) did not find a significant relationship (*r* = .04) between the overall TCI score and the entrepreneurial success of 40 teams in a business plan competition. However, the major share of studies found a positive relationship between the overall team climate for innovation and team performance: For example, Lee and Idris (2017) found a strong positive relationship (*r* = .70) between the overall TCI score and the job performance of 42 Malaysian work teams. Similarly, Gil and colleagues (2005) discover a positive relationship (*r* = .56) between the overall TCI score and the team performance of 67 Spanish healthcare teams. Pirola and Merlo (2010) found a positive relationship (*r* = .46) between the overall TCI score and the leader-rated progress towards objectives of 25 Australian R&D teams. As we further hypothesized above that each of the separate team climate for innovation dimensions is positively related to team performance, we propose:

*Hypothesis 5: Team climate for innovation is positively related to team performance.*

### 2.2.3 Team Climate for Innovation and Team Innovation

As a third goal of this study, we seek to meta-analytically update the findings of Hülsheger and colleagues (2009) on the relationship between team climate for innovation and team innovation and further deepen our understanding of not only how, but also when team climate for innovation is related to team innovation. For this purpose, we follow Hülsheger and colleagues' (2009) approach of applying a broad category of innovation – referring to the generation and implementation of new ideas (Amabile, 1996; West & Farr, 1990; Woodman et al., 1993; Zhou & Hoever, 2014) – instead of differentiating between creativity and innovation. We understand team innovation as "the intentional introduction and application within a team, of ideas, processes, products or procedures new to the team, designed to significantly benefit the individual, the team, the organization, or wider society" (West & Wallace, 1991, p. 303). Based on the theoretical arguments and empirical results of Hülsheger and colleagues (2009), we assume to find a positive relationship between the team climate for innovation, its dimensions and team innovation in the updated set of studies:

> *Hypothesis 6: Team climate for innovation (a) and its dimensions vision (b), participative safety (c), task orientation (d), and support for innovation (e) are positively related to team innovation.*

### 2.2.4 Moderating Factors of the Team Climate for Innovation-Criterion Relationship

As a fourth goal of this study, we seek to investigate when team climate for innovation is related to the key criteria of team performance and innovation – that is whether the team climate for innovation-criterion relationships generalize across contexts, criteria, and research design characteristics.

#### 2.2.4.1 Contextual Moderators

Several major reviews on creativity and innovation have stressed the importance of investigating the context in which the work of individuals and teams is embedded; specifically, cultural contexts have been highlighted as relevant, but understudied (e.g., Anderson et al., 2004, 2014; Shalley et al., 2004; van Knippenberg, 2017; Zhou & Shalley, 2003; Zhou & Hoever, 2012). Newman and colleagues (2020) underlined the lack of research on work and cultural context and call for research on the context of team climate for innovation. As meta-analysis allows the exploration of contextual factors moderating the investigated relationships, which are difficult to investigate in primary studies (Hunter & Schmidt, 2004), in the following we have a closer look at potential moderators of work and cultural context.

*Creativity requirement.* Unsworth and colleagues (2005) define creativity requirement as “the perception that one is expected, or needs, to generate work-related ideas” (p. 542). They proposed that the relationship between supporting work factors (such as support for innovation) and work creativity is stronger, when creativity requirement is high. In a similar vein, Montag and colleagues (2012) propose that distinguishing between expected and unexpected creativity may help to explain inconsistent findings. If the creativity requirement of a job is high, team members perceive the expectation to be creative (Unsworth et al., 2005). Being aware of this expectation, they may be able to make use of high levels of team climate for innovation, translating them into team innovation. However, if team members do not perceive the expectation to be creative, the level of team climate for innovation may not make a difference, as they may simply not make use of their opportunities to engage in innovative behaviors. In this case, even high levels of team climate for innovation would not translate into team innovation. Supporting this assumption, Bain and colleagues (2001) found that team climate for innovation was related to the creativity and usefulness of outcomes in research teams, but not in development teams. Team climate for innovation might be to be only related to team innovation within an innovation context, where the creativity requirement is high. We therefore propose:

*Hypothesis 7: Team climate for innovation is more strongly related to team innovation if the creativity requirement is high.*

*Cultural context.* According to Hofstede (1980) culture can be understood as a collective programming in which members of different groups differ, which often coincides with national boundaries. Importantly, both innovation and performance has been shown to be influenced by culture (Rabl et al., 2014; Tian et al., 2018). Thus, also the validity of the relationships of team climate for innovation with these outcome criteria might be contingent upon features of cultural context in which the teams’ work takes place. For instance, there may be cultural groups in which high levels of team climate for innovation within a team fall on fertile ground: As the cultural values support innovation, teams are able to use the benefits of team climate for innovation to produce more innovations and perform better. However, there may also be cultural groups in which the cultural values oppose innovation, in which even teams with high levels of team climate for innovation cannot transfer it into innovation and performance. To our knowledge, this is the first study to explore the moderating effect of culture on the relationship between team climate for innovation and its outcome criteria.

Meyer and colleagues (2012) describe three major frameworks that have tried to differentiate cultures (i.e., Hofstede, 1980; House et al., 2004; Schwartz, 2006), which all capture the unique aspects of cultural groups by a set of dimensions. The manifestations of these dimensions have an impact on behaviors and expectations on behaviors within each cultural group (Hofstede, 1980; Zellmer-Bruhn & Gibson, 2006). We investigate the moderating role of the cultural dimension of each major culture framework, which we consider as most relevant to team climate for innovation: uncertainty avoidance (Hofstede, 2001), intellectual autonomy (Schwartz, 2006), and performance orientation (House et al., 2004). In the following, the reasons for investigating these three dimensions are described and hypotheses are deducted.

*Uncertainty Avoidance.* Uncertainty avoidance is the extent to which members of a society feel threatened by uncertainty or ambiguity (Hofstede, 2001). Individuals from cultures characterized by high uncertainty avoidance tend to avoid interpersonal risks and individuals from cultures with low uncertainty avoidance tend to accept competition and dissent within the team (Tian et al., 2018). As the nature of innovation is uncertain and risky (Mumford et al., 2002) and it requires a response to complex and ill-defined problems (Anderson et al., 2014), high levels of uncertainty avoidance can hinder innovation (Shane, 1993) due to higher levels of stress (Byron et al., 2010). However, social support and psychological safety can lead to a reduction of anxiety, stress, and uncertainty (e.g., Edmondson, 2018; Hackman & Oldham, 1976; Idris & Dollard, 2014; Sverke et al., 2002; Viswesvaran et al., 1999). Therefore, team climate for innovation may act as a buffer to this negative effect: If risk taking and deviations from status quo, which are necessary for innovation, are not part of the social norm, team climate for innovation may create the necessary safe space required for innovation by supporting participation, engagement in innovative behavior, and focus on a shared vision.

Similarly acting as a buffer, in a recent meta-analysis the relationship between transformational leadership and team innovation has been shown to be moderated by uncertainty avoidance in such a way that the relationship is stronger if uncertainty avoidance is high (Watts et al., 2020). Similar to transformational leadership, team climate for innovation provides teams with the psychological resources of a shared collective vision, commitment to it during complex, ambiguous projects, and social support (Gong et al., 2009; Sarros et al., 2008; Watts et al., 2020; West, 1990). Further, as several studies showed that transformational leadership is related to increased levels of team climate for innovation and its dimensions (e.g., Abdullah, 2014; Comber, 2014; Keil et al., 2017; Pirola-Merlo et al., 2002), in can be assumed that – depending on uncertainty avoidance – team climate for innovation may have a similarly directed effect on innovation.

To sum up, we expect a stronger relationship between team climate for innovation and team innovation, if uncertainty avoidance is high, because the supporting climate will help teams in managing their uncertainty, thus, being able to engage in innovative behaviors. We expect a smaller, but still positive, relationship, if uncertainty avoidance is low, as teams in a low uncertainty avoidance setting may not specifically require team climate for innovation in order to engage in innovative behaviors. Therefore, we propose:

*Hypothesis 8: Team climate for innovation is more strongly related to team innovation in cultures with high levels of uncertainty avoidance.*

*Intellectual Autonomy.* According to Schwartz (2006), intellectual autonomy refers to the extent to which members of a society encourage “individuals to pursue their own ideas and intellectual directions independently" (p. 140). Values that are usually promoted in a society with high intellectual autonomy are broadmindedness, curiosity, and creativity (Schwartz, 2006). The empirical research on the concept of intellectual autonomy in the context of innovation is so far sparse, but two studies show a clear relationship with innovation: Gelade (2008) show that nations with high intellectual autonomy performed better in patent indices and that the intellectual autonomy of a nation moderated the relationship between national IQ and patent indices. Feng and Lui (2012) found intellectual autonomy to be a strengthening moderator of the relationship between R&D investment of a nation and the nation rate of innovation. Thus, intellectual autonomy seems to function as an enabling factor for innovation.

Even though to our knowledge no studies on the team level have been conducted, there is reason to believe that intellectual autonomy will act as an enabling factor at the team level as well. If the intellectual autonomy of a society is high, team members will be culturally encouraged to be curious, think creatively, and try out new solutions. Thus, we assume a positive interaction with team climate for innovation in the workplace: If the individual team members are culturally encouraged to engage in creative behaviors from early age on, they will have had the opportunity to try out their creative skills and develop creative self-efficacy. This self-efficacy and the cultural appreciation of broadmindedness may help team members to translate the benefits of team climate for innovation into innovation, thus, strengthening the relationship. On the other hand, in a society in which individuals are not encouraged or even hindered from pursuing their creative ideas, even high levels of team climate for innovation may not translate into innovation, because team members lack the cultural incentive to pursue their own ideas and further do not perceive the societal expectation to be curious, creative, or broadminded. Therefore, we propose:

*Hypothesis 9: Team climate for innovation is more strongly related to team innovation in cultures with high levels of intellectual autonomy.*

*Performance Orientation.* Performance orientation refers to the extent to which members of a society encourage and reward "group members for performance improvement and excellence" (House et al., 2004, p. 40). Further, it also refers to the degree to which societies reward being innovative in order to improve performance (House et al., 2004). Societies with a high level of performance orientation tend to value competitiveness, striving for excellence, and formal performance feedback; societies with a low level of performance orientation tend to value harmonious personal relationships and more indirect communication, while direct performance feedback is rather considered as judgmental (House et al., 2004). This cultural dimension is closely related to the team climate for innovation dimension of task orientation, which also focuses on performance evaluation, improvement, and excellence.

Prior research shows that higher levels of cultural performance orientation are associated with an increased effort in problem-solving in innovation contests (Bockstedt et al., 2015). Thus, we assume that if performance orientation is high, team members are more willing to put additional effort into making use of the benefits of team climate for innovation for team innovation and team performance. They may be more apt to make use of the participative safety they experience by proposing ideas, put more effort into pursuing the shared vision and using the material and cognitive resources supplied by support for innovation. Further, if cultural performance orientation is high, the cultural predisposition to strive for performance and excellence is aligned with the social norm and practice to do so for teams with high task orientation. In contrast, teams in contexts low in performance orientation may be less able to make use of the team member's knowledge to generate ideas due to indirect communication processes and may also fail to properly monitor, evaluate, and refine their innovations and performance outcomes due to their hesitance to provide and accept direct feedback. Therefore, we propose:

*Hypothesis 10: Team climate for innovation is more strongly related to a) team innovation and b) team performance in cultures with high levels of performance orientation.*

#### 2.2.4.2 Criterion-related Moderators

In addition to the context, the heterogeneity in findings on the team climate for innovation-criterion relationship could also be due to differences in the conceptualization and operationalization of the criteria. While traditionally antecedents and process variables have received much attention in terms of construct consolidation and clarification (Mathieu et al., 2008), outcome variables, such as performance and innovation, have suffered from inconsistencies in definition and measurement (Campbell et al., 1993; Ilgen, 1999; Mathieu et al., 2008; Montag et al., 2012). To untangle these inconsistencies, prior research has stressed the importance of distinguishing criteria in terms of a) criterion specificity (e.g., Kuenzi & Schminke, 2009), b) criterion function (e.g., Beal, et al., 2003; Montag et al., 2012), and c) criterion dimension (e.g., Cohen & Bailey, 1997; Montag et al., 2012). However, empirical work has frequently used composite measures (Mathieu et al., 2008), e.g., mixing different types of outcomes and behaviors in one measure of team performance or innovation. While composite measures may be well suited to resemble the overall performance of teams performing multiple functions, they might also be difficult to understand and interpret (Mathieu et al., 2008) and may hinder comparison of empirical findings. Thus, besides reporting the relationship of team climate for innovation with an overall criterion composite, we choose a more fine-grained approach and investigate different types of team performance and innovation.

*Criterion specificity.* First, we seek to compare the strength of the relationship of team climate for innovation with team innovation and with team performance. Thereby, we go beyond merely linking facet-specific climate to global outcomes (cf. Kuenzi & Schminke, 2009), but further investigate whether the team climate for innovation is indeed as facet-specific as assumed or whether it may be similarly strongly related to global outcomes. Global outcomes characteristically reflect broader constructs, like performance or job satisfaction, while facet-specific outcomes reflect narrower and more specific constructs such as innovation (tied to climate for innovation) or accident rates (tied to climate of safety) (Kuenzi & Schminke, 2009).

The positive correlation between team climate for innovation and innovation has been demonstrated (Hülsheger et al., 2009). However, it has not yet been clarified if team climate for innovation influences mainly innovation-specific outcomes. Although team climate for innovation was developed as a facet-specific construct, Anderson and West (1998) state that it could also be connected to other team outcomes instead of one specific outcome. The theoretical framework of team climate for innovation (West, 1990; Anderson & West, 1998) frames it as a facet-, and therefore, outcome-specific climate suggesting the conclusion that it should show a stronger relationship with the facet-specific outcome of innovation than with the global outcome of team performance. Thus, we propose:

*Hypothesis 11: Team climate for innovation is more strongly related to team innovation than to team performance.*

To differentiate team innovation from other types of team effectiveness (like general performance), West and Anderson (1996) applied the basic input-process-output (IPO) model to specify a theory of team innovation. Similarly, Mathieu and colleagues (2008) highlight that team effectiveness outcomes include multiple criteria and differentiate between innovation and performance in their analysis of studies. However, other authors have considered team innovation as a sub-facet of team performance, arguing that team performance should be understood as a multi-dimensional construct (e.g., Ancona & Caldwell, 1992; Hackman & Walton, 1986). Therefore, team performance measures including aspects of team innovation have been introduced and applied (e.g., Ancona & Caldwell, 1992). For the purpose of this study, we distinguish team performance from team innovation, following Kuenzi and Schminke (2009) in differentiating between facet-specific and global outcomes. Thus, for the comparison of team performance and team innovation, performance measures which include aspects of innovation are excluded.

*Criterion function.* Second, we seek to compare the strength of the relationship of team climate for innovation with team performance / innovation behavior with the strength of its relationship with team performance / innovation outcomes. Several scholars highlighted the importance of differentiating between performance behaviors and performance outcomes (Beal et al., 2003; Campbell et al., 1993): “Behaviors are actions that are relevant to achieving goals, whereas outcomes are the consequences or results of performance behaviors.” (Mathieu et al., 2008, p. 416). The same distinction has been stressed for creative behaviors in contrast to creative outcomes (Montag et al., 2012). While the conceptualization of performance solely as an outcome is fairly common, it fails to consider that there are many factors outside of the control of teams which can prevent the translation of performance behaviors into performance outcomes (Beal et al., 2003; Campbell et al., 1993). Due to the possibility of these preventing factors, we hypothesize:

> *Hypothesis 12: Team climate for innovation is more strongly related to a) team innovation behavior than to team innovation outcomes and to b) team performance behavior than to team performance outcomes.*

*Criterion dimension.* Third, we seek to compare the strength of relationship of team climate for innovation with team performance / innovation outcome quality with the strength of its relationship with team performance / innovation outcome quantity. Different scholars stressed that quality and quantity are two separate dimensions of outcome effectiveness (Cohen & Bailey, 1997; Mathieu et al., 2008; Montag et al., 2012). Empirical results support this assumption by showing only weak correlations between quality and quantity indicators of performance and innovation (e.g., Oldham & Cummings, 1996; Peralta et al., 2015; West & Anderson, 1996). For instance, the difference between three radical innovations and three incremental innovations may not become apparent in a quantitative innovation criterion; similarly, the technical quality of a product may not be related to the efficiency of the team who developed it. We therefore ask:

> *Research Question 2: Does the relationship between team climate for innovation and team innovation and performance differ in strength, depending on the type outcome (quality vs. quantity)?*

#### 2.2.4.3 Research Design Characteristics

Following the comprehensive approach by Fraizer and colleagues (2017), we examine the moderating effects of publication bias, common method bias, and sample characteristics. In addition, we investigate quality of team climate for innovation measurement. First, as published studies tend to report stronger relationships (Hubbard & Armstrong, 1997; Rosenthal, 1979), we assume that the team climate for innovation-criterion relationships are stronger in published papers in comparison to unpublished works. Second, we expect stronger relationships, if the criterion is measured by the same source as the team climate for innovation in comparison to diverging sources. As team climate for innovation is almost always measured by self-rating, the relationships may be inflated by common method bias (Podsakoff et al., 2003), if the criterion is self-rated as well. Sources of this inflation can for example be human consistency motifs, social desirability, leniency biases or positive and negative affectivity (Podsakoff et al., 2003). Logically, this inflating effect would not be present in independent ratings or objective indicators. Empirical evidence supports this notion: Climate for innovation had a larger effect on innovation outcomes when self-rated than when other-rated (Hammond et al., 2011; Hülsheger et al., 2009). Fourth, as a large percentage of studies relied on samples from the health care sector, we investigate the influence of health care samples in comparison to other samples.

Finally, as a sizable number of studies used non-validated versions or parts of the TCI to measure team climate for innovation, we compare studies that use complete versions of the TCI with studies that used incomplete versions of the TCI. In sum, we seek to answer the following question:

*Research Question 3: Do research design characteristics influence effect sizes of the relationships between team climate for innovation and its criteria?*

### 2.2.5 Mediation of the Relationship of Team Climate for Innovation with Team Performance

To integrate our findings on the team climate for innovation-criterion relationship and to clarify the relationship between the two examined outcomes, our fifth and final goal is to investigate the mechanism of why team climate for innovation is related to team performance. As described above, team climate for innovation is related to both the facet-specific outcome of team innovation and the global outcome of team performance (cf. Kuenzi & Schminke, 2009). However, the question remains whether the relationship of team climate for innovation with the team performance is mainly driven by its relationship with team innovation or whether it is mainly due to a direct effect. Following the theoretical framework by West (1990), team climate for innovation is defined as a facet-specific climate (Kunzi & Schminke, 2009) and therefore should exert its influence on team performance mainly through its influence on the face-specific outcome of team innovation. While the relevance of innovation as a determinant of performance in R&D teams is immediately clear, the importance of innovation is also given for teams who's main performance output is not based on innovation (Zhou, 2008): Adapting and improving processes in order to improve team efficiencies or the introduction of new ways of solving workplace problems can increase performance in organizations across work environments (Eisenhardt & Tabrizi, 1995; Gong, 2009; Harari et al., 2016). Supporting the assumption of an indirect effect, several meta-analyses have provided evidence for the positive influence of innovation on performance on the individual level (Harari et al., 2016) and on the organizational level (Bowen et al., 2010; Chang et al., 2014; Rosenbusch et al., 2011; Vincent et al., 2004). Unfortunately, to our knowledge no meta-analysis of this relationship on the team level exists so far. Still, we assume a similar relationship on this level as well. Therefore, if team climate for innovation increases team innovation, team innovation will in turn increase team performance. Thus, we propose:

*Hypothesis 13: Team innovation mediates the relationship between team climate for innovation and team performance.*

## 2.3 Method

### 2.3.1 Literature Search

We conduct a comprehensive literature search to identify published and unpublished studies as well as dissertations measuring team climate for innovation or one of its dimensions at the team level. We apply a variety of search strategies: First, we conducted an automated online search of citation databases and search engines (e.g., Business Source Premier, PsycINFO, PsycARTICLES, Social Sciences Citation Index, Scopus). Our search key words comprise a list of synonyms for team climate for innovation and its dimensions (this list can be found in Appendix A). We complemented this broad search with a 'backward search' of reference lists and a 'forward search' of citations of seminal articles, literature reviews, and meta-analyses on innovation and organizational climate (e.g., Anderson et al., 2014; Hülsheger et al., 2009; James et al., 2008; Kuenzi & Schminke, 2009; Mathieu et al., 2008; Mathisen et al., 2004; Newman et al., 2020; van Knippenberg, 2017; Zhou & Hoever, 2014) and of studies on the development or validation of one of the TCI measures (e.g., Anderson & West, 1994, 1996, 1998; Kivimäki et al., 1997, 1999) via Web of Science and Google Scholar to ensure we did not overlook any relevant studies. Complementing these electronic search strategies, we conducted a manual searched of top-rated journals in organizational psychology and management (e.g., Journal of Applied Psychology, Academy of Management Journal, Journal of Management, Personnel Psychology, Administrative Science Quarterly, Journal of Organizational Behavior, Organization Science) and of specialized group-focused journals (e.g., Small Group Research, Group Dynamics). To minimize publication bias, we scanned programs of relevant conferences (e.g., Academy of Management, Society for Industrial and Organizational Psychology, European Association of Work and Organizational Psychology, Interdisciplinary Network for Groups Research, Association for Psychological Science, European Academy of Management) and searched for unpublished conference papers and dissertations through ProQuest, SSRN.com, Researchgate.com and Academy of Management Archives. Our literature search includes articles from 1990 until July 2021.

### 2.3.2 Inclusion Criteria and Sample

First, we only included primary studies that are empirical and quantitative in nature; theoretical or qualitative studies, archival studies, reviews and reexaminations of previous data were excluded. In addition, we excluded studies that had not been subject to peer-review (e.g., master theses, working papers). Second, we only include studies with a valid measure of TCI or one of its dimensions assessed by individual team members as well as aggregated to and reported on the team level. Studies which applied climate measures with an organizational (instead of a team) referent or used dyads instead of teams were excluded. In cases where a team structure of the data set was described in the study, but correlations of TCI were only provided on the individual, non-aggregated level, we contacted the authors to obtain the required team level data. Third, we only included studies that measured TCI and, if applicable, the outcome criteria team performance or team innovation at the team level or aggregated to the team level and in alignment with our definitions. To ensure independence of effect sizes and prevent double counting, we examined studies for originality of data, especially those which were authored by the same individuals. If we encountered studies that relied on the same sample, we either only included the study that was most comprehensive in terms of sample size and variables used. Or, if there was a partial overlap between the studies, we combined the relevant information across studies and treated them as a single sample. Finally, we included studies if they reported the necessary team level correlation or sufficient information to compute them. If necessary statistical information (e.g., correlations, reliabilities, sample size) was missing, we made at least two attempts to contact the author (teams) to obtain the missing information.

Applying the described inclusion criteria, a final sample of 71 studies representing 87 independent samples with an overall of 6,078 teams consisting of over 32,000 individuals was identified. Thereof, 83.9% of the studies were published studies, 11.5% unpublished doctoral dissertations and 4.6% unpublished conference papers. The data set included 86 field studies and one lab experiment. Only nine of the samples consisted of student team samples. The other included work team samples represented a broad range of team types (Sundstrom, 1999), including project/development (24), service (23), management (6), action (3), and production (2) teams. All included studies are listed in the reference section and marked by an asterisk.

### 2.3.3 Coding Procedure

The coding process was performed following the procedures suggested by Lipsey and Wilson (2001). Each sample was coded for study characteristics (e.g., type of study), sample characteristics (e.g., number of teams (k), average team size), variable characteristics (e.g., used measure, reliabilities, rating source), and effect sizes.

For moderator analyses on context-related moderators, each sample was further coded for two measures of creativity requirement: 1) on the team level: ‘high’, if the sample was explicitly described to consist of R&D teams or teams who’s primary task was research or product development; ‘low’, if the teams task description did to not involve research or product development tasks; 2) on the national level: Based on the country of data collection which was later matched with the national R&D expenditures as percentage of the gross domestic product of the respective country (continuous variable) according to the Global Competitiveness Report 2019 (Schwab, 2019). For the moderator analyses on cultural context, the country of data collection was matched with the country scores for uncertainty avoidance provided by Taras and colleagues' (2012) meta-analysis of Hofstede's national cultural dimension scores, with national cultural dimension scores for intellectual autonomy provided by Schwartz (2008), and with national cultural dimension scores (average of societal practices and societal values) for performance orientation provided by the GLOBE study (House et al., 2004).

For moderator analyses on criterion-related characteristics, each criterion was further coded for the categories 'behavior', 'outcome quality', 'outcome quantity' or 'mixed'. If the measure was a scale, the respective category was coded if more than 75% of items captured the respective type of criterion. Concerning performance, 'behavior' was coded if the measure captured the team members' aggregated behavior or team's overall behavior relevant for achieving goals (e.g., cognitive task performance, collaborative behavior, learning behaviors; cf. Mathieu et al., 2008). 'Outcome quality' was coded if the measure captured qualitative aspects of a team's output (e.g., quality of care, product quality, user satisfaction). 'Outcome quantity' was coded if the measure captured quantitative aspects of a team's output (e.g., effectiveness, efficiency, productivity, sales). Further, each performance variable was coded as either 'includes aspects of innovation' or 'does not include aspects of innovation'. For the comparison of the team climate for innovation relationship with performance and innovation, only the latter category of relationships was used[4]. Concerning innovation, 'behavior' was coded if the measure captured the team members' aggregated innovative or creative behavior or team's overall innovative or creative behavior, including aspects of idea generation, dissemination, and implementation (e.g., introducing or searching for new ideas, evaluating or championing ideas, explor-

[4] This led to six studies being excluded from the mentioned moderator analysis.

ing). 'Outcome quality' was coded if the measure captured qualitative aspects of a team's innovative output (e.g., ratings of ideas/ products/ processes concerning their novelty, usefulness, creativity, impact). 'Outcome quantity' was coded if the measure captured quantitative aspects of a team's innovative output (e.g., number of innovations or products, extent of implementation).

For the moderator analyses on research design characteristics, each relationship was further coded as: 'published' (i.e., published journal article) vs. 'unpublished' (i.e., dissertation or conference paper); 'same source' (team members assessed both TCI and the respective criterion) vs. 'different source' (team members assessed TCI, while the criterion was either assessed by a different person or based on objective measures); 'health care sample' vs. 'other sample'; 'high TCI quality' (validated TCI or TCI dimension scale) vs. 'low TCI quality' (non-validated selection of TCI items).

For the planned mediation analysis, we needed to estimate the relationship between team innovation and team performance, because to our knowledge so far no meta-analysis on this relationship at the team level exists. As a data base for this estimation we used 1) all effect sizes on this relationship reported in our data set and 2) searched for studies reporting this effect size with metaBUS (Bosco et al., 2017). MetaBUS is a cloud-based research synthesis platform which contains effect sizes coded from empirical studies from social science research. Given that the effect sizes produced by metaBUS are uncorrected, we identified the studies containing the respective effect sizes via metaBUS and then proceeded to code the effect sizes and reliabilities ourselves. Through this procedure we obtained a data set of 10 samples for the relationship between team innovation and team performance.

The first author coded all included samples in regard to all relevant study, sample and variable characteristics, including 731 predictor-criterion relationship, 209 relationships between the TCI dimensions, and 10 innovation-performance relationships. In addition, a second trained coder coded approximately 30% of samples. A high level of inter-coder agreement (Krippendorf's alpha ranged from α = .86 for predictor reliability to α = 1 for country of data collection) was reached across the 277 predictor-criterion relationships that were jointly coded (Hayes & Krippendorff, 2007). All disagreements were resolved and consensus was reached through discussion.

### 2.3.4 Meta-analytic Procedures

Following the meta-analytical approach by Schmidt and Hunter (2015), we correct each effect size for both sampling and measurement error in both predictor and criterion. Thus, we first aggregated the sample-size-weighted mean estimate of each observed relationship. As all except for two studies of the final sample reported Person's correlations coefficient (r), we use it as our effect size metric. In case other effect size metrics were reported, we converted them according to Lipsey and Wilson (2001). Each sample contributed only one correlation for each criterion to the analyses to ensure independence of observations (cf. Hunter & Schmidt, 2004). For the overall analyses of the team climate for innovation-criterion relationship, linear composite correlations were calculated, if conceptual replications were reported for a sample (e.g., self-rating and supervisor-ratings of team performance or idea generation and implementation as two facets of innovation; Schmidt & Hunter, 2015). If the information reported was insufficient for calculating composites, the average of the correlations was used instead of a composite. For the moderator analyses, a 'shifting unit of analysis' approach (Cooper, 2010) was chosen and conceptual replications were in addition coded independently (e.g., quality vs. quantity of team performance; cf. Hülsheger et al., 2009).

Second, we report the true mean correlation estimates (ρ), which are the sample-size-weighted mean observed correlations corrected for unreliability of measurement in both predictor and criterion. Depending on the nature of the measure of the variables, we corrected the correlations for measurement error by using different reliability indices: For TCI measures (i.e., team members' rating of TCI) and criterion measures subjectively assessed by multiple raters (e.g., team members' rating of the team's innovative behavior), we used ICC(2) for the correction of rater-specific measurement error; if ICC(2) was not reported, we calculated it based on F-statistics or ICC(1); if neither ICC(2), ICC(1) or F-statistics were given, we contacted authors to obtain ICC(2) or raw individual-level data (cf. De Jong et al., 2016). For criterion measures subjectively assess by a single rater (e.g., team leader's rating of the team's innovative output), we used Cronbach's Alpha for the correction of item-specific measurement error. For single item measures rated by a single rater, we imputed Wanous and Hudy's (2001) reliability. For relationships which were combined from multiple correlations from the same sample by using linear composites, we used Mosier reliability composites to combine ICC(2)s and/or Cronbach's Alphas (Schmidt & Hunter, 2015). If for subjective measures no reliability coefficient was reported at all nor could it be obtained from the authors, we imputed the meta-analytical ICC(2) or Cronbach's alpha estimate calculated from all other studies in the sample which reported this reliability coefficient for the respective variable type (cf. Kepes et al., 2013). If the criterion was assessed based on objective measures or TCI was experimentally manipulated, we assumed perfect reliability and thus set reliability to 1.

In addition to interpreting the magnitude of the true correlation estimates (ρ), we further report 95% confidence intervals (CI) around each estimate to reveal the precision of the estimates (Whitener, 1990). CIs of 95% indicate a 95% probability for the true correlation estimate to reside within the interval's lower and upper bound. A narrow CI indicates a high precision of the estimate, while a broad CI indicates low precision. It can be used as a significance test in such a way that if the CI does not include zero, the true correlation estimate can be interpreted as statistically significant at a level of $p < .05$ (Cummings, 2012).

Furthermore, we report 80% credibility intervals (CV) which indicate variability of correlations within the observed sample. A narrow CV indicates the variability in effect sizes is low, while a high CV indicates a high variability in effect sizes, which indicates that moderating influences are present in the sample. Thus, the CV give us information on whether the true correlation estimate can be generalized or whether it is specific to a certain context and moderators should be investigated.

Finally, as findings of meta-analyses can be subject to distortion by publication bias, we illustrate the distribution of effect sizes and investigate potential publication bias by inspecting whether the funnel plot is symmetrical. As Figure 2.1 and 2.2 show, the distribution of effect sizes is symmetrical for the relationship of team climate for innovation with both team performance and team innovation. Therefore, publication bias does not seem to be an issue of this study.

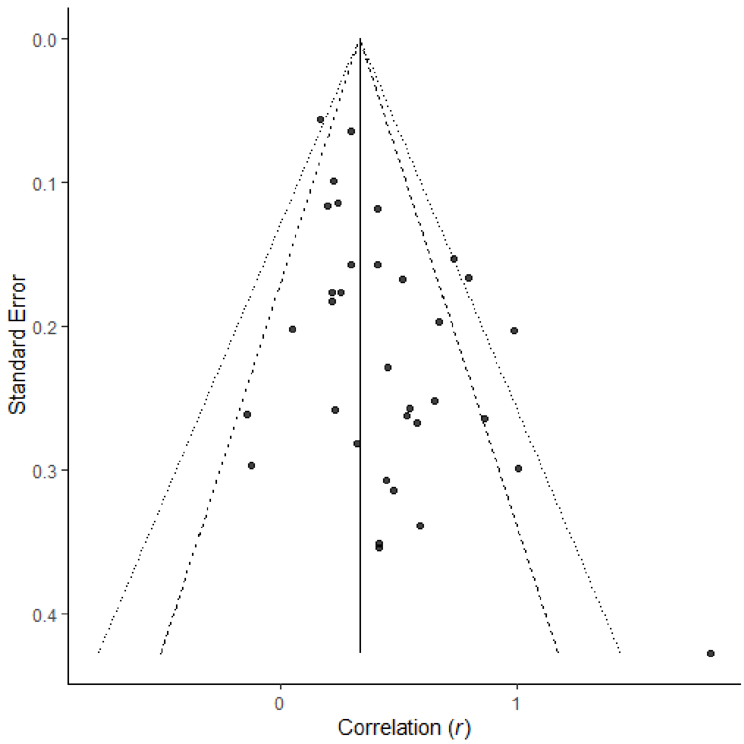


*Figure 2.1.* Funnel plot for team climate for innovation – performance.

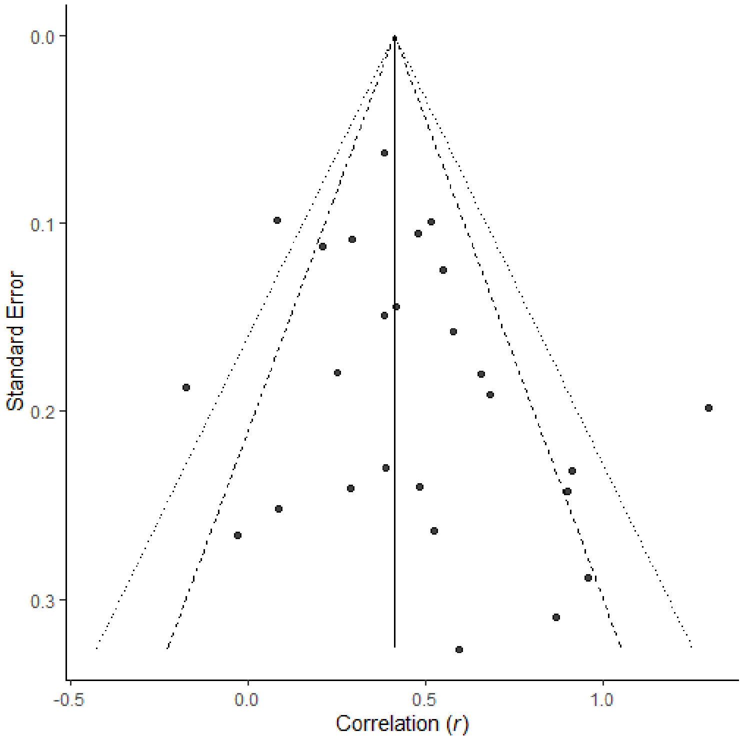


*Figure 2.2.* Funnel plot for team climate for innovation – innovation.

### 2.3.5 Hypotheses Testing

We tested our hypotheses by interpreting the true correlation estimates (ρ) and the 95% CIs. For the estimation of all above mentioned parameters, subgroup, and meta-regression analyses, we used the package "psychmeta" in R (Dahlke & Wiernik, 2019). Research Question 1 and Hypothesis 13 we tested by following the approach by Viswesvaran and Ones (1995): We calculated the correlations between the variables by meta-analytical procedure (as described above) separately for each outcome and performed structural equation modeling based on the thus derived correlation matrices and the harmonic means of the sample sizes for factor and mediation analysis (cf. Harrison et al., 2006; Rockstuhl & Van Dyne, 2018). For structural equation modeling, we used the package "lavaan" in R (Rosseel, 2012).

*Confirmatory factor analysis.* We conducted a confirmatory factor analysis loading the four first-order latent dimensions factors of team climate for innovation on the second-order latent factor of team climate for innovation. As recommended by Hu and Bentler (1999), model fit was evaluated by assessing the standard root mean residual (SRMR; values of ≤ .08 resemble a good fit) and the comparative fit index (CFI; values of ≥ .95 resemble a good fit).

*Moderator analyses.* For testing moderator hypotheses, we used subgroup analyses and meta-regressions with both continuous and dummy coded moderators. *psychmeta* outputs provide intercept and regression coefficients. If the coefficient is significant, this implies that the correlation between predictor and criterion is significantly stronger or weaker for the respective moderator variable, depending on the sign of the coefficient. For dummy coded moderators, we used one of the categories as a reference group and all other categories as dummy variables. Thus, the coefficient for the reference group was indicated by the intercept coefficient. For example, to compare the relative magnitude of the relationships of team climate for innovation and its four subdimensions with the criteria, we used team climate for innovation as a reference group and four dummy variables to capture the four subdimensions of team climate for innovation.

*Mediation analysis.* For testing the mediator hypothesis, we compared two structural equation models. Model 1 represents full mediation model, which only models the indirect effect, while Model 2 represents a partial mediation model, which allows free estimation of the indirect and direct effect of team climate for innovation on performance.

## 2.4 Results

### 2.4.1 Construct Validity of Team Climate for Innovation

We address Research Question 1 via three analyses: First, to justify the use of the single-factor team climate for innovation construct, we analyze whether its four subdimensions load together on a single higher order latent factor. To do so, we computed the corrected meta-analytical correlations between the four subdimensions, which can be found in Table 2.1. The mean corrected correlation among the subdimensions is > .90, which is very high (cf. Cohen, 1988). In the specified confirmatory factor model the first-order constructs of vision, participative safety, task orientation, and support for innovation were each loaded onto a single second-order latent construct representing team climate for innovation. The specified model demonstrated an acceptable fit: $\chi^2(2, N=1,856)$ = 1,248.92, $p$ < .001, *SRMR* = .02, *CFI* = .92, and the loading for each of the subdimensions was statistically significant (see Figure 2.3). An alternative model in which the subdimensions were each treated as independent factors (i.e., a four-factor model without a higher order factor) provided a poor fit to the data: $\chi^2(6, N=1,856)$ = 16,106.09, $p$ < .001, *SRMR* = .71, *CFI* = .00. Thus, the second-order factor model was retained as the best representation of the data.

**Table 2.1:** Mean true correlation estimate among team climate for innovation dimensions

| Variable | 1 | 2 | 3 |
|---|---|---|---|
| 1. Vision | - | | |
| 2. Participative Safety | | - | |
| *r* (*SD*) | .63 (.12) | | |
| ρ [95% *CI*] | .86 [.79, .94] | | |
| *k* (*N*) | 38 (2,508) | | |
| 3. Task Orientation | | | - |
| *r* (*SD*) | .68 (.14) | .73 (.12) | |
| ρ [95% *CI*] | .90 [.80, .99] | .95 [.86, 1.05] | |
| *k* (*N*) | 34 (1,748) | 33 (1,740) | |
| 4. Support for Innovation | | | |
| *r* (*SD*) | .65 (.15) | .78 (.11) | .73 (.11) |
| ρ [95% *CI*] | .85 [.75, .95] | .99 [.89, 1.09] | .97 [.86, 1.07] |
| *k* (*N*) | 35 (1,761) | 35 (1,761) | 34 (1,811) |

*Note*. *r* = sample-size-weighted mean observed correlation; *SD* = standard deviation of r;
ρ = mean true score correlation; 95% *CI* = 95% confidence interval around the mean true score correlation; *k* = number of independent samples; *N* = cumulative sample size.

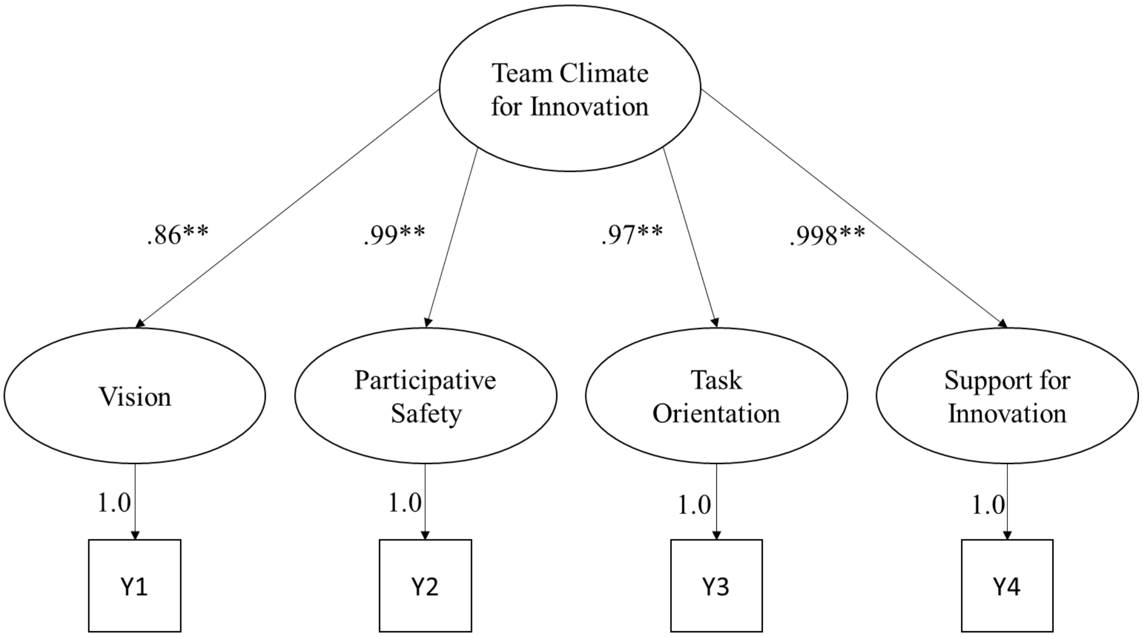


*Figure 2.3.* Standardized factor loadings of the first-order subdimensions on the second-order team climate for innovation factor.
** $p < .01$.

Second, we analyzed the discriminant validity of the four team climate for innovation dimensions against the available criteria of team performance and team innovation. Table 2.2 presents the results of the meta-regression. The results suggest that the predictive value of the four subdimensions did not significantly differ from each other for the criteria of team performance and team innovation. As we do not find statistically different relationships of the four dimensions with the criteria, we conclude that the discriminant validity of the subdimensions is low, which supports the application of team climate for innovation as a unitary construct.

**Table 2.2:** Meta-regression results for relationship of team climate for innovation dimensions with criteria

| Moderator | *Estimate* | *SE* | *Z-value* | *p-value* | $Q_R$ | $Q_M$ |
|---|---|---|---|---|---|---|
| **Team Performance** | | | | | 591.82** | 1.24 |
| Intercept (Vision) | 0.46 | .06 | 7.09 | <.001 | | |
| Participative Safety | 0.05 | .09 | 0.49 | .62 | | |
| Task Orientation | -0.02 | .10 | -0.21 | .84 | | |
| Support for Innovation | 0.08 | .09 | 0.84 | .40 | | |
| **Team Innovation** | | | | | 179.50** | 1.23 |
| Intercept (Vision) | 0.42 | .06 | 6.61 | <.001 | | |
| Participative Safety | -0.01 | .08 | -0.07 | .95 | | |
| Task Orientation | 0.02 | .09 | 0.22 | .83 | | |
| Support for Innovation | 0.07 | .08 | 0.86 | .39 | | |

*Note*. Unstandardized estimates are reported. *SE* = standard error. $Q_R$ = $Q$ statistic for residual heterogeneity. $Q_M$ = $Q$ statistic for overall moderator model.
$^*p < .05$. $^{**}p < .01$

Third, we compared the predictive value of the unitary team climate for innovation construct with that of its four subdimensions for the available criteria team performance and team innovation. If none of the subdimensions has predictive value beyond the unitary construct, the use of the unitary construct is justifiable. A meta-regression was performed, in which the unitary construct was coded as the reference variable and each of the subdimensions was coded as a dummy variable. Table 2.3 presents the results of the meta-regression. None of the subdimensions displayed a stronger relationship with either of the criteria than the unitary construct of team climate for innovation. Regression coefficients of all subdimensions indicated no statistical significance. The explained variance was not significantly increased by the inclusion of the subdimensions.

**Table 2.3:** Meta-regression results for differences between studies using the unitary team climate for innovation construct and studies using team climate for innovation dimensions

| Moderator | *Estimate* | *SE* | *Z-value* | *p-value* | $Q_R$ | $Q_M$ |
|---|---|---|---|---|---|---|
| **Team Performance** | | | | | 626.67** | 2.09 |
| Intercept (TCI) | 0.63 | .15 | 4.28 | <.001 | | |
| Vision | -0.16 | .16 | -1.06 | .29 | | |
| Participative Safety | -0.12 | .16 | -0.77 | .44 | | |
| Task Orientation | -0.19 | .17 | -1.15 | .25 | | |
| Support for Innovation | -0.09 | .16 | -0.58 | .56 | | |
| **Team Innovation** | | | | | 216.98** | 1.09 |
| Intercept (TCI) | 0.48 | .13 | 3.73 | <.001 | | |
| Vision | -0.05 | .15 | -0.35 | .73 | | |
| Participative Safety | -0.06 | .14 | -0.44 | .66 | | |
| Task Orientation | -0.04 | .15 | -0.26 | .80 | | |
| Support for Innovation | 0.02 | .14 | 0.13 | .90 | | |

*Note*. Unstandardized estimates are reported. *SE* = standard error. $Q_R$ = *Q* statistic for residual heterogeneity. $Q_M$ = *Q* statistic for overall moderator model.
$^{*}p < .05$. $^{**}p < .01$

All three analyses support the assumption that the unitary construct of team climate for innovation is justified. LePine and colleagues (2002) propose that there is no advantage in using the separate subdimensions in an analysis if there is no difference in the validity of the unitary construct relative to the subdimensions. Thus, these results provide an affirmative response to Research Question 1.

### 2.4.2 Team Climate for Innovation Relationships

Table 2.4 presents the meta-analytic correlations between team climate for innovation and its subdimensions with the criteria team performance and team innovation. As vision (ρ = .44; H1), participative safety (*ρ* = .50; H2), task orientation (ρ = .34; H3), support for innovation (ρ = .41; H4), and the overall team climate for innovation construct (ρ = .37; H5) were all significantly related to team performance, Hypotheses 1, 2, 3, 4, and 5 were supported. Similarly, Hypotheses 6a), b), c), d), and e) were supported, as vision (ρ = .37), participative safety (ρ = .38), task orientation (ρ = .42), support for innovation (ρ = .44), and the overall TCI construct (ρ = .44) were all significantly related to team performance.

**Table 2.4:** Meta-analysis of team climate for innovation and its dimensions

| variable | *k* | *N* | *r* | $SD_r$ | ρ | $SD_\rho$ | 80% *CV* | $SE_\rho$ | 95% *CI* |
|---|---|---|---|---|---|---|---|---|---|
| **Team Performance** | | | | | | | | | |
| Team Climate for Innovation | 34 | 1,788 | .30 | .19 | .37 | .20 | .11, .64 | .04 | .28, .46 |
| Vision | 34 | 2,484 | .34 | .27 | .44 | .40 | -.08, .96 | .07 | .29, .59 |
| Participative Safety | 32 | 2,249 | .38 | .21 | .50 | .30 | .11, .89 | .06 | .38, .62 |
| Task Orientation | 28 | 1,415 | .26 | .16 | .34 | .17 | .12, .56 | .05 | .24, .43 |
| Support for Innovation | 35 | 1,959 | .30 | .20 | .41 | .27 | .07, .76 | .05 | .30, .52 |
| **Team Innovation** | | | | | | | | | |
| Team Climate for Innovation | 26 | 1,272 | .36 | .23 | .44 | .22 | .15, .73 | .05 | .33, .55 |
| Vision | 20 | 911 | .29 | .18 | .37 | .14 | .19, .56 | .05 | .27, .47 |
| Participative Safety | 26 | 1,248 | .32 | .20 | .38 | .19 | .12, .63 | .05 | .28, .48 |
| Task Orientation | 19 | 961 | .35 | .15 | .42 | .14 | .24, .60 | .05 | .32, .52 |
| Support for Innovation | 24 | 1,303 | .34 | .19 | .44 | .19 | .20, .69 | .05 | .34, .55 |

*Note*. *k* = number of independent samples; *N* = cumulative sample size (number of teams); *r* = sample-size-weighted mean observed correlation; $SD_r$ = standard deviation of *r*; ρ = mean true score correlation; $SD_\rho$ = standard deviation of ρ; *CV* = credibility interval of ρ; $SE_\rho$ = standard error of ρ; *CI* = confidence interval of ρ.

### 2.4.3 Moderator Analyses

Table 2.5, 2.6, and 2.7 present the results of the moderator analyses for the relationship of team climate for innovation with team performance and team innovation. As the results of the meta-regression in Table 2.5 show, Hypotheses 7, 8, and 9a were not supported, as the regression coefficients of creativity requirement, uncertainty avoidance, intellectual autonomy, and performance orientation were non-significant for the relationship of team climate for innovation and team innovation. Similarly, Hypothesis 9b was not supported, as the regression coefficients of performance orientation was non-significant for the relationship of team climate for innovation and team performance. Interestingly though, uncertainty avoidance was a significant moderator (*Estimate* = 0.38, $p < .01$) of the relationship of team climate for innovation with team performance (but not – as expected – with team innovation). In cultures with high levels of uncertainty avoidance the relationship of team climate for innovation with team performance was stronger.

**Table 2.5:** Meta-regression results for moderator analysis on the relationship between team climate for innovation – performance and team climate for innovation – innovation

| Moderator | *Estimate* | *SE* | *Z-value* | *p-value* | $Q_R$ | $Q_M$ |
|---|---|---|---|---|---|---|
| **Team Performance** | | | | | 33.72* | 12.55* |
| Intercept | 7.88 | 5.07 | 1.55 | .12 | | |
| CR – team level | -0.21 | .13 | -1.60 | .11 | | |
| CR – national level | 0.19 | .15 | 1.32 | .19 | | |
| Uncertainty avoidance | 0.38 | .15 | 2.59 | <.01 | | |
| Intellectual autonomy | -0.48 | .32 | -1.49 | .14 | | |
| Performance orientation | -1.09 | .80 | -.14 | .17 | | |
| **Team Innovation** | | | | | 20.62 | 8.26 |
| Intercept | 3.21 | 5.13 | 0.63 | .53 | | |
| CR – team level | 0.08 | .12 | 0.64 | .52 | | |
| CR – national level | 0.07 | .14 | 0.53 | .60 | | |
| Uncertainty avoidance | 0.13 | .13 | 1.01 | .31 | | |
| Intellectual autonomy | 0.28 | .31 | 0.88 | .38 | | |
| Performance orientation | -0.82 | .86 | -0.94 | .35 | | |

*Note*. CR = creativity requirement; Unstandardized estimates are reported. *SE* = standard error. $Q_R$ = $Q$ statistic for residual heterogeneity. $Q_M$ = $Q$ statistic for overall moderator model.
$^{*}p < .05$. $^{**}p < .01$

As the results of the meta-regression in Table 2.6 show, there was a significant difference in the team climate for innovation-criterion relationship between the criteria team performance and team innovation (*Estimate* = -.21, $p < .001$), when all samples applying performance measures which included aspects of innovation were excluded. Team climate for innovation was then more strongly related to team innovation than to team performance. Therefore, Hypothesis 11 was supported.

**Table 2.6:** Meta-regression results for moderator analysis on the overall team climate for innovation – criterion relationship

| Moderator | *Estimate* | *SE* | *Z-value* | *p-value* | $Q_R$ | $Q_M$ |
|---|---|---|---|---|---|---|
| Intercept | 0.46 | .12 | 3.83 | <.001 | 30.33* | 29.47** |
| Performance | -0.21 | .09 | -2.25 | .02 | | |
| Published | 0.04 | .14 | 0.30 | .76 | | |
| Source | 0.64 | .12 | 5.33 | <.0001 | | |
| Health care sector | -0.24 | .10 | -2.36 | .02 | | |
| TCI quality | 0.13 | .11 | 1.25 | .21 | | |

*Note*. Published, 1 = yes, 2 = no; Source, 1 = same, 2 = different; Health care sector, 1 = yes, 2 = no; TCI quality, 1 = high, 2 = low. Unstandardized estimates are reported. *SE* = standard error. $Q_R$ = *Q* statistic for residual heterogeneity. $Q_M$ = *Q* statistic for overall moderator model.
$^{*}p < .05$. $^{**}p < .01$

As the results of the subgroup analyses in Table 2.7 show, Hypotheses 12a) and 12b) were supported[5]. The relationship between team climate for innovation and team performance was stronger for performance behavior (ρ = .58) than for performance outcomes (ρ = .23). The relationship between team climate for innovation and team innovation was stronger for innovation behavior (ρ = .53) than for innovation outcomes (ρ = .36). Further, the relationship between team climate for innovation and team performance did not largely differ in strength between outcome quality (ρ = .24) and outcome quantity (ρ = .23). The size of the correlation coefficient for the relationship between team climate for innovation and team innovation was larger for outcome quality (ρ = .36) than for outcome quantity (ρ = .27). However, when analyzed via meta-regression, the difference in the strength of relationship between team climate for innovation and team innovation between outcome quality and quantity was non-significant (*Estimate* = -.07, *p* = .44). These results provide a negative response to Research Question 2 both concerning team innovation and team performance.

[5] Apart from the subgroup analysis, Hypotheses 12a) and 12b) were further supported by the results of two meta-regressions:
1) Performance: behavior vs. outcome (*Estimate* = -.35, $p < .001$);
2) Innovation: behavior vs. outcome (*Estimate* = -.25, $p = .02$).

**Table 2.7:** Results for main effect and subgroup analyses

| Variable | $k$ | $N$ | $r$ | $SD_r$ | ρ | $SD_\rho$ | 80% *CV* | $SE_\rho$ | 95% *CI* |
|---|---|---|---|---|---|---|---|---|---|
| **Team Performance** | | | | | | | | | |
| **Team Climate for Innovation** | **34** | **1788** | **.30** | **.19** | **.37** | **.20** | **.11, .64** | **.04** | **.28, .46** |
| Behavior | 10 | 263 | .38 | .28 | .58 | .34 | .10, 1.06 | .14 | .27, .89 |
| Outcome | 14 | 858 | .18 | .11 | .23 | 0 | .23, .23 | .04 | .15, .31 |
| Outcome quality | 13 | 844 | .19 | .11 | .24 | 0 | .24, .24 | .14 | .15, .33 |
| Outcome quantity | 6 | 581 | .17 | .10 | .23 | .06 | .13, .32 | .06 | .07, .39 |
| **Team Innovation** | | | | | | | | | |
| **Team Climate for Innovation** | **26** | **1272** | **.36** | **.23** | **.44** | **.22** | **.15, .73** | **.05** | **.33, .55** |
| Behavior | 15 | 675 | .42 | .27 | .53 | .26 | .18, .89 | .08 | .36, 70 |
| Outcome | 14 | 808 | .32 | .14 | .36 | .08 | .25, .47 | .04 | .27, .45 |
| Outcome quality | 14 | 808 | .31 | .16 | .36 | .120 | .19, .52 | .05 | .25, .46 |
| Outcome quantity | 9 | 392 | .23 | .13 | .27 | 0 | .27, .27 | .05 | .15, .40 |

*Note*. $k$ = number of independent samples; $N$ = cumulative sample size; $r$ = sample-size-weighted mean observed correlation; $SD_r$ = standard deviation of r; ρ = mean true score correlation; $SD_\rho$ = standard deviation of ρ; *CV* = credibility interval of ρ; $SE_\rho$ = standard error of ρ; *CI* = confidence interval of ρ.

Finally, the results of the meta-regression in Table 2.6 show the moderating influence of research design characteristics on the team climate for innovation-criterion relationship. There was no significant difference in the strength of relationship between published and non-published studies. As expected, there was a significant difference between samples in which the criterion was assessed by the same source as team climate for innovation and samples in which the criterion was assessed by a different source (*Estimate* = .64, $p < .001$). Further, samples from the health care sector showed a significantly weaker relationship than samples from other sectors (*Estimate* = -.24, $p = .02$). Finally, the quality of the TCI measurement did not significantly influence the relationship. These results provide an affirmative response to Research Question 3, highlighting the importance of data source and industrial sector.

### 2.4.4 Mediator Analyses

Hypothesis 13 predicted that team innovation would mediate the relationship between team climate for innovation, and team performance. To test this hypothesis, we computed the corrected meta-analytical correlations between team climate for innovation, team innovation, and team performance, which can be found in Table 2.8.

**Table 2.8:** Mean true correlation estimate among team climate for innovation, team innovation, and team performance

| Dimension | 1 | 2 | 3 |
|---|---|---|---|
| 1. Team Climate for Innovation | - | | |
| 2. Team Innovation | | - | |
| *r* (*SD*) | .36 (.23) | | |
| ρ [95% *CI*] | .44 [.33, .55] | | |
| *k* (*N*) | 26 (1,272) | | |
| 3. Team Performance | | | - |
| *r* (*SD*) | .30 (.19) | .33 (.25) | |
| ρ [95% *CI*] | .37 [.28, .46] | .38 [.14, .62] | |
| *k* (*N*) | 34 (1,788) | 10 (495) | |

*Note*. *r* = sample-size-weighted mean observed correlation; ρ = mean true score correlation; 95% *CI* = 95% confidence interval around the mean true score correlation; *k* = number of independent samples; *N* = cumulative sample size.

Figure 2.4 shows the path coefficients for Model 1 (full mediation model). The path from team climate for innovation to team innovation is positive and statistically significant (β = .44, *95% CI* = .39 to .49), as is the path from team innovation to team performance (β = .38, *95% CI* = .32 to .44). The indirect effect of team climate for innovation on team performance is β = .17 (*95% CI* = .13 to .20). Thus, Hypothesis 13 is supported.

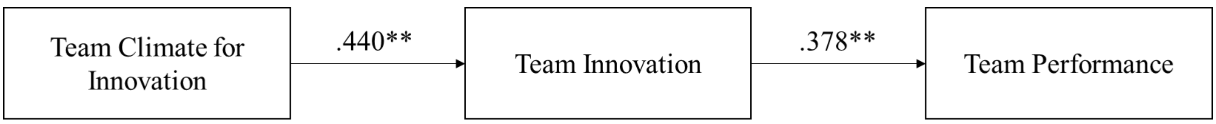


*Figure 2.4.* Meta-analytic path analysis results for the full mediation model (Model 1).
*$p < .05$. **$p < .01$.

In addition, we compared the full mediation model (Model 1) with a partial mediation model (Model 2). The results of model comparison tests are presented in Table 2.9. A nested model comparison between the proposed full mediation model and the saturated partial mediation model resulted in a significant chi-square difference ($\Delta\chi^2$ (1) = 56.08, p < .001). This indicates that the partial mediation fits the data better than the full mediation model. The direct effect of team climate for innovation on performance was significant (β = .26, *95% CI* = .19 to .32), while 32% of the total effect of team climate for innovation on team performance was due to its indirect effect (*Estimate* = .12, *p* < .001) in the partial mediation model. These results show that the direct link of team climate for innovation on team performance is vital for explaining the data. Further, the results indicate that team climate for innovation exerts influence both through the direct link to team performance and through the indirect link via team innovation. Figure 2.5 shows the path coefficients for Model 2 (partial mediation model).

**Table 2.9:** Results of the meta-analytical structural equation model comparisons

| Path coefficient | Proposed mediation model | Partial mediation model |
|---|---|---|
| TCI → TI | .44** | .44** |
| TI → TP | .38** | .27** |
| TCI → TP | | .26** |
| $\chi^2$ | 56.08 | .00 |
| *df* | 1 | 0 |
| $\Delta\chi^2$ | | 56.08** |
| Δ*df* | | 1 |
| Total effect of TCI on TP | .17** | .37** |
| Indirect effect of TCI on TP | .17** | .12** |
| Total effect of TI on TP | .38** | .27** |

*Note*. Harmonic *N* = 891. TCI = team climate for innovation; TI = team innovation; TP = team performance.
[a] Chi-square difference for each model reflects its deviation from the proposed model.
** *p* < .01.

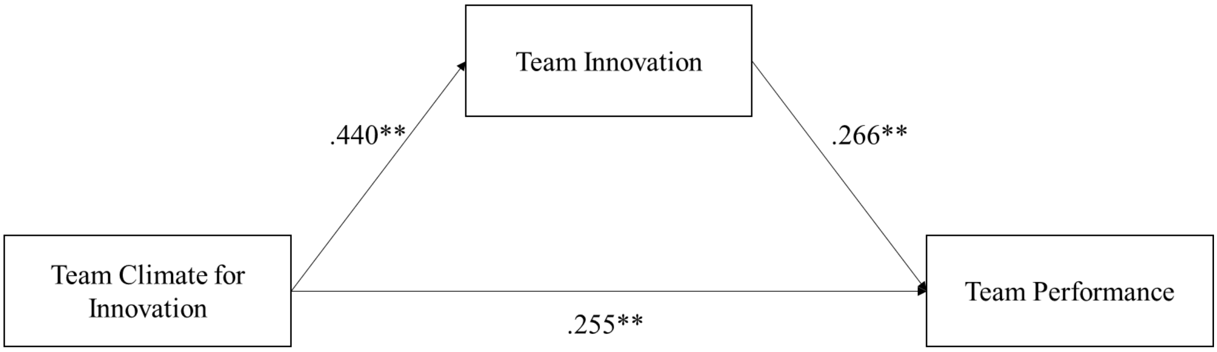


*Figure 2.5.* Meta-analytic path analysis results for the partial mediation model (Model 2). *$p < .05$. **$p < .01$.

## 2.5 Discussion

### 2.5.1 Summary of Findings and Theoretical Contributions

We set out to resolve inconsistences in the existing team climate for innovation literature and to create consensus among contradictory findings of prior research. Cumulating evidence from 87 independent samples consisting of 6,078 teams with a total of 950 effect sizes, the presented meta-analysis quantitatively summarizes three decades of primary studies that investigated the construct of team climate for innovation and its relationship with the criteria team performance and team innovation. Thereby, we aimed to clarify the construct's structure ("what"), the strength and direction of the relationships ("how"), the contingencies of the relationships ("when") and the mechanism of the relationship ("why"). Four central findings emerge:

First, our findings demonstrate the validity of West's (1990) theoretical conceptualization of the team climate for innovation construct. A confirmatory factor analysis based on the meta-analytically derived correlations reinforced the notion that team climate for innovation forms a single, second-order latent construct. Conditional random effects meta-regression revealed that the unitary team climate for innovation construct was at least as strongly related to the criteria as any of the subdimensions, but did not reveal evidence of discriminant validity among the four team climate for innovation dimensions. Thus, these findings support West's

(1990) conceptualization of team climate for innovation as a single second-order construct consisting of the four climate dimensions of vision, participative safety, task orientation, and support for innovation. This knowledge will help researchers to theoretically and methodologically apply the team climate for innovation construct correctly: Instead of using the separate subdimensions, which yields no advantage in terms of explanatory power (cf. LePine et al., 2002), future research should use the unitary construct, which will make studies more comparable and less misguiding.

Second, our meta-analysis is the first to present an estimate of the true relationship of the unitary team climate for innovation construct with team performance ($\rho = .37$) and team innovation ($\rho = .44$). The relationship between the subdimensions of team climate for innovation and team performance range between .34 (task orientation) and .50 (participative safety). According to Cohen (1988), these results indicate medium-sized effects. Thereby, we extent the findings by Hülsheger and colleagues (2009), who only investigated the relationships between the subdimensions of team climate for innovation and overall team innovation, in several ways: First, we update the state of research on the relationships they investigated. Second, we establish the relationship of the unitary team climate for innovation construct with team innovation. Third, we not only investigate the relationship of team climate for innovation and its subdimension with innovation but also with team performance. Fourth, we differentiate the analyzed relationships through a more fine-grained moderator analysis (innovation vs. performance, behavior vs. outcome, outcome quality vs. quantity, context moderators, and additional research design moderators).

Interestingly, in comparison to the meta-analysis by Hülsheger and colleagues. (2009), we find a more homogeneous picture of the relationship between the subdimensions of team climate for innovation and team innovation: While Hülsheger and colleagues (2009) report a substantially stronger correlation for support for innovation ($\rho = .58$) and a substantially weaker correlation for participative safety (ρ = .15), in our analyses all dimensions showed an estimated true correlation with team innovation in the rather homogenous range of .37 to .44. An explanation for this difference in findings is the difference in the number of included samples. For example, for the relationship between support for innovation and innovation we included 24 samples with data on 1,303 teams, while Hülsheger and colleagues (2009) only included 10 samples with data on 367 teams. Further, within our own data set we find that the average correlation for the mentioned relationship differs significantly between studies published before 2009 and studies published after 2009, being stronger for earlier studies and weaker for later studies.

Third, while our analyses indicate a certain generalizability of the relationships between team climate for innovation and the mentioned criteria across different contexts, we identify several contingency factors. Concerning the nature of the criteria, our findings indicate that criterion specificity plays a role in such a way that team climate for innovation is more strongly related to team innovation than to team performance. Similarly, criterion function moderates the relationship in such a way that it is stronger for innovation and performance behavior than for innovation and performance outcomes. However, the criterion dimension was not a relevant moderator in such a way that the found main effects generalized across criteria of quality and quantity. Moreover, concerning research design characteristics our analyses demonstrate three interesting aspects: First, we did not find a significant difference in the strength of relationship between published and non-published studies, indicating that publication bias was not an issue when investigating this relationship. This finding is in accordance with recent research providing empirical evidence that the file drawer problem does not pose a major threat to the validity of meta-analytical findings (Dalton et al., 2012). Second, if the criterion was rated by the same source which rated the team climate for innovation, the relationship was substantially higher than for other source ratings or objective measures. This indicates that common method bias (Podsakoff et al., 2003) is an issue when investigating these relationships. This finding aligns with similar results from former meta-analyses (e.g., Hammond et al., 2011; Hülsheger et al., 2009; Frazier et al., 2017) and again highlight the importance of preventing this inflation of effect sizes by adequate research designs in primary studies. That being said, it is important to note that if the criteria were measured by ratings of others or objective measures (which was the case in almost 70% of studies), team climate for innovation was still a strong predictor of team performance and innovation. Finally, our results indicate that the effects of team climate for innovation on our investigated criteria tended to be weaker in the health care sector (from which over 35% of our samples originated). This finding suggests that future research should be aware of the industrial sector, in which they investigate team climate for innovation and team innovation and team performance. In sum, our moderator analyses helped to identify conditions under which team climate for innovation is more (and less) important, to explain heterogeneity between studies and to promote a more accurate and contextualized understanding of this construct and its consequences.

Interestingly and contrary to our expectations, work and cultural context factors did not decrease the generalizability of the found main effect of team climate for innovation on team innovation and team performance, except for the unexpected moderating effect of uncertainty avoidance on the relationship with team performance. First, creativity requirement did not function as a significant moderator of either relationship. An explanation could be that in this study we focused on the requirement for creativity concerning the outcome of the team's work; however, even teams whose goal it is not to produce an innovative outcome may benefit greatly from process innovation in their every day's task (Zhou, 2008). If these teams are aware of this necessity for process innovation, they may as well experience an expectation to be creative and, thus, display a similarly strong relationship between team climate for innovation and innovation and performance. Second, neither of the cultural context factors acted as a significant moderator of the investigated relationships (apart for uncertainty avoidance, which unexpectedly moderated the relationship between team climate for innovation and team performance). An explanation could be that team climate for innovation at the same time acts as a buffer for cultural factors that are less beneficial for innovation (i.e., high uncertainty avoidance, low intellectual autonomy, low performance orientation) as well as a booster for cultural factors that are beneficial for innovation (i.e., low uncertainty avoidance, high intellectual autonomy, high performance orientation). Their two-way directed moderating influences may cancel each other out. That said, perhaps the most important result of our moderator analyses is the robust positive effects of team climate for innovation across work context and culturally distinct geographic regions, which extends the breadth of team climate for innovation theory by suggesting that the benefits of this team climate extend across a wide range of contexts.

Finally, our findings show that team climate for innovation exerts influence on team performance both via a direct route as well as via an indirect route through team innovation. The finding of the indirect effect via team innovation together with the result that team climate for innovation is more strongly related to team innovation, supports the idea of team climate for innovation being a facet-specific climate (Kuenzi & Schminke, 2009) as proposed by Anderson and West (1998). However, our results also show that around 70% of the effect of team climate for innovation on team performance is due to its direct effect. This indicates that – while being designed as a facet-specific climate – it still has important implications for global outcomes. Future research should therefore also consider team climate for innovation as an important predictor of team performance and further investigate it in relation to other global criteria (e.g., job satisfaction, organizational commitment, well-being).

In sum, reducing the current ambiguity in the literature, our findings contribute to team climate and innovation research by clarifying the structure of team climate for innovation (“what”), establishing the strength and direction of its relationship with team performance and innovation ("how"), identifying contingency factors of these relationships ("when") and explaining the mechanism of influence between team climate for innovation and team performance ("why").

### 2.5.2 Implications for Practice

The findings from this meta-analysis also offer important implications for practitioners and advice for management practices. First, one key practical implication of this study is the conclusion that team climate for innovation is an effective approach for improving team performance in a broad range of contexts (i.e., work contexts, and geographic regions). West (2000) suggested that organizations should encourage teams by emphasizing not only productivity outcomes but also creativity and innovation in order to increase innovation in teams, which was supported by a meta-analysis of Hülsheger and colleagues (2009). Our results extend these findings by revealing that organizations can indeed also enhance the general performance of teams by promoting a climate for innovation. Further, we show that this does not only apply to performance behavior, but similarly to performance outcomes of both quality and quantity. Moreover, we show that even if innovation is not the final goal within the team, increasing team innovation through an increase in team climate for innovation will in turn also increase team performance. In the light of the presented results, more organizations and managers should pay attention to the improvement of team climate for innovation, as this could provide organizations with both an improved effectiveness and a competitive advantage due to an increase in innovation. Especially, managers in organizational contexts benefit from our clear recommendations, as they may find value in acting as "climate engineers" (Naumann & Bennett, 2000), in order to improve team performance and innovation. These leaders should promote environments in which all team members share a common vision and commitment to quality excellence, feel free to openly speak their mind, and support each other.

Second, in cultural contexts which are shaped by uncertainty avoidance (e.g., Japan, Greece, China, France), investing in the facilitation of team climate for innovation may be especially critical. For instance, managers in these cultural regions, whose behavior is likely to be shaped by the same cultural norms and values as their teams, should be made aware of the underlying assumptions of the culture in which they are working and be specifically trained to foster team climate for innovation within their teams.

Finally, for the evaluation and monitoring of team climate for innovation within work teams, it seems to be sufficient to consider the overall unitary measure of team climate for innovation, as the separate dimensions do not explain variance in team performance and innovation above and beyond the unitary measure. In order to efficiently assess team climate for innovation, the short, 14-item version of the TCI (Kivimäki et al., 1997) can be applied. However, we would like to add, even though the separate dimensions of TCI do not explain variance beyond the overall unitary measure, the dimensions still provide a clear set of factors which can help managers in deducting specific interventions, practices and procedures if they wish to increase team climate for innovation in their organization.

Overall, our study provides an opportunity for leaders and organizations to develop a strategy to augment the performance and innovation in their teams.

### 2.5.3 Limitations and Considerations for Future Research

Although we believe that our findings contribute to team climate for innovation research in the way described above, there are some limitations of our study that should be considered. First, the majority of primary studies in our data set were based on cross-sectional survey data, while only one study by Ma and Corter (2019) of all 71 included studies was experimental in nature. Therefore, our ability to make causal inferences between the investigated variables is very limited. Even though we are aware that a team level perception of climate is subject to complex social interactions, which makes the experimental manipulation a challenge, we would like to urge our fellow researcher to accept this challenge and seek to experimentally replicate our findings to overcome this limitation.

Second, in our search for eligible papers we noticed a large number of studies applying team climate for innovation only at the individual level, despite the theoretical model and measurement being explicitly conceptualized at the team level. We were especially surprised by the number of studies validating the TCI in the native language of their authors on the individual level, but in which a validation on the team level is missing. Thus, it cannot be ruled out that the lack of cultural effects within our meta-analysis is due to insufficient validation of the Team Climate Inventory on the team level in languages other than English. Hence, research would benefit from more team level and cross-level investigation of team climate for innovation, especially across cultural contexts.

Third, a lack of studies simultaneously assessing overlapping and related psychological states hindered us from fully addressing van Knippenberg's (2017) call for construct consolidation. For instance, looking at his exemplary proposed comparison of participative safety, psychological safety, and trust, in our data set we can only find a single study that reports the correlation of participative safety with psychological safety and not a single one with trust. To prevent proliferation of concepts and boil down overlapping concepts to their essence, more research on the discriminant validity of team climate for innovation and its subdimensions is necessary.

Fourth, even though several recent reviews called for differentiation between creativity and innovation (e.g., Anderson et al., 2014; Hughes et al., 2018; Montag, et al., 2012; Perry-Smith & Mannucci, 2017), we were not able to distinguish between these two constructs due to conceptually unclear measurement in the primary studies. As Hughes and colleagues (2018) show, not only the conceptual definitions, but even more so the most commonly used measurement scales for workplace creativity and innovation contain elements of both creativity and innovation. Therefore, we followed Hülsheger and colleagues (2009) and Harari and colleagues (2016) in combining measures of creativity and innovation into a single category of innovation. However, future research may find interest in a fine-grained differentiation between phases of the creative and innovative process, as this could help uncover the incremental validity of the team climate for innovation subdimensions. The different dimensions may explain more or less variance depending on the different stages of the process: For instance, idea generation may particularly benefit from a high level of participative safety, idea elaboration from task orientation, idea championing from support for innovation, and idea implementation from a shared vision (cf. Perry-Smith & Mannucci, 2017).

Finally, a critical question to our knowledge so far unaddressed by theory and primary studies is the so called “dark side” (Griffin & O’Leary- Kelly, 2004), namely potential negative consequences, of team climate for innovation. Negative consequences that accompany constructs that are otherwise regarded as positive have been investigated and identified for creativity and innovation (e.g., Breidenthal et al., 2020; Gong et al., 2013; González-Romá, & Hernández, 2016). The construct of team climate for innovation may be subject to the ‘pro-innovation bias’, which consists of the notion that innovation exclusively has positive consequences (cf. Anderson et al., 2014), which may have led to the neglect of its negative effects. Adding to Anderson et al.’s (2014) call for more research on the negative consequences of innovation, we ask our fellow researchers to explore how and when team climate for innovation may lead to negative consequences to develop a deeper understanding of the constructs nature.

### 2.5.4 Conclusion

In this study, we meta-analytically show that team climate for innovation should be treated as a unitary construct. Further, our findings reveal a positive relationship of team climate for innovation and its dimensions with both team performance and innovation. The results indicate that the strength of these relationships is contingent upon the innovation-specificity and function of the assessed criteria as well as on research design characteristics. Finally, the findings suggest that team climate for innovation is more strongly related to team innovation than to team performance and it exerts both a direct and indirect (mediated through team innovation) influence on team performance. Despite the stated limitations, our study moves the research stream of team innovation forward by clarifying several inconsistencies in the prior research on team climate for innovation.

## 2.6 References

References marked with an asterisk (*) indicate studies included in the meta-analyses.

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## 2.7 Appendix A

**Used key words**

*Team climate for innovation*: Team climate for innovation; team innovation climate; team innovative climate; team climate AND innovation; innovation climate AND team; "team climate inventory"

*Vision*: Vision AND team climate; vision AND innovation climate; team vision AND innovation; "team vision"; "departmental objectives"; "shared vision" AND team AND innovation; "Shared objectives"; "clarity of objectives" AND team; "clarity of vision" AND team; “objectives” AND “team climate”

*Participative Safety*: Participative safety; participatory safety; "team psychological safety"; “psychological safety” AND "team climate"; “psychological safety” AND team AND innovation; "psychological safety” AND "participation" AND team; "departmental participation"; "participation" AND "team climate"; "participation in the team"

*Task Orientation*: "Task orientation"; "emphasis on quality" AND team; "quality emphasis" AND team; "climate for excellence" AND team

*Support for Innovation*: "Support for innovation"; "team encouragement"; "team support" AND innovation

# 3 The Role of Creative Leadership Modes in Team Creativity and Innovation

**Abstract**

Leading for creativity is a key challenge for organizations producing innovative outcomes. However, it remains unclear whether and when it is more essential for leaders to support their followers' creativity or to be creative themselves in order to lead their teams towards the achievement of innovative outcomes. In this paper, we establish and test a theory on three different modes of creative leadership: facilitating, directing, and integrating. We develop and validate a scale for measuring these three modes. Furthermore, we test their differential effects on team creativity and team innovative outcomes by investigating 646 junior scholars nested in 259 scientific teams from nine German universities. Our study reveals that a team's creative behavior is positively related to the facilitating and integrating creative leadership modes, while a team's innovative productivity is positively related to the directing and integrating creative leadership mode. Our study contributes to understanding and measuring creative leadership and the distribution of creative and supportive tasks between leaders and teams.

*Keywords:*

creative leadership; leadership modes; team creative behavior; team innovative productivity

*Note: This chapter is based on a paper (under review) co-authored by Lea-Therese Strobel, Maria Strobel, Isabell M. Welpe, and M. Audrey Korsgaard. Therefore, the plural instead of the singular is used throughout this chapter.*

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Strobel, L.-T., Strobel, M., & Welpe, I. M. (2019, July). *Shaping creative contexts: How creative leadership modes affect innovation behavior and satisfaction.* Paper presented at the International Conference: Organizing Creativity in the Innovation Journey, Berlin (Germany), 11-12 July 2019.

### 3.1 Introduction

Having a leader who supports or facilitates the creative process in followers can be a critical factor to fostering innovation in teams. While research demonstrates the importance of facilitative leadership to stimulating creativity and innovation in others (Anderson et al., 2014; Zhou & Hoever, 2014), it is, arguably, an over-simplified version of what leaders can do to promote creativity and innovation. First, there are a myriad of potentially relevant leadership modes (Rosing et al., 2011; Mainemelis et al., 2015), and focusing on one mode in isolation may overestimate its importance while underestimating the overall impact of leadership on creativity and innovation. Second, many of the leadership behaviors posited to impact creativity and innovation (e.g., Oldham & Cummings, 1996; Somech, 2006; Tierney et al., 1999; Zhang & Bartol, 2010) treat leaders as facilitators or enablers rather than active participants. Without understanding the leader's potential to actively contribute to creativity and innovation, the ability to leverage the expertise of leadership is limited. Finally, given that creativity and innovation are related but distinct phenomena (Anderson et al., 2014; Montag et al., 2012), the behavioral strategies that leaders should employ may differ.

In this investigation, we seek to develop and test a more comprehensive framework of behavioral strategies leaders may use to foster creativity and innovation. To do so, we draw on the work of Mainemelis and colleagues (2015). Based on a large-scale, interdisciplinary review on creative leadership, they identified three leadership strategies that vary in the degree to which the leader and the followers are active contributors to the process of creating and innovating. The first is *facilitating*, which corresponds to the traditional view of creative leadership as supporting and offering resources and not actively contributing. The second is *directing*, wherein the leader is the primary generator of creative contributions and the followers primarily undertake supportive tasks. The third is *integrating*, wherein both the leader and the followers generate creative contributions, which the leader then synthesizes to establish a creative synergy (Mainemelis et al., 2015). While evidence of the impact of these three strategies exists, their combined and relative efficacy is not known, and a comprehensive measure of all three strategies does not exist. Accordingly, in this investigation, we develop a measure of the creative leadership mode to examine the unique contribution of each strategy to creativity and innovation. We investigate our hypotheses in the context of academic research teams within universities in Germany, because in this institutional environment, all three leadership strategies are possible and commonly occurring, which allows us to directly compare their effects.

The research aims and contribution of our study is fourfold. First, drawing on the classifications of Mainemelis and colleagues (2015), we introduce the construct of *creative leadership modes*, encompassing three strategies that vary in the degree to which the leader, follower, or both are active contributors to team creativity and team innovation. Because this framework incorporates the active role of leadership, the current study addresses the call for the investigation of leaders' creativity (Epitropaki et al., 2017; Mainemelis et al., 2015). Second, we develop and validate a scale for measuring the three creative leadership strategies of facilitating, directing and integrating. In doing so, we are able to examine the combined and unique influence of each, thereby providing a more comprehensive understanding of the role of leadership in team creativity and team innovation. Third, we address calls for careful differentiation between creativity and innovation (Anderson et al., 2014; Hughes et al., 2018; Montag, et al., 2012; Perry-Smith & Mannucci, 2017). In this way, we are able to explore whether creative leadership modes have different consequences depending on the desired outcome of the innovation process. Fourth, we contribute to the understanding of the organization of research teams (Shibayama et al., 2015) by shedding light on how different leadership modes can foster scientific creativity (cf. Heinze et al., 2009) and the innovative productivity of research teams.

## 3.2 Theory

Creativity is described as the generation of novel and useful ideas (Amabile, 1988; Oldham & Cummings, 1996), and innovation usually refers to the conversion of these ideas into new and improved products, processes or services (West, 2002). Creativity is commonly regarded as an important antecedent of innovation, but research suggests that the two are not perfectly related (Sarooghi et al., 2015). Researchers have called for investigating them separately (Montag et al., 2012), specifically regarding the effects of leadership on creativity and innovation (Hughes et al., 2018). Therefore, in line with empirical research indicating that the two depend on different processes and lead to different outcomes (Anderson et al., 2014; Hughes et al., 2018), we investigate the two as separate constructs.

### 3.2.1 Creative Leadership Modes

In their integrative review, Mainemelis and colleagues (2015) identified three conceptualizations of creative leadership: facilitating, integrating, and directing. These conceptualizations are distinguished from one another primarily by the relative proportions of creative and supportive contributions made by leaders and followers during the innovative process. While both creative and supportive contributions are vital for creative and innovative outcomes, they do not exclude each other, and their respective magnitude follows a continuum (Mainemelis et al., 2015). Mainemelis and colleagues (2015) found that these types of creative leadership typically occur in different contexts, with the facilitating type being most prevalent in the traditional corporate settings that are typically studied in organizational behavior research. In contrast, they found the integrating and directing creative leadership modes were used in contexts where creativity is the core task for value creation (e.g., film making and jazz combos for the integrating mode and haute cuisine and classical orchestras for the directing mode). However, there are many settings with weaker contextual conditions, which may require multiple creative leadership approaches (Gebert et al., 2010).

We argue that the different approaches to creative leadership can coexist within a single context and potentially even co-occur. Mainemelis and colleagues (2015) assume that the collaborative context is often “ex-ante socially structured in a way that favors the emergence of one of the three manifestations of creative leadership" (Mainemelis et al., 2015, p. 406). We argue that for teams in weaker contextual conditions, individuals may influence the possibilities for creative (or supportive) contributions. In particular, leaders are predisposed to shape – intentionally or unintentionally – creative collaboration according to their own preferred creative leadership approach. Through giving directions and through task distribution, they strongly affect their followers and their own work (Yukl, 2012), form normative expectations (Carmeli & Schaubroeck, 2007) and thereby control opportunities for creative and/or supportive contributions.

Building on Mainemelis and colleagues' (2015) classification of creative leadership contexts, we extent this conceptualization by theoretically introducing creative leadership modes. We define creative leadership modes as different approaches to distributing creative and supportive tasks between leaders and team members to attain an innovative outcome. We argue that through these modes, leader both give to, and require from, followers more or less creative contribution and support. In doing so, leaders' creative modes shape the norms and expectations of the group regarding what the leader and followers should do with regard to creativity and innovation. Thus, creative leadership modes are reflected in the shared perception of team members regarding how creative and supportive tasks are distributed between leaders and followers.

*Facilitating creative leadership mode*. In the facilitating creative leadership mode, the development of new ideas is primarily the task of the team members; leaders support them in this task but are not expected to make creative contributions (cf. Mainemelis et al., 2015). This mode is theoretically based on a prominent perspective within the organizational creativity literature: It is the task of leaders to supply followers with the required resources and establish an environment conducive to creative work (e.g., through encouragement, support, or a good team climate) (e.g., Amabile et al., 1996; Janssen, 2005; Madjar et al., 2002; Mumford et al., 2002;

Zhang & Bartol, 2010). The facilitating mode entails the expectation that team members make creative contributions and the leader makes supportive contributions.

*Integrating creative leadership mode*. In the integrating creative leadership mode, the development of new ideas is the task of both the leader and team members. The leader synthesizes creative contributions from both the leader and team to establish creative synergy (cf. Mainemelis et al., 2015). This mode is based theoretically on the knowledge integration perspective introduced by van Knippenberg (2017), which stresses the importance of integrating knowledge, perspectives, ideas, and expertise from diverse members of the innovation team. First, exposure to and exchange of the diverse information available within the team fosters creativity and the development of new insights in the creative collaboration between the leader and team members. Second, the team offers a natural platform for the integration and exploitation of diverse information (van Knippenberg, 2017). In the interaction between the leader and team members, this integration results in a creative synergy, where the collective creative outcomes are greater than the sum of the individual input. The more the team engages in information integration, the more innovative the outcomes of the team should be (van Knippenberg, 2017). The integrating mode entails the expectation that both the leader and team members make creative contributions and both sides may similarly generate supportive contributions.

*Directing creative leadership mode*. In the directing creative leadership mode, the development of new ideas is primarily the task of the leader, who directs her team members to provide mainly supportive contributions in order to implement her own creative ideas (cf. Mainemelis et al., 2015). This mode is theoretically based on the idea of the ‘creative genius’ (Simonton, 2003). First, the creative genius has an extraordinary creative capacity. Second, she realizes her own creative potential and productively turns it into original innovations. These unusual creative abilities combined with the drive to create numerous innovations puts the creative genius in an exceptional position to direct subordinates to implement her creative visions

(Simonton, 1988). The directing mode entails the expectation that team members make supportive contributions to implement the creative vision of the leader.

### 3.2.2 The Relation of Creative Leadership Modes to Creativity and Innovation

We expect the creative leadership modes to be differently related to creativity and innovation. While the facilitating mode may be as a fostering factor for creative behavior, the directing mode may focus team efforts on implementing innovative outcomes. The integrating mode combines both of these functions and entails a synergistic factor; therefore, it may be conducive to both creativity and innovation. In the following paragraphs, we derive our hypotheses explaining how the three modes differentially relate to the creative behavior and the innovative productivity of teams.

*Facilitating creative leadership mode*. In the facilitating creative leadership mode, team members are the primary idea generators, and the leader merely supports team members in their creative endeavors. Thus, team members are expected to contribute creatively, while the leader is expected to make supportive contributions. We maintain that the facilitating creative leadership mode will positively relate to the creative behavior of team members. In line with this proposition, several studies have investigated the effects of supervisor support and encouragement for creativity on the creativity of followers (Gilson & Shalley, 2004; Janssen, 2005; Madjar et al., 2002; Zhang & Bartol, 2010), and the findings indicate a positive effect of leaders' support for or encouragement of creativity on team members' creative behavior. Thus, we hypothesize the following:

*Hypothesis 1. The facilitating creative leadership mode is positively related to creative behavior.*

*Integrating creative leadership mode*. In an integrating creative leadership mode, both the leader and team members are idea generators. Thus, both the leader and team members are expected to make creative contributions, which are integrated to realize a creative goal. We maintain that the integrating creative leadership mode will positively relate to the creative behavior of team members. The involvement of the leader and team members in creative tasks allows team members to perceive their leader as a creative role model and observe her creative skills (Koseoglu et al., 2017; Reiter-Palmon & Illies, 2004). In line with this proposition, Jaussi and Dionne (2003) found that if leaders are perceived as creative role models, the creativity of their followers increases. According to Shalley and Gilson (2004), modeling helps to clarify expectations concerning creative and innovative performance and, furthermore, leads to enhanced skill acquisition. As Shalley and Perry-Smith (2001) found, exposure to a creative model leads to higher creative performance. Similarly, the mere observation of leaders' creative problem-solving skills by followers increases followers' creativity (Basadur, 2004; Hemlin & Olsson, 2011; Reiter-Palmon & Illies, 2004).

Further supporting our argument, the integrating creative leadership mode entails expectations that both the leader and team members will make creative contributions. This fosters joint decision-making or at least involvement in decision-making by team members as well as sharing of information and ideas between leaders and team members (Somech, 2006; West & Anderson, 1996). In turn, this may foster an atmosphere in which followers strive to propose new ideas and jointly evaluate and refine them (West, 2002), in line with expectations. In this way, participation is considered to enhance creativity as well as innovation (Andriopoulos, 2001; Hülsheger et al., 2009). Thus, we hypothesize the following:

*Hypothesis 2a. The integrating creative leadership mode is positively related to creative behavior.*

As participation is considered to enhance innovation (Hülsheger et al., 2009), we also maintain that the integrating creative leadership mode will positively relate to the team's innovative productivity. According to Axtell and colleagues (2000), participation in decision making as well as support for innovation are strong predictors of innovative outcomes. West (1990) argues that this is due to an increase in experienced ownership, which team members feel because of the outcomes these decisions result in. The feeling of ownership in the team is further increased, as the team is expected to contribute ideas (as in the facilitating creative leadership mode) and to develop and implement them (as in the directing creative leadership mode). High degrees of ownership for an idea are associated with identification with and commitment to the idea (Basadur, 2004; Rouse, 2013), which may lead to a higher likelihood of idea implementation.

At the same time, integrating creative leadership mode entails a synergistic factor, as the leader collects, combines and integrates ideas from the team with her own. The integration of information is assumed to be conducive for innovative outcomes (van Knippenberg, 2017). In addition, as in the integrating mode leaders are involved in making creative contributions, they are able to shape the innovation process with their expertise and provide creative direction and idea evaluation (Mumford et al., 2002, 2003). Past research has emphasized the positive effects both of leaders' expertise and of leaders providing direction and evaluation on innovative performance (for a review, see Mumford et al., 2002). According to Amabile (1988), for successful implementation planning, both technical skills and in-depth organizational expertise are required.

In conclusion, in an integrating creative leadership mode, leaders enhance a team's innovative outcomes by integrating of ideas through expertise-informed evaluation and direction in the implementation process, while team members improve innovative outcomes through high levels of commitment. Thus, we hypothesize the following:

*Hypothesis 2b. The integrating creative leadership mode is positively related to innovative productivity.*

*Directing creative leadership mode*. In the directing creative leadership mode, the leader is the primary idea generator, and team members merely support their leader in the realization of her creative vision. Thus, followers are expected to align with and implement their leader's creative vision. We maintain that the directing creative leadership mode will positively relate to the team's innovative productivity. As leaders are expected to make creative contributions, the team benefits from the leader's expertise in shaping the implementation process successfully. As mentioned above, past research has emphasized the positive effects both of leaders' creative contribution of providing creative direction and evaluating ideas and of their expertise with respect to idea implementation (for a review, see Mumford et al., 2002; Amabile, 1997). Given the ill-defined nature of creative work (Mumford et al., 2002), teams working in a directing creative leadership mode further receive essential feedback regarding which ideas are qualified for implementation through the creative involvement, direction, and evaluation of the leader.

Finally, the leader's creative contribution of directing the team towards a specific creative goal, namely, the implementation of the creative idea generated and evaluated by the leader, enhances the team's innovative outcome (Mumford et al., 2002, 2003). The directing creative leadership mode entails the expectation that team members will align with their supervisor's vision. The clear goal envisioned by the leader may help the team adapt to the uncertainty and sometimes ill-defined nature of creative work (Mumford et al., 2002). Consequently, teams who share clear objectives show better innovative outcomes (for a review and meta-analysis, see Hülsheger et al., 2009). Finally, if the leader alone engages in idea development and evaluation, processes that consume a considerable amount of time and cognitive resources, team members have the capacity to focus completely on implementing innovative outcomes. Thus, we hypothesize the following:

*Hypothesis 3. The directing creative leadership mode is positively related to innovative productivity.*

## 3.3 Method

### 3.3.1 Data Collection and Sample

We collected data on academic teams in German research facilities, which we consider ideally suited for studying creative leadership modes for the following reasons. First, we sought a context, which is flexible enough that all three creative leadership modes may be manifested. The academic research enterprise offers the freedom to shape the creative collaboration between academic supervisors and their team members to resemble any of the three conceptualizations. Second, teamwork is usually a vital part of scientific research where the innovative outcomes of academic supervisors and their team members are primarily coauthored publications (Maier-Leibnitz & Schneider, 1991; Muller-Camen & Salzgeber, 2005). Finally, creativity and innovativeness are necessary requirements for successful research (Keller, 2006).

We collected data between September 2018 and January 2019 as part of an online-survey of scientific personnel at universities in Germany. We systematically obtained contact details via the publicly available homepages of academic departments and recruited participants via email. Participation was voluntary, and confidentiality was assured.

The survey was sent to members of the academic supervisors' teams, who were PhD students or post-doctoral researchers. In total, 1,873 participants completed the survey. For scale development, we included all participants without missing values on the items of the scale we developed. The sample for the scale development consisted of 1,334 junior scholars. For hypothesis testing, we excluded participants with missing values on any of the key measures. Further, we restricted the samples to teams with at least two participants, no more than 40 team members and an $r_{wg} \geq 0.5$ on the scale for measuring creative behavior. The final sample for the hypotheses testing consisted of 646 individuals nested in 259 teams from nine universities. Forty-eight percent of the participants were female; 33.6% held a PhD. The average age was 33.04 ($SD$ = 7.67). The average number of participants per team was 2.49 ($SD$ = 0.82), with a range from two to seven participants per team. Team size ranged from two to 39 ($M$ = 13.75, $SD$ = 8.64). A total of 29.7% of the teams worked in the field of law, social science, or economics, 29.0% in math or science, 19.3% in humanities, 11.2% in engineering and 10.8% in other fields.

### 3.3.2 Scale Development

*Item generation*. Building on the theoretical concept of Mainemelis and colleagues (2015), we generated an initial pool of 18 items via a theory-driven, deductive approach (Hinkin, 1995) to capture the abovementioned three content domains of creative leadership modes: directing, facilitating, and integrating (a complete list of items can be found in Table 3.1). The items focused on the expected distribution of creative and supportive tasks between leader and team members. We adapted the items to the academic research context (i.e., “professor” instead of “leader”, “scientific staff” instead of “team”).

*Qualitative feedback*. We conducted a pilot test of the items in a sample of 10 PhD students familiar with and experienced in organizational behavior research. We asked them to provide feedback regarding the comprehensibility, clarity, and readability of the items. In addition, three individuals who held M.Sc. degrees in psychology and who were literate in scientific methodology sorted the randomized items and labeled the resulting dimensions. This sorting was a test of the content validity of the items written to reflect each dimension. All individuals came to the same conclusion and made no misclassifications. Therefore, we retained all 18 items.

*Factor analysis*. As part of a rigorous psychometric analysis of the new measure, we conducted an exploratory factor analysis (EFA) and a confirmatory factor analysis (CFA). The EFA was utilized to support the selection of a reduced set of items and to explore the reliability and dimensionality of the scale. The CFA was conducted to confirm and validate the resulting scale. Following the procedure recommended by Krzystofiak and colleagues (1998), we used a randomly selected split-half subsample of 641 individuals ($N_1$) to perform the EFA, while we used the second split-half subsample of 693 individuals ($N_2$) for perform the CFA. The resulting subsamples still exceeded the minimum sample size of 500 recommended for EFA and CFA (MacCallum, Widaman, Zhang, & Hong, 1999). We analyzed the initial 18-item scale by using the data of the first subsample ($N_1$) and employing principal axis factor extraction with orthogonal rotation (Varimax) in SPSS. After the first EFA, we reduced the scale by excluding items with loading weights smaller than .50 or cross-loadings on more than one factor larger than .32 (Tabachnick & Fidell, 2001) and balanced the scales. We then performed a CFA on the now nine-item scale in AMOS using the second subsample ($N_2$).

### 3.3.3 Measures for Hypothesis Testing

All measures, except for the newly developed scale, which was developed in German, were back-translated following the procedure recommended by Brislin (1970). Participants rated items on a scale ranging from ‘1’ for strongly disagree to ‘7’ for strongly agree.

*Creative leadership modes*. We measured creative leadership modes with the newly-developed Creative Leadership Mode Scale. Three items each were averaged to measure facilitating, directing and integrating modes scale. The final scale can be found in the Table 3.1.

*Creative behavior.* We measured creative behavior via four items by Tierney and colleagues (1999) adapted for self-rating. The items used were “I generate novel but operable work-related ideas”, “I try new ideas and approaches to problems”, “I seek new ideas and ways to solve problems”, and “I generate ideas revolutionary to the field” (Cronbach’s alpha = .81).

*Innovative productivity.* We operationalized the innovative productivity of the team as the number of publications in peer-reviewed journals coauthored by the academic supervisor and at least one team member. Academic supervisors in Germany typically publish papers coauthored by one or more members of their team (cf. Braun et al., 2013). In the rare instances that supervisors in our sample did publish without one or more team members, we excluded these publications from analysis. We identified publications from 01.01.2018 to 31.07.2019 via ISI Web of Knowledge and used them for subsequent analyses. As the survey in which we assessed creative leadership modes took place at the end of 2018, we established a concurrent assessment of creative leadership modes and innovative productivity. The number of publications included per team ranged from zero to 56, with an average number of 4.79 (*SD* = 7.69) publications per team. Between 01.01.2018 and 31.07.2019, 69.9% of the teams had five publications or fewer, 16.2% of the teams had between six and 10 publications, 8.1% of the teams had between 11 and 20 publications, and 5.8% of the teams had more than 20 publications.

*Control variables.* To exclude alternative explanations for the relationships between the investigated variable, the influence of third variables that exert influence on the proposed outcome variables, as indicated by prior research, were controlled for. The models controlled for the expertise of team members (Amabile, 1998; by assessing the ratio of junior scholars who already had a PhD to those who did not), the average team tenure (average duration of working with the respective academic supervisor), and the team size (Hülsheger et al., 2009). Further, they controlled for the field of research (STEM vs. non-STEM subjects), since the number of publications may vary greatly between different fields of research.

## 3.4 Results

### 3.4.1 Scale Development

*Exploratory factor analysis*. Using the first split sample, we conducted an EFA on the initial 18-item scale. The magnitude and scree plot of the eigenvalues supported a three-factor structure, which accounted for 68.8% of the total variance. After items that cross-loaded were eliminated, we balanced the scales to be composed of an equal number of items, selecting the nine items with the highest factor loadings, grouped into three dimensions: directing creative leadership mode (α = .92), facilitating creative leadership mode (α = .77), and integrating creative leadership mode (α = .95). In a second principal axis factor analysis of the remaining nine items, the magnitude and scree plot of the eigenvalues again supported a three-factor structure, which now accounted for 74.9% of the total variance. Table 3.1 shows the factor loadings of both EFAs.

*Confirmatory factor analysis (CFA).* Using the second split sample, we performed a CFA on the reduced 9-item scale using maximum likelihood estimates in AMOS. The model fit the data well ($\chi^2(24) = 111.88$, $p < .001$, $CFI = .98$, $RMSEA = .07$ and $SRMR = .06$). All first-order factor loadings were statistically significant at a significance level of $p < .001$ and reasonably large, ranging from .58 to .95 ($M = .85$).

### 3.4.2 Team level Aggregation

To check whether the intergroup agreement and intergroup reliability were high enough for team level aggregation, we calculated the $r_{wg}$ values using a uniform null distribution as well as intraclass correlations (*ICC(1)*) and the reliability of group mean index (*ICC(2)*). The mean value of $r_{wg}$ was $r_{wg} = .67$ ($SD = 0.33$) for the facilitating creative leadership mode, $r_{wg} = .66$ ($SD = 0.35$) for the directing creative leadership mode, and $r_{wg} = .60$ ($SD = 0.38$) for the integrating creative leadership mode. The *ICC(1)* values were .35, .36, and .22 for the facilitating, directing, and integrating creative leadership modes, respectively, while the *ICC(2)* values were .57, .58, and .42. All ICC values were significant at a level of $p < .001$. These results support aggregation of all three scales (LeBreton & Senter, 2008).

For creative behavior, we obtained mean values of $r_{wg} = .82$ ($SD = 0.22$); *ICC(1)* was .14 and *ICC(2)* was .29. ICC values were significant at a level of $p < .001$. Although the *ICC(2)* was low, the remaining indices supported aggregation.

Table 3.2 shows the means, standard deviations, and correlations of the examined variables aggregated on the team level.

**Table 3.1:** Rotated factor matrix of exploratory factor analyses on items for measuring creative leadership modes

| | EFA on initial 18 items [a] | | | EFA on final 9 items [b] | | |
|---|---|---|---|---|---|---|
| Items | 1 | 2 | 3 | 1 | 2 | 3 |
| **Facilitating** | | | | | | |
| The task of the scientific staff is to develop new research ideas. | 0.15 | -0.32 | **0.76** | 0.15 | -0.33 | **0.69** |
| New research ideas are developed primarily by the academic staff (and not by the professor). | -0.03 | -0.31 | **0.72** | 0.02 | -0.22 | **0.89** |
| The professor is mainly the "manager" of the group and is hardly involved in the creative work. | -0.18 | -0.13 | **0.50** | -0.12 | -0.06 | **0.57** |
| The professor creates the conditions for scientific staff to develop their own research ideas. | **0.53** | -0.25 | **0.53** | | | |
| The professor actively encourages scientific staff to develop their own research ideas. | **0.53** | -0.22 | **0.58** | | | |
| Leadership means that the professor promotes the creativity of others in generating research ideas. | **0.50** | -0.21 | **0.61** | | | |
| **Directing** | | | | | | |
| The professor provides research ideas and expects them to be implemented. | -0.17 | **0.84** | -0.15 | -0.12 | **0.85** | -0.16 |
| Leadership means that the professor translates his/her own creative research ideas into reality through the work of the scientific staff. | -0.11 | **0.85** | -0.19 | -0.07 | **0.86** | -0.21 |
| The task of the scientific staff is to implement the research ideas of the professor. | -0.09 | **0.87** | -0.18 | -0.05 | **0.87** | -0.20 |

| | EFA on initial 18 items [a] | | | EFA on final 9 items [b] | | |
|---|---|---|---|---|---|---|
| Items | 1 | 2 | 3 | 1 | 2 | 3 |
| New research ideas are developed primarily by the professor (and not by the academic staff). | -0.02 | **0.66** | -0.38 | | | |
| The professor is clearly the "creative mind" of the group that develops the research ideas. | 0.06 | **0.72** | -0.32 | | | |
| The professor establishes strong guidelines for research topics and projects. | -0.20 | **0.79** | -0.17 | | | |
| **Integrating** | | | | | | |
| Leadership in this team means that the professor brings together the different creative contributions of himself and the academic staff. | **0.88** | -0.01 | 0.03 | **0.89** | -0.04 | 0.02 |
| The professor integrates his/her creative research ideas with those of the scientific staff. | **0.91** | -0.06 | 0.02 | **0.93** | -0.11 | -0.02 |
| The professor creates synergies between his/her creativity and the creativity of the scientific staff. | **0.92** | -0.04 | 0.04 | **0.94** | -0.10 | -0.02 |
| New research ideas are developed by both the professor and the research associates. | **0.82** | -0.17 | 0.08 | | | |
| The professor and the scientific staff are equally involved in the development of new research ideas. | **0.82** | -0.16 | 0.05 | | | |
| The professor works closely with the scientific staff to develop new research ideas. | **0.87** | -0.01 | 0.01 | | | |

*Note*. $N$ = 641. Extraction method: Principal axis analysis; Rotation method: Varimax.
[a]Total variance explained: 68.8%.
[b]Total variance explained: 74.9%.

**Table 3.2:** Means, standard deviations, and correlations of the key study variables

| Variables | *M* | *SD* | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. PhD[a] | 0.34 | 0.33 | | | | | | | | |
| 2. STEM subject[b] | 0.40 | 0.49 | -.11 | | | | | | | |
| 3. Team tenure | 58.88 | 36.83 | .57* | -.06 | | | | | | |
| 4. Team size | 13.74 | 8.64 | .00 | .41* | .03 | | | | | |
| 5. Facilitating | 3.96 | 1.15 | -.02 | .15* | -.02 | .18* | (.80) | | | |
| 6. Directing | 3.67 | 1.38 | -.06 | .25* | .03 | .18* | -.44* | (.92) | | |
| 7. Integrating | 4.27 | 1.33 | -.02 | .07 | -.05 | -.11 | .03 | -.15* | (.95) | |
| 8. Creative behavior | 5.07 | 0.67 | .00 | .09 | -.06 | .08 | .23* | -.13* | .19* | (.81) |
| 9. Innovative productivity | 4.79 | 7.69 | -.06 | .40* | .10 | .40* | .14* | .20* | .00 | .06 |

*Note.* *N* = 259 teams. Cronbach's alpha is displayed on the diagonal in parentheses.
[a]PhD is coded 1, no PhD is coded 0.
[b]STEM subject is coded 1, non-STEM subject is coded 0.
*$p < .05$

### 3.4.3 Hypothesis Testing

Prior to hypothesis testing, we examined whether there was significant between-organization variance in the outcome variables by running null (intercept-only) models. The results showed that organization did not account for a significant amount of variance in creative behavior ($\chi^2(8) = 2.52$, $p = .112$). Therefore, we tested the hypothesis regarding creative behavior using ordinary least squares (OLS) regression. Note that modeling the random effect did not alter the pattern of significance. In contrast, the results for innovative productivity showed that a significant amount variance in innovative productivity resided at the organization level ($\chi^2(8) = 3.91$, $p = .048$), which necessitated using random coefficients model, to account for the level-2 random effect of organization.

*Creative behavior.* As shown in Table 3.3, the addition of the facilitating, directing, and integrating creative leadership modes as predictors for individual creative behavior significantly increased the model fit ($\Delta F = 7.13$, $p < .001$). The coefficient of the facilitating creative leadership mode was positive and significant ($b = .11$, $p < .010$), supporting H1. Similarly, the coefficient of the integrating creative leadership mode was positive and significant ($b = .09$, $p = .004$), supporting H2a.

**Table 3.3:** OLS regression analyses for creative leadership modes predicting creative behavior

| | Model 1 | | Model 2 | |
|---|---|---|---|---|
| Control variables | *B (SE)* | *p* | *B (SE)* | *p* |
| Intercept | 5.03 (0.10) | <.001 | 4.29 (0.30) | <.001 |
| PhD[a] | .11 (0.15) | .450 | .09 (0.14) | .509 |
| STEM subject[b] | .09 (0.09) | .336 | .05 (0.10) | .634 |
| Team tenure | .00 (0.00) | .226 | .00 (0.00) | .300 |
| Team size | .00 (0.01) | .413 | .00 (0.01) | .362 |
| | | | | |
| Facilitating creative leadership | | | .11 (0.04) | .010 |
| Directing creative leadership | | | -.02 (0.04) | .600 |
| Integrating creative leadership | | | .09 (0.03) | .004 |
| $R^2$ | .02 | | .09 | |
| $\Delta F$ | | | 7.13 | <.001 |

*Note. N* = 259 teams.
Unstandardized coefficients and standard errors (in parentheses) are reported.
[a]PhD is coded 1, no PhD is coded 0.
[b]STEM subject is coded 1, non-STEM subject is coded 0.

*Innovative productivity.* The measure of innovative productivity, the number of publications, is a zero-inflated count variable, which does not meet the requirement of equidispersion. Assuming equidispersion in an overdispersed model may lead to incorrect conclusions due to underestimation of standard errors or overestimation of the significance of beta coefficients (cf. Payne et al., 2015). We therefore tested the hypotheses via a two-level negative-binomial generalized linear mixed-level model. As shown in Table 3.4, the addition of the facilitating, directing, and integrating creative leadership modes as predictors for a team's innovative productivity significantly increased the model fit ($\chi^2$ = 26.37, $p$ < .001). The coefficient of the integrating creative leadership mode was positive and significant ($b$ = .20, $p$ = .008), supporting H2b. Similarly, the coefficient of the directing creative leadership mode was positive and significant ($b$ = .43, $p$ < .001), supporting H3. Unexpectedly, the analysis further displayed a positive and significant coefficient for facilitating creative leadership mode ($b$ = .35, $p$ < .001).

**Table 3.4:** Random coefficient analysis for creative leadership modes predicting innovative productivity

| | Model 1 | | Model 2 | |
|---|---|---|---|---|
| | *Estimate (SE)* | *p* | *Estimate (SE)* | *p* |
| Intercept | -0.28 (0.27) | .289 | -4.10 (0.81) | <.001 |
| Organization | 0.03 (0.17) | | 0.04 (0.20) | |
| PhD[a] | -.09 (0.33) | .782 | .00 (0.33) | .988 |
| STEM subject[b] | .97 (0.21) | <.001 | .81 (0.21) | <.001 |
| Team tenure | .01 (0.00) | .051 | 0.00 (0.00) | .081 |
| Team size | .06 (0.01) | <.001 | .05 (0.01) | <.001 |
| Facilitating creative leadership | | | .35 (0.10) | <.001 |
| Directing creative leadership | | | .43 (0.09) | <.001 |
| Integrating creative leadership | | | .20 (0.08) | .008 |
| Deviance | 1212.1 | | 1185.7 | |
| AIC | 1226.1 | | 1205.7 | |
| BIC | 1250.9 | | 1241.3 | |
| $\chi^2$ | | | 26.37 | <.001 |

*Note. N* = 259 teams, 9 organizations.
Unstandardized coefficients and standard errors (in parentheses) are reported.
[a]PhD is coded 1, no PhD is coded 0.
[b]STEM subject is coded 1, non-STEM subject is coded 0.

## 3.5 Discussion

We set out to extent and test a theory on creative leadership modes (facilitating, directing, and integrating) and their relation with the creativity and innovation of teams. Drawing on the classifications of Mainemelis and colleagues' (2015) model of creative leadership, we developed a measure of leadership creative modes and validated its tripartite factor structure. Using a sample of 259 academic research groups, we examined the relationships between these modes and both the groups' self-report of creative behavior and the groups' actual output of research publications as a measure of innovative productivity.

Our results reveal that a unique combination of leadership modes contribute to creativity and innovation. As hypothesized, we found that, whereas the facilitating and integrating leadership modes were positively and significantly related to creative behavior, directing and integrating leadership modes were positively and significantly related to innovative productivity. It is noteworthy that by examining these relationships simultaneously, we were able to demonstrate the unique impact of each mode above and beyond the impact of other modes.

Unexpectedly, facilitating creative leadership mode was also related to innovative productivity. This finding may be specific to the context of our study and the used innovative productivity measure, the number of journal publications. In the academic context, a main hurdle to implementation of ideas in form of publications is that they are rejected by the peer-reviewed journals they were submitted to and, thus, have to be resubmitted or submitted to other journals. This leads to an iterative process of reworking the original idea. First, the creativity-enhancing environment of facilitating creative leadership mode may lead to a bigger pool of creative ideas concerning the revision and resubmission of papers, which in turn may enhance the likelihood of publication. Second, while in corporate contexts ideas need to be novel and useful in order to be implemented, in the academic context for particularly original work sometimes only the novelty criterion may be decisive for acceptation by a journal. Innovative productivity may be enhanced in the facilitating mode, as in the iterative process of revision and resubmission the gradual enhancement of novelty and creative quality is encouraged, which makes the papers eventually ripe for publication.

### 3.5.1 Implications for Theory and Practice

We believe that our study advances previous research on creative leadership in several ways. First, we extent the theory of Mainemelis and colleagues (2015) by introducing creative leadership modes, conceptualizing them as different modes of distributing creative and supportive tasks between the leader and the team members. In addition, we developed and validated a measurement tool for these creative leadership modes, namely, the Creative Leadership Mode Scale. This scale showed good psychometric properties in terms of internal consistency and construct validity of its three dimensions. We thus contribute to the creative leadership research by conceptualizing and illuminating the leader’s role in the innovation process (Anderson et al., 2014; Epitropaki et al., 2017; Mainemelis et al., 2015) and offering a tool for measuring of leaders’ creative characteristics within work groups (Jaussi & Dionne, 2003; Koseoglu et al., 2017).

Second, the creative leadership modes have important implications for team outcomes: Our findings suggest that the facilitating and integrating creative leadership modes seem to be especially relevant to fostering creativity in teams and the integrating and directing creative leadership modes are relevant to producing team innovation. First, we answer the call for careful differentiation between creativity and innovation (Anderson et al., 2014; Hughes et al., 2018; Perry-Smith & Mannucci, 2017) by investigating the relationship of the creative leadership modes with both outcomes separately. Second, we follow Montag and colleagues' (2012) suggestion to further differentiate between creative behavior and its outcomes. In this vein, our study also speaks to research on the organization and management of research groups (Lee et al., 2015; Perry et al., 2016) and on training of future scientists (Shibayama, 2019), pointing to the relevance of facilitating and integrating creative leadership modes for nurturing the creative potential of research group members.

Our study offers important implications for practice. First, we developed and validated a scale for measuring the creative leadership modes present within a group. This measurement tool can help leaders and organizations determine their status concerning the distribution of creative and supportive contributions between leaders and the team. Second, introducing the concept of creative leadership modes in leadership guidelines and development programs may help raise awareness in light of current demands and suggest techniques for establishing new/different modes of interacting with the team. Third, the results of our study provide the first insights into which creative leadership mode is more suitable in which phase of the innovation cycle. This knowledge may be a straightforward lever for strategically influencing the creative and innovative process in teams. Focusing on the purposeful distribution of creative tasks between leaders and teams can help leaders shape their own and their followers' creative context intentionally and thereby induce team creative behavior or team innovative productivity. Finally, when staffing teams for creative work, attention should be paid to the distribution of creative tasks within the team, which should also involve thinking about the leaders' role. Overall, our study provides an opportunity for leaders and organizations to develop a strategy to augment the creativity and innovation of their teams.

### 3.5.2 Limitations and Future Research

When interpreting the findings of our study, it should be noted that it is not free of limitations. As it is the first study to measure and empirically test creative leadership modes, we encourage future research to test, validate, and extend our theoretical model and measurement of creative leadership modes. Particular attention should be paid to the following issues: First, our analyses and results do not allow causal claims. Even though a number of alternative explanations for the relationship of the creative leadership modes with the proposed outcome variables were excluded by controlling for third variable influence, the study cannot provide evidence on the direction of the effects observed in the regression analyses or the mechanisms leading to these effects. Future research should employ (field/quasi-) experimental methods and time series analyses to answer questions of causality. In addition, future research investigating mediators and moderators would help to illuminate the mechanisms of the influence of creative leadership modes on outcomes. For example, followers' individual creativity within a directing creative leadership mode might be dependent on their creative role identity, as highly creative people or people identifying as such might display creative behaviors even if the creative leadership mode present in the group does not encourage them to contribute creative ideas.

Second, it is important to consider some of the unique features of the setting. First, the academic research environment is a dynamic context characterized by short-term contracts and low team stability. Thus, future research should investigate the impact of leadership modes in longer-term teams. Second, we employed an unusual objective metric of innovative productivity: research publications. It differs from measures of innovation in other contexts in the definition of usefulness of the implemented idea. While in corporate contexts novel ideas are only implemented if they are directly useful in a practical way (e.g., by increasing revenue, saving spending), research articles are selected and vetted in regard to the usefulness of their contribution, not their commercial profit. Thus, future research should investigate whether the findings can be replicated with other operationalizations of innovative productivity.

Finally, as this is the first empirical study on creative leadership modes, we did not address the question of temporality. For instance, creative leadership modes might develop over time in a negotiation process between the leader and followers. Alternatively, the increasing expertise of followers (and/or leaders) might change the creative leadership mode over the lifetime of the team. In addition, different phases of the creative/innovative process might benefit differently from different creative leadership modes, and studying this would require a finer-grained assessment of the iterative phases of working together to attain a creative goal.

In addition, future research may investigate whether the integrating creative leadership mode, being associated with both creativity and innovation, is also associated with other favorable outcomes, such as high levels of team learning, team member satisfaction, or a higher percentage of team members who decide to pursue a career in academia.

### 3.5.3 Conclusion

In our study, first, we theoretically introduced the concept of creative leadership modes as they pertain to leaders and their teams. Second, we developed and validated a tool for measuring the facilitating, directing, and integrating creative leadership modes. Third, we demonstrated the differential relationships of the creative leadership modes with creative behavior and innovative productivity of teams. Despite the stated limitations, our study contributes to organizational creativity research by offering initial insights into how to distribute creative and supportive tasks between leader and team members.

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# 4 Creative through Time Pressure? A Cross-Level Perspective on Creative Self-Efficacy and Knowledge Sharing


**Abstract**

Creative ideas – and the innovations they enable – are key competitive advantages for organizations. However, as organizations need to innovate faster than their competitors in order to survive, the creative processes of individuals and teams are increasingly subject to time constraints. Drawing on the social cognitive theory and the social exchange theory, we investigate the relationship between time pressure and creativity at the individual and team level integrating two opposing mechanisms. We propose that time pressure positively influences individual creativity through a motivational mechanism (namely creative self-efficacy), while it negatively influences team creativity through a social mechanism (namely the lack of knowledge sharing). We collected multi-source data from 138 team members and 27 supervisors participating in two product development programs. A mixed-level analysis approach did not yield significant results, potentially due to insufficient statistical power. However, exploratory post hoc analyses revealed promising results: The individuals' creative self-efficacy partially mediated the investigated relationship between individual time pressure and individual creativity. Team time pressure had a negative indirect effect on team creativity via team knowledge sharing. In our conclusion, we discuss the implications of our findings for future research and organizations.



*Keywords:*

(team) creativity, time pressure, mixed-level, creative self-efficacy, knowledge sharing


*Note: This chapter is based on a paper (under review) co-authored by Niklas Dreymann and Lea-Therese Strobel. Therefore, the plural instead of the singular is used throughout this chapter.*

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## 4.1 Introduction

Generating creative ideas is an essential antecedent of innovation and, therefore, crucial for the survival and effectiveness of organizations (Anderson et al., 2014; Zhou & Hoever, 2014). However, driven by digitization and the increasingly complex and volatile market environment, organizations are required to respond with ever-faster product and innovation cycles (e.g., Chen et al., 2012; Welpe et al., 2018). In a recent survey, 39% of the 2,500 corporate innovation leaders questioned considered the speed of adopting new technologies as crucial, making it the third most important issue in new product development projects for the respondents (Boston Consulting Group, 2019). Emerging frameworks for product development, such as Scrum or Lean startup, apply time-boxing processes and aim at massively shortening the time to market of products (Ries, 2014; Schwaber & Beedle, 2002). Therefore, the creative processes of individuals and teams developing innovations are increasingly subject to time constraints.

Organizational creativity research offers first insights on the relationship between time pressure and creativity. Concerning individual creativity, theoretical frameworks proposed and empirical investigations found both a negative (e.g., Amabile, 1988; Andrews & Smith, 1996) and a positive (e.g., Baer & Oldham, 2006; Khedhaouria et al., 2017; Ohly & Fritz, 2010) influence of time pressure. For this reason, investigation of the role of mediators in this relationship rather than the direct relationship has been highlighted as an important aim for future research (e.g., Acar et al., 2019; Byron et al., 2010; LePine et al., 2005). In particular, researchers suggest that capability judgments, such as creative self-efficacy, may represent a hitherto unexamined mediating mechanism in this relationship (Farmer & Tierney, 2017; Ohly, 2018). Concerning team creativity, even though team-based structures become more prominent in organizations (Anderson et al., 2014), research on the team level is still scarce. For example, initial qualitative research by Rosso (2014) indicates a negative relationship between time pressure and team creativity as the communication of knowledge becomes more difficult. In an experimental study, Kelly and McGrath (1985) observed that teams with more severe time constraints interacted significantly less and produced less creative products than teams with less severe time constraints. Finally, emerging mixed-level research points at the importance of team level mechanisms affecting individual creative processes (e.g., Dong et al., 2017; Hirst et al., 2018). For instance, Richter and colleagues (2012) revealed that a team's shared informational resources had a positive, cross-level influence on the relationship between individual creative self-efficacy and individual creativity. Acar and colleagues (2019) integrated the current state of research in a comprehensive literature review and theoretically introduced the idea that time pressure may have a positive effect on individual creativity via a motivational mechanism of creative self-efficacy, but a negative effect on team creativity via a social mechanisms of knowledge sharing.

However, empirical research on individual and team creativity has so far not simultaneously assessed whether and how these underlying mechanisms mediate the relationship between time pressure and creativity across levels, which makes the understanding of this relationship as a mixed-level phenomenon incomplete (for reviews, see Acar et al., 2019; Razinskas & Hoegl, 2020). As managers strive to lead their employees towards highly creative outcomes (Dong et al., 2017; Gong et al., 2009; Gong et al., 2013), they must know whether exerting time pressure has opposing influences on individuals and teams. Summing up, this raises the following research question: How and why does time pressure affect individual and team creativity?

Drawing on social cognitive theory (Bandura, 1997) and social exchange theory (Blau, 1964; Emerson, 1976), this study applies a mixed-level approach to determine whether and why time pressure serves as a positive challenge or a negative hindrance to individual and team creativity. Thereby, we contribute to the organizational creativity research in the following ways: First, we untangle the influence of time pressure on individual and team creativity and unravel the mechanisms of how time pressure simultaneously influences creativity at different levels. We contribute to research on the constraint-creativity relationship by clarifying inconsistent findings in the previous literature and by offering integrative mixed-level empirical evidence on motivational and social mechanisms, which has been called for by Acar and colleagues (2019). Second, we investigate a person-situation interaction (van Knippenberg & Hirst, 2020) of an individual motivational state (creative self-efficacy) with a situational group process (knowledge sharing) that enables more opportunities for creativity. By examining the team as a resource that individuals have different tendencies to exploit (cf. Richter et al., 2012), we contribute to prior person-in-situation research focusing on group factors in a shared work context which activate individuals' creative potentials (cf. van Knippenberg & Hirst, 2020). Finally, we shed light on the cross-level interactive effects of individual and group processes in the generation of ideas, as called for by Razinskas and Hoegl (2020).

## 4.2 Theory

While creativity in organizations refers to the process of generating novel and useful ideas (e.g., Amabile & Pratt, 2016), innovation refers to the subsequent process of "implementing ideas toward better procedures, practices, or products" (Anderson et al., 2014, p. 1298). For this reason, researchers consider creativity as the first essential step of innovation (Amabile et al., 1996; Anderson et al., 2014; Mumford & Gustafson, 1988). Creativity models have emphasized the importance of contextual influences in the work environment as decisive factors for individual and team creativity (Amabile & Pratt, 2016; Woodman et al., 1993). For example, the componential theory of creativity suggests that a work environment which fosters intrinsic motivation is crucial for being creative (Amabile & Pratt, 2016). Besides intrinsic motivation, researchers concluded that creativity emerges from a variety of other individual cognitive or motivational processes (Acar et al., 2019; Mumford & Gustafson, 1988).

However, the generation of novel and useful ideas may also result from the interaction with others—such as the members of one's team (Anderson et al., 2014; Taggar, 2002; Woodman et al., 1993). Based on this interactionist perspective, team creativity is more than merely the aggregation of individual creative ideas (Woodman et al., 1993): It is a result of a mutual exchange and processing of information with others (Goncalo & Staw, 2006; Taggar, 2002; Woodman et al., 1993).

Due to these different creative processes on the individual and team level, contextual influences of the work environment may have different effects on individual and team creativity (Acar et al., 2019; Anderson et al., 2014). Furthermore, beside individual-level variables exerting an influence on team creativity (e.g., Pirola-Merlo & Mann, 2004; Taggar, 2002), the creative processes in a team can also exert cross-level influences on the creative process of the individual (Dong et al., 2017; Gong et al., 2013; Richter et al., 2012).

### 4.2.1 Creativity under Constraints

A prominent contextual influence in organizations' work environment is time pressure (Acar et al., 2019; Anderson et al., 2014; Razinskas & Hoegl, 2020). Time pressure is the extent to which individuals believe they have insufficient time to complete their work tasks or need to work faster than usual (Baer & Oldham, 2006; Kinicki & Vecchio, 1994). Creativity researchers categorize time pressure as a constraint, representing an externally imposed factor that affects individual and team creativity (Acar et al., 2019; Roskes, 2015; Rosso, 2014).

While early theories proposed a negative influence of constraints in general on creativity (e.g., Amabile, 1988), more recent research developed more nuanced theoretical approaches to address this issue (Acar et al., 2019; Roskes, 2015; Rosso, 2014). For instance, in the initial componential theory of creativity, Amabile (1988) assumed a negative relationship between constraints in general and individual creativity, arguing that constraints hinder intrinsic motivation, and thus, individual creativity (see also Amabile et al., 1996). In contrast, Roskes (2015) differentiates between two different categories of constraints and motivation: She distinguishes between limiting and channeling constraints as well as approach and avoidance motivation. Specifically, she suggests that limiting constraints, such as time pressure, in combination with approach motivation, the willingness to strive for success, may have a positive effect on individual creativity. Finally, the theoretical framework by Acar and colleagues (2019) provides the most comprehensive account of the constraints-creativity relationship to date, covering mechanisms between constraints and creativity on individual, team, and organizational levels.

Based on an extensive literature review, Acar and colleagues (2019) theorize on the relationship between constraints and creativity by introducing three mediating mechanisms: A motivational, a cognitive, and a social process route. For example, creative self-efficacy constitutes a motivating mechanism, and knowledge sharing constitutes a social mechanism. In general, the authors assume that whether the relationship between constraint and creativity is positive or negative depends on the investigated environment. Thus, constraints may simultaneously have opposing effects on creativity through different mediating mechanisms. For example, time pressure may have a positive effect on cognitive or motivational processes for creativity (e.g., Baer & Oldham, 2006; Khedhaouria et al., 2017) but an adverse effect on social processes (e.g., Kelly & McGrath, 1985; Rosso, 2014).

Since constraints, such as time pressure, also represent a form of stress, the consideration of theoretical frameworks in stress research also offers valuable insights from a different research area. In their challenge-hindrance stressor framework, LePine and colleagues (2005) assume that challenge and hindrance stressors affect work-related outcomes of individuals in different ways (see also LePine et al., 2004; Podsakoff et al., 2007). In their categorization, time pressure is a typical challenge stressor. The authors argue that all stressors are positively related to strain, but that challenge stressors are also positively related to work performance. In turn, the authors consider the individual's motivation as a partially mediating mechanism in the relationship between stressors and performance.

In summary, the presented theoretical frameworks in creativity and stress research both propose positive or negative influence of constraints depending on the situation. In particular, they suggest that constraints, such as time pressure, can be beneficial for the individual's creativity, if perceived as a motivating challenge (Acar et al., 2019; LePine et al., 2005; Roskes, 2015). Simultaneously, constraints may also be detrimental to team creativity—for example, by preventing important creativity-related social processes (Acar et al., 2019; Rosso, 2014). In conclusion, time pressure may be both a positive challenge and a negative hindrance to the creativity of individuals and teams.

### 4.2.2 Time Pressure and Creativity at the Individual Level – The Mediating Role of Individual Creative Self-Efficacy

Early studies have reported a negative influence of time pressure on individual creativity. For example, Andrews and Smith (1996) observed that product managers working under high time pressure developed less creative marketing programs. In contrast, there is a growing body of research suggesting that the individual's creative performance can benefit from time pressure. For example, Andrews and Farris (1972) found a significant, positive relationship between the time pressure reported by scientists at a given point in time and the innovativeness of their work evaluated by their supervisors five years later. Rostami and colleagues (2019) found a direct positive influence of perceived time pressure on creative behavior. To make sense of these mixed findings, researchers recently proposed investigating the role of mediators in this relationship rather than the direct relationship (Acar et al., 2019; Byron et al., 2010; LePine et al., 2005).

Acar and colleagues (2019) proposed that creative self-efficacy may be a motivational mechanism in the relationship between time pressure and creativity (see also Farmer & Tierney, 2017; Ohly, 2018). Creative self-efficacy is defined as "the belief one has the ability to produce creative outcomes" (Tierney & Farmer, 2002, p. 1138). In contrast to more general personality-related beliefs about the self, such as self-esteem, self-efficacy is a conceptually narrower capability judgment of individuals to accomplish a specific task (Bandura, 1997). Individuals form this capability judgement by evaluating their personal and situational resources and constraints (Bandura et al., 1992). Thus, (creative) self-efficacy can be conceptualized as a motivational task-specific, situation-dependent state (Gist & Mitchell, 1992; Tierney & Farmer, 2002). In the organizational context, aspects of the work environment, e.g., perceived capacity, have a profound influence on this capability judgment (Gist & Mitchell, 1992). Since creativity is inherently challenging due to many constraints in the work environment, such as time pressure, it depends on the individual's willingness to engage proactively with challenges (Farmer & Tierney, 2017).

Based on the social cognitive theory (Bandura, 1997, 2001), we argue that time pressure serves as a challenging, and thus motivating, stimulus to foster the individuals' beliefs in achieving creative solutions—their creative self-efficacy—which leads to higher individual creativity. The theory states that the individuals' learning behavior results from an interplay of their self-efficacious functions and the social environment in which they perform particular behaviors (Bandura, 1997, 2001). It suggests that individuals invest resources in their work if they believe that the intended results are achievable by their actions. Based on these assumptions, LePine and colleagues (2005) argued that challenge stressors, such as time pressure, may enhance the motivation of individuals through the perception that increased effort leads to achieving the desired results. In this way, challenge stressors motivate by offering the potential to support personal growth (LePine et al., 2005). In addition, in their teamwork team members often need to handle several task simultaneously or have to get tasks done quickly (Amabile et al., 2002). As time pressure is an inherent part of team work, it may lead to individual team members feeling involved and needed in the project work, thus feeling positively challenged and motivated to lean in. Hence, time pressure can be understood as a trigger for activating the motivational process of self-efficacy, which in turn is beneficial for the creation of novel and useful ideas (Khedhaouria et al., 2017).

As individuals are most creative when motivated by the challenging task itself (Amabile, 1983), the increase in creative self-efficacy through time pressure will in turn increase creative outcomes. Higher levels of self-efficacy lead to behaviors and attitudes positively related to creativity (Tierney & Farmer, 2002), like a broad search for information, sustaining of efforts, or being less inclined to abandon creative processes (Tierney & Famer, 2011). In contrast, individuals who score a lower level of creative self-efficacy appear to be less cognitively persistent (Farmer & Tierney, 2017). Hence, they are less likely to discover and embrace new knowledge, which may prevent them from being creative. Consequently, individual creative self-efficacy can be assumed to act as a positive mediating mechanism between individual time pressure and individual creativity.

Empirical evidence offers support to this assumption: A meta-analysis by Liu and colleagues (2016) demonstrated that creative self-efficacy mediates various relationships between contextual predictors of the work environment and individual creativity. Some empirical research in product development contexts likewise indicates that motivating mechanisms can mediate the positive relationship between time pressure and individual creativity (Khedhaouria et al., 2017; Ohly & Fritz, 2010). Furthermore, meta-analytical studies demonstrated a positive relationship between time pressure and self-efficacy (Irmer et al., 2019) as well as creative self-efficacy and individual creativity (Haase et al., 2018; Liu et al., 2016). Thus, we present the following hypothesis:

*Hypothesis 1: There is a positive relationship between individual time pressure and individual creativity, which is mediated by individual creative self-efficacy.*

### 4.2.3 Time Pressure and Creativity at the Team Level – The Mediating Role of Team Knowledge Sharing

While there is relatively thorough empirical evidence on the relationship between time pressure and creativity at the individual level, there is less empirical evidence at the team level. For example, Rosso (2014) discovered time pressure as a major constraint for R&D teams. The author found that in teams with disabling dynamics, insufficient cooperation and communication time pressure negatively influenced team creativity. Supporting these conclusions, Kelly and McGrath (1985) observed in an experimental study that teams with more severe time constraints interacted significantly less with their team members and produced less creative products than teams with less severe time constraints. Therefore, in contrast to the individual level, we assume a negative relationship between time pressure and creativity at the team level.

Team creativity is more than merely the aggregation of novel and useful ideas of individuals: It also comprises collective team processes (Goncalo & Staw, 2006; Taggar, 2002). In these processes, knowledge sharing between team members promotes the integration of different viewpoints, which in turn enables team creativity (van Knippenberg, 2017). Cummings (2004, p. 352) defined knowledge sharing as "the provision or receipt of task information, know-how, and feedback regarding a product or procedure." Thus, knowledge sharing includes seeking and contributing behaviors that exceed the mere exchange of information (Cleveland & Ellis, 2015). In general, access to diverse, non-overlapping information is crucial for team members' creative endeavors (Richter et al., 2012; Sijbom et al., 2018). In summary, researchers suggested that knowledge sharing is a valuable resource for generating novel and useful ideas within a team (Dong et al., 2017; Gong et al., 2013; Sung & Choi, 2012).

Drawing on the social exchange theory (Blau, 1964; Emerson, 1976), we argue that time pressure hinders team knowledge sharing, thereby acting as a detrimental mechanism for team creativity (Acar et al., 2019). The social exchange theory states that individuals evaluate the benefits and costs of engaging in interaction with others. For individuals under time pressure, the perceived cost of interacting with their team members may exceed the perceived benefits of knowledge sharing. As a result, this may prevent individuals from interacting with others to share knowledge. Furthermore, time-pressed individuals need to prioritize their cognitive capacities, which may further reduce their social behavior (Cohen, 1980). Consequently, team knowledge sharing can be assumed to act as a negative, mediating mechanism between team time pressure and team creativity.

Empirical evidence supports this assumption: In a qualitative study, Rosso (2014) found that the communication of knowledge in teams is an essential mechanism between constraints, such as time pressure, and team creativity. Furthermore, there is strong evidence in knowledge management research that time pressure inhibits knowledge sharing (Cleveland & Ellis, 2015). Based on a meta-analysis, Hülsheger and colleagues (2009) concluded that the internal communication of knowledge between team members has a positive effect on the generation of a team’s ideas. Also, empirical research in product development contexts stresses that time pressure inhibits team knowledge sharing activities (Chong et al., 2012; Kelly & McGrath, 1985; Maruping et al., 2015). Knowledge sharing, in turn, has been shown to positively influence team creativity (Dong et al., 2017; Gong et al., 2013). Therefore, we present the following hypothesis:

*Hypothesis 2: There is a negative relationship between team time pressure and team creativity, which is mediated by team knowledge sharing.*

#### 4.2.4 Cross-Level Effect of Team Knowledge Sharing

As team knowledge sharing gets more difficult under time pressure, we assume this also interacts with individual creativity processes. The social cognitive theory states that the individuals’ learning behavior results from an interplay of their self-efficacious functions and the social environment in which they perform particular behaviors (Bandura, 1997, 2001). As particularly creative self-efficacious individuals may seek interaction with others (Bandura, 2001) and are more prone to engage in a broad search for information (Tierney & Farmer, 2002), knowledge sharing with team members may be a vital environmental resource for them to develop novel and useful ideas. Hence, team knowledge sharing may strengthen the relationship between individual creative self-efficacy and individual creativity.

First, team knowledge sharing can broaden the individual's knowledge pool, encompassing diverse team members' perspectives that may inspire each individual in a team (Dong et al., 2017; Gilson et al., 2013). The sharing of information may also stimulate the individuals' divergent thinking, which can be conducive to individual creativity (Gong et al., 2013). Second, open communication in a team can be beneficial for diffusing ideas (Hülsheger et al., 2009) and receiving feedback (Sijbom et al., 2018). In other words, team knowledge sharing can support individuals in accessing and discussing comprehensive information and, thus, foster strategies for developing new products and processes (van Knippenberg, 2017). Individuals can make better use of their knowledge and competencies by supplementing them with those of the team (Dong et al., 2017; Gong et al., 2013). So, while creative self-efficacy might be the mechanism translating time pressure into individual creativity, team knowledge sharing could further increase the effectiveness of coping with creative challenges. Consequently, team knowledge sharing can be assumed to act as a positive cross-level influence between individual creative self-efficacy and individual creativity.

Empirical evidence supports this assumption: Research in product development contexts indicates a cross-level effect of team knowledge sharing activities on creative processes (Dong et al., 2017; Gong et al., 2013; Richter et al., 2012). In particular, Richter and colleagues (2012) showed that shared informational resources – the knowledge about who knows what – in a team have a positive moderating influence on the relationship between individual creative self-efficacy and individual creativity. In this study, we broaden the authors' assumptions by suggesting that – under time pressure – not the mere shared informational resources, but the active team process of knowledge sharing is an essential moderating influence. Thus, we present the following hypothesis:

*Hypothesis 3: The relation between individual creative self-efficacy and individual creativity is moderated by team knowledge sharing in such a way that individual creative self-efficacy is more positively related to individual creativity when team knowledge sharing is high.*

Figure 4.1 depicts the hypothesized mixed-level model of this study.

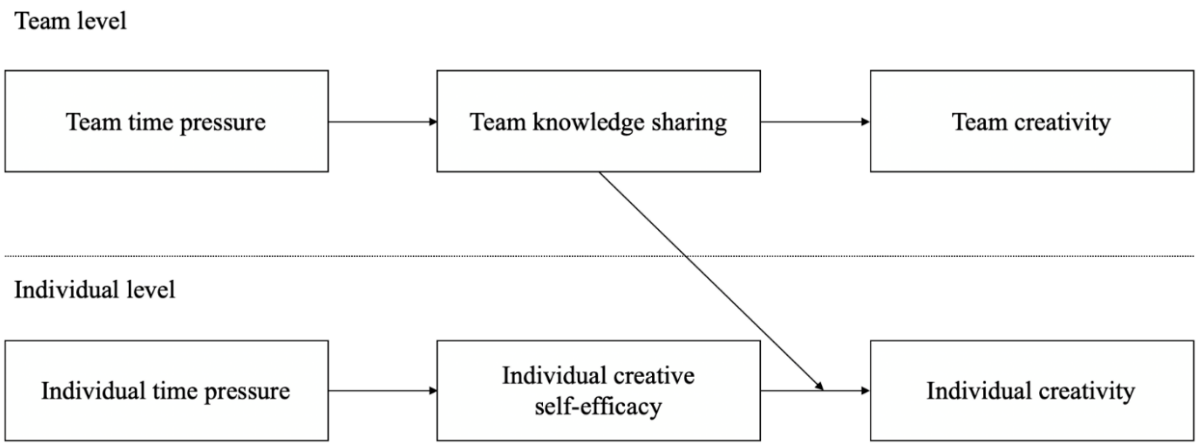


*Figure 4.1.* Hypothesized mixed-level model of time pressure and creativity.

## 4.3 Method

### 4.3.1 Sample and Procedure

The minimum sample size required was determined by power analysis. To determine the required sample size on the team level, we followed the recommendations of Scherbaum and Ferreter (2009) and assumed an average effect size of .50, a standard .05 alpha error probability, and an intra-class correlation of .18 for the calculations. When assuming an average team size of six team members, a sample size of at least 40 teams was determined as necessary to achieve a power level of .80. At the individual level for the most complex model, we followed the recommendations of Peruigini and colleagues (2018) and assumed a standard .05 alpha error probability, the correlation from Richter and colleagues (2012) as the minimum effect size, and a power of .80. For a moderated mediation regression, 199 individuals was the minimum sample size required.

We collected data from product development teams from two extracurricular, voluntary student programs at a German university. The purpose of these programs was to develop either novel product prototypes based on challenges proposed by external companies, which operated, e.g., in the fields of biotechnology, construction, healthcare, and mobility, or novel products and concepts that promoted scientific understanding in society. Exemplary products designed in the programs were an application for preparing patients before surgery in a hospital, a foldable oven, or an online platform for citizen participation in politics. The tasks of the product development teams and their multidisciplinary composition were similar to study contexts in the organizational R&D context (Dong et al., 2017; Richter et al., 2012). Similar to the R&D context, a high degree of creativity was essential for the teams to complete their programs successfully. Also, the programs imposed several strict deadlines and processes so that the teams were under time pressure during the entire program. Each team was coached by one or several supervisors. Supervisors were graduate students and closely supervised the teams in the development of their products and team dynamics. Overall, the sample consisted of 254 individuals nested in 47 teams. The teams were at different stages of the programs so that their team tenure ranged between 3 and 20 months, while a part of the teams had already completed the program.

Data was collected via an online survey during February and March 2020 from team members and supervisors. Participants were recruited via email and informed that participation was voluntary and confidentiality assured.

Eventually, 166 team members in 45 teams and 31 supervisors participated in this study. Hence, the response rate was 65.35% for team members and 72.09% for supervisors. After excluding participants with missing data on one of the main scales and teams with missing supervisor ratings or less than two participating team members, our final sample consisted of 138 team members from 31 teams. The average team size was 6.23 (*range* = 3–13); the average number of participants per team was 4.45 (*range* = 2–8). The average team tenure was 10.25 months (*SD* = 7.59). Within the final sample, 39.86% of the team members were female, and the average age was 23.80 years (*SD* = 3.07). Further, we obtained ratings on individual and team measures by 27 supervisors. Among the supervisors, 33.33% were female, and the average age was 25.56 years.

#### 4.3.2 Measures

The team members rated their time pressure, individual creative self-efficacy, and team knowledge sharing. The supervisors assessed the individual creativity of the team members and team creativity of the whole team. The survey language was English, as it was the official language of the programs. Therefore, the translation of items was not necessary. Unless otherwise noted, all variables were measured on 7-point Likert scales ranging from 1 (*Strongly disagree*) to 7 (*Strongly agree*).

*Individual time pressure.* Team members rated their individual time pressure on the five-item scale from the English version of the Instrument for Stress Oriented Task Analysis (Irmer et al., 2019). The 7-point Likert scale ranged from 1 (Never) to 7 (Very often). The items referred to a quantitatively high workload. A sample item was "How often are you pressed for time?" (Cronbach's alpha = .86).

*Individual creative self-efficacy.* Team members rated their individual creative self-efficacy on a three-item scale by Tierney and Farmer (2002). The team members were asked to provide the extent to which they agreed that the items described themselves in the scope of the respective program. A sample item was "I have confidence in my ability to solve problems creatively." (Cronbach's alpha = .76).

*Individual creativity.* Supervisors rated team members' individual creativity on a four-item scale, which was adapted from Tierney and colleagues (1999). Namely, the four items were "Generates novel, but operable work-related ideas.", "Tries new ideas or methods first.", "Seeks new ideas and ways to solve problems.", and "Generates ground-breaking ideas related to the field." (Cronbach's alpha = .86).

In addition, in order to incorporate empirical evidence highlighting a stronger relationship between individual creative self-efficacy and self-rated (vs. supervisor rated) individual creativity (Haase et al., 2018), a modified version of the supervisor rating scale was filled in by the team members. A sample item was "I generate novel, but operable work-related ideas." (Cronbach's alpha = .75).

*Team time pressure.* To form the team time pressure measure, the individual time pressure score was aggregated to the team level. This approach was supported by the acceptable inter-group agreement of *rwg* = .75 and *ICC(1)* = .15, and a reliability of group mean index of *ICC(2)* = .38. ICC values were significant at a level of $p < .05$.

*Team knowledge sharing.* Team members completed a three-item scale, which Gilson and colleagues (2013) adapted from Faraj and Sproull (2000), to measure their team's knowledge sharing. The items referred to the extent to which team members considered their team to be engaged in knowledge sharing activities. A sample item was "People in our team share their special knowledge and expertise with one another." (Cronbach's alpha = .84). The individual team member scores were aggregated to the team level (*rwg* = .77, *ICC(1)* = .10, *ICC(2)* = .29).

*Team creativity.* Supervisors rated their team's creativity on a four-item scale by Shin and Zhu (2007). The 7-point Likert ranged from 1 (*Poorly*) to 7 (*Very much*). Supervisors were asked to compare the creative performance of their team with that of other teams in the respective program. A sample item was "How creative do you consider your team to be?" (Cronbach's *alpha* = .80).

*Control measures.* To account for their influence on the proposed outcome variables, we controlled for age (in years), gender (dummy coded with 1 = male and other, 2 = female) and team tenure (in months) on the individual level (cf. Richter et al., 2012), and for team size on the team level (cf. Dong et al., 2017; Hirst et al., 2009).

### 4.3.3 Analytical Approach

We analyzed the individual and cross-level relationships by applying mixed-level modeling of two-level models. Individual team members resided at Level 1 and were nested within Level 2 teams. We group-mean centered individual creative self-efficacy and added its group mean to the Level 2 intercept-only model as a covariate for the cross-level interactions (Hypothesis 3) to reduce potential multicollinearity in the Level 2 estimation. Team level relationships were analyzed with multiple regressions based on ordinary least squares (OLS). Finally, we tested the individual level mediation hypothesis (H1) with Hayes and Rockwood's (2020) Monte Carlo simulation-based tests and the team level mediation hypothesis (H2) with Hayes' (2018) bootstrapping-based test for mediation. The bootstrapping intervals, comprising 1000 repetitions, were also calculated for each relationship in the models to address non-linearity and non-normality constraints and to obtain more robust results (e.g., Pek et al., 2018).

## 4.4 Results

### 4.4.1 Descriptive Statistics

Table 4.1 shows means, standard deviations, and correlation of the examined variables.

**Table 4.1:** Descriptive statistics, correlations, and reliabilities

| Variables | *M* | *SD* | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|---|
| *Individual level* | | | | | | | | |
| 1. Age | 23.80 | 3.07 | — | | | | | |
| 2. Gender | 1.43 | .53 | .14 | — | | | | |
| 3. Team tenure | 10.25 | 7.59 | .22* | .00 | — | | | |
| 4. Individual time pressure | 4.19 | 1.23 | .16 | -.06 | .06 | (.86) | | |
| 5. Individual creative self-efficacy | 4.98 | 1.13 | -.12 | -.26* | .06 | .02 | (.86) | |
| 6. Individual creativity | 4.98 | 1.13 | -.12 | -.23* | .06 | .02 | -.00 | (.86) |
| *Team level* | | | | | | | | |
| 1. Team size | 6.23 | 2.31 | — | | | | | |
| 2. Team time pressure | 4.25 | .76 | -.23 | — | | | | |
| 3. Team knowledge sharing | 5.92 | .64 | .06 | -.29 | (.84) | | | |
| 4. Team creativity | 5.50 | .88 | .17 | -.04 | .32 | (.80) | | |

*Note.* $N$ = 138 individuals in 31 teams. Pearson's correlation coefficient shown. Reliabilities (Cronbach's alpha) for the scales are in parentheses and presented along the diagonal.
* $p < .05$

### 4.4.2 Hypothesis Testing

Prior to hypothesis testing, we examined whether there was significant variance between the two programs in the outcome variables by running null (intercept-only) models. The results showed that 39.00% of the variance of individual creativity resided at the team level and 2.00% at the program level. The Chi-square test between a null model ignoring the team and program level showed a significant difference to the model that incorporated the team level ($\chi^2(1, N{=}138) = 33.21$, $p < .01$), but no significant difference to the model that also incorporated the program level ($\chi^2(1, N{=}138) = .50$, $p = .48$). Thus, applying a two-level model for the analysis of individual level relationships, but not a three-level model incorporating the program level, was justified.

The results of the mixed-level analysis are summarized in Table 4.2 (Hypotheses 1 and 3); those of the multiple regressions in Table 4.3 (Hypothesis 2). There were no differences in significance between the results of the regression and bootstrapping analysis. The (indirect) effects were significant when the bootstrapping confidence interval did not include zero.

*Test of individual level relationships.* As shown in Table 4.2, individual time pressure did not relate significantly to individual creative self-efficacy ($\gamma = .00$, $p = .99$; Model 1). Furthermore, individual time pressure did not relate significantly to individual creativity ($\gamma = .06$, $p =$ 40; Model 2). Individual creative self-efficacy did not relate significantly to individual creativity when individual time pressure was included in the model ($\gamma = .05$, $p = .55$; Model 3). Investigation of the mediation effect using the Monte Carlo simulation procedure with 10,000 repetitions showed no indirect effect ($\beta = .00$, *95% CI* [-.02, .02]), indicating that there was no significant mediating influence of individual creative self-efficacy in the relationship between individual time pressure and individual creativity. Thus, Hypothesis 1 was rejected.

*Test of team level relationships.* As shown in Table 4.3, team time pressure was negatively related to team knowledge sharing, but the regression coefficient was not significant ($\beta = -.25$, $p = .12$; Model 1). Team time pressure did not relate significantly to team creativity ($\beta = .01$, $p = .98$; Model 2). Team knowledge sharing did not relate significantly to team creativity when team time pressure was included in the model ($\beta = .47$, $p = .08$; Model 3). Investigation of the mediation effect using the Monte Carlo simulation procedure with 10,000 repetitions showed a non-significant negative indirect effect ($\beta = -.12$, *95% CI* [-.44, .06]), indicating that there was no significant mediating influence of individual team knowledge sharing in the relationship between team time pressure and team creativity. Thus, Hypothesis 2 was rejected.

**Table 4.2:** Mixed-level analyses of individual level relationships

| | DV = Individual creative self-efficacy | | DV = Individual creativity | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Model 1 | | Model 2 | | Model 3 | | Model 4 | |
| | γ | 95% CI | γ | 95% CI | γ | 95% CI | γ | 95% CI |
| *Individual & team level covariates* | | | | | | | | |
| Age | .00 | [-.05, .06] | -.01 | [-.08, .04] | -.02 | [-.08, .05] | -.01 | [-.08, .05] |
| Gender | -.21 | [-.49, .09] | -.40* | [-.64, -.05] | -.34* | [-.65, -.02] | -.36* | [-.64, -.01] |
| Team tenure | -.01 | [-.04, .02] | -.01 | [-.06, .03] | -.01 | [-.06, .03] | -.02 | [-.06, .03] |
| Team size | -.03 | [-.11, .05] | .15* | [.02, .29] | .15* | [.01, .30] | .15* | [.01, .30] |
| Team knowledge sharing | .20 | [-.11, .47] | .07 | [-.43, .51] | .06 | [-.40, .50] | -1.07 | [-3.65, 1.33] |
| Team time pressure | .30 | [-.03, .60] | .10 | [-.38, .51] | .06 | [-.39, .53] | .18 | [-.38, .69] |
| Team mean of individual creative self-efficacy | | | | | | | -.19 | [-.86, .45] |
| *Individual level predictors* | | | | | | | | |
| Individual time pressure | .00 | [-.13, .16] | .06 | [-.07, .20] | .07 | [-.07, .22] | .05 | [-.09, .23] |
| Individual creative self-efficacy | | | | | .05 | [-.13, .23] | -1.20 | [-4.07, 1.37] |
| *Cross-level interaction* | | | | | | | | |
| Team knowledge sharing x Individual creative self-efficacy | | | | | | | .21 | [-.21, .68] |
| *Pseudo $R^2$* | .11 | | .45 | | .45 | | .47 | |

*Note.* *N* = 138 individuals (Level 1) in 31 teams (Level 2). Unstandardized estimates are reported. DV = dependent variable.
* $p < .05$

*Test of cross-level interaction.* As shown in Table 4.2, the cross-level moderation of team knowledge sharing and individual creative self-efficacy did not relate significantly to individual creativity (γ = .22, $p$ = .32; Model 4), indicating that there was no significant moderating influence of team knowledge sharing on the relationship between individual time pressure and individual creativity. Thus, Hypothesis 3 was rejected.

**Table 4.3:** Analyses of team level relationships

| | DV = Team knowledge sharing | | DV = Team creativity | | | |
|---|---|---|---|---|---|---|
| | Model 1 | | Model 2 | | Model 3 | |
| | β | 95% CI | β | 95% CI | β | 95% CI |
| *Covariates* | | | | | | |
| Team size | -.00 | [-.10, .15] | .07 | [-.16, .17] | .07 | [-.18, .18] |
| *Predictors* | | | | | | |
| Team time pressure | -.25 | [-.72, .17] | .01 | [-.50, .51] | .12 | [-.36, .56] |
| Team knowledge sharing | | | | | .47 | [-.14, .95] |
| *ANOVA* | *F(2,28) = 1.32, p = .28* | | *F(2,28) = .41, p = .67* | | *F(3,27) = 1.42, p = .26* | |
| $R^2$ | .09 | | .03 | | .14 | |

*Note.* *N* = 31 teams. Unstandardized estimates are reported. DV = dependent variable.
* *p* < .05

### 4.4.3 Post hoc Analyses

The originally proposed analyses did not show the proposed relationships. However, the power analyses may have already pointed to this shortcoming, as the minimum sample size required was reached neither on the team nor on the individual level. The lack of statistical power may have disguised the true relationships. To increase statistical power, we conducted post hoc analyses on less complex models. Apart from switching to single-level analyses, we applied two further modifications: First, we excluded two cohorts of the program with the largest team tenure. These cohorts had already completed the program half a year or a full year ago. Both supervisors and team members in these cohorts had expressed concerns about the reliability of their ratings. Furthermore, the teams of the two cohorts were significantly larger (*M* = 9.08, *SD* = 3.18) than teams of the other cohorts (*M* = 5.79, *SD* = 1.66; $t(164) = 8.52$, $p < .001$). The covariate team size had a significant impact on individual creativity in the originally proposed analysis (see Table 4.2). This led to a reduced sample of 127 team members nested in

24 teams for the post hoc analyses. Second, we used the team members' self-rating of individual creativity as a dependent variable instead of the supervisor rating. Several supervisors had reported that while it was feasible to rate their teams' creativity, it was difficult to rate the individual members.

With these modifications, we re-examined the individual level relationships from Hypothesis 1. Table 4.4 summarizes the results of the multiple regressions. Multiple regressions revealed that individual time pressure related significantly and positively to individual creative self-efficacy ($\beta = .14$, $p = .04$; Model 1). In addition, individual time pressure related significantly and positively to self-rated individual creativity ($\beta = .21$, $p = .01$; Model 2). Finally, individual creative self-efficacy was significantly and positively related to self-rated individual creativity when time pressure was included in the model ($\beta = .57$, $p < .001$; Model 3). The mediation analysis revealed that individual creative self-efficacy partially mediated the positive relationship between time pressure and individual creativity. The indirect effect was significant ($\beta = .08$; *95% CI* [.00, .15]).

For the team level post hoc analysis, we weighted the 24 teams according to the number of participants per team. The minimum number of participants per team was two; the maximum was eight. Response rate per team ranged from 40% to 100% ($M = 72.90\%$, $SD = 18.28\%$). The team weighting by the number of its participants (Biemer & Christ, 2008; Kalton & Flores-Cervantes, 2003) more closely reflects that the measures, which were aggregated to the team level (team time pressure and team knowledge sharing), are more reliable for teams with a higher number of participants. Teams with more participants had a higher weighting, and teams with fewer participants had a lower weighting. We deduced the team level ratings to the individual level to implement this simple cell weighting (Kalton & Flores-Cervantes, 2003).

**Table 4.4:** Post hoc analyses of individual level relationships

| | DV = Individual creative self-efficacy | | DV = Individual creativity | | | |
|---|---|---|---|---|---|---|
| | Model 1 | | Model 2 | | Model 1 | |
| | β | 95% *CI* | β | 95% *CI* | β | 95% *CI* |
| *Covariates* | | | | | | |
| Age | .02 | [-.05, .10] | -.01 | [-.09, .06] | -.02 | [-.07, .03] |
| Gender | -.13 | [-.47, .18] | -.01 | [-.41, .22] | -.02 | [-.30, .24] |
| Team tenure | -.04* | [-.07, -.02] | -.05* | [-.08, -.02] | -.02 | [-.05, .01] |
| *Predictors* | | | | | | |
| Individual time pressure | .14* | [.00, .29] | .21* | [.05, .36] | .13* | [.00, .27] |
| Individual creative self-efficacy | | | | | .57* | [.35, .78] |
| *ANOVA* | *F(4,122) = 2.92, p = .02* | | *F(4,122) = 3.78, p = .01* | | *F(5,121) = 14.63, p < .001* | |
| $R^2$ | .09 | | .11 | | .38 | |

*Note.* *N* = 127 individuals. Unstandardized estimates are reported. DV = dependent variable.
* *p* < .05

With these modifications, we re-examined the team level relationships from Hypothesis 2. Table 4.5 summarizes the results of the multiple regressions. Team time pressure related significantly and negatively to team knowledge sharing (β = -.34, $p < .01$; Model 1). Team time pressure was not related to team creativity (β = .01, $p = .93$; Model 2). Team knowledge sharing was significantly and positively related to team creativity when team time pressure was included in the model (β = .76, $p < .001$; Model 3). The bootstrapping-based test with 10,000 repetitions showed a significant and negative indirect effect of team time pressure on team creativity through team knowledge sharing. The indirect effect was β = -.26 (*95% CI* [-.46, -.08]).

**Table 4.5:** Post hoc analyses of weighted team level relationships

| | DV = Team knowledge sharing | | DV = Team creativity | | | |
|---|---|---|---|---|---|---|
| | Model 1 | | Model 2 | | Model 3 | |
| | β | 95% *CI* | β | 95% *CI* | β | 95% *CI* |
| *Covariates* | | | | | | |
| Team size | .03 | [-.04, .12] | -.10 | [-.21, .01] | -.12* | [-.22, -.03] |
| *Predictors* | | | | | | |
| Team time pressure | -.34* | [-.57, -.11] | .01 | [-.28, .27] | .27* | [.07, .44] |
| Team knowledge sharing | | | | | .76* | [.51, .97] |
| *ANOVA* | *F(2,98) = 10.46, p < .01* | | *F(2,98) = 1.78, p = .17* | | *F(3,97) = 13.42, p < .01* | |
| $R^2$ | .18 | | .04 | | .29 | |

*Note.* *N* = 101 individuals in 24 teams. Unstandardized estimates are reported. DV = dependent variable.
* *p* < .05

## 4.5 Discussion

We set out to investigate the mediating mechanisms that explain the relationship between time pressure and creativity at the individual and team level. Using a sample of 138 individuals from 31 project development teams, we tested three hypotheses. The results of the hypotheses testing show that individual creative self-efficacy did not mediate the proposed positive relationship between individual time pressure and individual creativity. Also, team knowledge sharing did not mediate the proposed negative relationship between team time pressure and team creativity. Finally, the results showed no positive cross-level interaction effect of team knowledge sharing and individual creative self-efficacy on individual creativity. In summary, the originally proposed analyses did not show the proposed relationships.

However, the main limitation of our study is that the small sample size at both levels may have masked potential effects, as the limited power probably does not suffice for a mixed-level approach with small effect sizes (e.g., McNeish & Stapleton, 2016; Scherbaum & Ferreter, 2009). This fact may substantially explain the non-significant effects of our mixed-level analysis and, by implication, encourages further research with larger sample sizes. Furthermore, our sample contained two cohorts of participants, who had finished the product development program half a year ago or longer, and in which many participants reported difficulties answering the questionnaire retrospectively. These participants may have diluted the true effects in the originally proposed analyses through unreliable answers.

Nevertheless, the findings of the exploratory post hoc analyses provide some support for this study's theoretical model. These analyses did not encompass the mixed-level modeling to increase statistical power and excluded the two oldest cohorts of participants. First, individual creative self-efficacy partially mediated the positive relationship between individual time pressure and self-rated individual creativity. If these results are supported by future studies, the results would provide some support for the theoretical frameworks of Acar and colleagues (2019) and Roskes (2015), whose work suggests that constraints can have a positive influence on the individuals' creative performance through motivational mechanisms. Furthermore, they would underpin the meta-analytical findings on the challenge-hindrance framework by LePine and colleagues (2005), suggesting that challenge stressors, such as time pressure, can have a positive influence on the individuals' motivation, and consequently enhance their performance.

Second, applying team weighting, team time pressure had a significant negative indirect effect on team creativity through team knowledge sharing. If these results are supported by future studies, this would suggest that time pressure is an inhibiting factor for knowledge sharing activities, indirectly decreasing team creativity. This result then would provide some support for the theoretical frameworks of Acar and colleagues (2019) and Rosso (2014). Notably, in the post hoc analyses, team time pressure also had a significant positive effect on team creativity when team knowledge sharing was included in the model, while it had no effect when team knowledge sharing was not included. This could indicate that at the team level, in addition to the negatively mediating social route, a positively mediating mechanism through the cognitive or motivational route may be present at the same time. For example, a team level equivalent of individual creative self-efficacy, such as team efficacy (Gully et al., 2002) with reference to creative tasks, could act as a motivational mechanism at the team level.

Finally, we could not demonstrate a significant moderating effect of team knowledge sharing on the relationship between individual creative self-efficacy and individual creativity. Thus, we could not extend the results of Richter and colleagues (2012), who investigated a team's shared informational resources as an analogous moderator in the relationship between these variables. In their operationalization, the authors referred mainly to access to comprehensive knowledge and less to knowledge sharing activities. Transferring this knowledge efficiently and effectively to creative self-efficacious individuals may further enhance their creativity (Durham et al., 2000; Gong et al., 2013; Richter et al., 2012). Therefore, the accessibility of comprehensive team knowledge and its effective and efficient translation to individuals may yield a stronger interacting influence on an individual's creativity than the team's potentially inefficient engagement in knowledge sharing activities.

In conclusion, the results of the post hoc analyses provide some indications for this study's theoretical model. Notably, they support the proposition of Acar and colleagues (2019) that time pressure may have opposing effects on individual and team creativity via different mechanisms. Thus, time pressure may influence creativity positively on the individual level via individual creative self-efficacy and negatively on the team level via team knowledge sharing. If these results are supported by future studies, they may explain the contradictory findings of previous studies, which have identified positive (Hsu & Fan, 2008; Khedhaouria et al., 2017; Ohly & Fritz, 2010), negative (Amabile et al., 2002; Andrews & Smith, 1996), or curvilinear relationships (Baer & Oldham, 2006; Binnewies & Wörnlein, 2011) between time pressure and creativity.

#### 4.5.1 Implications for Theory and Practice

We contribute to the existing literature in three ways. First, to our knowledge, this is the first study that investigates mediating mechanisms linking time pressure and creativity at the individual level, team level, and cross-level within one investigation. The results of our post hoc analyses offer first indications that time pressure has opposing effects on individual and team creativity via different mechanisms. Thereby, we address current calls for a differentiated, mixed-level view on the relationship between time pressure and creativity (Acar et al., 2019; Razinskas & Hoegl, 2020). Furthermore, we tested parts of the integrative theoretical framework on the constraint-creativity relationship proposed by Acar and colleagues (2019) by covering one input constraint, namely time pressure, one mechanism via each of the motivational and the social route as well as both team- and individual-level creativity.

Second, in our post hoc analyses, we identified individual creative self-efficacy as a mediator in the positive relationship between individual time pressure and self-rated individual creativity. Thereby, we make a first step towards clarifing inconsistent findings from previous research (Andrews & Smith, 1996; Khedhaouria et al., 2017; Ohly & Fritz, 2010) and respond to calls for research to examine creative self-efficacy as a mechanism linking influences in the working environment and individual creativity (Farmer & Tierney, 2017; Ohly, 2018).

Third, in our post hoc analyses, we identified an indirect effect of team knowledge sharing in the relationship between team time pressure and team creativity. Thereby, we addressed the call of Acar and colleagues (2019) to investigate the impact of input constraints on social mechanisms linked to creativity, which they identified as an understudied topic.

Furthermore, our study offers important implications for practice, if the results of the post hoc analyses can be replicated in future studies. First, the results enable team leaders to understand the opposing effects that time pressure may have on the creativity of individuals and teams. This awareness can help managers to exert time pressure at the individual level to encourage the individual's creative performance while reliving time pressure on the team level to not endanger team creativity. Second, leaders can benefit from understanding the mechanisms that translate time pressure to a higher or lower creative performance. On the one hand, leaders can improve individual creativity by framing it as a motivating challenge to complete creative tasks under time pressure and explicitly highlighting that the team members are highly capable of achieving the creative goals, thereby fostering their creative self-efficacy. On the other hand, leaders can alleviate the negative influence of time pressure via the social mechanism by actively fostering knowledge sharing. New team-based organizational frameworks, such as Lean startup or Scrum, provide a range of approaches to promote team knowledge sharing (Ries, 2014; Schwaber & Beedle, 2002). For example, short daily meetings or the physical co-location of teams may be beneficial for team knowledge sharing (Schwaber & Beedle, 2002). Also, the implementation of digital knowledge and communication tools may enhance teamwork (Rao, 2005). Furthermore, explicit formal standards (Cleveland & Ellis, 2015; Quigley et al., 2007) and incentives for knowledge sharing (Bartol & Srivastava, 2002) may help to reduce the negative influences of time pressure on team creativity. Overall, our study provides an opportunity for leaders and organizations to develop strategies to augment the creativity of their teams and team members.

### 4.5.2 Limitations and Future Research

When interpreting the findings of our study, it should be noted that it is not free of limitations. Particular attention should be paid to the following issues: First, the originally proposed analyses were underpowered. While the preliminary power analysis resulted in a required sample size of 40 teams with six team members, equaling 240 participants at the individual level, to obtain a power level of .80, only 138 evaluable team member data sets from 31 teams could be collected in this study. Hence, we acknowledge that this sample size is very low for testing mixed-level models with small effect sizes (McNeish & Stapleton, 2016; Scherbaum & Ferreter, 2009). Therefore, existing effects may not be detected due to low power. In our less complex post hoc analyses, without a mixed-level approach and fewer covariates, we were able to find significant effects supporting evidence for the proposed hypothesis model. Consequently, future research should generate a larger sample in order to be able to detect present effects.

Second, our analyses and results do not allow causal claims, as we cannot provide evidence on the direction of the effects observed in our regression analyses or the mechanisms leading to these effects. For example, creative self-efficacious individuals may perceive less time pressure. Potentially, teams, which are known for high time pressure, may attract less creative team members. Although these sequences appear less plausible from a theoretical perspective (cf. Acar et al., 2019; Amabile & Pratt, 2016; LePine et al., 2005), future research should apply experimental studies or time series analyses to verify the causal relationships between time pressure and creativity and their mediating mechanisms.

Third, there are limitations to the measurements applied in this study. First, the objectivity and the discriminatory power of the time pressure measure could be improved. For instance, the experimental manipulation of the available time for a specific task offers an objective measure for time pressure in comparison to the subjectively experienced time pressure assessed in this study. Also, further research could apply time pressure measures that explicitly distinguish between hindrance and challenge time pressure at the individual and team level (e.g., as in Chong et al., 2011; Chong et al., 2012). This can provide a more detailed understanding of the influence of time pressure on creativity. Second, although it is common research practice to measure creativity at the individual and team level via supervisor ratings (Anderson et al., 2014; Podsakoff et al., 2003), these ratings nonetheless should be treated with caution. Despite frequent interaction between supervisors and team members, supervisors may have trouble differentially assessing the individual's creative contribution to a team outcome. Indeed, in this study the team member's self-rated, but not supervisor rated individual creativity, had a significant relationship with individual time pressure and individual creative self-efficacy (as reported in prior meta-analyses, e.g., Irmer et al., 2019; Haase et al., 2018). Therefore, future research should consider cross-validating the team leader ratings by using alternative measures, such as peer ratings or objective indices (Anderson et al., 2014). In conclusion, these measurement limitations may explain why the investigated relationships in the originally proposed analyses remained insignificant.

Finally, we acknowledge that other moderating or mediating factors not examined in this study may influence the proposed relationships at the individual and team level. Concerning mediating mechanisms, future research should focus especially on the other routes highlighted in the framework by Acar and colleagues (2019), which are not investigated so far (e.g., social route and cognitive route on the individual level; cognitive and motivational route on the team level). For instance, future research should consider investigating mediators such as production blocking (Diehl & Stroebe, 1987; social route), or team mental models (Toader & Kessler, 2018; cognitive route). Furthermore, examining the following moderators could increase understanding of the constraint-creativity relationship: At the individual level, for instance, personal characteristics, such as the need for cognition, may have a positive moderating influence on the relationship between time pressure and creative self-efficacy (Wu et al., 2014). Further, creative self-efficacious individuals may especially benefit in their creative efforts from knowledge sharing activities with a team whose professional backgrounds are diverse (Hülsheger et al., 2009). At the team level, team climate factors may have a moderating influence on the relationship between time pressure and team knowledge sharing (Hülsheger et al., 2009; van Knippenberg, 2017). For example, teams with a strong cohesion may still share sufficient knowledge under time pressure. Future research should try to integrate these constructs in order to extend and validate the proposed theoretical model.

#### 4.5.3 Conclusion

Working creatively under time pressure is an organizational necessity in an increasingly digitized world. The trend towards team-based structures in organizations makes it essential to understand how and why time pressure affects the creativity of individuals and teams. In this study, we investigated the influence of time pressure on individual creativity through individual creative self-efficacy and on team creativity through team knowledge sharing. Although the originally proposed analyses revealed no significant effects, the results of the post hoc analyses suggest that the assumptions may be confirmed in a larger sample size. The results encourage further mixed-level research on the impact of constraints on the multi-faceted creative processes in teams.

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# 5 Discussion[6]

This dissertation investigates interpersonal team processes and contexts factors conductive and detrimental to team creativity and team innovation from a mixed-level perspective. As such, it explores the relationships of team climate for innovation, creative leadership modes and time pressure with the creativity and innovation of teams. More specifically, this dissertation sets out to address the following research goals: First, to analyze the structure of team climate for innovation and determine how (direct effect), when (moderation), and why (mediation) team climate for innovation is related to team performance and team innovation. Second, to investigate how different creative leadership modes (facilitating, directing, and integrating) are related to team creativity and team innovation. Third, to examine how and why (motivational and social mechanisms) time pressure influences individual and team creativity.

Taken together, all chapters of this dissertation contribute to its overall goal of advancing our understanding of creativity and innovation in the workplace. While the three empirical chapters focus on their individual research questions by targeting different antecedents and add to different theoretical conversations, they do share a central focus: They all focus on the core phenomenon of creativity and innovation in the empirical context of teams applying the theoretical lens of mixed-level research, which has been highlighted as an important avenue by organizational behavior researchers throughout the last decades (e.g., Anderson et al., 2014; Hülsheger et al., 2009; van Knippenberg, 2017; West, 1990; Woodman et al., 2007; Zhou & Hoever, 2014). In addition, this dissertation offers practical contributions on what organizations and managers can do to promote a team environment conductive to creativity and innovation. The following sections summarizes the findings and contributions of each chapter.

[6]This discussion is partly based on Strobel and colleagues (2022a), Strobel and colleagues (2022b), and Dreymann & Strobel (2022); the full references can be found in the Appendix.

## 5.1 Discussion of Main Findings and Contributions

*Chapter 1* provides the general motivation and research questions for this dissertation and the theoretical background for studying team creativity and team innovation in a mixed-level organizational context. After introducing the definition of teams and the organizing IPO framework, team creativity and team innovation are conceptualized and distinguished from each other. Further, the three investigated antecedents (team climate for innovation, creative leadership, and time pressure) are described and the chosen mixed-level perspective is classified. Finally, an overview over the methodological approach (research design, sample, data collection, and analysis), the main results, and the contributions is given.

*Chapter 2* sets out to resolve inconsistences in the existing team climate for innovation literature and to create consensus among contradictory findings by conducting a meta-analysis that quantitatively summarizes three decades of primary studies. The meta-analytical findings offer several contributions: First, three different meta-analytical analyses support West's (1990) conceptualization of team climate for innovation as a single second-order construct consisting of the four climate dimensions of vision, participative safety, task orientation, and support for innovation. This construct consolidation, which has been called for by van Knippenberg (2017), will help researchers to theoretically and methodologically apply team climate for innovation correctly: According to these results, instead of using the separate subdimensions, which yields no advantage (cf. LePine et al., 2002), future research should use the unitary construct, which will make studies more comparable and less misguiding. Second, to the author's knowledge this meta-analysis is the first to present an estimate of the true relationship of the unitary team climate for innovation construct with team performance ($\rho = .37$) and team innovation ($\rho = .44$). This will free researchers up to pursue innovative and complex research questions instead of repeatedly investigating these formerly inconsistent relationships (cf. Anderson et al., 2014). Third, the meta-analytical moderator analyses helped to identify conditions under which team climate for innovation is more (and less) important, to explain heterogeneity between studies, and to promote a more accurate and contextualized understanding of this construct and its consequences. Finally, the meta-analytical findings show that team climate for innovation exerts influence on team performance both directly as well as indirectly through team innovation. Thereby, this study contributes to a more substantive understanding of the mechanism through which team climate for innovation influences team performance. In sum, chapter 2 contributes to team climate and innovation literature by clarifying the structure of team climate for innovation ("what"), establishing the strength and direction of its relationship with team performance and innovation ("how"), identifying contingencies of these relationships ("when"), and investigating the mechanism of these relationships ("why"). Thereby, this dissertation also responds to calls for meta-analytical investigation of organizational innovation (e.g., Anderson et al., 2004, 2014; Anderson & King, 1991; Damanpour, 1991).

*Chapter 3* set out to extent and test a theory on creative leadership modes (facilitating, directing, and integrating) and their relationship with the creative and innovative performance of teams. Drawing on the classifications of Mainemelis and colleagues' (2015) model of creative leadership, this dissertation developed a measure of creative leadership modes and validated its tripartite factor structure. Thereby, this dissertation extents the theory of Mainemelis and colleagues (2015) by introducing creative leadership modes, conceptualizing them as different modes of distributing creative and supportive tasks between the leader and the team members. This dissertation thus contributes to the creative leadership research by illuminating the leader's role in the innovation process (Anderson et al., 2014; Epitropaki et al., 2017; Mainemelis et al., 2015) and offering a tool for measuring of leaders' creative characteristics within work groups (Jaussi & Dionne, 2003; Koseoglu et al., 2017). Further, this dissertation examines the relationship of the three leadership creative modes with both the teams' creative behavior and innovative productivity. The results reveal that a unique combination of leadership modes contribute to creativity and innovation: The facilitating and integrating creative leadership modes seem to be especially relevant to fostering creativity in teams and the integrating and directing creative leadership modes seem to be relevant to producing team innovation. It is noteworthy that by examining these relationships simultaneously, this dissertation is able to demonstrate the unique impact of each mode above and beyond the impact of other modes. Finally, this dissertation follows Montag and colleagues' (2012) suggestion to further differentiate between creative behavior and its outcomes. In this vein, the study also speaks to research on the organization and management of research groups (Lee et al., 2015; Perry et al., 2016) and on training of future scientists (Shibayama, 2019), pointing to the relevance of facilitating and integrating creative leadership modes for nurturing the creative potential of research group members.

*Chapter 4* set out to investigate the mediating mechanisms that explain the relationship between time pressure and creativity at the individual and team level. In summary, the originally proposed mixed-level analyses for hypothesis testing did not yield significant results. However, the main limitation of this study is that the small sample size at both levels may have masked potential effects, as the limited power probably does not suffice for a mixed-level approach with small effect sizes (e.g., McNeish & Stapleton, 2016; Scherbaum & Ferreter, 2009). Nevertheless, the findings of the exploratory post hoc analyses provide some support for this study’s theoretical model. First, individual creative self-efficacy partially mediated the positive relationship between individual time pressure and self-rated individual creativity. If this finding could be reproduced in a larger sample with the originally planned set of analyses, the results would provide support for the theoretical frameworks of Acar and colleagues (2019) and Roskes (2015), whose work suggests that constraints can have a positive influence on the individuals’ creative performance through motivational mechanisms. Furthermore, they would underpin the findings on the challenge-hindrance framework by LePine and colleagues (2005), suggesting that challenge stressors, such as time pressure, can have a positive influence on the individuals’ motivation, and consequently enhance their performance. Finally, they would clarify inconsistent findings from previous research (Andrews & Smith, 1996; Khedhaouria et al., 2017; Ohly & Fritz, 2010) and respond to calls for research to examine creative self-efficacy as a mechanism linking influences in the working environment and individual creativity (Farmer & Tierney, 2017; Ohly, 2018). Second, applying team weighting in a post hoc analysis, team time pressure had a negative indirect effect on team creativity through team knowledge sharing. If these results are supported by future studies, this would suggest that time pressure is an inhibiting factor for knowledge sharing activities, indirectly decreasing team creativity. This result would provide support for the theoretical frameworks of Acar and colleagues (2019) and Rosso (2014). In sum, the results of the post hoc analyses provide some indications for this study's theoretical model. Notably, they support the proposition of Acar and colleagues (2019) that time pressure may have opposing effects on individual and team creativity via different mechanisms. Overall, this study addresses current calls for differentiated, mixed-level research on the relationship between time pressure and creativity (Acar et al., 2019; Razinskas & Hoegl, 2020).

*Chapter 5* summarizes the main findings of the empirical chapters and the dissertation as a whole. Based on the findings, it deduces the theoretical contributions as well as the practical implications and recommendation for organizations. Finally, limitations and directions for future research are illuminated and an overall conclusion of the dissertation is formed.

*In sum*, this dissertation contributes to the understanding of the creative and the innovative performance of teams in the workplace by advancing our knowledge on interpersonal team processes and context factors that foster or hinder the performance, innovation and creativity of teams. They do so by making individual theoretical contributions to concepts and theories in different research conversations within the organizational behavior literature. Thereby, this dissertation offers avenues for creating more suitable work environments for teams who aim at generating original ideas and transforming them into innovations which help their organizations to survive and to thrive.

## 5.2 Practical Implications

In today's increasingly complex and volatile market environment, creative ideas and the innovations they enable are crucial for the survival and success of organizations (Anderson et al., 2014; Zhou & Hoever, 2014). Creativity helps organizations to cope with unpredicted challenges and dynamic environments (Zhou & Hoever, 2014); the resulting innovation allows organizations to sustain a competitive advantage (Leifer et al., 2000; Pirola-Merlo & Mann, 2004; van Knippenberg, 2017). Thus, from the standpoint of a manager, organizations are constantly on the lookout for new creative ideas in order to develop original, successful products and services to "provide the next big breakthrough" or to enhance their processes to improve the effectiveness of their organization (Acar et al., 2019, p. 2). However, senior managers have been found to be unsure how to promote creativity and innovation in the teams of their organization (Barsh et al., 2008).

This dissertation provides avenues for managers and organizations to augment creativity, innovation, and thus the performance of their teams. The empirical chapters make several contributions to practice by taking different antecedents into account. Particularly, the dissertation contributes to fostering creativity and innovation in teams by providing insights into how, when, and why team climate for innovation makes teams more innovative and effective (chapter 2), which way of distributing creative and supportive tasks between team leader and team members is aligned with the team's creativity and innovation (chapter 3), and how and why time pressure serves as a challenging or hindering factor for individual and team creativity (chapter 4).

More specifically, the empirical chapters make the following practical contributions: *Chapter* 2 highlights team climate for innovation as an effective approach for improving team performance and team innovation both concerning quality and quantity in a broad range of contexts (i.e., work contexts, and geographic regions). Even if innovation is not the primary goal of the team, increasing team innovation through higher levels of team climate for innovation will in turn also increase overall team performance. The results suggest that practitioners should be aware that team members' shared perception of team climate for innovation translates into team members collaborating more or less effectively. By promoting team climate for innovation organizations may be able to enhance the effectiveness of their teams: As managers are capable of actively changing climates (Grant, 2007), they may find value in acting as "climate engineers" (Naumann & Bennett, 2000). Specifically, the dissertation suggests that they undertake actions to make their teams share a common vision and commitment to quality excellence, to encourage them to feel free to openly speak their mind, and to support each other in their creative endeavors. In addition, senior managers and organizational developers should foster a culture conductive to a climate for innovation by stressing the value of creativity, innovation, and excellence as well as open communication and participation.

*Chapter 3* highlights that different creative leadership modes are associated with different stages of the innovative process. While the facilitating and the integrating creative leadership mode are associated with the creative behavior of the team, the integrating and the directing mode are associated with the team's innovative productivity. Thereby, the results of chapter 3 provide the first insights into which creative leadership mode is more suitable for which goal: If leaders aim to primarily enhance the creative behavior of their team, they should purposefully distribute the creative tasks in such a way that primarily the team members are involved (facilitating); if they aim to enhance innovative productivity, they should conduct the creative tasks themselves. However, if leaders strive for both creative behavior and innovative productivity, they should try to install creative synergy by involving both team members and themselves in the creative tasks. Moreover, chapter 3 offers a validated scale for measuring the creative leadership modes present within a group. This allows teams to assess the status quo of their predominant mode, which can be a first step to purposefully adapting the distribution of creative tasks between team members and leader in order to enhance the desired outcome.

*Chapter 4* highlights the opposing effects time pressure may have on the creativity of individuals and teams, if the results of the post hoc analyses are replicated by future studies. If this is the case, then time pressure would exert a positive effect on individual creativity as it creates a positive challenge, while it would exert a negative effect on team creativity as the team lacks the time to share their knowledge. If the results are replicated by future studies, first, this could indicate that practitioners may improve individual creativity by framing it as a motivating challenge to complete creative tasks under time pressure and explicitly highlighting that the team members are highly capable of achieving the creative goals, thereby fostering their creative self-efficacy. Second, it could indicate that practitioners may alleviate the negative influence of time pressure via the social mechanism by actively fostering knowledge sharing. For instance, short daily meetings, incentives for knowledge sharing, or implementing digital knowledge sharing and communication tools may be beneficial for team knowledge sharing (Bartol & Srivastava, 2002; Rao, 2005; Schwaber & Beedle, 2002) and thus help to reduce the negative influences of time pressure on team creativity. As constraints are an inevitable part of everyday life in organizations, managers and team members should understand how constraints influence creativity and what they can do to effectively deal with them (Acar et al., 2019).

*Taken together*, managers and organizations can use the findings of the three empirical chapters to foster creativity and innovation in their teams. To make use of the practical contributions mentioned above, the findings' implications should be integrated into leadership guidelines and development programs. For instance, leadership trainings could focus on conveying tools and strategies on how to foster a team climate for innovation. Also, introducing the concept of creative leadership modes and the opposing mechanisms in the relationship between time pressure and creativity may help raise awareness in light of the current demands. The awareness and understanding of the relationships and mechanisms of the investigated constructs may help leaders to develop techniques for establishing appropriate modes of interacting with the team as well as ways of strategically influencing the perceived time pressure of individuals and teams. As leaders play a central role in designing conditions conductive to team effectiveness (Morgeson et al., 2010), all mentioned approaches will offer straightforward levers to strategically creating an environment that fosters creativity and innovation.

## 5.3 Limitations and Future Research

Although the findings contribute to creativity and innovation research and managerial practice in the way described above, there are some limitations of the included studies that should be considered. On a detailed level, the limitations of each study are described within each chapter; however, in the following several general limitations are discussed. First, due to the application of correlational research designs, the analyses and results of the three studies do not imply causality. This is also the case for the meta-analysis in chapter 2, as all but one study within its sample were based on cross-sectional survey data. As the studies cannot provide evidence on the direction of the effects observed, alternatively to the assumed direction it would be possible, for instance, that dependent and independent variables affect each other in a bidirectional fashion. Although this appears less plausible from a theoretical perspective (cf. Acar et al., 2019; Mainemelis et al., 2015; van Knippenberg, 2017; West, 1990), future research should apply (field/quasi-)experimental studies or time series analyses to verify the causal relationships of the proposed and investigated conceptual research models.

Second, the generalizability of the studies' findings remains uncertain due to the unique features of the specific research settings of the field surveys (chapter 3 and 4), which may limit the generalizability of the findings across contexts[7]. For instance, the data suggests that participants of both studies on average were rather young (chapter 3: $M$ = 33.04 years; chapter 4: $M$ = 23.80 years) and had received an above average academic education (chapter 3: doctoral candidates and post-doctoral researchers; chapter 4: students at a German university). Further,

[7] In contrast, the sample of studies investigated in the meta-analysis of chapter 2 covers a wide range of contexts (e.g., different industries, geographical regions, team types) and, in addition, systematically investigates the moderating influence of several context factors.

in both research settings the work teams were characterized by a low temporal stability (Hollenbeck et al., 2012): For chapter 3, the investigated academic research environment is characterized by short-term contracts and low team stability. In chapter 4, student project teams are investigated who worked together in two extracurricular, voluntary product development programs for less than a year. Additionally, the leader-follower relationship of the investigated teams may differ from traditional work contexts: Academic supervisors usually not only functioned as a leader, but also as an academic mentor (chapter 3) and the supervisors from chapter 4 only supervised the teams in the development of their products and team dynamics but did not assume the role of a disciplinary leader. For the mentioned reasons, the findings of these studies are only transferable to other contexts to a certain extent. While the findings of this dissertation provide valuable insights, future research should aim to replicate the findings in contexts more strongly resembling traditional work settings to empirically test their generalizability.

Third, while this dissertation makes an effort to carefully distinguish different types of criteria (as called for by Ilgen, 1999; Mathieu et al., 2008; Montag et al., 2012), none of the empirical chapters covers the whole range of criteria for assessing creativity and innovation. Whereas creativity and innovation can and should be distinguished from one another (Hughes et al., 2018; Montag et al., 2012; Perry-Smith & Manucci, 2017), both can further be distinguished concerning their function and dimension: Montag and colleagues (2012) highlight the importance of differentiating between creative or innovative performance behavior (e.g., generating or implementing an idea) and outcomes (e.g., an idea or product judged as novel and useful). In addition, creative or innovative outcomes can be further differentiated concerning the quality (e.g., ratings of ideas or products concerning their novelty or impact) and the quantity of the outcome (e.g., number of ideas or patents). While this dissertation carefully distinguishes between these types of criteria, chapter 3 only assesses the influence of creative leadership modes on creative behavior and innovation quantity (number of published articles).

Chapter 4 only assesses the influence of time pressure on creative behavior. In contrast, the meta-analysis (chapter 2) does differentiate not only innovative and performance behavior from the outcomes of this behavior, but also quality and quantity of the outcomes; however, it comes short on the differentiation of creativity and innovation. Future research should therefore apply a range of different creativity and innovation criteria when investigating the discussed constructs in order to gain a detailed idea of which interpersonal processes are most conductive to which aspects of creativity and innovation. This knowledge would help leaders and organization to fine tune their strategies for creating an environment conductive to their specific goals for creative and innovative performance of their teams.

Furthermore, future research may find interest in examining the question of temporality and team dynamics in regard to the discussed concepts. First, the studied interpersonal processes may develop and change over time. For instance, depending on the stage of team maturity (i.e., forming, storming, norming, performing, reforming, and conforming; Morgan et al., 1993) different interpersonal processes may predominate or emerge as beneficial for creativity and innovation. A directing creative leadership mode, for example, might be especially helpful in the forming and performing stages of the team evolution, while a facilitating might be more conductive during the storming stage. An integrating creative leadership mode may only be possible to develop at a certain stage of team maturity. Similarly, different mechanisms may play a role in translating time pressure into team creativity depending on the maturity of team. Second, the benefit of the studied interpersonal processes may change with different phases of the creative and innovative process. For instance, idea generation may particularly benefit from a high level of participative safety, idea elaboration from task orientation, idea championing from support for innovation, and idea implementation from a shared vision (cf. Perry-Smith & Mannucci, 2017). Similarly, the positive or negative influence of time pressure may predominantly translate through social mechanisms during idea elaboration when knowledge sharing is key, while during idea implementation the influence may be driven predominantly by motivational mechanisms, such as challenge-appraisal. Therefore, examining the investigated antecedents of creativity and innovation through the lens of temporality and team dynamics may offer interesting avenues for future research.

## 5.4 Conclusion

This dissertation investigates a variety of interpersonal processes that are fostering and hindering the creative and innovative performance of teams. The findings indicate the examined antecedents exert a relevant influence on a team's behavior and outcomes in the workplace: A team climate conductive for innovation, the distribution of creative and supportive tasks between leader and team members as well as time pressure and its motivational and social consequences are substantially related to team creativity, team innovation, and team performance. By investigating these concepts and relationships in a mixed-level approach this dissertation contributes to a better understanding of team creativity and team innovation in the workplace. Thereby, it can help practitioners to shape the social work environments in such a way that teams are encouraged and enabled to generate original ideas and implement them effectively. This will make innovation flourish and shape the direction of the future.

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# 6 Appendix

### Appendix A: Reference for the First Empirical Chapter (Chapter 2)

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### Appendix B: Reference for the Second Empirical Chapter (Chapter 3)

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### Appendix C: Reference for the Third Empirical Chapter (Chapter 4)

Dreyman, N., & Strobel, L.-T. (2022). *Creative through time pressure? A cross-level perspective on creative self-efficacy & knowledge sharing.* Manuscript submitted for publication at European Journal of Management.